ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2012

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

FIRST SESSION

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

RODNEY P. FRELINGHUYSEN, New Jersey, *Chairman*

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NOTE: Under Committee Rules, Mr. Rogers, as Chairman of the Full Committee, and Mr. Dicks, as Ranking Minority Member of the Full Committee, are authorized to sit as Members of all Subcommittees.

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LORAINE HECKENBERG, and PERRY YATES,
Staff Assistants

PART 6

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Loan Guarantee Program and ARPA-E, FY 2012 Budget	**407**

Printed for the use of the Committee on Appropriations

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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2012

WEDNESDAY, MARCH 30, 2011.

DEPARTMENT OF ENERGY—ENVIRONMENTAL MANAGEMENT, LEGACY MANAGEMENT, FY 2012 BUDGET

WITNESSES

INES TRIAY, ASSISTANT SECRETARY FOR ENVIRONMENTAL MANAGEMENT

DAVID GEISER, ACTING DIRECTOR, OFFICE OF LEGACY MANAGEMENT

Mr. WOMACK [presiding]. Good afternoon, everyone. We have before us today Dr. Ines Triay; Assistant Secretary for Environmental Management. She is accompanied by Mr. David Geiser, Director of Office of Legacy Management. They will be presenting the President's Fiscal Year 2012 Budget Request for the Offices of Environmental Management and Legacy Management.

The fiscal year '12 request for Environmental Management is $6.1 billion, $124 million more than fiscal year 2010. The Environmental Management program has the difficult mission of cleaning up the legacy of five decades of nuclear weapons production as well as other nuclear research activities.

The current effort requires cleanup of dangerous materials at 18 sites across 11 states. Dr. Triay, we appreciate your aggressive efforts to clean up these sites. In addition to the roughly $6 billion your office receives each year, the Stimulus Act provided your program with a substantial amount of additional funding. Many of those projects are meeting cost and schedule targets, allowing you to accelerate your cleanup goals and accomplish a great deal of work.

However, despite your efforts, the Office of Environmental Management remains on the Government Accountability Office's high-risk list once again this year. With major increases being requested for your largest construction project, the Waste Treatment Project at Hanford, we need to hear how you have addressed the problems of the past.

The Legacy Management budget request is $170 million, $21 million less than fiscal year '10 levels, to fulfill the responsibilities of the Department where cleanup activities have already been completed. Mr. Geiser, to your credit, your office accepted additional site and program responsibility while reducing your overall request. We are interested in hearing more on your plan to take on more responsibility while controlling costs.

Our chairman, Mr. Frelinghuysen, is absent today recovering from a recent surgery and doing well, I might add. I will reiterate

the same information he has given to every witness who has testified before this Subcommittee this year.

It is highly unlikely there will be any new funding in 2012 from our Subcommittee. We must, therefore, balance a number of important activities while doing its part to reduce spending and bring down our deficit. I would ask that you ensure that the hearing record, responses to the questions for the record, and any supporting information requested by the Subcommittee, are delivered in final form to the Subcommittee no later than four weeks from the time you receive them. I also ask that if Members have additional questions, they submit them for the record to the Subcommittee by 5:00 tomorrow.

With these opening comments I would like to yield to our Ranking Member, Mr. Pastor, for any opening comments he would like to make.

Mr. PASTOR. Well, thank you, Mr. Chairman. And in view that we may have a vote here in a short while I will submit my opening statement for the record, and yield back, and welcome our panel members.

OPENING STATEMENT
The Honorable Ed Pastor
Energy and Water Development Subcommittee
House Committee on Appropriations

Hearing on the Fiscal Year 2012 Budget Request for the
Department of Energy's Office of Environmental Management
March 30, 2011

Good afternoon. Dr. Triay, thanks for taking the time to come today. It is good to see you again. Mr Geiser.

The Environmental Management program is critical to meeting the country's obligation to address the environmental legacies of the Cold War and the Manhattan Project. Given that EM's portfolio is one of the nation's largest environmental and financial liabilities, we have the responsibility to address the waste and contamination in the communities that contributed to these efforts in a deliberate and competent manner.

Dr. Triay, I know and appreciate your aggressive efforts to improve the way you do business. But we have to do better in terms of project management. With billions of dollars invested, every year we need to see results. Dr. Triay, I understand your budget request has been characterized as a "compliance based budget", I look forward to your explanation of the budget request. In particular, I would like to hear more detail about some of the significant changes in funding that are included.

Mr. Geiser, you inherit these sites when the clean-up has been completed, and we look forward to your views on your mission, and the challenges you are facing in the future.

Thank you, Mr. Chairman for the time.

Mr. WOMACK. So be it. And now to the witnesses before us today. Assistant Secretary for Environmental Management, Dr. Ines Triay.

Ms. TRIAY. Good afternoon, Mr. Chairman, Ranking Member, and Members of the Subcommittee. I am pleased to be here today to address your questions regarding the Office of the Environmental Management's fiscal year 2012 Budget Request.

The fiscal year 2012 budget request of $6.1 billion will protect human health and the environment through the safe environmental cleanup of past nuclear weapons development and government sponsored nuclear energy research.

The Office of Environmental Management's primary responsibility is to keep our employees, the public, and the states where cleanup sites are located, safe from radioactive and hazardous materials contamination. We continue to adhere to a "Safety First" culture that integrates the environment, safety, and health requirements and controls into all work activities.

Over the last two decades, the Office of Environmental Management's compliance posture has evolved to where we have a well-defined and established relationship with our regulators. The fiscal year 2012 budget request maintains a compliant position by honoring regulatory commitments. There are approximately 40 cleanup agreements that provide a framework for cleanup of the Cold War legacy that EM will continue to abide by.

The Office of Environmental Management's goal in fiscal year 2012 is to meet 100 percent of its enforceable agreement milestones that are located within the cleanup agreements. For example, our fiscal year 2012 budget requests fully funds the Tri-Party Agreement settlement with Washington State, as well as the transuranic waste retrievals at Idaho that are consistent with terms of the Idaho Settlement Agreement.

Over the past two years, the Office of Environmental Management has made significant progress in accelerating environmental cleanup across the Departmental complex. We estimate that by the end of fiscal year 2011, the acceleration of excess facilities decontamination and decommissioning, and cleanup of contaminated areas will reduce the legacy cleanup footprint by 40 percent. This will lead to approximately 90 percent footprint reduction by 2015.

In terms of square miles, we project that by the end of fiscal year 2011 the footprint will have been reduced from 900 square miles to 540 square miles. By 2015, it is envisioned that the footprint could be reduced to 90 square miles. Footprint reduction efforts have resulted in estimated cost avoidances of approximately $3 billion and cost savings of approximately $4 billion in the lifecycle cost.

In fiscal year 2012, the continued management and removal of legacy transuranic waste from generator sites will directly support risk reduction and aid in the goal of reducing site footprint. We estimate that the disposition of 90 percent of legacy transuranic waste will be completed by 2015.

The last few years, the Office of Environmental Management has been focusing on providing opportunities to small business to perform environmental cleanup work. Recovery Act prime and subcontractors have awarded a total of $1.8 billion to small businesses.

In addition, base prime and subcontracts have awarded $1.7 billion to small business in fiscal year 2010.

Overall, the feedback we have received from small businesses participating in Recovery Act has been extremely positive. Recovery Act funds have allowed small businesses to enhance their competitive skills, pursue opportunities in new market sectors, and reinvest in their companies' infrastructure. The Office of Environmental Management will continue to promote the usage of small businesses and identify future opportunities for small businesses to perform our environmental cleanup work.

Mr. Chairman, Ranking Member, and Members of the Subcommittee, I am honored to be here today representing the Office of Environmental Management. We are committed to achieving our mission in a safe, effective, and efficient manner and we will continue to apply innovative environmental cleanup strategies so that we can complete quality work, safely, on schedule, and within cost, thereby demonstrating value to the American taxpayer.

I am pleased to answer any questions you may have.

Written Statement of Inès Triay
Assistant Secretary for Environmental Management
United States Department of Energy
Before the Subcommittee on Energy and Water Development
Committee on Appropriations
United States House of Representatives

March 30, 2011

Good afternoon, Mr. Chairman, Ranking Member Visclosky, and Members of the Subcommittee. I am pleased to be here today to answer your questions on the President's Fiscal Year (FY) 2012 budget request for the Department of Energy's (DOE) Office of Environmental Management (EM). The EM FY 2012 budget request of $6.13 billion will protect human health and the environment through the safe environmental cleanup of the past nuclear weapons development and government-sponsored nuclear energy research.

Environmental Management Program Strategies: A National Responsibility

➢ *We reduce risks and protect our workers, our communities, and the environment through cleanup.*

EM's primary responsibility is to keep our employees, the public, and the states where cleanup sites are located, safe from radioactive and hazardous materials contamination. EM continues to adhere to a "Safety First" culture that integrates environment, safety, and health requirements and controls into all work activities. EM will continue improving safety performance with the goal of achieving zero accidents or incidents.

➢ *Our cleanup work is urgent and essential to the health and safety of communities across the nation.*

To best address the urgency of work to be done, EM continues to pursue its cleanup objectives of achieving the greatest risk reduction benefit per radioactive content (wastes that contain the highest concentrations of radionuclides), while meeting regulatory compliance commitments, and promoting best business practices to maximize cleanup progress.

EM's priorities to support this approach include:

- Activities to maintain a safe, secure, and compliant posture in the EM complex
- Radioactive tank waste stabilization, treatment, and disposal
- Spent (used) nuclear fuel (SNF) storage, receipt, and disposition
- Special nuclear materials (SNM) consolidation, processing, and disposition
- High-risk soil and groundwater remediation
- Transuranic (TRU) waste and mixed low-level (MLLW)/low-level waste (LLW) disposition

- Soil and groundwater remediation
- Excess facilities decontamination and decommissioning (D&D)

➢ *Our mission is not discretionary- we must address the cold war environmental legacy and honor our regulatory commitments.*

Over the last two decades, EM's compliance posture has evolved to where EM and its regulators have a well-defined and established relationship. The FY 2012 EM budget request maintains a compliant position by honoring regulatory commitments. There are approximately 40 cleanup agreements that provide a framework for cleaning up the cold war legacy that EM will continue to abide by. EM's goal in FY 2012 is to meet 100 percent of its enforceable agreement milestones that are found within cleanup agreements.

The FY 2012 EM budget request funds the Tri-Party Agreement settlement with Washington State, as well as, TRU waste retrievals at Idaho consistent with terms of the Idaho Settlement Agreement. Additionally, the FY 2012 EM budget request positions Los Alamos National Laboratory to comply with the 2005 Compliance Order on Consent. Though it is crucial and necessary for EM to fund the activities required by these agreements and consent orders, EM must also have the flexibility to balance these priorities with other requirements across the complex. In addition, at Oak Ridge, EM must demonstrate soil and groundwater cleanup progress in order to comply with other regulatory commitments.

➢ *Time is not on our side- costs and risks increase over time.*

The EM program is large and complex, with urgent activities that must be performed. For example, at the Idaho National Laboratory, plutonium and organic solvent wastes primarily from the Rocky Flats Plant were disposed in shallow pits from 1952 to 1970. The waste was contained in carbon steel drums which have deteriorated over the years as a result of water infiltration and flooding events. These wastes sit above the sole source Snake River Plain Aquifer, which is the size of Lake Erie, and is the irrigation supply for a substantial agricultural industry in the northwest. The EM FY 2012 budget request will allow Idaho National Laboratory to make significant progress in protecting the aquifer with an aggressive program to retrieve, repackage, and dispose of these wastes at the Waste Isolation Pilot Plant (WIPP) by the anticipated completion date in 2015.

Another example is at the Savannah River Site. Tank 48 is a modern, Type III waste tank that holds approximately 240,000 gallons of highly radioactive liquid waste that is also contaminated with hazardous organic materials from past operations of the In-Tank Precipitation process in the mid-1990's. The waste in this tank must be kept isolated due to flammability and chemical incompatibility concerns; however, it occupies space in the tank farm that is required to support the aggressive waste treatment pace needed to clean and close all Savannah River Site tanks by 2026. A Fluidized Bed Steam Reforming process is under development to eliminate the organic component of the waste in Tank 48 and allow the radioactive components to be vitrified in the Defense Waste Processing

Facility to eliminate the hazard and allow this valuable tank space to be returned to tank farm service. The EM FY 2012 budget request supports the Fluidized Bed Steam Reforming process startup in late 2014 and completion of Tank 48 waste treatment by late 2016, allowing Savannah River Site to maintain the accelerated waste cleanup and tank cleaning efforts.

At Los Alamos National Laboratory, the primary mission since 1943 has been nuclear weapons research and development. Waste resulting from this research includes both liquid and solid radioactive waste from plutonium processing, organic solvents, highly explosive by-products, metals and polychlorinated biphenyls. At Los Alamos National Laboratory, the cleanup of soil and groundwater is regulated by the New Mexico Environmental Department pursuant to RCRA. The 2005 Compliance Order on Consent requires that environmental investigations and remediation activities be completed by 2015. There are approximately 860 of the original 2,100 waste sites remaining that require investigation and remediation actions. The EM FY 2012 budget request will allow Los Alamos National Laboratory to maintain the momentum that is necessary to meet the Consent Order requirements.

Finally, there are 29 cubic meters of radioactive sludge currently stored within the water filled K-West Basin at the Hanford Site, approximately 400 yards from the Columbia River. The sludge was created when irradiated fuel rods deteriorated and corroded after many years of underwater storage. The EM FY 2012 budget request allows EM to remove the sludge from the basins and store it in a safer location until 2014, when it will be treated and packaged for transportation to WIPP for disposal.

- *We have demonstrated value for the American Taxpayers by delivering significant progress in the past several years in reducing risks associated with the Cold War environmental legacy- but our work is not done.*

Over the past two years, EM has made significant progress in accelerating environmental cleanup across the DOE complex. EM estimates that by the end of FY 2011, the acceleration of D&D of excess facilities and cleanup of contaminated areas will reduce the legacy cleanup footprint by 40 percent, leading to approximately 90 percent footprint reduction by 2015. Footprint reduction efforts have resulted in estimated cost avoidances of approximately $3 billion and cost savings of approximately $4 billion in life-cycle cost. In terms of size, in 1989, the legacy cleanup footprint was 3,125 square miles. Twenty years later, the footprint was reduced to 900 square miles. EM projects that by the end of FY 2011, 540 square miles of footprint will remain. By 2015, EM envisions that the footprint could be reduced to 90 square miles. The shrinking of the legacy footprint will lead to the D&D of 2,636 facilities and 7,745 completed remediation actions. By 2020, EM envisions that legacy cleanup will be virtually complete, with Hanford being the only large site with multiple cleanup missions remaining.

In FY 2012, the continued management and removal of legacy TRU waste from generator sites will directly support risk reduction and aid in the goal of reducing site footprint. EM estimates that the disposition of 90 percent of legacy TRU waste will be

complete by 2015. To accomplish the 2015 goal, 40,000 cubic meters of TRU waste will need to be disposed. At this time, 78,000 cubic meters of the 118,000 cubic meters total of legacy TRU waste have already been disposed. By 2020, EM envisions that all TRU waste will be sent to WIPP, with the exception of TRU waste from the Hanford Site.

- *The Environmental Management portfolio is one of our nation's largest environmental liabilities-we have a responsibility to relieve future generations of this liability.*

EM will continue identifying opportunities to make strategic investments that reduce the overall cost of the cleanup program while condensing project completion dates. The current life-cycle cost estimate for EM is between $275 billion to $308 billion. This includes $90 billion in actual costs from 1997 through 2010, and an additional estimate of $185 billion to $218 billion to complete EM's remaining mission.

Tank waste accounts for approximately one third of the total EM life-cycle cost and is a major contributor to EM's overall environmental liability. To address this large liability, EM has created the Enhanced Tank Waste Treatment Initiative led by the Enhanced Waste Strategic Team. The Team is looking at ways to focus and integrate efforts to develop and deploy technologies that are necessary to accelerate the completion of the tank waste cleanup mission. EM will focus its technology development and deployment investments to mature the science and technology associated with tank waste processing, treatment, and waste loading. In addition, EM will leverage base funding to optimize tank waste processing capabilities to enhance current tank waste cleanup approaches. To date, EM's Enhanced Tank Waste Strategic Team has identified seven major transformational strategies to reduce the life-cycle cost and length of program execution. Several of these strategies have been incorporated into Savannah River Site's tank waste program while many of these strategies are also being considered for incorporation into the Hanford site's tank waste programs. At Savannah River Site, these strategies will allow EM to accelerate the tank waste cleanup schedule by six years, reducing EM's life-cycle cost by $3 billion.

To address many of the high risk activities, $133 million has been requested for research and development in FY 2012, of which $60 million is requested within the Office of River Protection to support Hanford and Savannah River Site tank waste issues. The requested funding will be used to continue the acceleration of development and deployment of needed technologies related to tank treatment, waste chemistry for characterization and separation; advanced retrieval technologies; improved melter throughput; and increased glass waste loading. The budget request of $32.3 million for EM's Technology Development and Deployment Program supports groundwater and soil remediation subsurface science issues through the development of state-of-the-art methods and models to understand and quantify subsurface flow and contaminant transport behavior in complex geological systems. This reduces the uncertainty in the current models and methods for performance assessments. In addition, Technology Development and Deployment funding will be utilized in FY 2012 to support maturation of the Hot Isostatic Press technology to be deployed at Idaho National Laboratory.

However, this encompasses only a portion of the overall research and development initiatives being conducted across the complex in conjunction with the national laboratories. In FY 2012, the remaining funds for many of these research investments are embedded within the individual projects and programs at EM sites and are critical investments in science and technology that range from technology adaptations to demonstrations that promote the maturation of technology.

- *Improving contract and project management to ensure projects are on schedule and within cost.*

The EM program is large and complex, requiring the tracking of numerous schedules and costs. To ensure that EM delivers the best value for the American taxpayers, the FY 2012 budget request reflects an increased focus on improved acquisition, contract, and project management. To achieve this, EM will develop contract statements of work and deliverables based on clear project requirements, robust front-end planning and risk analysis, ensuring that nuclear safety requirements are addressed early, and changes to the contract and the project baseline are managed through strict timely change control processes. EM will continue to implement performance-based contracts where appropriate.

In a continuation of EM's Journey to Excellence, the EM Base Program Portfolio was restructured using the same project framework used in establishing the American Recovery and Reinvestment Act of 2009 (Recovery Act) projects. Base program operations activities have been separated from capital work within a Project Baseline Summary. Capital Asset Projects will be managed in accordance with DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. EM is currently developing the policies and guidelines for operations activities, as they are not governed by DOE Order 413.3B.

EM's continued progress in contracts and project management has resulted in EM meeting three of the five criteria needed to be removed from the Government Accountability Office's (GAO) High Risk List. EM's objective has been to improve contract and project management to increase its efficiency and effectiveness so that EM delivers high quality performance for the American taxpayers. GAO has noted that: EM has demonstrated strong commitment and leadership; demonstrated progress in implementing corrective measures; and developed a corrective action plan that identifies root causes, effective solutions, and a near-term plan for implementing those solutions.

One of GAO's standing concerns is that EM must provide the capacity (people and resources) to address problems. To address GAO's first concern, three Program Sponsors at EM Headquarters have been assigned to three large capital projects: Sodium Bearing Waste Treatment Facility at Idaho; Salt Waste Processing Facility at Savannah River Site; and Uranium-233 Down-Blending and Disposition Project at Oak Ridge. EM is also enhancing its partnership with the U.S. Army Corps of Engineers by placing senior construction experts from the Corps as Deputy Federal Project Directors at these construction projects. EM has obtained expertise from the national laboratories,

including hiring a Chief Scientist from Los Alamos National Laboratory to provide recommendations to the Assistant Secretary for Environmental Management on complex technical and design issues. The EM program has defined goals and actions in order to make EM the employer of choice to attract highly knowledgeable candidates while highlighting ways to strengthen our current workforce. Additionally, EM is continuing to conduct Independent Project Reviews that include a review on project staffing adequacy.

GAO's second concern is that EM must monitor and independently validate the many corrective measures that it has taken are both effective and sustainable over the long term. To address GAO's second concern, EM is continuing to validate that the corrective measures taken are effective and sustainable by improved management involvement at the Monthly Project Review meetings with each site. EM also conducts semi-annual Independent Project Reviews for larger projects. The Department believes that there are success criteria that can be used to demonstrate to GAO that EM performance justifies removal from the High Risk List. These success criteria provide for 90 percent of projects to be completed within 10 percent of the original cost baseline based on a three year-rolling average. Additionally, EM will continue to share project and operations activity information openly with GAO and other stakeholders. EM is confident that it will maintain project performance, thereby demonstrating that ongoing improvements in contract and project management are effective and sustainable.

Highlights of the FY 2012 Budget Request

The Department's FY 2012 budget request for EM is $6.13 billion, of which $5.41 billion is for defense environmental cleanup activities, $219 million is for non-defense environmental cleanup activities, and $504 million is for the Uranium Enrichment Decontamination and Decommissioning Fund. Examples of planned activities and milestones for FY 2012 by site-specific categories are:

Idaho National Laboratory, Idaho

(Dollars in Thousands)

FY 2010 Current Appropriation	FY 2012 Request
$469,168	$392,000

- *Complete construction and readiness testing in preparation for startup of operations of the Sodium Bearing Waste Treatment Facility.*

  The Sodium Bearing Waste Treatment Project supports DOE's EM mission of safely storing and treating liquid radioactive wastes. This project will treat approximately 900,000 gallons of sodium bearing waste stored in tanks that are 35 to 45 years old. The treatment of this waste will enable EM close the final four tanks, complete treatment of all tank waste at Idaho, and meet the Notice of Noncompliance- Consent Order Modification to cease use of the Tank Farm

Facility by December 31, 2012. Startup operations of the Sodium Bearing Waste Treatment Facility are estimated to begin in January 2012.

- *Ship contact-handled TRU waste to WIPP, and dispose of MLLW and LLW, as required in the 1995 Idaho Settlement Agreement.*

  During FY 2012, 4,500 cubic meters of contact-handled TRU waste will be shipped to WIPP for disposal. In addition 1,640 cubic meters of MLLW/LLW will be shipped for disposal to WIPP by September 2012.

Los Alamos National Laboratory, New Mexico

(Dollars in Thousands)

FY 2010 Current Appropriation	FY 2012 Request
$200,438	$361,577

- *Disposition of MLLW and TRU waste.*

  The Solid Waste Stabilization and Disposition Project is comprised of the treatment, storage, and disposal of legacy TRU waste and MLLW generated between 1970 and 1999 at Los Alamos National Laboratory. The end-state of this project is the safe disposal of legacy waste. In FY 2012, in support of the requirements in the 2005 Compliance Order on Consent, Los Alamos National Laboratory will dispose of 1,300 cubic meters of MLLW and 1,000 cubic meters of TRU.

- *Maintain soil and water remediation.*

  The Soil and Water Remediation Project scope at Los Alamos National Laboratory includes identification, investigation, and remediation of chemical and/or radiological contamination attributable to past Laboratory operations and practices. The remaining scope of the project includes characterization, monitoring, and protection of the surface and groundwater at the Laboratory and approximately 860 Potential Release Sites left to be investigated, remediated or closed by evaluation and assessment of human health and ecological risks. In FY 2012, activities include complete groundwater monitoring and reporting requirements consistent with the 2005 Compliance Order on Consent and the Resource Conservation and Recovery Act Operating Permit; and complete and deliver the revised Corrective Measures Evaluation Report for Material Disposal Area G to meet the 2005 Compliance Order on Consent requirements.

Oak Ridge Site, Tennessee

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$436,448	$401,056

- *Continue D&D of facilities and remedial actions at the East Tennessee Technology Park (ETTP).*

  ETTP was originally built as a uranium enrichment facility for defense programs. The D&D of K-25, the former gaseous diffusion process building within ETTP, is the top priority because of worker safety concerns stemming from the continual deterioration of the building. In FY 2012, activities at ETTP include: continue characterization and removal of high-risk equipment in the East Wing; begin removal of gaseous diffusion equipment from the North End of K-25; and start demolition of the North End of K-25.

- *Maintain operation of the Transuranic Waste Processing Center.*

  By the end of FY 2012, Oak Ridge will process a cumulative total of 163 cubic meters of contact-handled TRU waste and a cumulative total of 221 cubic meters of remote-handled TRU waste at the Transuranic Waste Processing Center in preparation for eventual shipment and disposal at WIPP. The continued operation of the Transuranic Waste Processing Center to process contact-handled TRU and remote-handled TRU enables Oak Ridge to meet the Site Treatment Plan milestones.

Paducah Site, Kentucky

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$165,127	$143,769

- *Operation of the Depleted Uranium Hexafluoride (DUF6) Conversion Facility.*

  The DUF6 Conversion Facility converts depleted uranium hexafluoride into a more stable form of depleted uranium oxide suitable for reuse or disposition. The depleted uranium oxide will be sent to a disposal facility, and the hydrogen fluoride co-products will be sold on the commercial market. In FY 2012, activities include: operate the DUF6 Conversion Facility at full capacity; and package 18,000 metric tons of depleted uranium in preparation for disposal.

- *Continue groundwater treatment operations.*

  Past nuclear energy and national security missions resulted in groundwater contamination within and around the Paducah site. In FY 2012, activities include: complete construction of the Southwest Plume Sources Treatment System and initiate operations; and complete C-400 Groundwater Plume Project that removes trichloroethylene dense non-aqueous phase liquids.

Portsmouth Site, Ohio

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$310,307	$310,035

- *Operation of the DUF6 Project conversion facilities and dispose of uranium oxide and hydrofluoric acid.*

  The DUF6 Conversion Facility converts depleted uranium hexafluoride into a more stable form of depleted uranium oxide suitable for reuse or disposition. The depleted uranium oxide will be sent to a disposal facility, and the hydrogen fluoride co-products will be sold on the commercial market. In FY 2012, activities include: operate the DUF6 Conversion Facility and package 13,500 metric tons of depleted uranium for disposal.

- *Accelerate D&D of Gaseous Diffusion Plant ancillary facilities and systems.*

  The scope of this project includes remedial actions due to contamination resulting from the plant's historical uranium enrichment operations and facility D&D. In FY 2012, there will be an increased focus on D&D of Portsmouth's Gaseous Diffusion Plant ancillary facilities and system, as well as, removal of excess equipment and hazardous materials.

Richland Site, Washington

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$1,080,503	$1,005,987

- *Continue facility D&D and remedial actions within the River Corridor.*

The River Corridor Closure Project includes the D&D of contaminated facilities and various remedial actions within the geographic area of over 210 square miles within the Hanford Site adjacent to the Columbia River. In an effort to reduce Hanford's cleanup footprint, FY 2012 activities include: complete D&D of two buildings and removal of one soil site in the 100 K Area; complete the selected removal and/or remedial actions for eleven of the high priority facilities in the 300 Area; and initiate remediation of the deep chromium contamination waste site 100-C-7.

- *Conduct high priority groundwater remediation efforts.*

To protect the groundwater resources within the Hanford site, remediation activities that address groundwater contamination, including carbon tetrachloride, chromium, technetium, and strontium must be conducted. In FY 2012, EM will begin Phase 1 operations of 200W pump and treat system. To meet FY 2012 enforceable agreement milestones, planned activities include, but are not limited to: continue the Remedial Investigation/Feasibility Study process to develop proposed plan for all 100 and 300 Areas' Operable Units; and expand the current pump-and-treat system at 100-HR-3 Operable Unit.

Office of River Protection, Washington

(Dollars in Thousands)

FY 2010 Current Appropriation	FY 2012 Request
$1,096,600	$1,361,391

- *Manage the tank farms in a safe and compliant manner until closure.*

The radioactive waste stored in the Hanford tanks was produced as part of the nation's defense program and has been accumulating since 1944. To ensure protection of the Columbia River, 53 million gallons of radioactive waste must be removed and processed to a form suitable for disposal, and the 177 underground storage tanks stabilized. In FY 2012, activities include: complete bulk retrieval from one C Farm single-shell tank; complete hard heel removal from three C Farm single-shell tanks; and continue to perform single-shell tank integrity evaluations.

- *Continue construction of the WTP complex.*

WTP is critical to the completion of the Hanford tank waste program by providing the primary treatment capability to immobilize (vitrify) the radioactive tank waste at the Hanford Site. The WTP complex includes five major facilities: Pretreatment Facility, High-Level Waste Facility, Low-Activity Waste Facility,

Analytical Laboratory, and the Balance of Facilities. As of January 2011, WTP construction is approximately 58 percent complete. In FY 2012, activities include: at the Pretreatment Facility, place 3,500 cubic yards of concrete (89 percent complete) and install 825 tons of structural steel, (44 percent complete); at the High-Level Waste Facility, install the Thermal Catalytic Oxidizers and the Offgas Carbon Adsorber; the design of the Low-Activity Waste Facility will be complete; at the Analytical Laboratory, construction will be complete consisting of all major civil, structural, piping, mechanical, and electrical power equipment installed and inspected and all piping hydro-tested to confirm capability to meet design requirements; and at the Balance of Facilities, complete construction of the Chiller Compressor Plant and the Anhydrous Ammonia Facility.

Savannah River Site, South Carolina

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$1,342,013	$1,363,728

- *Reduce radioactive liquid waste.*

  The mission of the Liquid Tank Waste Management Program at Savannah River Site is to safely and efficiently treat, stabilize, and dispose of approximately 37 million gallons of legacy radioactive waste currently stored in 49 underground storage tanks. In FY 2012, activities include: continue construction of the Salt Waste Processing Facility; continue operation of the Defense Waste Processing Facility and vitrify 312 canisters of HLW; operation of Actinide Removal Process and Modular Caustic Side Extraction at planned rates; complete construction of Saltstone Disposal Unit #2; continue Tank 48 Treatment Process Project; and close two tanks which will meet two Federal Facility Agreement tank closure commitments with due dates in the first quarter FY 2013. Closure of these two tanks is the first delivery on the recently approved tank acceleration strategy.

- *Continued storage, treatment, and disposal of LLW, MLLW, and hazardous waste.*

  In FY 2012, SRS will dispose of up to 2,517 cubic meters of newly generated LLW; dispose of 50 cubic meters of MLLW; and dispose of up to 150 cubic meters of hazardous waste.

WIPP, New Mexico

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2010 Current Appropriation	FY 2012 Request
$234,981	$233,771

- *Operate WIPP in a safe and compliant manner and dispose of contact-handled and remote-handled TRU waste from 27 DOE sites.*

  WIPP in Carlsbad, New Mexico, is the nation's only mined geologic repository for the permanent disposal of defense-generated TRU waste. In FY 2012, the EM budget request supports maintaining an average shipping capability of 21 contact-handled TRU waste and 5 remote-handled TRU waste shipments per week.

Conclusion

Mr. Chairman, Ranking Member Visclosky, and Members of the Subcommittee, I am honored to be here today representing the Office of Environmental Management. EM is committed to achieve its mission in a safe, effective, and efficient manner. EM will continue to apply innovative environmental cleanup strategies so that we may complete quality work safely, on schedule, and within cost thereby demonstrating value to the American taxpayers. I am pleased to answer any questions you may have.

Mr. WOMACK. Thank you, Madam Secretary. Mr. Geiser.

Mr. GEISER. Good afternoon. I would like to extend my appreciation to the Chairman, Ranking Member, and Members of the Subcommittee for inviting me to present the Department of Energy's 2012 request for the Office of Legacy Management, or LM.

LM's mission is to manage the Department's post-closure responsibilities. Our 2012 request is $170 million. We have four primary goals: protect human health and the environment; preserve, protect, and share records and information; meet commitments to the contractor workforce; and optimize the use of land and assets.

We are requesting $39 million to protect human health and the environment at and near our legacy sites. This is to ensure that the systems installed to protect people and the environment are effective and that we are in compliance with environmental regulations.

At the end of 2010, LM was responsible for 87 sites that had played a role in the nation's nuclear weapons program. Our site responsibility is distributed across 28 states and ranges from the Aleutian Islands to Puerto Rico. As EM, the U.S. Army Corps of Engineers, and private licensees complete cleanup, we expect our responsibility to grow by 42 sites to a total of 129 sites by the year 2020.

We are requesting $14 million to manage over 100 cubic feet of physical records and a large amount of electronic information. We expect to process more than 1,500 requests into the Privacy Act, Freedom of Information Act, Energy Employees Occupational Illness Compensation Program Act, as well as other inquiries. The 2012 request includes $3 million for the management of records and information systems associated with the Yucca Mountain Project.

We are also requesting $95 million, which is the majority of LM's 2012 request, to support pension plan contributions and/or post-retirement benefits for more than 12,000 former contractor workers. The workers are associated with the following sites: Rocky Flats and Grand Junction in Colorado; Fernald Mound and Portsmouth in Ohio; Pinellas in Florida; Paducah in Kentucky; and the Yucca Mountain Project in Nevada. LM's conservative approach has increased pension plan assets, reduced volatility, and enabled a $40 million reduction in pension plan contributions.

Finally, we are requesting $8 million for property management and beneficial reuse. Where possible we make land and facilities available for public and private use. Today LM has almost 4,000 of our 13,000 acres in reuse. These uses include conservation, industrial, community, infrastructure, grazing, and forestry. In addition, LM has sold or transferred five properties in the last four years.

In closing, the Secretary remains committed to assuring that the Department meets our post-closure responsibilities. This includes the protection of human health and the environment, access to records and information, meeting our commitment to former contractor workers, and maximizing the beneficial reuse of properties no longer needed for the Department's missions.

Thank you.

Statement of David Geiser
Director, Office of Legacy Management
U.S. Department of Energy
FY 2012 Appropriations Hearing

Good morning Mr. Chairman, Ranking Member Visclosky, and distinguished members of the Committee. My name is David Geiser and I am the Director of the Office of Legacy Management (LM) at the Department of Energy (DOE). LM is responsible for ensuring that DOE's post-closure responsibilities are met by providing: long-term surveillance and maintenance of environmental remedies; access to historical records and information; contractor benefits continuity; and beneficial reuse of Federal property no longer needed for Departmental missions.

OPENING REMARKS

The Department created LM eight years ago to provide a long-term, sustainable solution to the legacy of the Cold War. Congress supported the creation of this office in Fiscal Year 2004 and recommended merging the Office of Worker and Community Transition (WT) with the legacy components of the Office of Environmental Management (EM). With LM responsible for post closure activities, the Department is better positioned to focus resources on continuing missions, allowing the Assistant Secretary for Environmental Management to concentrate on the remaining site cleanup activities and risk reduction.

LEGACY MANAGEMENT MISSION AND PROGRAM GOALS

LM's mission is to manage the Department's post-closure responsibilities and assure the future protection of human health and the environment. LM's primary goals are:

- Protect human health and the environment;
- Preserve, protect, and share records and information;
- Meet commitments to the contractor work force; and
- Optimize the use of land and assets.

LEGACY MANAGEMENT FISCAL YEAR 2012 FUNDING REQUEST

The Fiscal Year 2012 budget request for LM is $170 million and the request is tied directly to achieving our core mission and goals. The majority of the request ($95 million) will ensure funding for contractor pension plans and post retirement benefits for more than 12,000 retired contractor workers. The budget includes $39 million to protect

human health and the environment at DOE legacy sites and $14 million to preserve, protect, and make accessible legacy records. Managing legacy lands and assets will require about $8 million. Approximately $1 million will be used to manage the Department's environmental justice program and $13 million, roughly 7 percent of the LM request, will be used to cover the cost of federal salaries, training, and travel.

(Dollars in thousands)

FY 2010 Actual Appropriation	FY 2012 Request
$190,802	$170,100

PROTECT HUMAN HEALTH AND THE ENVIRONMENT

We are requesting $39 million to protect human health and the environment at our legacy sites. An essential component of our mission is to ensure that systems installed to protect people and the environment are effective and that we are in compliance with applicable environmental requirements. The Department is committed to addressing the environmental legacy responsibilities associated with the activities of the Department and predecessor agencies during World War II and the Cold War. In conducting this mission, LM has developed a strong reputation for working closely and effectively with our stakeholders, regulators, and representatives from local and state governments, and Tribal Nations.

At the end of Fiscal Year 2010, LM was responsible for 87 sites that had played a role in the Nation's nuclear weapons production effort. Our site responsibility is currently distributed across 28 states, and range from the Aleutian Islands to Puerto Rico. As a result of past cleanup efforts, many of these former nuclear weapons production sites are now wildlife refuges and nature preserves or support private sector commercial activities.

LM has made steady progress in our ability to manage increased program responsibilities while meeting the Administration's goals for reducing costs and increasing efficiency. LM's site responsibility is expected to grow to 91 sites by the end of this Fiscal Year, to 94 sites by the end of Fiscal Year 2012, and to 129 sites by the end of Fiscal Year 2020. This growth includes sites remediated by the U.S. Army Corp of Engineers (the Formerly Utilized Sites Remedial Action Program), former uranium-milling sites after cleanup by their current owners, and sites managed by EM. The next major site to be transferred from EM is the former Mound Plant in Miamisburg, Ohio. We have continued to work closely with our colleagues in EM to assure a seamless handoff of site responsibilities. LM's FY 2012 budget request contains funding for Mound.

PRESERVE, PROTECT AND SHARE RECORDS AND INFORMATION

We are requesting $14 million to manage legacy records. Integral to the cleanup and closure of sites is the preservation, protection, and public access to records and electronic information. Our records include historical site records, cleanup and long-term surveillance and maintenance records, and former contractor personnel and medical records.

LM manages more than 100,000 cubic feet of physical records and a large amount of electronic information. Part of the physical records collection includes a smaller collection of special media such as x-rays, photographs and negatives, and video and audio tapes that require special environmental controls. In addition, LM expects to process more than 1,500 requests for information under the Privacy Act, Freedom of Information Act, Energy Employees Occupational Illness Compensation Program Act, and other inquiries during Fiscal Year 2012.

In December 2009, we started to consolidate our records management operations at the LM Business Center in Morgantown, West Virginia. This facility was constructed by the General Services Administration and is compliant with National Archives and Records Administration (NARA) requirements. The LM Business Center houses the majority of LM's records collection and serves as LM's electronic data center. In 2010, DOE was awarded two "Gold" Certifications in Leadership in Energy and Environmental Design (LEED) from the U.S. Green Building Council for this facility. This is the first LEED double-gold building in West Virginia.

At the end of Fiscal Year 2010 LM, was assigned the responsibility of managing Yucca Mountain records and information systems, including the Licensing Support Network. We have been performing this function with prior year funds associated with the former Office of Civilian Radioactive Waste Management. The FY2012 request is the first time this responsibility is requested in the LM budget and is a $3 million increase.

MEET COMMITMENTS TO THE CONTRACTOR WORK FORCE

We are requesting $95 million to support post-closure contractor responsibilities. The LM request provides for payment of either pension plan contributions or post-retirement benefits or both for over 12,000 former contractor workers. Those former contractor workers are associated with the following sites: Rocky Flats and Grand Junction in Colorado, Fernald, Mound, and Portsmouth in Ohio, Pinellas in Florida, Paducah in Kentucky, and the Yucca Mountain Project in Nevada.

Under LM oversight, the contractor pension plan assets have increased and the volatility of payments has been reduced. With Congressional appropriations and solid pension plan investment returns, overall pension plan assets/liability ratios are at 90 percent or higher. As such, LM's request for pension plan payments has been reduced by around $40 million over four years. The cost of meeting contractor commitments for the Yucca Mountain project is $1.4 million; this is the first year this request is in the LM budget.

OPTIMIZE THE USE OF LAND AND ASSETS

We are requesting $8 million for property management and beneficial reuse. One of LM's goals is to enable beneficial reuse of our sites while still assuring the protection of human health and the environment. Where possible, LM makes land and facilities available for government, public, and private use consistent with the tenets of sustainability and good land management practices. Currently, LM has almost 4,000 of our 13,000 acres in reuse. The types of reuse under consideration include: disposition (the preferred reuse option), conservation, commercial and industrial activity, community infrastructure, grazing, and forestry.

LM has responsibility for several sites where land and wildlife conservation is a priority. The 1,300 acre Rocky Flats site in Colorado is largely surrounded by 4,000 acres transferred by the Department to the U. S. Fish and Wildlife Service. The natural features of the 1,050 acre Fernald Preserve in Ohio have been restored and include upland forests, open water, the beginnings of a tall grass prairie and a 10,000-square foot, LEED Platinum-certified Visitors Center. The Weldon Spring Site in Charles County, Missouri has been enhanced for both recreation and education including a hike-and-bike trail and a 9,000 square foot Interpretive Center. The two centers, established as part of the environmental remedy, are averaging over 20,000 visitors a year. They serve to inform the surrounding communities about site conditions and have proven to be an effective institutional control.

LM is working closely with EM to transfer the remaining parcels of the 306 acre Mound Site to the Mound Development Corporation (MDC) for community reuse. MDC has been working with DOE since 1993 to develop the property as a light industrial park. To date the Department has transferred 179 acres to MDC.

Finally, LM has sold or transferred five properties in the last four years. These sites include: the Wayne Interim Storage Site and the New Brunswick Laboratory in New Jersey, a portion of the Canonsburg Disposal Site in Pennsylvania; and the Blackridge site in Grand Junction, Colorado. In December 2010, LM transferred the surface of the 1,500 acre Salmon Site to the Mississippi Forest Commission as a wildlife refuge and forest demonstration project. This transfer made more than $2 million in timber available to the State of Mississippi. LM is currently working with the General Services Administration to transfer two additional sites, located in Monticello, Utah.

CONCLUSION

In closing, the Secretary is committed to assuring that the Department meets our post-closure responsibilities. These include: the protection of human health and the environment, access to records and information, meeting our commitment to former contractor workers, and optimizing the use of land and assets no longer needed for Departmental missions.

Mr. WOMACK. Thank you, Mr. Geiser.

One administrative note, we do anticipate that there will be a voting sequence sometime in the 4:00 to 4:15 timeframe and we will play it by ear to determine whether or not we recess the hearing or declare the hearing closed subject to the filing for the record any additional questions and/or supporting documentation.

Madam Secretary, your budget request proposes terminating operations at the H Canyon in Savannah River and placing the facility in a hot standby. Operations at H Canyon carry out EM's responsibility for the disposition of 21 metric tons of highly enriched uranium that was declared excess to defense needs. Operations support the four-year goal to secure nuclear materials by down blending the highly enriched reactor fuel recovered from unsecure international sites, and they also serve to uphold the commitments to the State of South Carolina to provide a disposition path for nuclear materials out of state.

Because of the importance of this work, Congress has set a clear and statutory requirement to maintain H Canyon in a high state of readiness, so please explain for the committee your rationale for the Department's proposal to shut down this disposition path for highly enriched uranium.

Ms. TRIAY. The highly enriched uranium effort that is ongoing now at the H Canyon in Savannah River site will be completed by June of 2011. I believe that the issue that you referred to with respect to the used nuclear fuel at the Savannah River Site is that there were proposals to reprocess the used nuclear fuel. The Department has decided not to move forward with that effort because of the Blue Ribbon Commission study that is ongoing. We wanted to see what were the recommendations of the Blue Ribbon Commission.

Having said that, we used the term safe standby with respect to being in the ready. Were a decision to reprocess the used nuclear fuel now at Savannah River Site to be made in the future, we will be ready to start reprocessing at that time.

The H Canyon, however, will operate. We are going to be doing the following activities at H Canyon: Number one, we are going to be dealing with the returns from our laboratories that sample and analyze our tank waste.

We are also going to be using the H Canyon in order to package transuranic waste to be dispositioned at the Waste Isolation Pilot Plant.

We will also be using H Canyon in order to continue our experiments to purify some of the plutonium that is now considered unable to go into the MOX process so that we can increase the amount of plutonium that is going to go through the MOX process.

We are also utilizing our capability in order to allow an opportunity for a collaboration with the Nuclear Energy program. Idaho and Savannah River would be looking at H-Canyon as a potential research facility in the next generation reprocessing techniques. This is to say that, number one, we will be operating the canyon. Number two, we are going to be in the ready when a decision—if that decision is made in the future to reprocess the nuclear fuel at Savannah River site using Purex.

With respect to the funding, this year in the 2012 request, we are requesting $150 million to address the issue that you brought up with respect to H-Canyon readiness, and that request is going to allow us to perform the activities that I just delineated and also be in-the-ready for our decision to reprocess should that decision be made in the future after the Blue Ribbon Commission gives its recommendations to the Secretary.

Mr. WOMACK. I want to make sure that we are not dealing with a difference in semantics here, but statutory requirement is a high state of readiness. And you are saying to be maintained in a ready state, are we saying the same thing? Are you saying that you will meet the statutory requirement and there will be no need for any sort of change in legislation?

Ms. TRIAY. There will not be any necessity for change in legislation, and when we said "safe standby," we meant safe standby in order to resume or engage in reprocessing of the spent nuclear fuel. We are going to be operating H-Canyon, and I can give you the actual funding that puts this in perspective. In 2010, we spent $210 million of funding in H-Canyon. In 2011, we are doing the same thing since we are in a continuing resolution. In the '12 budget, we requested $150 million for H-Canyon. So what I am saying is that when we submitted the Budget talking about safe standby, what we meant is that we were going to be on safe standby if the decision was going to be made to start reprocessing the spent fuel using Purex. But the H-Canyon will be operated during 2012 doing the activities that I delineated.

Mr. WOMACK. And as a follow-up question, shutting down operation at H-Canyon will generate new costs. Without a disposition path those materials would continue to be stored indefinitely in facilities that are somewhat in a deteriorating state. And the Defense Nuclear Facility Safety Board is warned that DOE may be compelled to undertake expensive, time-consuming, and hazardous efforts to process unstabilized materials.

So with that thought in mind, how much in savings do you expect the department to recoup taking into account an analysis of cost incurred to continue storage of unprocessed materials or other disposition pads that the department may propose?

Ms. TRIAY. The decision to not start the reprocessing of the used nuclear fuel at Savannah River Site was not based on cost. As you see from the budget the Savannah River Site actually increased in funding by $20 million.

What we were trying to accomplish was, No. 1, to see what are the decisions that get made as a result of this study from the Blue Ribbon Commission; No. 2, try to be prudent in terms of our decision-making, given that we were on continuing resolution with some uncertainty dealing with our budget for the fiscal year 2011. We did not want to start the activity of reprocessing used nuclear fuel.

The savings that you are probably referring to is the fact that we have gone through the database that you referred to in the letter from the Defense Board, and a lot of those materials that you refer to can be directly disposed of as transuranic waste or low-level waste. This is less expensive than to process the waste through a chemical separation, like the ones at H Canyon, and ultimately

have that waste go into vitrified storage waiting for a high-level waste repository.

So the savings that we were referring to was in terms of life cycle costs, not in immediate savings dealing with the funding that we have requested for the site.

So I believe that the other point that needs to be made is that if we need it to operate the H-Canyon to deal with any issues, any safety issues related to the used nuclear fuel, we would do that. We would be in the ready to do just that. We do not believe that there are any safety issues associated with our used nuclear fuel. We believe that it can be safely stored for decades, but in the event that that anything happens, this proposal for the $150 million for H-Canyon for 2012 would address that issue.

Mr. WOMACK. Thank you for your responses.

Mr. Pastor.

Mr. PASTOR. Mr. Chairman, because he has to go attend his own Subcommittee, I would yield to Mr. Fattah.

Mr. FATTAH. Thank you. And let me thank you, Assistant Secretary. You have had an extraordinary career. I was out with our Chairman, and we all wish him well in his recovery, with some of my colleagues on this Committee, particularly a gentleman who has some interest in the Idaho National Lab.

We were out at Los Alamos where you worked and held a number of key positions, but now you lead the largest environmental cleanup. you know. I mean, 30,000 employees—federal employees stretching across many states.

How many sites in how many states? You originally were in 35 states, some two million acres at 107 sites? Where are we at now in this process?

Ms. TRIAY. That's right. I mean we actually started with over 3,000 square miles. By the beginning of 2010 we were at 931 square miles. By the end of 2011, we are going to have reduced that active cleanup footprint by 40 percent with the vision of getting to 90 percent reduction by 2015.

In 1989, we were at 110 sites in 35 states. By the end of fiscal year 2010, we were at 18 sites in 11 states. We envision that by 2020 we could be in one major cleanup at the Hanford Site with some minor cleanup through the rest of the complex, and large sites, large cleanups like the Idaho cleanup could be completed by 2015 except for the calcine work at this site. So we really have made a tremendous amount of progress in this cleanup.

Mr. FATTAH. Well, I think members on both sides of the aisle are working hard to get us beyond these two week CRs, so I do not mean this in any partisan way, but are there any challenges related to the short-term CRs relative to the work that you are doing, which is vitally important to the nation's health, in terms of your ability to move forward? You have made tremendous progress as illustrated by those numbers. But is there anything that you would like to tell us? I think we will not see any more CRs, but is there anything about this moment in time that has been particularly problematic?

Ms. TRIAY. The decisions in moving forward with respect to some of the work associated specifically with major parts of the work. For instance, decisions that require different parts of the complex

can have ripple effects through the complex. Those decisions are difficult during CRs.

But with respect to the actual funding that we have because the request is similar to the funding for 2010, we have not experienced any funding issues. It is more in terms of the decisions that we need to make moving forward.

Mr. FATTAH. Thank you very much. Thank you for yielding to the Ranking Member, and let me thank the Chairman.

Mr. WOMACK. Mr. Simpson.

Mr. SIMPSON. Thank you. Secretary, it is nice to see you again. Thank you for being here, thanks for coming today.

First let me thank you for the good work that I think you are doing not only in Idaho but across the complex. You face some challenges, obviously. In many areas we are doing things that we have never done before whether it is the Waste Treatment Plant in Hanford—we on this Committee complain about the cost overruns from I think it was a $4 billion project to $14 billion or something like that. And we are building facilities we have never built before, and that creates some challenges across the complex. But I think you have done a great job at Idaho, and I thank you for the work that you have done there.

Having said that, it is your goal, as you just mentioned, to try to complete the project by 2015 except for the calcine work. The contract, CWI contract, is up for an extension or whatever, and we have three years left in that contract.

Do you know whether you are in a position that you are going to be extending that contract or rebidding it?

Ms. TRIAY. We are exploring the option of extending the contract, and that is a very disciplined and rigorous process within the Department of Energy. Ultimately, the Secretary would have to make that decision, so we are in that process right now.

We have kept all of our options open in the event that we decide not to move forward with that contract extension, but that is what we are exploring right now.

Mr. SIMPSON. Do you have any idea when that decision will ultimately be made?

Ms. TRIAY. Probably within months.

Mr. SIMPSON. Okay. As you clean up areas and transfer control to the Idaho National Lab under NE's budget, certain cost elements will be borne by the INL. I would like to be assured that plans are being developed between NE and EM to ensure that planning will be completed and that resources will be made available to ensure that the transition is smooth.

How are you working with NE to arrange for a transition of responsibilities and resources?

Ms. TRIAY. We are in active collaborative efforts with the Nuclear Energy program. We are particularly fortunate because the field manager of the Idaho Site, Mr. Rick Provencher was the head of the cleanup at the Idaho Site before he was promoted to Field Manager. So he is extremely well aware of the transition costs that our plan requires, and we are in the process of delineating those transition costs and ensuring that they get captured correctly so that the Nuclear Energy program is well poised to continue their

stewardship efforts with respect to the facilities that will be transitioned.

Mr. SIMPSON. You have advocated for, and I have not really advocated for but suggested it might be a good idea under certain circumstances, an accelerated cleanup at the Idaho Site. That would obviously take additional resources. My concern has been, as I have expressed to you, that if you are taking resources out of other higher risk areas to do an accelerated cleanup at Idaho, that might save us money in the long run, but at the cost of the higher risk areas.

We have additional funding in this budget for the Hanford Site in a couple of areas. Is that to accelerate cleanup there, or is that to address problems that currently exist? What is the additional funding for at the Hanford Site?

Ms. TRIAY. At the Hanford Site the additional funding is in the area of the Waste Treatment Plant where we are not increasing the total project cost. What we are doing is requesting a different funding profile. The way the funding profile of the Waste Treatment Plant was envisioned, all of the resolution of the risk, addressing the risks, was at the end of the cost, scope, and schedule baseline.

What we are doing is requesting additional funds in order to ensure that we can address the risks as the risks are realized. So that is one reason why we are asking for more funds at the Waste Treatment Plant.

We have also requested more funds in the tank farm area of the Hanford Site. And the reason for that is that that is indeed the highest risk. So we are not trying to accelerate the cleanup, although by being able to request and obtain this funding profile for the Waste Treatment Plant, that would—our estimates now indicate that we are going to be ready with design completed by 2013, completed with construction by 2016, and operational by 2019.

Mr. SIMPSON. One other question—and it will be several questions in this, and then I will have you both address this, the subject.

All DOE contractors pay into their pension funds through their overhead rate. The pensions are being funded at their legal minimum as specified in NRSA. When the cleanup contract is completed, and I am talking specifically about Idaho now, and there is a liability in the pension fund, how will that be handled? Will that shift over to legacy management?

And along those same lines, I have noticed that you have increased or asked for a substantial increase to deal with the pensions in your budget. Yours is actually down in dealing with the pensions. Why up in the EM, down in LM? Talk to me about the pensions issue, if you could.

Mr. GEISER. I could, to give you a rest.

Ms. TRIAY. Thank you. Thank you.

Mr. GEISER. I can explain why ours are down. So, a lot of—almost all our pension responsibility was transferred from EM at the closure of Fernald and Rocky Flat sites.

Mr. SIMPSON. Um-hmm.

Mr. GEISER. And at that time those pension plans were underfunded, but when the site closed the plan became a closed plan, so there are no more workers coming in to add to it. And so that con-

tractor, which is best practice, went to a very conservative investment approach. That was when the stock market was at the highest. So, they converted all those stocks to bonds. And then when the stock market went down, those pension plan assets actually increased in value. So, part of it was the timing. We went to a closed population at the top of the stock market, and so our pension plan assets went up while everyone else's were going down because of this investment approach by the contractor.

The other part is LM requested and the Congress gave us money to make up the difference in the unfunded amount, and so today all of the pension plans that LM is responsible for funding are all at 90 percent or more, and that enabled us to reduce our ERISA minimum payment from about 40 to 50 million a year down to 4 million and was projected for 2012.

Mr. SIMPSON. Okay.

Ms. TRIAY. In our case, there are a number of plans that have been difficult for us to manage with respect to cost, especially the Savannah River Site plan. As you know, these plans are managed by the contractor and that business is an allowable cost for the Department of Energy, so that is why we requested it in our budget.

The Chief Financial Officer has shown, I believe, very commendable leadership in this area of pensions.

Number one, the visibility, the transparency. They have—the CFO has done an excellent job making sure that we understand the pension costs and that obviously the Congress can understand them as well.

Number two, we are taking measures for when the new hires come in, instead of them also going into the defined benefits plan, they go into more market-based type of benefits moving forward.

And number three, we also are distributing lessons learned across the board, the best practices, like what Mr. Geiser has delineated. The CFO makes sure that all of the managers that are in charge of these pension plans understand the options that they have in order to get into a position where we not only have reduced the cost but also we are in a very predictable situation when it comes to cost moving forward. So, I believe that in future years you are going to see us in the same position that Mr. Geiser is at today but it is going to require some period of time to do the same types of things that he was able to do in the Legacy Management program.

Mr. SIMPSON. When EM leaves Idaho, and there is still a liability there—essentially, will LM take that over? Is that the plan?

Mr. GEISER. I do not—we have not addressed a situation yet where there is—where that transfer from EM to LM has a site that has an ongoing mission. So, every site that has come over and every pension plan that has come over has been for a closed site. I think this has to be a discussion between the Office of Nuclear Energy and Environmental Management and Legacy Management as to how that—what would be the best way to manage those pensions——

Mr. SIMPSON. I would be concerned if NE started taking on those additional liabilities rather than EM or LM. That is a discussion we need to start having, because that is going to happen within a few years here.

I appreciate it.

Ms. TRIAY. Absolutely.

Mr. SIMPSON. Appreciate it.

Mr. WOMACK. Madam Secretary, on March 3rd, Secretary Chu certified that there would be no adverse impact on uranium markets if the Department transferred over three years more than 4600 metric tons of natural uranium equivalent to the markets. We have some concerns about that statement.

First, a lack of credibility that the analysis holds since the Secretary had to be able to predict the state of the market three years out, which is very difficult to do. But the current state of the market indicates that the impact to the nuclear industry would most likely be negative in light of the effects of the Japanese nuclear disaster on world uranium markets. The action opens up a funding stream not just for this fiscal year or next fiscal but into year 2013. Instead of requesting appropriations from the Committee for the cleanup, this would circumvent the appropriations process. There is, frankly, no accountability once it transfers again.

In light of the Japanese nuclear disaster and its affect on the uranium markets, is this a prudent step?

Ms. TRIAY. The way that we have it set up as a result of those concerns, the transfer of uranium, is to do the transfers on a quarterly basis. That way we can see what the market is doing before a substantial amount of uranium can come into the market. So, we will definitely be looking at the state of the market. We will be working with you to ensure that in moving forward we do not affect the uranium markets adversely.

With respect to the reason that we believe this is a worthy investment, the cleanup program at the Portsmouth Gaseous Diffusion Plant has been initiated. And what we were trying to accomplish, of course, is to perform that cleanup in an efficient manner, and we needed these resources in order to do that. So that was the reason this was done, and we believe that you are going to see a very efficient cleanup being performed at the Portsmouth site. We are very pleased with the award that we have given to a contractor that has had much success in the past cleaning up different sites.

Mr. WOMACK. Do you think the Secretary will recertify his impact statement?

Ms. TRIAY. Since it is early still to tell exactly what is going to be the effects moving forward, I would like to work with your office to make sure that you feel comfortable with what we are doing, the idea of doing this on a quarterly basis is to give us the time to be deliberate about the decisions that we are making.

Mr. WOMACK. How much funding do you expect this transfer to provide for cleanup in Portsmouth?

Ms. TRIAY. On the order of $150 to $200 million per year, and since we initiated these transfers, we have hired the workforce, and the workforce now being transitioned into the new contract that we just awarded. So, we really think that it is a worthy utilization of resources, and we hope that we can prove how effective the cleanup is going to be performed.

Mr. WOMACK. I know I am new to this process and obviously new to the Committee, but is there precedent for authorizing this kind of activity for three full years even into the next administration?

Ms. TRIAY. The determination was made based on an analysis from an independent group of experts, and we believe that the Portsmouth decontamination and decommissioning cleanup is—long-term cleanup is going to take over a decade, so that is the reason that we feel that proposing to barter uranium, to transfer uranium in exchange for cleanup services for three years is prudent.

Mr. WOMACK. Thank you very much, Madam Secretary.

Mr. Simpson.

Mr. SIMPSON. Just a couple quick things.

Safeguards and securities budget is down $30 million, a 57 percent reduction, at Oak Ridge. Why is that?

Ms. TRIAY. Mainly at Oak Ridge because of the carryover funds. We were trying to take into account those balances so that we could request only the money that we needed, given the constraints on the budget. Having said that, across the board we are endeavoring to reduce the cost of safeguards and security while maintaining a secure posture. As we watch cost reduction as we finish cleaning up the sites, as we finish securing used nuclear fuel and nuclear materials, we are going to be looking at the costs associated with our program to make sure that we are cost efficient and that we reduce the cost commensurate to the risk while maintaining a secure posture.

Mr. SIMPSON. At the Sodium Bearing Waste Treatment Facility, the costs were about $109 million, 24 percent over estimated costs. Why did the cost rise so dramatically, and what is the project status? Is critical decision 4 still on track for the fourth quarter of 2011 to start operations?

Ms. TRIAY. In the Sodium Bearing Waste Facility, the total project cost is $571 million, and we have not increased that total project cost.

What we have done is we have modified the contract and ensured that we have a cap associated with this portion of the work so that if there is any cost overrun as a result of the performance issues that the contractor is responsible, rather than the government, for paying those costs.

Having said that, we expect that we are going to finish construction by May, that we are going to be operating the facility by the end of this calendar year, that we are going to be able to meet the compliance milestone to finish the retrieval and processing of the waste in the last three tanks that are left with the sodium bearing waste so that we can move forward and close the last four tanks, which then will mean that the entire tank waste cleanup at Idaho will be completed very close to December of 2012. So, we are making extremely good progress.

With respect to the why—you know, why are we having these issues that necessitated that contract modification to cap the liability of the Department of Energy, a lot of this deals with how the nuclear industry is restarted. The nuclear industry necessitates nuclear quality assurance not only in the work that gets done in the facility but also associated with the procurement actions that need to be taken in order to manufacture the equipment inside the facility.

We have found that in restarting that nuclear construction industry, both our contractors and, more importantly, their contrac-

tors—in other words, our subcontractors, that tend to be even smaller companies than our prime contractors, have had some difficulty in restarting and having very rigorous quality assurance programs, and that has necessitated some oversight measures which increase the cost. And for that reason we believe that even though we, I think, have assisted in terms of the nuclear posture for construction projects, it has taken longer than expected, and it has taken more money than planned.

Mr. WOMACK. Thank you.

I want to thank the witnesses today. The fact that we have a vote pending on the floor necessitates either a recess or adjournment. I think my colleagues are in agreement that it is practical to go ahead and adjourn. Questions should be submitted for the record to any responses according to the timelines and the milestones established in my opening remarks. I want to thank you for service to our nation and thank you for the opportunity to be today.

Ms. TRIAY. Thank you.

Mr. WOMACK. This meeting is adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

ENVIRONMENTAL MANAGEMENT FISCAL YEAR 2012 BUDGET HEARING

MARCH 30, 2011

DEFENSE ENVIRONMENTAL CLEANUP

PROPOSAL TO CLOSE DOWN H-CANYON

Subcommittee. Madam Secretary, your budget request proposes terminating operations at the H-Canyon in Savannah River and placing the facility into hot standby. This facility provides the national capability for downblending highly enriched uranium and supports a number of national security missions.

Operations at H-Canyon carry out EM's responsibility for the disposition of 21 metric tons of highly enriched uranium that was declared excess to defense needs. Operations support the four year goal to secure nuclear materials by downblending the highly enriched reactor fuel recovered from unsecure international sites. They also serve to uphold the commitments to the state of South Carolina to provide a disposition path for nuclear materials out of the state.

Because of the importance of this work, Congress has set a clear, statutory requirement to maintain H-Canyon in a "high state of readiness."

What is the rationale for the Department's proposal to shut down this disposition path for highly enriched uranium?

Ms. Triay. For approximately the past three years, H-Canyon has been operating to complete the blend down of enriched uranium recovered from the processing of surplus unirradiated highly enriched uranium (HEU) materials. The Department intends to complete the current HEU blend down work in 2011, and H-Canyon will then continue in an operational condition. The Department has identified groups of materials that could be processed through H Canyon/HB-Line facilities. They are used nuclear fuel (UNF), certain plutonium materials which are not suitable for fabrication into mixed oxide (MOX) fuel, and enriched uranium contaminated with transuranic material. Much of the remaining material that could be processed in H Canyon in the future is used nuclear fuel. The Secretary of Energy has determined that no processing of aluminum-clad UNF will occur until the recommendations of the President's Blue Ribbon Commission (BRC) on America's Nuclear Future are issued and evaluated by the Department.

The proposed operational condition of H-Canyon will allow the flexibility to process aluminum-clad UNF or any other appropriate nuclear materials, in the future, should that decision be made. In the interim, the aluminum-clad UNF will remain in safe wet storage in L-Basin at SRS.

The Department is planning to transition H-Canyon and HB-Line facilities to modified operations in fiscal year 2012. H-Canyon will continue to receive sample returns from the Savannah River National Laboratory and F Area Laboratory and disposition the samples to the liquid waste system. H-Canyon will also remediate large boxes of legacy transuranic waste and .HB-Line is being considered to blend surplus non-pit plutonium material, not suitable for fabrication into mixed oxide (MOX) fuel with an additive to make the material difficult to recover and reduce the plutonium concentration to less than ten percent. The blended material

would be packaged into pipe-over-pack containers and subsequently shipped to Waste Isolation Pilot Plant.

Subcommittee. How does your proposal fulfill the statutory requirements to maintain the facility and to provide the staff to maintain and operate it? Or are you suggesting a legislative change?

Ms. Triay. The Department's plans comply with the statutory requirements to maintain H Canyon and to provide appropriate staffing. The H Canyon would be flushed and de-inventoried to place the facility in a safer posture. The Department would retain the critical staff, perform proficiency runs which maintain the operator qualifications, and exercises the processing equipment.

Subcommittee. What alternative disposition paths do you propose for the fissile and other excess nuclear materials that were to be previously processed at H-Canyon? How will the Department satisfy the agreement with South Carolina?

Ms. Triay. As discussed in the response to the first question, the used nuclear fuel will remain in safe wet storage in L-Basin at SRS until the recommendations of the President's Blue Ribbon Commission (BRC) on America's Nuclear Future are evaluated by the Department. For the remaining surplus plutonium materials which were previously planned to be processed at H Canyon, the Department is considering a number of alternatives, including disposing of some of the material at WIPP.

COSTS OF CLOSING DOWN H-CANYON

Subcommittee. Shutting down operations at H-Canyon will also generate new costs. Without a disposition path, those materials would continue to be stored indefinitely in deteriorating facilities. The Defense Nuclear Facilities Safety Board has warned, "DOE may be compelled to undertake expensive, time-consuming, and hazardous efforts to process unstabilized materials."

How much in savings do you expect the department to recoup, taking into account an analysis of costs incurred to continue storage of unprocessed materials or other disposition paths that the Department may propose?

Ms. Triay. The Department has determined that no processing of aluminum-clad UNF will occur until the recommendations of the President's Blue Ribbon Commission (BRC) on America's Nuclear Future are issued and evaluated by the Department. In the interim, the aluminum-clad UNF will remain in safe wet storage at SRS and L Basin is planned to be modified to accommodate increased storage capacity. The pre-conceptual design cost estimate for the design, fabrication, and installation of the additional racks and modifications is approximately $60 million over several years.

The Department is considering other alternatives for the remaining fissile and excess nuclear materials, including disposal at the Waste Isolation Pilot Plant, which is anticipated to result in a cost avoidance of approximately $250 million and accelerate the removal of this material from the state of South Carolina by several years.

WITNESS TAMPERING INVESTIGATION

Subcommittee. Madam Secretary, the Defense Nuclear Facilities Safety Board is investigating allegations that some Hanford workers were pressured to downplay safety concerns during one of the Board's hearings in October at Hanford. We understand that the Department of Energy has questioned the Board's jurisdiction to investigate these types of allegations in a letter from the Secretary. The Board defends their investigation as strictly to determine whether a safety culture exists at Hanford and if workers feel coerced or intimidated into downplaying their concerns. Indeed, it would be a matter of great concern if schedule and cost pressures were to take precedence over valid safety issues. Hearing such allegations is disturbing.

What are the facts of the case that you know? Is DOE taking the allegations seriously?

How has DOE investigated these allegations itself? Is the DOE Inspector General looking in to the matter? Are there any other actions or findings that DOE is taking to ensure that safety is being taken seriously at Hanford that we should be aware of?

Ms. Triay. The Department of Energy takes any and all allegations of this kind very seriously. Any such conduct will not be, and has not been, tolerated. Such conduct would be directly contrary to the Department's strong and successful efforts to inculcate its safety culture message.

Nevertheless, recognizing the importance of these issues, the Energy Department's Office of General Counsel conducted an investigation headed by a former Assistant United States Attorney. The investigation entailed extensive interviews and document review. The investigation concluded unequivocally that no employee of the Energy Department, or any of its contractors' employees, pressured a Board witness to change his or her testimony. The General Counsel's office shared the results of its investigation with the Board.

The Department of Energy has a strong history and culture of safety in working with unique nuclear hazards and facilities. We stand by our safety record and the nuclear safety culture of the Department. One effort that has been ongoing for the last few years is via the Department's contractor organization, Energy Facilities Contractor Group (EFCOG) to identify Safety Culture Focus Areas and Associated Attributes that could provide the greatest impact on improving safety and production performance within the DOE complex. The safety of our workers and the public is of fundamental importance to our projects and our operations and will always remain at the center of the Environmental Management Program. The Department also has other processes that foster ability for individuals to raise safety and technical issues. These include but are limited to a process for differing professional opinions (DPOs) to facilitate dialogue and resolution on DPOs related to environment, safety, and health aspects of DOE facilities and activities and through an employee concerns program.

ACCELERATED FUNDING FOR HANFORD

Subcommittee. Madam Secretary, the overall funding level for River Protection at Hanford is a significant increase over fiscal year 2010, with an additional $150 million for the Waste Treatment Facility and $115 million for Tank Farm Activities. This is a large increase.

Will you explain how you arrived at these figures? I understand there was a significant technical review of the Waste Treatment Plant project that lead to this request, what, exactly is this funding intended to accomplish?

Ms. Triay. The President's fiscal year (FY) 2012 budget request includes $840 million (M) for the Waste Treatment Plant (WTP) project and $521M for the Tank Farms project, for a total request of approximately $1.36 billion for the Office of River Protection's (ORP) tank waste cleanup at Hanford. The threat posed by Hanford's 53 million gallons of highly radioactive waste, currently stored in 177 aging underground tanks, is real and compelling.

The Waste Treatment and Immobilization Plant (WTP) Project has reached a pivot point transitioning from a design/construct to a construct/commission project and the project team has performed an evaluation of the Estimate at Completion and remaining risks with a focus on the entire picture of the project using available sophisticated project and risk management tools. The following activities represent key WTP project work scope that would be funded utilizing the FY 2012 $150M increased funding request:

- Incorporation of design resolution for Pretreatment Vessel Mixing (M3) into the committed design;
- Incorporation of design resolution in the Pretreatment Facility for the cesium nitric acid recovery process system (CNP) and the cesium ion exchange process system (CXP) into the committed design;
- Pretreatment Facility CNP/CXP modifications including procurement of additional hot cell equipment;
- Implement fire protection features equivalent to DOE-Standard "1066" (change from original design requirements); fabrication of dampers / filter housings and hangers;
- Pretreatment Facility pipe installation, including Planning Area 03 and Planning Area 04 modules M3 Mixing modifications and vessel internals (both on site and off site) fabrication;
- Resolution and implementation of design modifications addressing potential contamination of the Steam Condensate Water System sent back to the Balance of Facilities boilers from the Pretreatment Facility;
- Civil build installations of Pretreatment Facility out cell piping and electrical systems; and
- Equipment Procurements (Heat Exchangers Air Compressors, Jumpers, Blowers) for Pretreatment, High Level Waste and Low Activity Waste facilities.

The $521M request for the Tank Farms project enables ORP to prepare the tank farm feed/delivery systems essential to reliably and consistently provide waste feed to the WTP when operations begin, as early as 2016. Planned activities at this funding level include continued single-shell tank waste retrievals, infrastructure and facility upgrades, supplemental low-activity

waste treatment, waste transfers, secondary waste/effluent facility upgrades, and WTP pre-operations and commissioning work.

Subcommittee. Is this an increase in funding for the project or does it reflect a change in the profile of the funding, that is are you simply moving the funding forward in time?

Ms. Triay. The funding request of $840M in FY 2012 is a forward shift of funding from project out years to the present. However, the Total Project Cost of the Waste Treatment Plant does not increase above the $12.263 billion total.

SAFETY ISSUES ON THE WASTE TREATMENT PLANT DESIGN

Subcommittee. Madam Secretary, after ten years of design and construction, the Defense Nuclear Facilities Safety Board still has outstanding safety issues on the design of the Waste Treatment Plant at Hanford that have not been resolved. One of those concerns is that the radioactive waste that includes heavy particles must remain mixed in tanks within the plant using a system with no moving parts. Those tanks will be in black cells that will be too radioactive to ever access, so if particles settle out of the mixture and collect on the bottom of the tank, there is a risk of a nuclear criticality accident or trapped gases could pose an explosion hazard. It may still be necessary to change the design slightly, such as adding in additional piping, to ensure safe operations,

Yet the budget request for this project proposes to accelerate construction activities by adding $150 million over the current level of $690 million.

Subcommittee. With the present nuclear crisis unfolding in Japan right now and the fact that the organization that oversees nuclear safety in defense nuclear facilities has raised safety concerns, shouldn't we pause to reconsider our safety basis for the facility? If not pause, then how can it be prudent to proceed at an even greater pace before doing everything we can to ensure the facility design is as safe as it can be?

Ms. Triay. The threat posed by Hanford's 53 million gallons of highly radioactive waste, stored in 177 aging underground tanks, is real and compelling. WTP is the enabling facility that will treat these millions of gallons of highly radioactive and chemically-hazardous wastes to a solid form, such that the wastes do not harm the public, the environment, or the nearby Columbia River. The accidents witnessed in Japan associated with nuclear reactors were caused by temperatures and pressures that are physically not possible in the WTP. The amount of hydrogen generated at the Japanese reactor during the accident was very large and is due to the reaction of melting the zirconium fuel cladding at very high temperatures. The operation of the WTP is fundamentally different from that of a nuclear reactor; there is no high temperature from residual heat and zirconium reactions generating large quantities of hydrogen. WTP has no waste with high residual decay heat that requires cooling and the WTP operates at pressures and temperatures that are considerably lower than nuclear power plants. The events in Japan, however, warrant a review for natural phenomena hazards for events beyond design basis accidents to consider for purposes of emergency management planning, (i.e., such as simultaneous flooding, earthquakes, and ashfall), but in accordance with the Department's nuclear safety regulations and supporting requirements, do not drive modifications to the safety basis of the WTP.

Based on the results of the work to date on mixing of wastes with pulse jet technology, the necessary modifications and/or enhancements to the WTP design for vessel mixing have been identified. Continued testing will confirm the modifications and define the operational capabilities of the WTP vessels to mix and safely treat Hanford's tank waste. Many design enhancements have already been adopted based upon earlier testing results, such as additional solids accumulation inspection and waste heel removal capabilities for the vessels located in the black cells. These modifications/enhancements also contribute to mitigation of potential nuclear criticality and potential trapped explosive gasses in the vessels of concern.

Subcommittee. What is DOE's plan and schedule to resolve the safety concerns of the Defense Nuclear Facilities Safety Board?

Ms. Triay. The remaining DNFSB concerns with the WTP design are well understood and over the last five years DOE has been executing an extensive program of investigation, testing, and external peer reviews (led by experts from academia and industry), which has resolved the majority of the project risks associated with these concerns. The remaining DNFSB design concerns are with the Pretreatment Facility (one of four major facilities comprising the WTP project) and do not impact the remaining facilities. The continued testing of the pulse jet mixing technology will confirm the identified modifications and define the operational capabilities of the WTP vessels to mix and safely treat Hanford's tank waste. This testing is expected to be completed in 2013 prior to installation of the remaining vessels employing pulse jet mixers.

Subcommittee. What, if any portion of the budget increase will address this issue?

Ms. Triay. The requested $150 million increase in fiscal year 2012 includes funding for

WTP project work scope to support technical resolution of the pulse jet mixing issues, including:

- Incorporation of design resolution for Pretreatment Vessel Mixing (M3) into the committed design;

- Pretreatment Facility pipe installation, including Planning Area 03 and Planning Area 04 modules M3 Mixing modifications and vessel internals (both on site and off site) fabrication.

Subcommittee. What is the range of costs it might take to make the changes that are being suggested by the Board?

Ms. Triay. Mixing modifications are included in the WTP project baseline, and do not represent additional cost to the project.

RISK OF HYDROGEN EXPLOSION AT WASTE TREATMENT PLANT

Subcommittee. Madam Secretary, one of the other safety concerns raised by the Defense Nuclear Facilities Safety Board was that safety standards have been downgraded for the Waste Treatment Plant to allow hydrogen explosions to occur as the gas builds up in the piping and vessels. We have seen what hydrogen can do after witnessing the hydrogen explosions at the Fukushima Daiichi nuclear power plant.

What is your assessment of the danger posed by the buildup of hydrogen gases in the systems of the Waste Treatment Plant?

Ms. Triay. The Waste Treatment Plant (WTP) operates at pressures and temperatures that are considerably lower than nuclear power plants. These factors individually, and combined, result in hydrogen generation rates and release of energy from hydrogen events that are orders of magnitude lower than are possible at a reactor plant. This allows systems for WTP to be safely designed to accommodate any postulated hydrogen events that could possibly occur during the life of the plant.

The primary means of protection for the public, worker, and the environment against the buildup of hydrogen in the WTP are the safety class boundary (walls) and ventilation systems for the waste processing areas. These systems separate the public, workers, and environment from potential explosive hazards and provide protection from release of radioactive materials. Concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB) focused on the vulnerabilities to the integrity of other confinement systems, primarily piping and ancillary vessels resulting from a hydrogen event. The tanks where the majority of the hydrogen volume is generated are designed to include ventilation capabilities as part of the process ventilation system which are credited safety systems. The potential for hydrogen in piping and ancillary vessels (HPAV) is therefore separate from the mixing vessels. The approach WTP incorporates for hydrogen events provides the greatest confidence for safe operation over the life of the plant.

Design for HPAV events considers two approaches: 1) the use of active controls, such as flushing or venting capabilities in piping segments prone to hydrogen accumulation that are greater than four inches in diameter; and 2) evaluation of the suitability for passive controls in piping less than four inches in diameter, based upon the frequency and severity of hydrogen events. Physical detonation tests simulating the most severe hydrogen detonation events were performed on the types of piping materials that will be used in WTP construction using gas mixtures of hydrogen and nitrous oxide, which represent the most severe events predicted for WTP. These tests confirmed that pipe fragmentation will not occur, even in the unlikely event that enough hydrogen builds up in these small diameter systems to detonate.

Subcommittee. When were the safety requirements for hydrogen changed, and what was the justification? Was it simply to save costs? What studies were done, or what technical information was used to support downgrading the safety basis?

Ms. Triay. The safety requirements for hydrogen have not changed. However, there has been a revision to the design approach to achieve those safety requirements. In 2002, the project

initiated actions to address lessons learned from the NRC in "Hydrogen Combustion Events in Foreign BWR Piping." At that time, active venting controls were developed to prevent accumulation of hydrogen. In parallel, an extensive program of analysis and testing was initiated to gather data to support a broader passive control strategy in which the systems would be designed to withstand potential hydrogen detonation. Between 2002 and 2008, the WTP project performed extensive testing on how piping responded to hydrogen detonation events.

The testing involved causing hydrogen-related events in piping systems to understand the applicable loading and how to design piping that can withstand the events without damage that would impair the pipe.

Additionally, in late 2008 the Office of River Protection (ORP) decided to re-evaluate the design control strategy for the HPAV event for purposes of evaluating whether alternative design approaches for dealing with hydrogen could simplify the facility.

- ORP chartered two task forces early in 2009 to determine whether alternative design approaches for dealing with hydrogen would simplify the facility and provide increased assurance of safe and reliable operations.
- The first task force observed that an overly conservative prescription of the Material at Risk was causing the functional safety classification of systems to be inconsistent with the actual level of risk portended by the facility.
- The second expert task force observed that alternative evaluation methods and design criteria could result in a design that is less operationally complex, operationally more reliable, and with potential construction and operational cost savings.

As a result of this new information the design control strategy has been modified to design the piping system to withstand deflagration or detonation where it can be demonstrated that the pipe will not fail, consistent with the test data and design requirements (passive controls). In either situation, active or passive control, the safety basis classification of the systems remains the same.

Subcommittee. Why should construction continue for the facility without first resolving the outstanding hydrogen concern, including a reassessment of the safety requirements and a new determination that current safety standards are sufficient?

Ms. Triay. DOE has high confidence in the design approach being used to assure the operational reliability for safe treatment of Hanford's radioactive tank waste.

On April 15, 2010, in a periodic report to Congress, the DNFSB expressed concern "that many changes to the design of WTP are being approved by the DOE prior to the resolution of numerous outstanding technical issues." In an effort to resolve those technical issues, the DNFSB suggested a comprehensive, independent, expert based review of the safety design strategy for control of hydrogen in pipes and ancillary vessels. This led to the formation of the HPAV Independent Review Team (IRT).

This team consisted of experts that evaluated the WTP approach for addressing HPAV events in three areas: 1) quantitative risk assessment (tool being used to evaluate frequency and

magnitude of hydrogen events); 2) gas phenomena; and 3) structural. The HPAV IRT concluded that the design approach for HPAV piping and components is acceptable provided that the project resolves the Findings identified by the team. The team further stated that the net results of this approach to design will be a low probability of pipe failure if hydrogen detonation occurs. The project is currently in the process of completing its efforts to address the HPAV IRT findings.

DOE has high confidence that the HPAV design approach yields a superior design for WTP that not only complies with DOE safety policies but assures the operational reliability necessary for efficient achievement of the critical waste treatment mission to safely treat Hanford's radioactive liquid waste.

URANIUM TRANSFERS

Subcommittee. Madam Secretary, on March 3, Secretary Chu certified that there would be no adverse impact on uranium markets if the Department transferred over three years more than 4600 metric tons of natural uranium equivalent to the markets. We have some concerns on this statement.

First, there is a lack of credibility that the analysis holds since the Secretary had to be able to predict the state of the market three years out, something with is very difficult, if not impossible, to do. But the current state of the market indicates that the impact to the nuclear industry would most likely be negative in light of the effects of the Japanese nuclear disaster on world uranium markets.

The action opens up a funding stream not just for this fiscal year, or next fiscal year, but into the year 2013. Instead of requesting appropriations from the Committee for the cleanup, this would circumvent the appropriations process and there is frankly no accountability once the transfers begin.

Subcommittee. In light of the Japanese nuclear disaster and its effect on the uranium markets, is this a prudent step?

Ms. Triay. The Department believes continuing with the transfers to the D&D contractor is a prudent step. The Department will continue to monitor the uranium markets and the potential effects the uranium transfers may have. Although there was a reduction of uranium prices in the days immediately following the Japanese nuclear disaster, the prices have rebounded.

Subcommittee. Will Secretary Chu be recertifying his impact statement?

Ms. Triay. At this time, the uranium market prices have rebounded and are still consistent with the analysis prepared to support the Secretarial Determination.

Subcommittee. If not now, at what point would DOE act to minimize negative market impacts, or would this not factor into account at any time over the three years?

Ms. Triay. The Determination permits the Department to make transfers up to the amounts authorized by the Secretary. The Department is not required to make those transfers. The Department will continue to evaluate the condition of the domestic uranium market, and if appropriate, would take appropriate steps, which could include modifying the actual amounts transferred, revising the Determination, or conducting a new market impact analysis to ensure the amounts authorized in the Determination would not have an adverse material impact on the domestic uranium conversion, enrichment, or mining industries.

Subcommittee. So, Madam Secretary, how much funding do you expect this transfer to provide for cleanup at Portsmouth each year?

Ms. Triay. The Department expects the transfers of uranium in exchange for services from the D&D contractor to fund between $150 to $200 million per year in D&D work at the Portsmouth site, on average over the three year period.

Subcommittee. Is there any precedent for authorizing this activity for three full years, even into the next Administration?

Ms. Triay. Yes, the Secretarial Determination covering the National Nuclear Security Administration's transfers to fund the blending down of U.S. highly enriched uranium to commercial reactor-grade low enriched uranium covered a period between 2006 and 2009, a three-year period that spanned Presidential administrations.

Subcommittee. Does this activity increase the budget deficit?

Ms. Triay. The effects of this activity on the budget deficit are difficult to determine given the significant uncertainty regarding the factors needed for such an assessment.

WORKFORCE RESTRUCTURING

Subcommittee. Section 3161 of the Fiscal Year 1993 National Defense Authorization Act requires a work force restructuring plan be developed whenever work force restructuring occurs throughout the nuclear weapons complex. We understand that EM is looking to restructure a sizeable number of workers at several sites this year, including Savannah River, Idaho National Laboratory, Hanford, and Portsmouth.

When will the workforce restructuring plan be provided to the Committee?

Ms. Triay. Savannah River, Idaho National Laboratory, and Hanford last updated their Section 3161 workforce restructuring plans in 2009, 2008, and 2002 respectively. Each site is operating under these plans as they proceed with their site specific contractor workforce restructuring. The Department is in the process of updating the Section 3161 workforce restructuring plan for Portsmouth/Paducah; once the plan has been approved and signed by the Secretary of Energy it will be shared with the relevant Congressional stakeholders.

Subcommittee. Can you explain what is driving the need for restructuring the workforce at those sites and how you will carry out your plan? Are there any other defense sites that are in a similar situation, either this year or in fiscal year 2012?

Ms. Triay. The Department has already announced contractor workforce restructuring at the following defense sites: Savannah River, Idaho, Hanford, Paducah, and Waste Isolation Pilot Plant (WIPP) sites. The primary driver for the contractor workforce restructuring at these sites is the expected completion of the American Recovery and Reinvestment Act (Recovery Act) activities at each site by September 2011. As the Recovery Act program started and workers were brought on to support the accelerated cleanup effort, each of the site contractors followed all of the local labor agreement requirements. To the fullest extent possible DOE looked to save jobs on the existing prime contracts and utilize subcontractors to support the Recovery Act effort.

In addition to the impacts on the Recovery Act workers at the identified sites, both Savannah River and the Idaho sites included base program contract workers in their recent workforce restructuring action. This is being driven by completions of base program scope and the need to realign the contractor workforce to meet the needs of the ongoing cleanup mission at each of the sites.

The DOE is currently evaluating contactor workforce impacts of the Department of Defense and Full-Year Continuing Appropriations Act, 2011. The DOE does not anticipate any additional workforce impacts from the FY 2012 budget request.

Subcommittee. What will be the impacts to the workforce at those sites? How many workers will be affected?

Ms. Triay. The following table highlights an estimate of the workforce restructuring impacts at the defense sites only:

Sites	Recovery Act Impacts	Base Program Impacts	Totals
Savannah River	600	500	1100
Idaho	400	200	600
Hanford	1600		1600
Paducah	270		270
WIPP	90		90
Totals	2960	700	3660

SUCCESS OF RECOVERY ACT PROJECT MANAGEMENT

Subcommittee. Madam Secretary, last summer, the GAO investigated the cleanup projects being funded by the Recovery Act and reported good news. It found that most DOE cleanup projects were meeting their cost and schedule targets. This is in contrast to the project management problems which keeps your office on the GAO's High Risk List. One of the major differences in management of Recovery Act projects is the unprecedented transparency in financial reporting.

Do you think that the additional transparency on projects funded under the Recovery Act has contributed to the success of those projects? Given the successes there, are there any plans to incorporate similar transparency measures and reporting in your base program?

What other factors do you think have contributed to the Recovery Act projects being completed so successfully?

Ms. Triay. Yes. The American Recovery and Reinvestment Act (Recovery Act) transparent process of planning, reporting, and execution contributed to the success of the Office of Environmental Management (EM) projects. To build on that momentum, EM has combined the monthly base program and Recovery program reviews for monitoring project execution and performance. A standardized format integrates project, contract, safety and funds management data across all sites. Lessons learned in planning and executing Recovery Act projects are communicated on a quarterly basis with the Department of Energy (DOE) corporate community.

Additionally, EM continues its active engagement with stakeholders, regulators, and the public through conference calls, newsletters, and the EM website. Other factors such as metrics/milestone status tools, financial assessment scorecards, project-level risk assessment tools, risk mitigation plans, and phased/gated spending plans contributed to the overall success of Recovery Act projects and helped us manage an integrated operation to identify issues early.

INSPECTOR GENERAL FINDS WASTE OF TAXPAYER DOLLARS AT HANFORD

Subcommittee. Madam Secretary, in February, the DOE Inspector General released the results of an investigation finding that $43 million was wasted on a failed project to treat sludge at a spent nuclear fuel cleanup project at Hanford's K Basin. They found that the project had not been effectively managed by DOE because the contractor failed to apply key project management principles as the project progressed and the Department did not ensure the project was adequately managed.

The IG's key finding was that officials selected a technology for the project without performing a feasibility study or conducting tests to determine whether the system could safely contain radiation, despite safety concerns raised by the Defense Nuclear Facilities Safety Board. In light of these sorts of reports, the inclusion of EM on the GAO high risk list seems well justified.

Do you agree with the IG's findings? What have you learned from this incident?

What, if anything, has changed as a result of this review?

Ms. Triay. The recent DOE IG audit of the K Basins Sludge Treatment Project (STP), DOE/IG-0848, focused on historical performance issues of the project for the period of 2004 through 2007. IG previously conducted an audit of an earlier phase of the K Basins Sludge Treatment Project (STP) and documented its findings and recommendations in DOE/IG-0698 in 2005. The DNFSB placed the STP on its list of projects of most concern in its quarterly report to Congress in January 2008 because of project management concerns similar to those raised by IG in 2005.

In its review of the draft report of DOE/IG-0848, DOE/EM raised concern about the IG's characterization of EM's management of the STP. Specifically, the DOE/IG-0848 does not clearly identify the period of performance being audited (i.e., from 2004 to 2007), and does not discuss improvements in project performance since 2007. In fact, in September 2010, the DNFSB acknowledged that EM had successfully addressed all of its project management concerns with the STP, and therefore removed the STP from its projects of greatest concerns list contained in its quarterly report to the Congress, stating in a letter that "the Board believes that the project management improvements and DOE's formal approval of an acceptable alternative to support sludge processing adequately resolve this issue." Additionally, the most recent IG audit has not identified any specific concern about post 2007 project performance and management practices. IG incorporated the above inputs in issuing its final audit report (DOE/IG-0848), and acknowledged in it "the many process improvement initiatives EM has under way to improve project management. These reforms, once fully implemented, should increase the likelihood of successful project execution."

EM generally agrees with the IG recommendations for project management improvements as documented in DOE/IG-0848. We would like to point out that EM has completed the steps required to address three of the four recommendations, and is in the process of addressing the fourth recommendation concerning the recovery of the $1 million (plus interest) and any value remaining in the mobile solidification system module using government property disposition procedures.

For IG's recommendation #1 in DOE/IG-0848, EM has made improvements in project management practices, including: a) restructured projects into smaller, better defined capital asset projects and operations activities to reduce project risk and provide more focused management and oversight; b) improved front-end planning, assuring capital asset projects complete 70-90% design prior to establishing performance baseline with a minimum 80% confidence level and budgeted contingency; c) embraced the Office of Science model for peer review of major construction projects; d) engaged regulators and stakeholders to assure our project plans are consistent with their expectations; and e) improved and independently validated contractor cost estimates.

For the IG recommendation #2, EM: a) issued the Corporate Quality Assurance Program (QAP) (EM-QA-001) implementing a graded approach for complying with QA requirements; b) followed DOE-STD-1189, Integration of Safety into the Design Process for nuclear projects; c) flowed down the QAP to the field organizations and each field element is responsible for implementing QA requirements using its own QA Implementation Program (QIP); and d) worked closely with the Energy Facility Contractors Group and the EM QA Corporate Board, to address issues concerning the graded approach.

For the IG recommendation #3, EM: a) developed initiatives to further strengthen and clarify the role of Federal Project Directors (FPD); b) implemented an improved EM Business Model that shifts greater authority and accountability to the field, and strengthens Headquarters policy, planning and best practice dissemination functions; c)
made improvements in acquisition practices and contract management; and d) improved contract management practices, such as establishing partnering relationships with contractors to create a transparent and collaborative working environment to foster a better understanding of the rules of engagement and build better operating business relationships; working with industry to discuss ways to improve the pre- and post-contract award process; and working to ensure that our Federal staff and contractors across the EM complex understand and appreciate the need to maintain alignment of project and contract baselines.

Finally, in response to IG's recommendation #4 to recover the $1 million (plus interest) and to recover any value remaining in the mobile solidification system module using government property disposition procedures, EM is in the process of fully evaluating the excess equipment disposition and the costs for allocability, allowability, reasonableness, and recovery or offset of the $1 million (plus interest) of the Project Hanford Management Contract. The estimated completion date for both of these actions is January 31, 2012.

Subcommittee. This scenario seems to be a potentially repeatable scenario at the Waste Treatment Plant. There, the DNFSB has raised concerns that the technologies being developed will not be sufficient to ensure safety. Proceeding with designs for cleanup technologies despite a clear call for testing was shown to increase costs in the case investigated by the IG. Yet, you are submitting a request this year to accelerate completion of portions of the project to "increase confidence levels."

How is the new funding strategy for the Waste Treatment Plant less risky than current funding levels, when there is reason to believe that costs may continue to rise in order to ensure safety of the systems design? Aren't there lessons to be incorporated here?

Ms. Triay. The WTP Project has performed an evaluation of the Estimate at Completion and remaining risks with a focus on the entire picture of the project using available sophisticated project and risk management tools. The 2012 budget was developed by the project team as part of this evaluation using state of the art risk probabilistic tools. The total project cost remains $12.263 billion.

The remaining DNFSB design concerns are well understood and over the last five years DOE has been executing an extensive program of investigation, testing, and external peer reviews (led by experts from academia and industry), which have resolved the majority of the project risks associated with these concerns. The remaining DNFSB design concerns are with the Pretreatment Facility and do not impact the remaining facilities, which comprise over 80% of the WTP. The Pretreatment Facility is the last to be completed and is not proceeding at a greater pace.

REDUCED FUNDING FOR IDAHO NATIONAL LABORATORY

Subcommittee. Madam Secretary, the overall funding level for Idaho National Laboratory (INL) decreases by $77 million (16%) in FY 2012, from $469 million to $392 million. The cleanup contractor circulated a fact sheet to Congressional staff on the matter, but apparently has retracted some information making it difficult for us to understand the real impacts these funding levels will have at INL. Reports warned that "nearly 300 workers could be released as a result of a funding shortfall."

What are the real impacts of decreasing funding at INL in FY 2012?

What activities are ending, or will be deferred under the smaller funding stream?

Ms. Triay. There will be no significant impacts to the Idaho Cleanup Project as a result of the decreased funding in fiscal year (FY) 2012. This is attributed to accelerated completion of FY 2011 work primarily in the areas of decontamination and decommissioning and numerous Recovery Act projects. Completion of work sooner than originally planned has led to a work force restructuring plan that has been approved and will be implemented later this fiscal year enabling lower funding in 2012. The $392 million will allow for a compliant FY 2012 budget. In addition, technology development funding supports maturation of the hot isostatic press technology for the calcine disposition project.

HIGHLY RADIOACTIVE TANK WASTE AT IDAHO NATIONAL LABORATORIES

Subcommittee. The Department has a commitment to cease use of the Tank Farm Facility at Idaho National Laboratory by December 2012.

Will the Department be able to meet this requirement of the Settlement Agreement with the State of Idaho?

When will evacuation of the tanks commence? How much waste is expected to be treated in fiscal year 2012?

Ms. Triay. Yes. The Department will meet the Idaho Settlement Agreement date to cease use of the tank farm facility by December 2012. The process to remove the liquid waste in the three tanks will commence in December 2011. The processing campaign for the remaining 900,000 gallons will take ten months; therefore, all 900,000 gallons will be treated in fiscal year 2012.

NEW DISPOSITION PATH FOR U-233 (OAK RIDGE)

Subcommittee. We have reports that DOE is developing a new path for the U-233 that is now being stored at Oak Ridge National Laboratory.

What are the benefits of just disposing the material vice downblending, as the current baseline pursues? Is this being driven by the decision to close H-Canyon, or are there substantive benefits to pursuing a different approach?

Ms. Triay. Approximately half of the inventory of the U-233 material has been determined to eligible for either: 1) direct transfer to other Department of Energy programs that need the material; or 2) direct disposal as waste at the Nevada National Security Site (NNSS). The remaining half of the inventory will be processed in Building 3019 by downblending, and then packaged and disposed as waste.

The unit cost for direct disposition is projected to be far less than processing and disposal, and by getting rid of over half the inventory in this more efficient manner, the processing time and associated costs for the remaining half of the inventory can be greatly reduced. On top of reducing the processing time by half, the direct disposition campaign enables the utilization of a more efficient technological approach for processing that is less complex and requires less capital investment. This is because the direct disposition campaign eliminates one of the most radiologically and physically challenging inventory components.
The direct disposition campaign was not stimulated by a decision to close H-Canyon at Savannah River. The use of H-Canyon was thoroughly evaluated as a processing option by a team of experts which included SRS technical representatives, and determined to not be a viable alternative due to transportation and compatibility issues with certain elements of the U-233 inventory the resolution of which would have increased the overall cost of the project.

Subcommittee. With the safety issues that the Defense Nuclear Facilities Safety Board has noted in continuing to store this material at Oak Ridge, how long can this material stay in its current facility?

Ms. Triay. The direct transfer actions are currently being planned for completion by the end of FY 2013. Direct disposal actions may be completed as early as the end of FY 2014, depending on the resolution of logistical matters associated with transportation and disposal operations. Upon completion of these two activities, the risks in Building 3019 will be substantially reduced. For the balance of the material, the Alternatives Analysis for the final selection of the safest and most efficient processing technique is expected to be completed by the end of calendar year 2011. At that time, a plan will be developed for the necessary facility modifications. It is expected the balance of the material can be safely and securely maintained in the facility until it is processed and disposed.

Subcommittee. How long would it take, and how much would it cost, to pursue this new disposition path?

Ms. Triay. The cost and schedule estimate for the direct disposition campaign is expected to be finalized by the end of FY 2011. The cost and schedule estimate for processing, packaging and disposal of the balance of the material is expected to be finalized by the end of FY 2012.

SODIUM BEARING WASTE TREATMENT FACILITY

Subcommittee. Madam Secretary, the Sodium Bearing Waste Treatment Facility project at Idaho National Laboratories was a failed project from a project management perspective, with total costs rising by $109 million, or 24%, from the original validated baseline in 2008.

Why did costs rise so dramatically?

Ms. Triay. The project's cost growth was due, in part, to facility footprint increases driven by design changes needed to fully address seismic and geotechnical issues, commodity prices that were higher than planned, and the need for greater quantities of commodities than originally planned.

Subcommittee. What are the lessons learned from this project?

Ms. Triay. A key lesson learned is that the construction of nuclear facility with a unique design and first-of-a-kind waste processing systems require cost and schedule contingencies to address technological uncertainties.

Subcommittee. What is the project status?

Ms. Triay. The project is nearing construction completion, and is starting to turn systems over for start-up and testing.

Subcommittee. Is critical decision-4 (start of operations) still on track for the fourth quarter of 2011, as reported in your last project data sheet?

Ms. Triay. Yes. Construction completion and the start of operations are on track for the fourth quarter of fiscal year 2011.

SAVANNAH RIVER TANK CLOSURE COST GROWTH

Subcommittee. Madam Secretary, last September, Government Accountability Office (GAO) reviewed the Department's work at the Savannah River Site to close the tanks and construct the Salt Waste Processing Facility (SWPF), which is designed to treat a large portion of the waste removed from the tanks. GAO found that emptying, cleaning, and permanently closing the 22 underground liquid radioactive waste tanks is likely to cost significantly more and take longer than DOE estimated. Originally estimated to cost $3.2 billion, the contractor notified DOE last June that the total cost had increased by more than $1.4 billion, or 44%. Much of this increase is due to inaccuracies in the DOE's cost estimate performed back in the September 2007 request for proposals. Once again, EM's standing on the GAO's high risk list seems justified.

What is the Department doing to address GAO's recommendations and more importantly what are you doing to get a grasp of the schedule and cost of this project?

Ms. Triay. As noted in our published response letter to the GAO, the Department strongly disagreed with the GAO's implication that the overall costs of the tank waste closure project has significantly increased.

The GAO looked at only one contract award without taking into consideration the overall life-cycle cost and schedule of the tank waste program. In fact, as a result of new technologies, the Department expects to complete the project six years earlier than originally planned, resulting in over $3 billion of life-cycle savings. The Department continues to conduct monthly and quarterly cost and schedule reviews, along with independent construction reviews for the Salt Waste Processing Facility. Operations are on target to commence in 2014.

Subcommittee. How do pension costs play into the cost increases? I understand they are a large cost driver in this case. Did DOE provide the contractor with adequate guidance on the increased pension requirements?

Ms. Triay. As with many of our sites, pension costs do play a role in cost variation. Fluctuating economic conditions may require additional contributions during contract execution than had previously been assumed during the proposal development phase.

Subcommittee. Does the DOE order 413.3B (Program and Project Management for the acquisition of Capital Assets) exempt the tank closure project? If so, then why, and doesn't this seem at odds with the Department's efforts to finally get off the GAO High Risk List?

Ms. Triay. DOE Order 413.3B, Program and Project Management for the acquisition of Capital Assets, applies to the construction of the Salt Waste Processing Facility. Liquid waste operations, which involves the processing of the tank waste into a safe storable form, is a Department operation program. The Environmental Management program no longer subjects operations activities and programs to DOE Order 413.3B requirements.

COORDINATING CAPABILITY DECISIONS WITHIN THE DEPARTMENT

Subcommittee. It is clear from the request that the National Nuclear Security Administration (NNSA) programs are negatively impacted by the proposal to shut down operations at H-Canyon. The NNSA request includes funding for their share of what they expected to be ongoing downblending operations during fiscal year 2012, in support of their nonproliferation activities and others. Yet, your decision will clearly preclude carrying out those national security activities. This is one area where EM maintains a capability that also supports other vital activities of the Department.

As a crosscutting supporting activity, how was the decision to shut down H-canyon operations coordinated within the Department?

To what extent did EM take into account negative impacts to the national security activities of the NNSA?

Ms. Triay. The Office of Environmental Management (EM), the National Nuclear Security Administration (NNSA) and the Tennessee Valley Authority (TVA) have collaborated for over a decade on a program to convert surplus off-specification highly enriched uranium (HEU) to low enriched uranium for use in TVA's reactors. A substantial portion of the recovery and down-blending work has been accomplished in H-Canyon and HB-Line. All existing material delivery commitments to TVA under this program will be satisfied when the current H-Canyon processing campaign is completed in 2011.

Most of the remaining material that could be processed in H-Canyon in the future is used nuclear fuel. This used nuclear fuel inventory includes fuel that has and is planned to be received from other countries as part of NNSA's Global Threat Reduction Initiative. The Secretary of Energy has determined that no processing will occur until the recommendations of the President's Blue Ribbon Commission on America's Nuclear Future are issued and evaluated by the Department. The inclusion of HEU, in the form of used nuclear fuel, in the Department's surplus HEU Disposition Program has always been contingent on that material being recovered/purified through solvent extraction in H-Canyon for other reasons, such as to convert the material to forms suitable for disposal. If it is decided not to process used nuclear fuel to recover that material in H-Canyon, it will not become part of the HEU Disposition Program, but will remain in EM's used nuclear fuel disposition program.

For fiscal year 2012, H-Canyon will be in a modified operations status but it also could perform its historic processing mission if needed. H-Canyon's modified operations status would not affect NNSA's ability to bring additional fuel from other countries to the United States. NNSA has been working closely with EM, which is responsible for the storage and ultimate disposition of this material, to redesign and modify the storage capabilities at the Savannah River Site's L-Basin facility to accommodate all the fuel that NNSA plans to bring to the United States through the end of the program.

MANAGEMENT

USING BASE FUNDING TO PAY FOR RECOVERY ACT WORKERS

Subcommittee. Madam Secretary, the base funding that is annually appropriated is not intended to take care of costs of the Recovery Act. This includes severance payments to lay off workers that have been funded under the Recovery Act, as these added costs of the Recovery Act would take away from the base cleanup activities. It is clear that the Department was intending to shift costs of the Recovery Act to the base program, despite specific discussions on those expectations. As a result, this Committee placed a specific prohibition in H.R. 1 to clarify the statutory requirements for the Department.

To what extent did EM plan for the eventual layoff of Recovery Act workers?

Which sites are the most affected, and what are the costs? What decisions for the administration of Recovery Act funding have contributed to this dilemma?

What are your plans to ensure that the transition from the infusion of large amounts of Recovery Act funding does not negatively impact base cleanup activities?

Ms. Triay. To the fullest extent possible, EM looked to utilize subcontractors to support the Recovery Act effort and save jobs on the existing prime contracts. As the Recovery Act program started and workers were brought on to support the accelerated cleanup effort, each of the site contractors followed all the local labor agreement requirements. With the completion of the majority of EM's Recovery Act projects scheduled for September 2011, each site has reviewed its workforce requirements and in some cases workforce restructuring will be required to align with the site missions. For prime contractor employees who have worked on both base and Recovery Act projects, the sites have looked at allocating severance costs between base and Recovery Act based on a pro-rata basis of the specific individual's time with each program. The sites most affected are Richland and Savannah River.

CONTENTIOUS RELATIONSHIP WITH THE NUCLEAR SAFETY BOARD

Subcommittee. Madam Secretary, in a recent report describing mismanagement of an EM project to dispose of sludge at Hanford, the DOE Inspector General found that the federal site office permitted contractors to proceed with design, long-lead procurements, and construction before approving the preliminary safety and hazard analyses, despite specific concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB). In this case, it appears that DOE did not heed warnings raised by the Board. For several other reasons in addition to the safety issues, the project failed, resulting in a waste of $43 million in taxpayer dollars. This model is not one that we wish to play out again. Both DOE and the Board ultimately should have the same goal to deliver safe nuclear facilities to the country.

Can you explain how DOE interacts with the DNFSB and why there appears to be such a contentious relationship between the two organizations? What can be done to improve the working relationship?

Can you provide an example of projects where DOE would have been better off it had acted on the DNFSB's concerns earlier in some cases? Have you incorporated any of these lessons into your present interactions with the Board?

Ms. Triay. The K Basins Sludge Treatment Project (STP) is a good example of the current working, professional relationship between the DFNSB and EM. As noted in the DOE-IG audit (DOE/IG-0848) that reviewed STP performance from 2004 to 2007, the Board expressed similar project management concerns in its quarterly report to Congress in January 2008 placing the STP on its "Projects with Most Significant Unresolved Issues" list. DOE-RL and its contractors have made it a priority to address DNFSB staff concerns during the execution of project tasks. This has resulted in an open relationship that has resolved project technical approach misunderstandings and safety in design issues, early in the project, by reaching consensus solutions between STP project staff and the Board.

Ultimately, this approach has resulted in the DNFSB removing the STP from its "Projects with Most Significant Unresolved Issues" list that it reported to Congress, in September 2010. Recently, the DNFSB acknowledged the professional working relationship between DOE-RL and the DNFSB staff in a letter forwarding their comments on the STP Critical Decision-1, Conceptual Design.

From an overall program context, EM considers safety to be an overriding principle of the EM program. EM takes safety extremely seriously and continuously develops metrics and reporting mechanisms to identify concerns or proactively take actions to address issues. These mechanisms include a weekly report on recent safety-related events within the EM program provided to EM's Assistant Secretary to identify potential issues; a periodic report to EM's Assistant Secretary on safety metrics to identify potential adverse trends in specific areas, sites or contracts; and a yearly analysis of the results of EM site's self evaluation of safety and the effectiveness of measures they identified to assess performance. Also, key to safe performance is addressing issues identified by organizations external to EM, such as the Department's Office of Health, Safety and Security and the DNFSB.

In 2010, the Assistant Secretary established a goal to improve safety and quality performance towards a goal of zero accidents, incidents, and defects. A set of Strategies and Key Success Indicators is associated with this goal. One of these strategies is to use sound science and engineering along with development of a proactive relationship with the DNFSB to expeditiously resolve DNFSB concerns and issues. The indicator related to this strategy is to maintain zero overdue action items resulting from DNFSB letters or recommendations, as identified in the Department's formal tracking system. Through the first half of the fiscal year less than 10% of EM's action items were overdue and currently has none that are overdue.

In 2007, the DNFSB and the Department prepared a joint report on efforts to improve the timeliness of the resolution of safety issues resulting from the DNFSB's review of DOE's design and construction projects. One result of this effort is the identification of key issues with projects that the DNFSB periodically reports to Congress as noted earlier in the discussion of STP. EM uses this report as a tool to ensure that its projects are taking appropriate actions to address these issues. In early April, 2011 the Principal Deputy Assistant Secretary for EM issued a memorandum to senior EM management reminding them of the importance of actions to address these issues and the need to be engaged with the DNFSB through periodic interactions to address these issues.

From a Headquarters perspective, on a nominal monthly basis the Assistant Secretary and her senior staff meet with the DNFSB to identify topics it desires to hear from EM. These are fairly high-level discussions of specific technical issues. In addition, EM has arranged for nominal monthly discussions between senior DNFSB staff and WTP staff (DOE and contractor) and EM staff to address topics related to the WTP, including issues not formally identified in their periodic reports to Congress.

All of our field sites also endeavor to achieve good working relationships with the DNFSB, as discussed under the STP example. At our field sites where the DNFSB has onsite representatives, the local DOE and contractor staff have frequent interaction with these individuals. Where the DNFSB does not have onsite representatives, DOE and its contractors diligently arrange for tours and meetings to meet DNFSB and DNFSB staff requests. As one example, for the WTP, the project responded to over 100 separate document requests by the DNFSB staff in the months from October 2010 through February 2011. In conclusion, while DNFSB does raise issues with DOE's projects from time to time, consistent with DNFSB's role, DOE believes that it is responsive in addressing DNFSB concerns in a timely way, and the professional relationship is sound and interactive.

Regarding whether accepting a DNFSB recommendation earlier would have substantively improved the safety of a project, there have been opportunities in which incorporating safety features earlier in the design process would have ensured a robust safety posture without subsequent cost and schedule impacts. To that end, the DNFSB urged the Department to develop a technical standard to ensure incorporation of safety early in the design process. The result of that effort was the issuance of a technical standard in 2008 which EM is adopting in its new projects that will ensure a robust nuclear safety posture early during the design process that should preclude the need for adding such features after the design is well underway.

COMPUTER MODELING OF CONTAMINATION

Subcommittee. Madam Secretary, the Government Accountability Office (GAO) recently completed a review of the computer models EM uses to support cleanup decisions and found that you do not have an overall strategy for managing those models. They also found you do not regularly perform periodic quality assurance assessments on the development and use of those models, as required by DOE's own policy. GAO reports EM did quality assessments in only 3 of 8 cleanup decisions investigated.

Since the results of these decisions can cost billions of dollars to implement, it is crucial that these computer models are of the highest quality.

What is EM doing to address the GAO findings and specifically, what is the timeline for action?

Ms. Triay. The Office of Environmental Management (EM) is committed to ensuring that models developed in the field and at EM HQ comply with Department of Energy (DOE) directives and relevant national consensus standards. The EM Office of Corporate Information Technology will follow up to ensure that every computer modeling IT investment across the EM complex is documented through the Capital Planning and Investment Control process, which has been established and implemented EM complex-wide in accordance with the Information Technology Management Reform Act (Clinger-Cohen) requirements. We plan to conduct a survey to ensure that all the modeling tools in use in EM are included, including those referenced in the Government Accounting Office (GAO) report. We issued guidance to the EM field sites regarding IT investments on February 11, 2011, which included (1) a request for each EM field office to provide all IT investments not included in their current inventory to ensure that all IT investments are captured and reported and (2) reminded EM field offices to submit all new requests for IT investments to be potentially reviewed through the EM IT Governance process. EM will also process the current slate of computer models through our IT Governance process with the goal of streamlining, where appropriate, by December 30, 2011.

EM headquarters developed an IT Governance process to enable EM to more effectively manage IT with the goals of reducing duplication between EM sites to achieve maximum cost efficiency, promoting consistency, and sharing lessons learned across the nuclear weapons complex to enable our cleanup mission. Regarding periodic quality assurance assessments on the development and use of the models, EM complies with DOE directives and relevant national consensus standards. EM will review and, where needed, working with the DOE Chief Information Officer (CIO) and the Office of Health, Safety and Security (HSS), develop additional software quality assurance oversight criteria to ensure computer models that have been or are to be developed within EM comply with DOE directives and are implemented appropriately at all DOE EM facilities. Although the Office of Civilian Radioactive Waste (RW) has ceased operating, EM in a policy statement dated January 24, 2011, will continue to implement the requirements of the Quality Assurance Requirements and Description (DOE/RW-0333P). This document provides specific quality assurance requirements for software and computer modeling that have already been adopted and implemented across EM sites. In addition, EM has adopted NQA-1 as the consensus standard for its Quality Assurance program. NQA-1 specifically addresses the management of the software engineering method, which includes software model development.

In addition, EM has adopted NQA-1 as the consensus standard for its Quality Assurance program. NQA-1 specifically addresses the management of the software engineering method, which includes software model development.

LARGE GROWTH IN PENSION COSTS

Subcommittee. Madam Secretary, your request reports that $411 million of the request for EM is to pay for contractor pensions. This is up substantially from the $167 million contributed by EM in fiscal year 2010, though down from the amount contributed in 2009. A large portion of EM's pensions costs are for Savannah River, which accounts for half of EM's liabilities this year.

What are you doing to minimize the programmatic impacts of these large pension payments?

Ms. Triay. DOE has implemented three main actions to minimize large pension payments and allow the contractors to have more funds for mission-related work, in turn reducing the impacts to the program. In early January 2010, DOE eliminated the requirement that every Defined Benefit Pension Plan (DBPP) sponsored by a DOE contractor maintain an 80 percent funded status. Thus, DOE's current policy is to reimburse our contractors at the Employee Retirement Income Security Act (ERISA), as amended by the Pension Protection Act (PPA), minimum contribution level. Additionally, the PPA allowed contractors (plan sponsors) to amortize their DBPP funding shortfall over seven years instead of five years. This has reduced the amount required in a given year to meet the ERISA/PPA minimum contribution level, and subsequently the amount DOE/EM has to reimburse the contractor.

DOE and EM has encouraged its contractors to support pension plans other than DBPPs for new hires, and contractors have been doing this as they deem appropriate for their particular situations.

DOE contractors have taken advantage of the options allowed under the Preservation of Access to Care for Medicare Beneficiaries and Pension Relief Act of 2010 to extend the time required to achieve full funding of their DBPPs. This has reduced the amount required in 2011 to meet the ERISA minimum funding level, and thus the amount DOE/EM has to reimburse the contractor.

Subcommittee. Is the workforce restructuring being conducted at Savannah River driving up near term pension costs, or should this improve the situation of rising costs?

Ms. Triay. The workforce restructuring at SRS will have minimal impact to near-term pension costs. This will improve the long-term situation. As workers under the DBPPs retire, they will be replaced, as necessary, with employees falling under the defined contribution pension plans.

Subcommittee. What is being done by DOE at Savannah River specifically, to minimize the increasing costs? Have there been any changes in policies like at other DOE labs, such as increasing the amount employees pay into the plans or redirecting savings of indirect costs?

Ms. Triay. DOE has been reviewing the plans of all of its contractors offering DBPPs. It is important to note that the pension plan sponsors are the contractor and not DOE. DOE reimburses the costs of these plans based on the minimum funding requirement levels of ERISA/PPA. Additionally, SR has recently informed the department that it will elect pension relief under the Preservation of Access to Care for Medicare Beneficiaries and Pension Relief

Act of 2010 for the 2011 plan year. This means the SR 2011 pension shortfall will be amortized over 15 years instead of 7 years and will decrease the minimum required contribution in the short term. At this time, the SR contractor has not proposed any policy changes such as requiring employees to contribute to the plan, nor have they proposed a redirection of savings of indirect costs towards cleanup work.

USE OF ARMY CORPS OF ENGINEERS FOR PROJECT MANAGEMENT

Subcommittee. Madam Secretary, in response to GAO's concern that the Department does not have adequate staffing, I understand that the Department is using a Corps of Engineers' contract to access more project management and cost estimating expertise.

How many contractors are being hired under this mechanism and where?

Ms. Triay. The U.S. Army Corps of Engineers (USACE) has made available Architecture/Engineering (A/E) services contracts to the Office of Environmental Management (EM) in the form of professional service engineering contracts. The contractors are: Project Time and Cost, Inc.; MOCA Systems, Inc.; Hill International, Inc.; and MPR Associates, Inc. The number of contractor staff varies based on resource needs of EM. EM is securing these resources through an interagency agreement.

Subcommittee. Why did the Department choose this method of obtaining this expertise?

Ms. Triay. Several years ago, EM recognized that, notwithstanding its strengths in environmental remediation and waste management, a skill gap existed in the areas of construction and project management. In order to address these areas of weakness, EM entered into an inter-agency partnership with the USACE. The first phase of this partnership began with a resource analysis conducted by USACE of EM capabilities to identify gaps. The gaps are being filled with both USACE and support contractor employees with specialized expertise. This has since evolved into a "partnership" with USACE, wherein additional subject matter expertise is secured by EM for critical large construction projects in its on-going effort to improve the execution of its large capital construction projects and the overall project management system.

Subcommittee. Has a business case analysis been done to assess whether it is more beneficial to have an in-house capability or to contract these services out? Please provide a report on how much the Department is spending by project in FY 2010, FY 2011 and in FY 2012 on Army Corps of Engineer estimates and project management expertise.

Ms. Triay. EM has not yet completed the business case analysis for USACE support. However, EM has three USACE senior managers temporarily assigned to EM Headquarters in Washington, DC, the Savannah River Site in Aiken, SC, and the Oak Ridge Reservation, in Oak Ridge, TN. They are providing organizational, project management, contract management, engineering and design, and construction management consultation. They are also preparing mission and staffing assessments, which senior EM executives will utilize to decide the need, type and nature of longer term support. Through its various professional services contacts, the USACE also provides contractor support to the various projects. As indicated, USACE support costs for FY 2010 were $22.5 million. The cost estimate for FY 2011 is under review. These expenditures provide resources at a level of about 58 full-time equivalents (FTE), of which 51 FTEs are support contractors and seven FTEs are USACE federal employees. EM has not yet developed a cost estimate for FY 2012 pending the completion of the USACE-led mission and staffing analysis.

SAFEGUARDS AND SECURITY

Subcommittee. Madam Secretary, funding for safeguards and security is decreasing by $30 million. The largest decrease is for protective forces at Oak Ridge National Laboratory, which is cut by 57%.

Why is the protective force workforce shrinking so dramatically at Oak Ridge?

Ms. Triay. The funding requested for the East Tennessee Technology Park will provide for the reduced safeguards and security requirements as a result of cleanup progress at the Oak Ridge site.

URANIUM ENRICHMENT DECONTAMINATION AND DECOMMISSIONING FUND

PATH FORWARD FOR THE UE D&D FUND

Subcommittee. Madam Secretary, your budget request does not include, for the first time, any transfer out of the Defense Environmental Cleanup account into the Uranium Enrichment Decontamination and Decommissioning Fund. This subcommittee supports this position since we have paid the government's authorized contribution into the Fund. There is also no further attempt in this request to collect more fees from the private sector for cleanup. However, I think we all can agree that the work at these sites is far from done. We're at a situation now where the Administration has to take the lead in figuring out the best way to finish these projects up.

What is the current estimate of needed resources to finish cleanup at these sites?

Ms. Triay. The Office of Environmental Management's Life-Cycle cost range estimate to complete cleanup is $10.4 billion to $10.8 billion at Oak Ridge, $11.3 billion to 18.1 billion at Paducah, and $9.6billion to $16.4 billion at Portsmouth.

Subcommittee. What is the Administration's plan for ensuring this work gets done? Are you working with the private sector to come up with a consensus path forward?

Ms. Triay. The Department of Energy will continue to fund D&D cleanup activities at the Gaseous Diffusion Plants from the Uranium Enrichment Decontamination and Decommissioning (UE D&D) Fund as authorized.

Subcommittee. What legislative changes will need to be made?

Ms. Triay. The Budget includes a proposal to reauthorize the special assessment on domestic utilities for deposit into the Uranium Enrichment Decontamination and Decommissioning Fund. This authorizing legislation would direct that receipts resulting from the reinstatement of the assessment be deposited into the Fund and available for expenditure only to the extent and in such amounts as provided in advance in appropriations acts. The necessary appropriations language to trigger the collection and spending of the receipts is not currently being proposed and will only be transmitted to the Congress upon enactment of the proposed authorizing legislation. The amount collected from industry for a fiscal year would total no more than $200 million in the first year and the $200 million cap would be adjusted annually by the Consumer Price Index for all-urban consumers.

LEGACY MANAGEMENT

YUCCA MOUNTAIN RECORDS MANAGEMENT

Subcommittee. Assistant Secretary Geiser. DOE has given Legacy Management (LM) the responsibility of operating and maintaining the information systems (including the Licensing Support Network) associated with the Yucca Mountain project. LM has assumed responsibility for 12,000 ft^3 of records associated with the Yucca Mountain project. The request for Yucca Mountain project records and information systems is $3.4 million.

If Yucca Mountain is restarted, will this information be preserved or will there be major losses in knowledge? How are you maximizing the preservation of knowledge?

Mr. Geiser. The majority of the Yucca Mountain project (YMP) records and information are being maintained according to Federal regulations in a new, state-of-the art National Archives and Records Administration certified records facility at the LM Business Center (LMBC) in Morgantown, West Virginia. LM is in the process of transitioning and transferring the remaining YMP records and information to the LMBC. We plan to have the entire collection consolidated and stored in the LMBC by May 31, 2011. LM maintains the Licensing Support Network (LSN) participant document collection that is currently accessible via the NRC's LSN portal. The collection will be fully archived, maintained and preserved by LM.

Subcommittee. Are the funding levels requested sufficient to fully preserve this information? What will it take to fully maintain this knowledge?

Mr. Geiser. The FY 2012 requested funding level maintains the Yucca Mountain project information in accordance with current requirements.

Subcommittee. How does the cost of maintaining these records compare with other record maintenance efforts being managed by Legacy Management?

Mr. Geiser. LM does not anticipate any significant difference in the cost of maintaining Yucca Mountain project records in comparison with other site collections. Our current storage and maintenance plans for the Yucca Mountain collection is in accordance with National Archives and Records Administration regulations and DOE guidance.

MORE RESPONSIBILITY AND CONTROLLING COSTS

Subcommittee. Assistant Secretary Geiser, since 2010, the Office of Legacy Management has added site and program responsibility, while reducing your overall request. The fiscal year 2012 request for LM is $170 million, a reduction of $16 million, or 9%, over the current level. Over the next five years, we understand that your plans are to manage the work associated with the transfer of an additional 21 sites.

How do you expect to take on these additional responsibilities while controlling costs?

Mr. Geiser. LM will seek to control costs in three ways: (1) we will continue to work in advance of site transfers in order to achieve a smooth transition from the U.S. Army Corps of Engineers for the Formerly Utilized Sites Remedial Action Program (FUSRAP) sites, from DOE Environmental Management for CERCLA/RCRA sites, and from private U.S. Nuclear Regulatory Commission (NRC) licensees for Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II sites. This advance planning helps LM understand all aspects of the site long-term monitoring commitments, and to affect certain cost savings such as optimizing ongoing operations or reducing the number of wells, frequency of analysis and/or list of analytes. (2) As a high-performing organization we established efficiency goals for our organization and for our site contractor. To meet these goals we have incentivized our site contractor to develop innovative approaches that can reduce the cost of the baseline work scope. (3) LM is actively engaged in the disposal of real property that is not needed for our long-term mission requirements, thus reducing the burden and cost of managing excess land. Where disposal is not possible, LM actively seeks to reuse property, usually resulting in some cost savings.

Subcommittee. Do you expect your budget requirements to grow significantly?

Mr. Geiser. LM's projected budget requirements for protecting human health and the environment are based on over 25 years of long-term surveillance and maintenance experience. For sites currently in the LM inventory we do not expect significant increases in cost. However, sites that will be transferred have not yet reached their final clean-up decisions; the estimates for these sites are subject to change based on the final end states and final long-term commitments.

LM currently provides funding for pension contributions and/or post-retirement benefits (health and life insurance) for over 12,000 retired contractor employees. Prior year funding and a conservative investment approach allow the program to address the contributions required for contractor pension plans. However, funding for health insurance is an annual cost that is subject to a variety of market forces and the demographics of an aging retiree population. At this time, we project funding for retired contractor health insurance will rise at a rate greater than inflation.

LONG-TERM STORAGE OF MERCURY

Subcommittee. Assistant Secretary Geiser, your office is responsible for managing the long-term management and storage of mercury generated in the United States. The Mercury Export Ban Act of 2008 requires the DOE to designate a facility and have it operational by January 2013. The Office of Environment Management was responsible for selecting the Department's alternative and it chose new facilities at a commercially owned facility in Texas.

Will the facilities be operating and in your budget request by 2013? Did you coordinate with the Office of Environmental Management in selecting this alternative? What will be the costs to your program?

Mr. Geiser. The Department of Energy (DOE) has prepared an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) to support its decision making relative to the location of a long-term elemental mercury management and storage facility. While the EIS identifies a private site for the location of the facility, as the preferred alternative, DOE has not made a decision on the location. The Department's goal remains to have a facility operational by January 1, 2013.

DOE's Office of Legacy Management (LM) has coordinated with DOE's Office of Environmental Management (EM) on DOE's identification of the alternatives described in the Final Long-Term Management and Storage of Elemental Mercury EIS.

DOE published Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury on November 14, 2009. DOE is using this interim guidance to estimate costs associated with the storage of mercury.

Subcommittee. Since these facilities will not be on DOE land, will this be an alternatively financed project – meaning will these facilities be leased from the contractor and paid through the LM budget?

Mr. Geiser. As stated above, DOE has prepared an EIS in accordance with NEPA to support its decision making relative to the location of the facility. While the EIS identifies a private site for the location of the facility as the preferred alternative, DOE has not made a decision on the location.

Subcommittee. It has been well documented that when the federal government chooses private leases and other alternatively financed projects, they tend to be more expensive over the life of the operations. The only exception has been shown to be administrative buildings, which are easily repurposed and sold off for commercial use.

Was a business case analysis conducted? What are the life cycle costs of the leasing arrangement compared with the other alternatives considered, such as recapitalizing existing facilities at the Idaho National Laboratory?

Mr. Geiser. As stated above, DOE prepared an EIS in accordance with NEPA to support its decision making. While the Final Long-Term Management and Storage of Elemental Mercury EIS identifies a private site for the location of the facility as the preferred alternative, DOE has not made a decision on the location.

Subcommittee. Why was a private lease chosen over DOE and other government owned alternatives considered, particularly those sites where existing facilities were available for reuse (such as using existing facilities at Idaho National Laboratories)? Why is the preferred alternative better than the others that were considered?

Mr. Geiser. DOE prepared an EIS in accordance with NEPA to support its decision making relative to the location of a long-term elemental mercury management and storage facility. Public scoping meetings and hearings were held during this process, including in Idaho Falls, Idaho, and comments from the stakeholders associated with those potential host communities and states were considered prior to issuance of the final EIS. While the EIS identifies a private site for the location of the facility as the preferred alternative, DOE has not made a decision on the location.

Subcommittee. What will be done to ensure that full costs of these activities are reported in the budget request to Congress?

Mr. Geiser. DOE will take a number of steps to assure that Congress is aware of the full costs of these activities. First, MEBA provides that not later than October 1, 2012, DOE must determine and make available to the public the amount of the fee to be charged to organizations using the elemental mercury storage facility. This fee is to cover all costs associated with facility operations (excluding land acquisition or permitting). MEBA also requires this fee to be adjusted annually.

In addition, section 5(c) of MEBA provides, in part, that not later than 60 days after the end of each Federal fiscal year, the Secretary of Energy shall transmit to certain specified Congressional committees a report on costs incurred in the previous fiscal year associated with the long-term management and storage of elemental mercury. Section 5(b)(2) refers to the costs of management and storage as including facility operation and maintenance, security, monitoring, reporting, personnel, administration, inspections, training, fire suppression, closure, and other costs required for compliance with applicable law, but states that such costs do not include land acquisition and permitting. Building design and building construction costs shall only be included to the extent that the Secretary finds that the management and storage of elemental mercury accepted under the program under this section cannot be accomplished without construction of a new building or buildings.

To date, the costs DOE have incurred have been limited to those related to planning and compliance with NEPA. DOE intends to comply with the MEBA annual cost incurred reporting requirements described in section 5(c).

Subcommittee. What process is DOE using for selecting an alternative financing mechanism for this project?

Mr. Geiser. DOE does not plan to pursue an alternative financing mechanism for this project.

TOTAL COSTS OF LONG-TERM MERCURY STORAGE

Subcommittee. Assistant Secretary Geiser, the Mercury Export Ban Act of 2008 authorizes DOE to assess and collect at the time of delivery of mercury to the DOE storage facility to cover the costs of long-term management.

What is that range of expected costs to pursue the preferred alternative? How much of the total costs of maintaining a storage facility is expected to be recouped through fees?

Mr. Geiser. DOE has completed a rough order of magnitude cost estimate for the long-term elemental mercury management and storage activities in response to the performance based solicitation. It may be informative to also mention EPA's estimate. In 2007, the EPA conducted and published a more comprehensive life-cycle cost study on the long-term management and storage of elemental mercury. The original EPA cost range to build, operate and maintain an aboveground storage facility in the United States with the capability of storing 10,000 metric tons of elemental mercury over a 40-year storage period was from $1.5 million and $3.9 million annually. Based on DOE's Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury published November 14, 2009, DOE's initial cost estimate is within the original EPA cost range. DOE's goal, consistent with the Mercury Export Ban Act, is to collect sufficient fees to offset operation costs.

LEGACY CONTRACTOR PENSIONS

Subcommittee. Assistant Secretary Geiser, a sizeable proportion of the funding for the Office of Legacy Management is typically for legacy personnel costs. This year, the funding substantially decreases for contractor pensions to only $4 million.

How have you reduced the pension liabilities by so much?

Mr. Geiser. The unfunded actuarial accrued pension liabilities (i.e., the amount by which total plan liabilities exceed total plan assets) were reduced for two reasons.

Prior appropriation requests met conservative estimates for the Employee Retirement Income Security Act (ERISA) minimum required contributions for the pension plans associated with workers at the Rocky Flats and Fernald sites. When the ERISA minimum was calculated by the pension plan actuaries during each respective year, the appropriated amount was greater than the newly calculated requirement. However, any funds in excess of the ERISA minimum requirements were invested in the Rocky Flats and Fernald plans, thus reducing future funding demands for those sites.

The pension plan for former workers at the Pinellas site has been fully funded for several years and the Department is currently reviewing the contractor's proposal to terminate the plan through the purchase of insurance company annuities. The Yucca Mountain pension plan was fully funded using funds remaining under the USA Repository Services contract. The pension plan for the workers at the Mound site is underfunded; the ERISA minimum required contribution for FY 2012 is $4 million.

The second reason is that the contractor changed the investment mix of the pension funds from stocks to bonds prior to the 2008 downturn of the equity market. This action preserved the balance of the pension funds, allowing the pension plans to remain adequately funded.

Subcommittee. Is the level requested sufficient to fund the plans to 100%? If not, at what percentage will these plans be funded at the $4 million requested?

Mr. Geiser. Based on intermediate estimates provided by the Department's independent actuary, the $4 million request in FY 2012 should be sufficient to keep the pension plans at or above 90% funded (other than Mound, which is currently 82% funded). This request assumes the investment markets do not experience another significant downturn.

Subcommittee. What is the outlook over the next few years for pension costs of these plans?

Mr. Geiser. The ERISA minimum required contribution for the Mound pension plan is expected to decline gradually from $4 million to $0 by FY 2018. At this point we do not anticipate having to make additional contributions to the other site pension plans.

WEDNESDAY, MARCH 30, 2011.

DEPARTMENT OF ENERGY—ENERGY EFFICIENCY AND RENEWABLE ENERGY, FOSSIL ENERGY, ELECTRICITY DELIVERY AND ENERGY RELIABILITY, FY 2012 BUDGET

WITNESSES

HENRY KELLY, ACTING ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

PATRICIA HOFFMAN, ASSISTANT SECRETARY FOR ELECTRICITY DELIVERY AND ENERGY RELIABILITY

DR. VICTOR DER, ACTING ASSISTANT SECRETARY FOR FOSSIL ENERGY

Mr. WOMACK [presiding]. I would like to call this hearing to order. At the outset some of you may be curious as to why the Vice Chairman is in the primary seat this morning. Our Chairman, Rodney Frelinghuysen, has undergone a medical procedure related to mobility, and I am pleased to report that he is doing very well, at least at last report, and we are encouraged by that prognosis. Perhaps most important is the fact that Rob Blair is not up today. He is home with his wife, Taiya, dealing with the birth of their latest born, a baby girl. Mama and child are doing quite well, and we are pleased for Rob and his family and wish him all the very best.

The Subcommittee on Energy and Water Development meets today to hear testimony on the fiscal year 2012 budget request by the Department of Energy's research and development programs for energy efficiency, renewable energy, fossil energy, and the electricity delivery system. I would like to welcome Henry Kelly, the Acting Assistant Secretary for Energy Efficiency and Renewable Energy; Tricia Hoffman, the Assistant Secretary for Electricity Delivery and Energy Reliability; and Victor Der, Acting Assistant Secretary for Fossil Energy. I think we all look forward to your testimony.

It seems fitting to start the hearing by reminding ourselves of this nation's energy challenges. We import nearly two-thirds of the oil that we consume; 96 percent of our cars, trucks, and planes depend on oil. And with gas prices again creeping closer to $4.00 a gallon, our nation's dependence on imported oil is more alarming than ever. Electricity prices are also on the rise and demand is skyrocketing in countries like China and India for the same energy sources upon which we rely. These facts remind us of the importance of the issues we will be considering today. Our economy and our national security are tied up with our energy needs.

By having these three witnesses today, we will have a chance to see the stark choices the administration has made in picking technology winners and losers, not choices that everyone will support. The request proposes record increases for two of the programs be-

fore us, a $1.25 billion, 64 percent bump, for energy efficiency and renewable energy; and a $79 million, 50 percent increase, for grid research. At the same time the request slashes funding for fossil energy research and development by $183 million, a 29 percent reduction. Fossil energy generates more than 70 percent of our electricity and especially since this program funds research into improving the efficiency and cleanliness of this critical energy source, we will ask you to justify your reduction to that program while you request record increases for others.

And while all of these programs are important to our national security and economic prosperity, so too is addressing our record high national deficit. As Chairman Frelinghuysen has stated at each hearing, our subcommittee must do its part to reduce spending and bring down the deficit, and it is highly unlikely there will be any new funding in fiscal year 2012 for the subcommittee. Given these fiscal constraints, I hope to focus today on how well the proposed increases could be spent at a time when reducing our deficit is our top priority and every dollar of federal spending must be justified.

I must say at the outset that I do hope that you bring some better justification for the massive increases for energy efficiency and renewable energy. Your budget request is very thin for such substantial changes. We cannot assume we will have more money, and I look to the three of you to highlight the best investments and most promising programs for meeting our energy goals. I ask that each of you please insure that the hearing record, the questions for the record, and supporting information requested by the subcommittee are delivered in final form to the subcommittee no later than four weeks from the time you receive them. Members who have additional questions for the record will have until close of business tomorrow to provide them to the subcommittee office. At this point I will turn to Mr. Pastor for any comments he may have.

Mr. PASTOR. Thank you, Mr. Chairman, good morning and good morning to the panelists. And, Mr. Chairman, I ask for consent my remarks be entered into the record.

OPENING STATEMENT

THE HONORABLE ED PASTOR
ENERGY AND WATER DEVELOPMENT SUBCOMMITTEE
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the 2012 Budget Request for
Energy Efficiency and Renewable Energy, Fossil Energy, and
Electricity Delivery and Energy Reliability
March 30, 2011

Good morning. Ms. Hoffman, welcome back, it's good to see you again. Mr. Kelly and Mr. Der, thank you for being here today.

America faces persistent challenges to its energy sector that continue to threaten our economy, national security, and environment. Our economy—from our citizens' cars to our military's planes—relies heavily on petroleum fuels, much of which is imported from overseas. Power prices have been rising for years, and our electricity supplies depend on energy sources that give off harmful emissions and on a congested and aging electric power grid.

Today we consider the budget request for applied R&D activities at the Department of Energy aimed at addressing these difficult challenges. These programs—Energy Efficiency and Renewable Energy, Fossil Energy, and the Office of Electricity—are all critical areas of our nation's energy portfolio.

The budget request for Energy Efficiency and Renewable Energy is a large increase over any level you choose to compare it to. Mr. Henry, in this budget setting I hope you come prepared to discuss how this large increase could be used efficiently and effectively in pursuit of our energy independence.

The request for Fossil Energy is, to a lesser extent, a large reduction to any level of comparison. I understand this reduction is a result of the Administration's belief that renewable energy deserves its turn for Federal funding as the technology of the future. While I agree that renewable energy will, by necessity, be a large factor in the future, Mr. Der, I hope you can explain why a 30% reduction from 2010 for

Fossil energy R&D is appropriate at this time. Given that fossil fuels meet around 84 percent of U.S. energy demand, I would like to understand what the Department is doing to deliver technologies that can provide cleaner, low-carbon electricity generation using domestic resources of coal and natural gas.

The final topic area, Electricity Delivery and Energy Reliability, again sees a significant increase. While the increase itself is a modest amount of funding, on a percentage basis it is among the largest in the Department. I would like to understand how this investment will allow the nation to maximize existing resources and allow the expansion of clean energy generation through modernization of the nation's electricity transmission and distribution system.

Thank you, Mr. Chairman for the time.

Mr. WOMACK. Without objection. Assistant Secretary Hoffman, we will now turn to you for your opening remarks.

Ms. HOFFMAN. Good morning, Mr. Chairman and members of the committee. I would like to extend my thanks to the Chairman, the ranking member, and the esteemed members of the subcommittee for inviting me here today to present the Department of Energy's fiscal year 2012 budget request for the Office of Electricity Delivery and Energy Reliability.

Given the President's innovation agenda and emphasis on clean energy, our mission of leading national efforts to modernize the electricity delivery system, enhancing the security and reliability of America's energy infrastructure, and facilitating recovery from disruptions to energy supply, is especially relevant and timely. A modernized grid is essential to boosting the nation's investment in and use of clean energy and putting one million electric vehicles on the road within the next four years. While the grid now functions reasonably well, the demands of clean energy in a modern world are making it increasingly difficult for the grid to deliver electricity reliably, securely, and efficiently. Our FY 2012 budget request of $238 million will put us on the right path to greater efficiency and more adoption of cleaner energy.

Please allow me to briefly explain how this budget request supports these efforts. I will start with our R&D efforts, which accounts for more than 80 percent of our annual budgets. By collaborating with private industry, academia, public entities, our R&D activities promote competitive energy markets and a clean energy future through the development of an adaptable, smart, electric transmission and distribution system. This budget provides $193 million for research and development, part of which will fund the creation of a new smart grid technologies and systems energy innovation hub where experts will work together on applied science, engineering, economic policy, and other challenges to modernizing the electric grid. As with DOE's other innovation hubs, the idea is to create an environment that fosters creativity and innovation, and the emphasis will be on research, development, demonstration of novel technologies and architectures that facilitate and enable the increased adoption of wind, solar, electric vehicles, demand response and the like.

Energy storage is another very promising R&D area that warrants greater attention. For one thing, energy storage technologies can provide energy management, regulation, and ramping services in support of the transmission system, increasing overall reliability of the grid. Energy storage can also make it easier to take advantage of intermittent, renewable energy resources such as storing electrical energy so it can be available whenever it is needed. This budget request includes $57 million for energy storage activities, four times the 2010 funding level. This request will also support applied materials research, R&D on devices and systems, analysis of grid storage systems, and transitioning promising ARPA-E energy storage projects for grid-scale demonstration.

Our advanced modeling and grid research activity is another important area that is funded at $20 million in this request. Moving from interpreting and analyzing real-time data from the electrical system to predictability will allow experts to improve grid planning

and operations, including the modeling of resource generation, energy markets, and electricity flow. The R&D portion of this request also includes funding in other central areas such as transmission reliability and renewables integration with just over $20 million. This program supports research on advanced transmission level sensors, tools, and capabilities to help manage the transmission system and insure transmission-level renewable resources can be effectively integrated into the grid.

Furthermore, at $35 million, the smart grid R&D focuses on developing new technologies that integrate two-way communications into the electric distribution system. And within this request, $10 million will support research and development in power electronic devices that will provide faster switching, improved power conversion, and better flow control.

And in the important area of cyber security, we are requesting $30 million to continue research and development of new systems and approaches that will help the grid survive intentional cyber assaults without the loss of critical functionality.

Lastly, I would like to speak briefly about two other key areas in my organization. The Permitting, Siting, and Analysis Division provides technical assistance to states and regions on electricity policies and programs that increase access to reliable, affordable, and sustainable energy sources. The $8 million request in fiscal year 2012 will allow the continuation of this work and also expand on existing regional interconnection dialogues initiated under the 2009 American Recovery and Reinvestment Act.

Another part of my organization, Infrastructure Security and Energy Restoration, plays a crucial role in enhancing the security and resiliency of the nation's critical energy infrastructure and protecting the nation's key resources. The fiscal year 2012 budget request of just over $6 million will allow us to tackle these challenges and help the energy industry become more resilient as well as help government officials anticipate and respond to disruptions to the energy infrastructure when they do occur.

In conclusion, President Obama envisions a future where most of our electricity is generated by a range of clean energy sources. That future requires a reliable, efficient, and resilient grid. We believe that this time period is a pivotal moment for moving the nation closer to the President's vision.

Thank you for allowing me to summarize the fiscal year 2012 budget request for my organization. I ask that my written statement be submitted for the record, and I would be pleased to answer any questions that the committee may have.

STATEMENT OF
PATRICIA HOFFMAN
ASSISTANT SECRETARY
FOR ELECTRICITY DELIVERY AND ENERGY RELIABILITY
U.S. DEPARTMENT OF ENERGY
BEFORE THE
UNITED STATES HOUSE OF REPRESENTATIVES
HOUSE APPROPRIATIONS SUBCOMMITTEE ON
ENERGY AND WATER DEVELOPMENT
MARCH 30, 2011

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss the President's Fiscal Year (FY) 2012 budget request for the Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE).

President Obama has described his vision of how to win the future: out-innovate, out-educate and out-build the rest of the world. We at the Department of Energy are poised to help meet that vision, guided by the President's innovation agenda that includes three clean energy goals: increase investment in clean energy; generate 80 percent of electricity from clean energy sources by 2035; and put 1 million electric vehicles on the road by 2015. A modernized electric grid, in particular, is critical to enabling the successful achievement of these goals and the race to "win the future." Therefore, the $238 million investment in 2012 for OE supports the President's vision and OE's role in competing in a worldwide technological race. Today, availability and access to affordable electricity is something that most Americans take for granted. We depend on, and expect, the reliable, affordable, efficient and secure delivery of electricity while at home, at work, at school and wherever our activities lead us. But the electric power grid was not designed for the highly technical, modern lifestyle of today: a world where iPhones and iPads are a common commodity and where the plug-in electric vehicle is not just a concept but a growing reality. America's existing electricity delivery system, based on technology developed in the early 1900's, is beginning to struggle to meet the growing complexities and demands of the 21st century.

It is the mission of this Office to lead national efforts to modernize the electricity delivery system, enhance the security and reliability of America's energy infrastructure and facilitate recovery from disruptions to energy supply. A modern grid is crucial to meet the Nation's growing need for energy, sustain the economic recovery, ensure a cleaner environment, and enhance national security. If we fail to develop and deploy the next generation of electric transmission and distribution technologies and to implement new policies and challenge conventional approaches, we risk falling behind the global push towards greater efficiency and increased adoption of cleaner energy, in an increasingly competitive world.

The FY 2012 request of $238 million will set us on the right path to mitigate this risk and succeed. The increased investment will emphasize the integration of renewable energy sources, focus on long-term system planning, expand analytical capabilities, and promote aggressive approaches to next-generation grid technologies. Specifically, the request includes $193 million for research and development (R&D) to develop technologies in several crucial areas –

transmission and distribution systems, energy storage, and cyber security – so that the next generation of grid technologies can meet the Nation's needs and achieve deployment and commercialization. The R&D program request also includes funds for the creation of a new Smart Grid Technology and Systems Hub where a multi-disciplinary group of experts can work together to enhance smart grid technologies and systems. OE's request provides $8 million to provide technical assistance to states and regions, and to support electricity policy analysis that facilitates development of electricity infrastructure to meet our Nation's future energy challenges. The request also includes $6 million to improve the reliability and resiliency of critical energy infrastructure and to facilitate recovery from disruptions to the energy supply.

By the end of FY 2010, OE successfully obligated the $4.5 billion from the American Recovery and Reinvestment Act of 2009 for grid modernization. We will continue to oversee the execution of these funds, with particular emphasis on maximizing value for the taxpayer. These Recovery Act projects and their intended accomplishments influenced the development of the FY 2012 request.

HIGHLIGHTS OF THE FY 2012 REQUEST

OE's FY 2012 budget requests $238 million, a 38 percent increase over the FY 2010 appropriation, to accelerate the transformation of the electric power grid. For example, within the $238 million request, $20 million will support cutting-edge clean energy research and development (R&D) through a new Smart Grid Technologies and Systems Energy Innovation Hub, and $57 million will build on the momentum we've gained from Recovery-funded work to develop and commercialize grid-scale energy storage that will increase penetration of variable renewable generation into the grid and improve reliability. Also featured in our FY 2012 budget are expanded research efforts in advanced modeling of the grid at $20 million, which will provide a more comprehensive, in-depth systems understanding of the grid at both the transmission and distribution level.

Establishing the Smart Grid Technology and Systems Hub: The President has called for new investments in American innovation to help ensure that our economy is competitive. Consistent with this commitment to innovation, the Department's FY 2012 request proposes to double the number of Energy Innovation Hubs, which reflect a research approach that brings America's scientists and engineers together with non-technical experts (such as economists and policy analysts) to tackle the toughest problems in clean energy. One of the new hubs, the Smart Grid Technology and Systems Hub, will focus on high-level challenges to the transformation and modernization of the electricity infrastructure that makes up the electric grid. OE's FY 2012 request includes $20 million to establish this hub, which will invest in research, development, and demonstration of novel technologies and concepts to address these challenges with a systems-level approach, supplementing and connecting the on-going transformations in the electric industry. The flexibilities and capabilities introduced by these new technologies and concepts will facilitate the adoption and use of wind, solar, electric vehicles, storage, smart meters, and other advanced components.

The Hub will pursue integrated technology research on critical needs for advanced electric grid operation, moving the electric system from a static command and control system to a dynamic,

self correcting system. It will include development of advanced components and systems to increase utilization, flow control, and resiliency with condition monitoring, diagnostics, and reconfiguration for system evolution. It will explore new policy, markets, and designs for a modernized grid with layered controls and mechanisms to optimize transmission, distributed generation, micro-grids, storage, and demand management.

Building on other Hub concepts, the Smart Grid Technology and Systems Hub will call on a diverse, multi-disciplinary group to focus on the electric grid's unique challenges, addressing all aspects of the electric system by covering applied science, engineering, economic, policy and other issues that hinder grid modernization. Having a concerted effort with expertise from diverse backgrounds will foster an environment for creative and innovative solutions for the grid of today and tomorrow, ensuring economic strength and energy security. The Hub also represents an investment in human capital, building the capabilities, expertise and skills to foster the leaders for the power systems of tomorrow.

Increasing Investment in Grid-Scale Energy Storage R&D: Energy storage is an increasingly important solution to many of the challenges facing the grid, from integration of renewables to improved reliability, efficiency, and power quality. OE's FY 2012 request of $57 million for the Energy Storage program is an increase of $43 from FY 2010, a quadrupling of our investment over two years. The request represents investment in a diversified portfolio of storage technologies that includes large Compressed Air Energy Storage (CAES) and medium-to-small batteries and flywheels. These grid-scale technologies operate on various timescales and power levels, making the power system more robust and efficient. Large grid-scale, megawatt-level energy storage systems, or multiple, smaller distributed storage systems, have the potential to significantly reduce congestion in the transmission system and manage peak loads, increasing the overall reliability of the grid. Storage technologies also facilitate the integration of variable and intermittent renewable energy resources by storing electrical energy so that it can be available whenever it's needed.

The FY 2012 request supports advanced storage materials research, targeting key attributes of storage materials that affect lifetime, storage density, and cost; applied R&D on devices and systems, developing and testing advanced prototypes; and field validation of first-of-a-kind systems in life-like simulations and utility environments. It also supports analysis of storage systems, including the development of tools for utility and user planning for application of energy storage. Activities include field testing and modeling in collaboration with renewable energy developers and utilities to identify the most effective use of energy storage to integrate a high penetration of renewables like solar and wind. The request also supports a new suite of grid-scale energy storage demonstrations, maintaining the momentum and interest generated by the Recovery Act demonstrations. OE, with its focus on applied research for the electric grid, works collaboratively on energy storage research with the Offices of Science, Energy Efficiency and Renewable Energy, and the Advanced Research Projects Agency - Energy.

Building Advanced Modeling Grid Research capability: The FY 2012 request provides $20 million for Advanced Modeling Grid Research, an initiative that will enable the Department to interpret and analyze newly-available, real-time data from the electrical system to anticipate system challenges and to identify technical, operating, and policy solutions that might mitigate

them. This research, done in partnership with universities and industry, focuses on applying scientific insights to new electrical system data for improvements in grid planning and operations. We anticipate that this research will improve grid reliability through analysis of real-time system dynamics, allowing system operators to anticipate irregularities in grid operations, rather than having to react after an event has occurred. In FY 2012, this effort will be expanded to capture the interrelationships of multiple systems, such as the communications layer, controls and the physical electrical system, and the interactions and seams between models.

An explanation of the other elements in the FY 2012 budget request is provided below.

RESEARCH AND DEVELOPMENT

OE supports the applied research, development, and demonstration of technologies that modernize the electric power grid, increasing its reliability, flexibility, efficiency and functionality. The Research and Development (R&D) program is OE's largest, accounting for more than 80 percent of our total FY 2012 budget request. A clean energy future depends on the growth and maturity of renewable energy technologies like wind and solar, but the variable and intermittent nature of these resources present a challenge for a grid designed for a fixed, constant energy supply. Through collaboration with private industry, academia and public entities, our R&D activities promote both competitive energy markets and a clean energy future through the development of an adaptable, "smart" electric transmission and distribution system.

The FY 2012 request of $193 million for the R&D program emphasizes innovative tools and technologies that will enable increased integration of renewable resources, and in doing so help secure national energy independence. In addition to those previously discussed, the request includes funding for: Transmission Reliability and Renewables Integration, Smart Grid Research and Development, Power Electronics, and Cyber Security for Energy Delivery Systems.

The *Transmission Reliability and Renewables Integration* activity, funded at $20.8 million within the Clean Energy Transmission and Reliability subprogram, focuses on developing advanced transmission-level sensors, tools, and capabilities, and ensuring that transmission-level renewable resources can be effectively integrated into the grid. More sophisticated transmission technologies and power system information are essential as the demand for higher quality electricity and the integration of renewable resources grows. The work focuses on providing real-time data to improve electric transmission and distribution planning and operations, and includes support for renewable integration models and regional reliability studies.

The *Smart Grid Research and Development* activity focuses on developing the next generation technologies that integrate two-way communications and digital technology into electricity distribution systems, while encouraging consumer involvement. By providing consumers with information about their usage, and the ability to participate and communicate with the power system, we will realize the full potential of energy conservation and demand response. The activity, funded at $35 million, includes projects studying the development of microgrids, a grouping of local generation that can disconnect and function independently from the grid when conditions dictate, thereby enhancing energy security; analysis of high penetrations of renewable

resources at the distribution level; the integration of the charging and discharging of plug-in electric vehicles into the grid; and a consumer communications program together with outreach to State regulatory bodies on Smart Grid.

The *Power Electronics* activity, within the Smart Grid Research and Development subprogram, focuses on the development of utility-scale devices that provide faster switching capabilities, flexible power conversion and better flow control, resulting in improved grid performance and efficiency. Funded at $10 million in FY 2012, the activity emphasizes the development of Gallium Nitride on Silicon (GaN-on-Si) based devices in the near term, as they show significant promise in high voltage applications. We are focusing on increasing the operating voltage of these devices, optimizing the manufacturing process and validating their performance, with the goal of demonstrating commercial viability and encouraging adoption by the marketplace.

The *Cyber Security for Energy Delivery Systems* subprogram, funded at $30 million in the FY 2012 request, pursues the research and development of next-generation resilient communications and control systems that enable power systems to survive intentional cyber assaults without loss of critical function. Unlike conventional information technology systems which can break the cyber systems that control electric grid power flow, power systems are specifically designed to control real-time physical processes that deliver continuous power so their cyber security measures must be tailored to the unique requirements of these systems, such as response times of much less than a second. They must offer multiple levels of access for users, which may change depending on operating mode, have components that are by necessity physically located outside in populated areas and often spread across long distances, but must be available for operation at all times. Through research and development of next-generation technologies, system vulnerability research, and stakeholder training, the subprogram addresses the unique cybersecurity requirements and operational needs of the electric grid to ensure continuous, reliable electric power.

PERMITTING, SITING, AND ANALYSIS

With a requested $8 million in funding for fiscal year 2012, OE continues efforts to provide technical assistance to state and regional entities regarding their electricity-related policies. As utilities have increased their investment in next-generation energy technologies, we have experienced a marked increase in requests from state electricity officials for technical assistance on associated topics, including ratepayer-funded energy efficiency, smart grid and the related demand response, renewable energy, natural gas and clean coal. Electricity planners from both the public and private sectors are facing new challenges as the nation moves towards a clean energy future. Maintaining reliability and affordability while the generation portfolio evolves in numerous ways is a challenge. As the deployment of variable renewables grows, much of which is located in remote places far from where the electricity is needed, greater cohesive, regional thinking by state and local officials will be required. Accordingly, the FY 2012 request supports expanded collaboration with state and regional entities on interconnection transmission and electricity resource planning efforts, focusing on the operating and planning changes necessary to support an evolving electricity generation and delivery structure. The request also continues coordination of Federal authorizations for new transmission facility siting, issuance of permits for cross-border transmission lines, and authorization of electricity exports.

INFRASTRUCTURE SECURITY AND ENERGY RESTORATION

The FY 2012 budget request includes $6.2 million to enhance the security and resiliency of the electricity grid, and facilitate recovery from disruptions in energy supply. The increasing complexity and interdependency of national energy infrastructure and expanding globalization of energy markets, in conjunction with the threat of both natural disasters and deliberate attacks, represent significant challenges for the energy industry. This office has built close relationships with the owners and operators of energy infrastructure as well as other government agencies, and has developed a thorough understanding of the tools and technologies needed to support energy infrastructure. This places OE in a unique position to help discover technical solutions to protect critical energy assets as well as facilitate their adoption by the energy sector.

We will improve our situational awareness capabilities through advancements in modeling tools for natural gas and petroleum sectors, power outage and restoration visualization and near real-time capabilities. We will work with energy sector stakeholders to encourage the open exchange of information on physical and cyber threats to critical infrastructure. We will maintain teams of fully trained emergency responders, prepared to facilitate recovery from energy supply disruptions. We will develop a strategic analytical framework for identifying and modeling foreign energy infrastructure that, if compromised, could negatively affect national energy security. And we will work with Federal, state and local officials to strengthen preventative measures through tabletop exercises, forums and workshops that increase understanding of critical infrastructure protection and security issues.

These activities represent OE's contribution to the security and resiliency of national energy infrastructure, and promote consistent, reliable and efficient energy nationwide.

PROGRAM DIRECTION

Our FY 2012 budget request includes $31.2 million for Program Direction, which covers the cost of sustaining Federal staff and other services required to provide overall direction, management, and support for OE. The request supports 118 Full Time Equivalents (FTEs) in FY 2012, based in Headquarters and at the National Energy Technology Laboratory in West Virginia. This includes 12 additional technical staff with expertise in areas such as cyber security, power electronics, and smart grid technologies, as well as senior management personnel, needed to support OE's increasing workload and achieving its critical mission. The request supports an additional 26 FTEs that were funded through the Recovery Act in FY 2010. The grants and agreements awarded under the Recovery Act will continue for several years, and Federal staff provides critical technical project management and monitoring of ongoing Recovery Act grants and agreements.

CONCLUSION

Through our ongoing research and development and other efforts, we continue working to improve grid efficiency and reliability, improvements that can enable the Nation to move toward more affordable, accessible clean energy sources. Continued Federal investment in the research, development and deployment of new technologies, in combination with innovative policies and

investment in infrastructure, is crucial to improving performance of the Nation's grid and ensuring our energy independence, security and environmental well-being.

President Obama has defined an ambitious vision for our future, where most of our electricity comes from a wide range of clean energy sources, with electric vehicles that charge and discharge to the grid. We must modernize the electric grid to ensure it can support this future, reliably, securely and efficiently. As Energy Secretary Steven Chu has said, "The United States faces a choice today: will we lead in innovation and out-compete the rest of the world or will we fall behind? To lead the world in clean energy, we must act now. We can't afford not to."

This concludes my statement, Mr. Chairman. I look forward to answering any questions that you and your colleagues may have. Thank you.

Mr. WOMACK. Thank you, Madam Secretary, without objection. Dr. Kelly.

Mr. KELLY. Good morning. I would like to thank the Chairman, the ranking member, and other members of the subcommittee. Thank you for the opportunity to testify on the President's fiscal year 2012 budget request for the Department of Energy's Energy Efficiency and Renewable Energy Program.

In his State of the Union, the President laid out a plan for the United States to win the future by out-innovating, out-educating, and out-building the rest of the world, while at the same time addressing the problems of the deficit and meeting the national goals in energy, security, and the environment. And the work proposed here in the EERE budget is a crucial part of the plan to meet that challenge. That is why the President has asked for a significant increase in funding for energy efficiency in renewable energy, even in a budget which moves overall domestic discretionary spending to the lowest levels in a generation.

There will be fierce international competition to meet the rapidly growing world markets for next generation lighting, advanced batteries, wind machines, hybrid vehicles, and techniques for converting biomass into useful fuels. This is not a competition that we can take lightly. Countries around the world have mounted massive national efforts to put their companies into these markets. For example, the President has set a goal of getting a million electric vehicles in the U.S. on the road by 2015. China has a goal of putting a million electric vehicles a year on the road in 2015 and beyond.

The budget we are presenting here also supports several very specific goals that the President has laid out. One is getting 80 percent of America's electricity from clean energy sources by 2035, and the goal of ensuring that renewable electricity and fuels are available to Americans at affordable prices.

Now, these goals can only be met if U.S. businesses invest in new or expanded facilities and the new jobs needed that they will be creating. At EERE, each mission is to make sure that this happens by both developing the technologies through research and by removing the barriers that prevent moving inventions and ideas into profitable businesses.

Now, the diverse set of technologies supported by EERE's investment portfolio helps to ensure that the U.S. has many options for meeting its energy goals. Working with advisors from businesses, universities, and others, we have taken great care to ensure that we invest research funds for the largest potential impact, and we have refined the management of our programs to ensure that we can get the very best groups in the country working on our challenges, whether they are in universities, businesses, national laboratories, or a consortia of these.

Now, we have proposed growth in programs, but we have also reduced funding in many areas where we feel that either the programs have met their objectives or, in fact, are not on a trajectory to meet their objective. But we have proposed several new areas in this budget. On of them is the SunShot Program, which aims to make solar energy competitive in most parts of the country within this decade; a program that jump starts retrofits for America's 90

billion square feet of commercial buildings; a program that helps communities around the country put in place electric charging infrastructure needed to support this rapidly growing electric vehicle fleet that is entering the market; a program to help the advanced biomass fuels reach the market quickly; and a program to exploit the enormous offshore wind resources that are off both the coasts, and in the Great Lakes.

Now, while we count on private research and investments to drive the bulk of this innovation, it is often difficult for private organizations to justify the kinds of risky research that we are proposing to do in this budget. And this is certainly true in energy, a sector which has, for a variety of reasons, traditionally invested a lower fraction of its sales into research than most manufacturing enterprises.

And federal research, of course, has a very strong track record of producing social benefits in areas as diverse as hybrid seeds, the GPS, Google, the Internet. And most of today's rapidly growing clean energy industry results directly from work that has been supported in the past by EERE.

For example, the batteries that are now in electric vehicles grew directly out of EERE research. The high efficiency windows that now dominate the market and are both making houses more comfortable and more affordable came directly out of our research. The compact fluorescent lights and now the light-emitting diode lights that are going to be rapidly entering the market came from our research. Last year, U.S. companies produced 14 billion gallons of biofuel, again directly growing out of our projects. And the rapidly growing wind and solar industries in the U.S. also resulted directly from the kinds of research that we supported in the past. We are confident that the research that we are proposing now is going to continue this tradition.

We have been in EERE working in very close partnership with other parts of the Department of Energy to achieve these goals. The SunShot Initiative, for example, is jointly developed by our program, ARPA–E, and the Office of Science. And the Office of Science, of course, undertakes the extremely basic research that is needed to understand the physics and chemistry behind our technology.

ARPA–E focuses on highly innovative, high-risk enterprises. And ours, EERE, traditionally has focused on a detailed roadmap to try to get us to our goals and taking innovations wherever we can find them from early graduates in science from the rapid innovations in ARPA–E. And EERE is also working very closely with other federal agencies, both to streamline things like permitting and in other areas.

So in brief, we believe that we are putting forward a proposal that will directly support some of America's most crucial goals, and the department appreciates the leadership of this Committee in providing the resources needed to accomplish our shared goal of creating clean energy industries essential for a prosperous and secure American future.

We would be pleased to respond to any questions, and I have written testimony I would like to submit for the record.

Mr. WOMACK. Without objection. Thank you, Dr. Kelly.

STATEMENT OF

HENRY KELLY

ACTING ASSISTANT SECRETARY FOR

ENERGY EFFICIENCY AND RENEWABLE ENERGY

U.S. DEPARTMENT OF ENERGY

BEFORE THE

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

COMMITTEE ON APPROPRIATIONS

UNITED STATES HOUSE OF REPRESENTATIVES

MARCH 30, 2010

Mr. Chairman, Ranking Member Visclosky, Members of the Subcommittee, thank you for the opportunity to testify on the President's Fiscal Year (FY) 2012 budget request for the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE). (See Appendix A for FY 2012 budget summary table.)

In his State of the Union speech, President Obama laid out a plan for the United States to win the future by out-innovating, out-educating and out-building the rest of the world, while at the same time addressing the deficit.

EERE supports research, development, demonstration, and deployment (RDD&D) activities on technologies and practices essential for meeting national security goals by reducing dependence on oil, stimulating economic growth and job creation. EERE will achieve these goals by minimizing the cost of energy services, and meeting environmental goals by minimizing the emissions associated with energy production and use.

As the President said, "The first step in winning the future is encouraging American innovation." At EERE, we work to remove the barriers to the rapid conversion of innovative research into commercial products, manufacturing, and jobs. And we work with other federal, state, and local governments to speed the adoption of these American innovations. The new businesses in clean energy production, installation, and operation are playing a key role driving economic growth and job creation. The FY 2012 budget request is aimed at accelerating innovation and change in the Nation's energy economy. The EERE programs that I will outline for you today are fundamental to the President's plan.

In order to win the future, our Nation cannot afford to cede leadership in critical areas. The market for clean energy technology is growing quickly and many countries have mounted aggressive national efforts to capture market share. China, for example, has moved quickly to dominate the development of next generation clean energy products through low-cost production and investments in research infrastructure. As the President said, "this is our generation's Sputnik moment." To show his clear commitment to our future, he has asked for a significant increase in funding for energy efficiency and renewable energy, even in a budget which moves overall domestic discretionary spending to the lowest levels in a generation.

EERE emphasizes work where the potential impact is largest and where Federal funds are most critical. EERE balances its investments between high-risk research and private sector partnerships that speed the transition of innovations into practical business opportunities. The diverse set of technologies supported by EERE's investment portfolio helps ensure the U.S. has many options for meeting its energy goals. To achieve this end, the program management is designed to identify the best opportunities in the country to address these challenges and support work in universities, companies, national laboratories, and consortia.

The President has laid out a number of ambitious energy goals which our

programs directly impact, including:

- Challenging America to put 1 million electric vehicles on the road by 2015;
- Making our commercial buildings 20 percent more efficient by 2020;
- Generating 80 percent of America's electricity from clean sources by 2035;

Evidence shows how small public investments can lay the foundation for a vibrant private sector-led industry. Much of today's rapidly growing clean energy industry directly benefits from past and current EERE successes. These successes have given rise to new U.S. business investments and rewarding new job opportunities in manufacturing and other areas.

For example:

- The batteries in nearly every electric and hybrid car now being produced, and that will be produced in the coming decade, came from work supported by EERE.
- The high efficiency windows that now dominate windows sales because they make homes and offices more comfortable came directly from EERE research.
- The compact fluorescent lights and the solid-state lights on the markets that cut energy use by 75 percent or more came from our research.
- Last year, because of EERE research, U.S. companies produced 14 billion gallons of biofuels (about 8 percent of U.S. gasoline consumption) and about 10 GW of wind power was installed in the U.S., second only to natural gas power in capacity installed.
- And over 1.6 million low-income homes are safer, healthier, and more affordable as a result of EERE energy upgrades.
- (See Appendix B for more specifics on EERE's Track Record).

The challenges we face mean that we have to build on these successes and move with unprecedented speed and scale. Success is measured by private innovation and investment but well-crafted federal programs are essential. Working together we can look forward to:

- New buildings that use a quarter as much energy as today's typical buildings;
- A vigorous and profitable residential and commercial building retrofit industry cost effectively saving 30-50 percent of the energy used in existing buildings;
- Solar energy, offshore wind energy, and geothermal plants fully competitive with conventional sources of electricity;
- Fuels that can be drop-in replacements for gasoline, diesel fuel, or jet fuel priced competitively with products produced from petroleum;
- Large fleets of electric and hybrid cars supported by a network of charging stations to support them; and
- Trucks twice as efficient as those operating today.

While we are proposing investments designed to help bring about a future that includes these achievements, we are reducing or eliminating investment in programs that no longer need substantial DOE support or that are not on a track toward success. Land-based wind, for example, is now a more widely used commercial activity; as a result we are refocusing our RDD&D efforts on offshore wind. We have rebalanced our transportation program, shifting some emphasis from near-term uses of hydrogen for transportation to specialty applications like fork-lifts and stationary power in the near-term.

Our FY 2012 budget request is focused on the following themes:

- Rigorously reviewing our investment priorities to take into account their potential impact and the status of private investments, and identifying key barriers to the expanded adoption of clean energy technology.
- Implementing a clear set of goals for each program. The core goal for energy technologies is increasing efficiency and driving down costs so that they can compete without subsidies.
- Implementing strong research management practices that include rigorous competition and rigorous peer review.
- Increasing transparency and expanding external program reviews, including through the use of our new Energy Efficiency and Renewable Energy Advisory Committee.
- Eliminating duplication and increasing efficiency in areas like training, analysis, international programs, and other areas by combining them into an Office of Strategic Programs.

EERE has been working in close partnership within DOE to achieve national goals. The SunShot Initiative, for example, is designed to make solar energy fully competitive with conventional sources of electricity without subsidies by the end of the decade. EERE's efforts are managed in close collaboration with DOE's Office of Science and the Advanced Research Projects Agency – Energy (ARPA-E). While the Office of Science is tackling basic research and ARPA-E continues to advance extremely high-risk projects that the private sector is not ready to pursue, EERE is constantly working to apply these breakthroughs to the market in order to both save energy and create jobs within the industry.

EERE is also working closely with other federal agencies that can help meet our national energy goals. Examples include our work with the Department of the Interior (DOI) to accelerate the development of offshore wind energy, with Housing and Urban Development (HUD) on residential energy upgrades and improved ways to perform energy retrofits on low-income housing, and with the Department of Defense (DOD) in research collaborations and demonstrating efficient technologies in military facilities. And of course, our work with other federal partners through FEMP continues to be a way to help others reduce energy consumption in the executive branch.

CONCLUSION

This FY 2012 budget request will advance technologies and related practices to help meet the growing demand for clean, reliable, sustainable, and affordable energy while reducing energy consumption. Full funding for EERE programs will continue to enhance American innovation, ensure U.S. competitiveness in the international clean energy economy, generate jobs here at home, enhance national security, and protect the environment.

The Department appreciates the leadership of this committee in providing the resources needed to accomplish our shared goal of creating a secure and efficient clean energy economy.

PROGRAM SUMMARIES FOR FY 2012

Biomass Program – $340.5 million

The FY 2012 budget focuses RDD&D investments to drive innovation and biofuel production to meet Energy Independence and Security Act of 2007 (EISA) and Renewable Fuel Standard (RFS)[1] targets. Key efforts in the FY 2012 budget include:

- An innovative biofabrication effort that will standardize and scale up fundamental biological component fabrication, allowing for rapid prototyping and testing of innovative biofuel synthesis; and

- Integrated biorefinery projects and cellulosic biofuel reverse auctions that are expected to stimulate direct private sector investment and growth in the domestic biofuels industry.

The programs proposed in our Biomass budget are targeted to the practical steps needed to meet the RFS goals. These include the research and demonstrations needed to drive the delivered price of renewable fuels down to the point where they can compete directly with conventional petroleum fuels, and to find ways to streamline investment in next generation plants. A particularly exciting line of research is technology that can convert cellulose directly into fuels for direct substitutes for gasoline, diesel, and jet fuel. This would eliminate many of the problems faced in getting ethanol into markets at a large scale.

Building Technologies Program – $470.7 million

Buildings use more than 70 percent of all electricity produced in the U.S. and about 40 percent of all U.S. energy. There is enormous room for improvement in building energy use across the Nation. In this budget the program proposes a balanced portfolio of work in residential and commercial buildings that includes work applicable for new

[1] The RFS requires 36 billion gallons of renewable fuel per year by 2022, of which 21 billion gallons is to be advanced biofuels.

construction and the retrofit of existing buildings. It also balances research with programs designed to bring technologies rapidly into the market.

The research includes work on advanced building components such as cutting the cost and improving the performance of solid-state lighting (a technology that can be more efficient and longer lasting than compact fluorescents), highly efficient air conditioners and heat pumps (including the first basic improvement in heat pump technologies in two generations), affordable smart windows that can adjust to daylight and temperature, advanced insulation materials, and inexpensive sensors and controls. However, improving components alone does not necessarily result in buildings that are more efficient and more comfortable. This requires a sophisticated approach to the design of buildings and building operations and controls in order to ensure optimum performance of the building at all times (and diagnosis of problems making repairs quick and efficient). The budget continues funding for an ambitious energy innovation research Hub (a focused research center aimed at greatly accelerating research and development in key areas) in the old Philadelphia Navy Yard that will develop new approaches to whole building design and operations and test approaches in buildings near the Hub and around the country.

During the past few years, EERE has provided funding to jump-start a vigorous residential energy efficiency improvement program that is on track to upgrade more than 600,000 homes, develop business opportunities and new financing models for new retrofit businesses, and create thousands of jobs. This year the Administration is proposing a major new *Better Buildings Initiative* aimed at making commercial buildings 20 percent more energy efficient over the next decade through initiatives that include:

- Supporting a re-design of the current tax deduction for commercial buildings and upgrading to a credit that is more generous and will encourage building owners and real estate investment trusts (REITs) to retrofit their properties;
- Improving financing opportunities for efficiency upgrades through programs including a new *Better Buildings Pilot Loan Guarantee Initiative* for Universities, Schools and Hospitals, for which DOE requests $100 million in credit subsidy to guarantee up to $2 billion in loan guarantees for energy efficiency retrofits through the Loan Guarantee Initiative;
- Creating a $100 million Race to Green competitive grant program for state and municipal governments to implement innovative approaches to building codes, performance standards, and regulations to help make improving commercial building efficiency the common practice across the country;
- And calling on CEOs and university presidents to join DOE and other Federal partners in a *Better Buildings Challenge* to make their organizations the leaders in saving energy.

The *Better Buildings Initiative* builds on our investments through the Recovery Act and our continued commitment to passing "HOMESTAR" legislation.

The Building Technologies Program's 2012 portfolio will focus on rapid gains in efficient energy use through a balanced set of strategies including:

- Appliance standards that bring additional cost savings to consumers;
- Efforts for accelerated development and adoption of new building codes;
- Development of new information tools for energy-efficient building technology;
- Development of Building Energy Scores to enable consumers to understand how their buildings compare with other similar buildings in their energy use;
- Support for performance contracting (ESPC/ UESC) to invest in efficiency improvements that can be repaid through the energy savings stream generated;
- Support for building energy upgrades;
- Other methods to accelerate adoption of new efficiency technologies and practices; and
- Introduction of new materials and new manufacturing methods that can double the energy productivity of U.S. industry by 2020.

Federal Energy Management Program – $33 million

The Federal government is the single largest consumer of energy in the U.S. Thus, the government holds the opportunity to lead by example by powering its buildings and vehicle fleets with clean energy while making them more energy efficient. Investing taxpayer dollars in Federal energy efficiency saves taxpayers' money.

The Federal Energy Management Program's FY 2012 request will help Federal agencies serve as good stewards of taxpayer dollars while meeting requirements in Executive Orders 13514 and 13423, the Energy Policy Act (EPAct) of 1992, EPAct 2005, and EISA 2007. By providing technical expertise, training, reporting tools, and contracting support, EERE helps agencies make cost-effective investments in energy efficiency and renewable energy technologies at Federal facilities and in Federal vehicle fleets. Increased funding for technical assistance will support Federal investments and greenhouse gas (GHG) reduction efforts by developing guidance, technical assistance and GHG reporting protocols.

EERE facilitates performance based service contracts between Federal agencies and the private sector, enabling agencies to quickly install energy efficiency improvements that pay for themselves over time using savings from reduced energy bills. By demonstrating how much energy and money can be saved through clean energy technologies, EERE provides the private sector with examples that these new technologies are working and working well, making financing and widespread deployment more attainable.

Hydrogen and Fuel Cell Technologies Program – $100.5 million

The FY 2012 request refocuses some aspects of the program to reduce emphasis on near-term hydrogen vehicle applications and goals the Program has reached and increase focus on longer term research and specialized near-term applications. The Fuel Cell Technologies Program's FY 2012 request will fund RDD&D that can reduce petroleum use, greenhouse gas emissions, and contribute to a more diverse energy supply. These efforts include:

- Fuel cell systems R&D (higher performance, lower cost fuel cells);
- Safety, codes and standards development;
- Hydrogen fuel R&D (diverse ways to cost-effectively produce hydrogen from renewable energy);
- Systems analysis;
- Technology validation; and
- Manufacturing R&D.

Fundamental understanding of hydrogen interaction mechanisms could enable breakthroughs in areas such as hydrogen storage, catalysis, and membranes. Applying fuels cells to combined heat and power systems, light-duty highway vehicles, distributed stationary powers systems, and lift trucks holds potential to significantly reduce carbon emissions while mitigating oil demand.

Fuel cell vehicles using hydrogen produced from zero-carbon sources have among the lowest CO_2 emissions of all alternative-fuel vehicles. This includes emissions associated with the production, delivery, and storage of hydrogen – "well-to-wheels" emissions. Producing hydrogen from surplus renewable power can also greatly improve the economics of renewable energy generation, as it can provide additional revenue. EERE's hydrogen and fuel cell RDD&D continues to drive down costs while advancing these technologies.

Geothermal Technologies Program – $101.5 million

The Nation's geothermal resources are enormous and available in many parts of the country. Unlike intermittent renewables, geothermal plants can provide energy continuously and the economics of near-term geothermal look attractive, no plants have been built for a decade. EERE's program is designed to change this through well focused research and programs designed to mitigate the financial, regulatory, and other problems that have stymied deployment.

Specifically, the FY12 budget will:

- Pursue geothermal resources that are lower temperature, coproduced and geopressured to increase geothermal energy generation;
- Develop innovative exploration technologies to locate undiscovered hydrothermal resources that do not show surface expression (inadequate resource assessment technology means unproductive holes drilled and high costs); and
- Promote the development of naturally permeable sedimentary resources where minimal to no stimulation of the geothermal reservoir is required.

EERE will pursue sustained technology innovation and continued investments in enabling infrastructure to increase geothermal energy generation and expand it to all 50 states. This effort will have significant environmental and economic benefits. Leadership in geothermal technology provides domestic clean energy jobs and export

opportunities in several sectors including engineering and consulting services, drilling systems, and high temperature tools.

Industrial Technologies Program – $319.8 million

In the U.S., industrial processes consume about one-third of our energy.[2] Increased productivity – including energy productivity – is essential for growing U.S. manufacturing industries and maintaining manufacturing employment. New technologies can reduce production costs, energy use, and carbon emissions while simultaneously improving product quality. The FY12 budget will also launch a new a partnership with NIST's Manufacturing Extension Partnership to help America's manufacturers upgrade existing facilities with energy-efficient technologies.

The FY12 budget supports three major research themes:

1. Next generation materials like titanium, advanced steel alloys, and affordable composites that can increase performance, lower cost, and be produced with far less embodied energy.
2. Next generation manufacturing technologies using approaches like bio-processing, low temperature separation techniques (ionic liquids, membrane separations), and sophisticated sensor and control networks.
3. Support other EERE program areas in driving down the manufacturing cost of key clean energy technologies, including advanced photovoltaics, lighting devices, sensors and controls, batteries, and wind system components.

The FY 2012 request includes support for an *Energy Innovation Hub* on critical materials which will focus on reducing U.S. reliance on materials like the rare earths needed in today's advanced electric motors and the phosphors needed for solid-state lights. The Hub team will focus on finding ways to reduce use of critical materials, identify pathways that do not require critical materials, and decrease the cost of separating critical materials from recycle streams and ores.

The budget strengthens programs that ensure U.S. manufacturers have easy access to state-of-the-art energy technology. It builds on the successes of the Industrial Technical Assistance program that trains engineering students and manufacturing workers to conduct energy management activities, provide technical support and tools for industry to expedite implementation of energy saving projects, and create a credible, transparent, industrial energy management certification program.

Solar Energy Technologies Program – $457 million

As with President Kennedy's 1962 challenge to win the Space Race, DOE is making a similar effort today – launching the *SunShot Initiative* to drive down the installed cost of solar energy systems by about 75 percent to a dollar-a-watt at the utility scale before the end of the decade. At $1/watt, solar electricity would cost about $0.06 per kilowatt-hour

[2] http://www1.eere.energy.gov/industry/about/pdfs/itp_program_fact_sheet.pdf

and would be cost competitive – without subsidy – with traditional energy resources. This highly-collaborative effort refocuses EERE's prior solar efforts and involves DOE's Office of Science, the Advanced Research Projects Agency – Energy (ARPA-E), and input from industry. While the Office of Science is tackling basic research and ARPA-E continues to advance extremely high-risk projects that the private sector is not ready to pursue, EERE is constantly working to apply these breakthroughs to the market in order to both save energy and create jobs within the industry. The U.S. is the world's largest consumer of electricity and, at the same time, has the largest solar resource of any industrialized country.[3] This makes the U.S. better positioned than any other nation to capture significant benefits from the wide-scale use of solar energy. Achieving $1/watt for utility-scale solar systems would cause a boom in domestic manufacturing. This request enables EERE to further cutting-edge solar technologies.

Through the development of technologies that will allow solar energy systems to achieve grid parity with mature fossil fuels, SunShot will help the U.S. regain leadership in worldwide solar manufacturing and help the U.S. lead the 21st century global economy. Therefore, the solar energy technologies program's FY 2012 budget request is critical to funding the innovations necessary to achieve grid-party with already mature fossil fuels.

EERE's solar program will continue to develop concentrating solar power (CSP) technologies with thermal storage to reach base-load grid parity by 2020. This program maintains a focus on innovative solar photovoltaic (PV) manufacturing and will help stimulate the domestic PV manufacturing base. The solar program also seeks to streamline permitting, inspection, and interconnection and to develop IT-enabled solutions that can help drive down permitting costs for local jurisdictions.

Vehicle Technologies Program – $588 million

America has the opportunity to lead the world in electric vehicle manufacturing and deployment, which would significantly reduce the Nation's appetite for oil and increase our energy security. EERE's activities are focused on increasing electrification and fuel efficiency thereby lowering greenhouse gas emissions, and meeting the following goals:

- Placing one million electric drive vehicles on the road by 2015;
- Developing and deploying advanced battery manufacturing capacity to support 500,000 plug-in hybrid electric vehicles a year by 2015;
- Developing technologies that enable fuel economy increases to achieve a corporate average fuel economy (CAFE) standard of 37.8 miles per gallon for cars and 28.8 mpg for light trucks by 2016; and
- Saving 1.8 million barrels of petroleum per day by 2020.

The FY 2012 request supports these efforts to encourage advanced vehicle manufacturing and adoption, R&D, and a new competitive deployment program to help communities

[1] Based on radiation data collected by the National Renewable Energy Laboratory: http://rredc.nrel.gov/solar/old_data/nsrdb/

across the country become early adopters of electric vehicles. The vehicle technologies developed and manufactured with the support of annual appropriations and Recovery Act funding will help to improve the U.S. vehicle fleet fuel economy to meet strict new corporate average fuel economy (CAFE) requirements. To accelerate the introduction and market acceptance of electric vehicles, EERE is greatly expanding its emphasis on developing new generations of hybrid electric vehicles, plug-in hybrids, and electric vehicles. Coupling targeted R&D on batteries and power electronics and electric drive systems with supporting electric vehicle infrastructure deployment will help communities across the nation move from point A to point B safely, reliably, and comfortably in electric vehicles. The program has set the goal of reducing the cost of a high energy battery from $1,000/kWh in 2008 to $300/kWh by 2015 to enable cost-competitive market entry of plug-in hybrid electric vehicles (PHEV's).

Water Power Program – $38.5 million

Conventional hydropower (CH) technologies generate approximately 67 percent of the Nation's renewable energy supply. Improving existing CH systems represents one of the fastest and most cost-effective options for increasing clean and renewable energy generation in the U.S. and represents significant renewable generation potential in a wide variety of geographic regions. The FY 2012 budget supports hydroelectric feasibility studies to assess the potential for incremental or new hydropower generation through equipment additions and upgrades to increase generation, and powering existing non-powered dams. These studies will identify projects that can most quickly and cost effectively increase water electricity generation.

Along with investing in CH advances, the FY 2012 budget will invest in R&D and testing of innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from water. This is done by investing in cost-shared partnerships with wave, tidal, ocean current, river in-stream and ocean thermal technology developers. These partnerships will help create technology and manufacturing sectors that lead to further economic development in maritime and coastal communities.

Wind Power Program – $126.9 million

Wind has become one of the fastest growing sources of new electric generation in the U.S. The FY 2012 budget focuses the program on offshore wind. Offshore wind is attractive since some of the nation's best wind resources (strong and steady winds) are located off our coasts – including the Great Lakes - and many of these resources are close to major population centers. The key problem is that the costs of offshore facilities are much higher than land-based wind. Therefore, cost reduction is the core of the Wind Power Program's investment portfolio. A variety of highly innovative concepts has been proposed and will be explored with the programs proposed. Reliability is particularly important for offshore wind since maintenance costs are very high. Thus projects have been proposed that can cut part counts and increase reliability. Onshore wind will

continue to benefit from investments in wind turbine testing facilities, new manufacturing methods, innovative components, and wind resource characterization.

The program also supports work to facilitate the deployment of onshore and offshore wind technologies that will address problems like radar interference, reducing bird strikes, streamlining permitting, and other programs. The Wind Program is making these advancements possible by closely working with industry while simultaneously collaborating with other agencies and countries, as well as both state and local governments.

Weatherization and Intergovernmental Program – $393.8 million

The Weatherization and Intergovernmental Program's FY 2012 budget request will significantly accelerate the deployment of clean energy technologies and practices by supporting a network of governmental, community and business stakeholders. By facilitating clean energy investments, the State Energy Program (SEP) and the Weatherization Assistance Program (WAP) help increase supply and reduce demand of energy. A combination of financial and technical assistance to state, local, U.S. territory, and tribal governments empowers communities to design programs that meet their local energy needs.

Under SEP, states develop strategic plans and energy priorities that target both near-term clean energy deployment and long-term market transformation. States may also implement financing programs, such as revolving loan funds, which leverage Federal investments and increase access to private capital, thus leading the way in addressing one of the biggest market barriers to clean energy implementation. Every $50 million in SEP funding:

- Leverages $585 million for energy related economic development;
- Produces $333 million in sustained, annual energy cost savings for families, businesses, and state and local governments;
- Supports energy retrofits of 153 million square feet of state/local government buildings; and
- Provides 300,000 energy efficiency technical assistance contacts with consumers and small businesses to aid them in implementing cost-effective energy efficiency actions.

Through WAP, DOE provides funding to make energy efficiency upgrades for low-income households, creating safer, healthier, and more affordable homes for hundreds of thousands of Americans. Using the most tried and true advanced technologies and testing protocols available in the housing industry to enhance home energy performance, WAP supports the growth of a home energy upgrade industry. WAP funding is instrumental in building a trained workforce that supports a growing industry that will generate jobs while saving homes and businesses money. The FY 2012 request complements DOE's $11.3 billion in funding for WAP, SEP and EECBG under the Recovery Act, enabling EERE to build on lessons learned and continue to deploy clean energy at speed and scale.

Program Direction – $176.6 million

The Program Direction FY 2012 budget request supports the workforce needed to effectively administer a $3.2 billion base appropriation, and execute $2.3 billion of prior year projects. The FY 2012 staffing requirement is based on a workload assessment of more than 7,000 contracts, grants, agreements, and Congressionally-Directed Projects in various stages of the budget execution process. This funding provides for the executive direction, technical expertise, and business management necessary to accelerate the scale and pace at which activities are implemented, executed and closed out. It provides for contract support at headquarters and field offices to implement and execute EERE technology development programs. The funding supports the operation, maintenance, upgrade of DOE business intelligence systems, EERE Corporate Planning System, Performance Dashboards, and the local area network. Funding also covers GSA rent, commercial office spaces, security, and the Working Capital Fund common administrative services.

Strategic Programs – $53 million

EERE's strategic programs cover a wide range of responsibilities and activities. The program conducts crosscutting technology and policy analysis, evaluates RDD&D activities and impacts, coordinates strategy across the technology portfolio, analyzes EERE-specific legislation, strengthens research management, obtains effective external advice, uses modern communication tools to facilitate information accessibility to the public, ensures coordination and efficiency through training programs in EERE programs, and collaborates with foreign partners to advance clean energy RDD&D. The FY 2012 budget request enables EERE to maintain a strategic framework for its clean energy investments.

APPENDIX A – EERE Budget Summary

Thousands of dollars

Program	FY 2010 Current Approp*	FY 2011 CR	FY 2012 Request
Biomass	216,225	0	340,500
Building Technologies	219,046	0	470,700
Federal Energy Management	32,000	0	33,072
Fuel Cell Technologies	170,297	0	100,450
Geothermal Technology	43,120	0	101,535
Industrial Technologies	94,270	0	319,784
Solar Energy	243,396	0	457,000
Vehicle Technologies	304,223	0	588,003
Water Power	48,669	0	38,500
Weatherization and Intergovernmental Activities	270,000	0	393,798
Wind Energy	79,011	0	126,859
Program Direction	140,000	0	176,605
Strategic Programs	45,000	0	53,204
Facilities and Infrastructure	19,000	0	26,407
Congressionally Directed	292,135	0	0
Subtotal	**2,216,392**	**2,242,500**	**3,226,417**
Use Of Prior Year Balances	0	0	-26,364
Total	**2,216,392**	**2,242,500**	**3,200,053**

* SBIR/STTR funding transferred in FY 2010 was $23,310,200 for the SBIR program and $2,797,220 for the STTR program.

APPENDIX B – EERE Track Record of Success

Recent examples of noteworthy EERE accomplishments follow.

Biomass Program

- Validated sustained operations at a cellulosic ethanol biorefinery with 1.4 million gallons per year (MGY) capacity
- Brought cellulosic ethanol biorefinery with 2.5 MGY capacity online
- Completed the National Environmental Policy Act compliance process for over 75% of EERE's integrated biorefinery projects
- Completed ethanol blend testing for vehicle model years 2001 and newer, supporting U.S. Environmental Protection Agency waiver decisions on E15 in 2010 (for model years 2007 and newer) and 2011 (for model years 2001 – 2006)
- Improved biochemical conversion efficiency, demonstrating greater than 85% intermediate-sugars production from the conversion of oligomers to simple sugars (e.g., xylan to xylose)
- Achieved greater than 90% efficiency in a thermochemical conversion of methane to syngas
- Reduced feedstock logistics costs from $46 per dry ton to $38 per dry ton (on an oil-equivalent basis, about a $10 – 15 per barrel reduction in feedstock costs)

Building Technologies Program

- Issued eight appliance standards since January 2009 that will save consumers a projected $250-300 billion in electricity costs by 2030
- Published five final rules establishing amended energy conservation standards and four final rules establishing amended test procedures.
- Developed one of the largest gains in energy efficiency within a single code cycle. Working with American Society of Heating, Refrigerating and Air Conditioning Energizers (ASHRAE) and the International Code Council, developed ASHRAE Standard 90.1-2010, representing a 25% improvement over the previous version and finalized proposals to the 2009 International Energy Conservation Code (IECC) with 30% improvement
- Engaged more than 20 commercial building partners to design new building prototypes that use 50% less energy, and retrofit existing buildings for at least 30% energy savings
- Worked with DOE Commercial Building Energy Alliances to develop new performance criteria for 10-ton capacity commercial air conditioners (rooftop units). These high-efficiency rooftop units are expected to reduce energy up to 50-60% compared with current equipment.
- Working with the private sector, produced a laboratory package Lighting Emitting Diode (LED) device that delivers 139 lumens per watt, exceeding EERE's 2010 target
- Working with EPA, completed a prioritized list for updating and reviewing test procedures for existing and new ENERGY STAR products
- Building America demonstrated 40% savings over IECC 2006 in both cold and mixed humid climate by working with key leading builders

- Completed a cool roof design guide and an advanced roof guide with over 50% energy savings
- Heating, ventilation, and cooling (HVAC) R&D activities resulted in an electric heat pump water heater that exceeds the 2009 DOE ENERGY STAR standards for electric water heaters while providing the same amenity as conventional electric storage water heaters

Federal Energy Management Program

- Catalyzed an all-time Federal record by facilitating $589 million in energy savings performance contracts (ESPCs) that are estimated to save taxpayers more than $1.1 billion during the contract term
- Funded 119 technical assistance projects resulting in $122 million in project work in Federal facilities
- Assisted DOE in:
    - Reducing energy intensity by 23% (exceeding 2010 15% targeted reduction from 2003);
    - Reducing water by 12% since 2007 (exceeded 6% target); and
    - Obtaining 9% of electricity from renewables (exceeded 5% goal)
- Expanded capabilities to provide web-based training including over 10,000 participants

Geothermal Technologies Program

- Partnered with industry to demonstrate the extraction of lithium, a strategic mineral, from geothermal brines for use in electric vehicles and batteries
- Collaborated with DOE Office of Fossil Energy to demonstrate the production of 1,104 megawatt hours from 6.4 million barrels of wastewater coproduced with oil at the first facility of its kind in the U.S.
- Continued reducing geothermal development costs by designing and testing electrical insulation material capable of performing at temperatures up to 250°C and demonstrating a threefold increase in rate of drilling penetration at lab-scale using hydrothermal spallation drilling

Industrial Technologies Program

- World record in efficiency by partnering with industry to build 35-47% efficient small to medium gas engines for distributed power generation
- Partnered with 100 LEADER companies that committed to achieving 25% improvement in energy intensity over the next 10 years

Solar Energy Technologies Program

- Set a world record by producing a 27% efficient single junction solar cell
- PV Incubator program leveraged $1.2 billion in private capital with $59 million of DOE funds since 2007

Vehicle Technologies Program

- Reduced the cost of plug-in hybrid electric vehicle lithium-ion batteries to $800 per kilowatt-hour (kWh), a 20% reduction from 2008 baseline of $1,000/kWh
- EERE is on track to reduce cost to $300/kWh by 2015

Water Power Program

- Launched seven new hydroelectric facility upgrades, the first in 20 years
- Awarded 27 cost-shared grants to marine and hydrokinetic technology developers to advance commercial readiness of this emerging technology sector
- Conducting resource assessments to more precisely quantify the energy generation potential of all U.S. water resources, including conventional hydroelectric supplies as well as new resources derived from waves, ocean/tidal/river currents, and ocean thermal power
- Completed the initial model of a redesigned Francis hydropower turbine that significantly improves environmental performance of hydropower turbines
- Executed a Memorandum of Understanding (MOU) between DOE, the Department of Interior, and the Army Corps of Engineers focusing on increasing energy generation at federally-owned facilities and explore opportunities for new development of low-impact hydropower

Weatherization and Intergovernmental Program

- Weatherized 330,000 homes under Recovery Act
- Weatherizing low-income homes at a rate of 25,000 homes per month
- States upgraded an additional 15,750 buildings (14,500 residential) and thousands of renewable energy systems were installed through Q4 2010, including;
    - Nearly 2,500 solar photovoltaic systems installed with 25.5 megawatts of capacity
    - Over 1,100 solar thermal systems with nearly 38,000 square feet of capacity
    - Over 200 wind turbines installed with over 8.5 MW of capacity
    - Over 580 geothermal systems installed with over 2,800 tons of capacity

Wind Energy Program

- Completed advanced computer designs of three highly innovative deep offshore wind designs

Mr. WOMACK. Mr. Der.

Mr. DER. Good morning, Mr. Chairman, and Members of the Committee. I would like to extend my thanks to the Chairman, the Ranking Member, and the Members of the Subcommittee for inviting me here today to present the Department of Energy's fiscal year 2012 budget request for the Office of Fossil Energy.

The Office of Fossil Energy's primary mission is to ensure the continued use of our abundant fossil energy resources for clean, affordable, and reliable energy. We pursue this mission with cutting-edge research and development and through the management of the Strategic Petroleum Reserve, which is vital to the U.S. energy security. We also oversee the Northeast Home Heating Oil Reserve and the Naval Petroleum Reserves.

The Department of Energy is requesting $520.7 million for fossil energy programs in fiscal year 2012. This includes $452.9 million for fossil energy research and development of which $291.3 million is targeted for carbon capture and storage, and power systems, and research and development in cost-shared collaboration with our industry partners. This request also includes $121.7 million for the Strategic Petroleum Reserve and $14.9 million for the Naval Petroleum Reserves.

I would like to take a moment to touch on the highlights of our request. The 291.3 million request for carbon capture and storage, or CCS, and power systems research is critical to our mission, especially in the area of CCS. The Department's request in this area will fund the following R&D efforts, and CCS and power systems.

First, carbon capture. This effort is focused on the development of low-cost CO_2 capture technology for new and existing power plants as well as industrial plants.

Second, in the carbon storage R&D. The regional carbon sequestration partnerships are essential to this program, and a major objective is to develop the best practices for injection and safe, effective, long-term geologic storage of CO_2. By the end of 2012, the partnerships collectively plan to have injected and stored a total of 3 million metric tons of CO_2 at large-volume geologic storage sites. In fiscal year 2012, we will also continue initiatives that focus on site monitoring, verification, accounting, and assessment, as well as research on CO_2 use and reuse.

The third area is advanced energy systems research. This research is focused on enabling affordable CO_2 capture through cost reductions in advanced gasification and combustion technology while increasing power plant availability and efficiency.

And, finally, in the fourth area there, the cost-cutting research is to develop and deploy state-of-the-art instrumentation, sensors, and controls to improve efficiency and performance of advanced power systems. In addition, this research will focus on developing computational assimilation tools aimed at helping to accelerate the CCS development to deployment cycle.

In the area of unconventional natural gas R&D, Fossil Energy has conducted significant R&D of unconventional fossil fuel energy technologies, including methane hydrates research. However, the Department is requesting no funding for hydrocarbon production R&D as this is more appropriately funded by industry.

In the petroleum reserves area, the Department is requesting $121.7 million for the strategic petroleum reserve. This request assumes a cancellation of $71 million remaining from prior appropriations for a 1 billion barrel expansion in Mississippi. This remaining balance is being proposed for partially offsetting the funding operations and management activities of the strategic petroleum reserve.

The FY 2012 budget also proposes a non-emergency sale of approximately 6 million barrels of SPRO oil. This sale is for operational purposes, including the reduction of oil in those caverns that were overfilled to accommodate the construction of a replacement cavern at the Bayou Choctaw storage site.

The Department is also requesting $10.9 million for the Northeast Home Heating Oil Reserve, which protects New England against supply disruptions. The receipts from the sale of nearly 2 million barrels in fiscal year 2011 will be used to purchase a million barrels of ultra-low sulfur distillate. Our FY 2012 request will be offset by excess balances from that sale which are proposed for cancellation in fiscal year 2012.

The only remaining naval petroleum reserve managed by the Department of Energy is Naval Petroleum Reserve 3 in Wyoming. Oil production operations at NPR 3 will be discontinued except for incidental production associated with geothermal testing at the Rocky Mountain Oil Test Center. Environmental remediation will continue, however, and a plan will be developed for the sale or disposition of NPR 3.

The 14.9 million request for this program will also fund environmental remediation of a former naval petroleum reserve in California, which was sold in 1998.

In conclusion, Mr. Chairman, the fiscal year 2012 budget request for the Office of Fossil Energy would help us address the nation's energy security and environmental challenges. We believe this funding targets critical activities to support the achievement of the central objectives and will provide the resources needed to carry out our mission while ensuring maximum benefit to taxpayers for the investment.

With that, I ask that my written statement be submitted for the record and, also, Mr. Chairman, I would be happy to answer any questions that you and the Committee may have. Thank you.

Mr. WOMACK. Thank you very much, Dr. Der. Without objection.

Statement by Dr. Victor K. Der
Assistant Secretary for Fossil Energy (Acting)
U.S. Department of Energy

FY 2012 Appropriations Hearing
House Committee on Appropriations
Subcommittee on Energy and Water Development

March 30, 2011

Mr. Chairman, Members of the Committee, it is my pleasure to appear before you today to present the Office of Fossil Energy's (FE) proposed Budget for Fiscal Year 2012.

The Office of Fossil Energy's primary objective is to ensure that we can continue to utilize our traditional fuel sources for clean, affordable, reliable energy. Fossil fuels currently provide 83 percent of U.S. energy consumption and are expected to continue to play a critical role in meeting our Nation's energy needs for the foreseeable future. Making use of these assets in an environmentally responsible manner will help the United States meet its energy requirements, hold down cost increases for consumers, minimize environmental impacts, positively contribute to energy security and enable the Nation to better compete in the global marketplace.

First and foremost, FE's research and development (R&D) program supports the U.S. Department of Energy's (DOE) overall mission to achieve national energy security in an economic and environmentally sound manner. The mission of the FER&D program is to create technology and technology-based policy options for public benefit by enhancing U.S. economic, environmental, and energy security. This mission is achieved by developing technologies to enhance the clean use of domestic fossil fuels and to reduce emissions from fossil-fueled electricity generation plants to achieve near-zero atmospheric emissions power production.

The bulk of FE's current R&D program activities focus on: 1) CO_2 capture technology applicable to both new and existing fossil-fueled facilities; 2) CO_2 storage, with emphasis on CO_2 monitoring, verification and accounting; 3) advanced coal-fueled power systems that support carbon capture and storage (CCS), including integrated gasification combined cycle (IGCC) and oxy-combustion technologies; and 4) cross-cutting research to bridge fundamental science and engineering development.

Currently, we are pursuing the integrated demonstration of first generation CCS technologies with existing and new power plants and industrial facilities. These demonstrations are focused on using a range of capture technologies and storing CO_2 in a variety of geologic formations, including enhanced oil recovery. The current portfolio of funded projects is on course to meet the President's goal of bringing five to ten commercial scale demonstration projects online by 2016. In parallel, we are conducting and supporting long-term, high-risk R&D to significantly reduce coal power plant emissions (including CO_2) and substantially improve

efficiency to reduce carbon emissions, leading to a viable near-zero atmospheric emissions coal energy system and supporting carbon capture and storage.

FE also manages the Nation's 727-million-barrel U.S. Strategic Petroleum Reserve (SPR) that serves as the largest stockpile of government-owned emergency crude oil in the world. The SPR helps ensure U.S. energy security. This stockpile of crude oil provides energy and economic security against disruptions in U.S. oil supplies and also allows the United States to meet part of its International Energy Agency obligation to maintain emergency oil stocks. In addition, FE oversees the Northeast Home Heating Oil Reserve and the Naval Petroleum Reserves.

Fiscal Year 2012 Budget Request

DOE is requesting $520.7 million for FE programs in FY 2012. Included in this budget are $453.0 for Fossil Energy Research and Development; $121.7 million for the Strategic Petroleum Reserve; -$69 million (net) for the Northeast Home Heating Oil Reserve; and $14.9 million for the Naval Petroleum Reserves.

The FY 2012 budget request will allow FE to fulfill the mission I just outlined: to provide the Nation with the best opportunity to tap the full potential of its abundant fossil energy resources in an environmentally sound and affordable manner; and to ensure America's readiness to respond to short-term energy supply disruptions.

Fossil Energy Research and Development

The President's FY 2012 budget requests $453.0 million for a fossil energy research and development portfolio focused on advancing carbon capture and storage technologies. This program is designed to ensure we can continue to use the Nation's abundant fossil resources through the development of clean energy technologies, with a specific focus on dramatic reductions of global carbon emissions at acceptable cost.

The CCS Demonstrations program, including the Clean Coal Power Initiative, FutureGen 2.0, and Industrial CCS Demonstrations, enables and accelerates the deployment of advanced carbon capture and storage technologies to ensure clean, reliable, and affordable electricity for the United States. The 2012 budget request does not provide any demonstration funds because these projects are already strongly supported through the 2009 American Recovery and Reinvestment Act (ARRA). ARRA provided $3.4 billion for CCS, of which $2.5 billion is supporting large-scale demonstration projects.

CCS and Power Systems R&D

The CCS and Power Systems R&D FY 2012 budget request of $291.3 million represents more than 55 percent of FE's total FY 2012 budget request. The program provides research to significantly reduce coal power plant emissions (including CO_2) and substantially improve efficiency to reduce carbon emissions, leading to a viable near-zero atmospheric emissions coal energy system and supporting carbon capture and storage.

The Department is developing advanced clean coal technology with a goal of deploying high efficiency coal power plants achieving near-zero atmospheric emissions. The Office of Fossil Energy's CCS and Power Systems program is leading efforts to make possible greater utilization of the Nation's most abundant commercially available energy resource (coal) in an environmentally sensitive way. The core Research and Development efforts of the CCS and Power Systems program focuses on a variety of carbon capture and storage technologies for pulverized coal, oxy-combustion, and gasification plants: post-combustion carbon capture for new and existing plants, improved gasification technologies, development of stationary power fuel cells, improved turbines for future coal-based combined cycle plants, and creation of a portfolio of technologies that can capture and permanently store greenhouse gases.

In addition to the funding levels reflected in the CCS and Power Section, Program Direction accounts for NETL Program Specific Activities supporting CCS and Power Systems. This funding supports Federal staff directly associated with conducting research activities specific to CCS and Power Systems in Carbon Capture, Carbon Storage, Advanced Energy Systems and Crosscutting Research.

Carbon Capture. The President's budget requests $68.9 million for DOE's Carbon Capture program. This sub-program is focused on the development of post-combustion and pre-combustion CO_2 capture technologies for new and existing power plants. Post-combustion CO_2 capture technology is applicable to pulverized coal (PC) power plants, which is the current standard industry technology for coal-fueled electricity generation. Pre-combustion CO_2 capture is applicable to gasification-based systems such as IGCC, a potential technology for future generation of electricity from coal-fueled plants.

The increase in funding for post-combustion R&D will include funding for slip stream testing of a larger number of advanced technology systems and will shorten the time required for development of systems ready for commercial application.

Carbon Storage. The FY 2012 budget requests $115.5 million for Carbon Storage R&D. The activities conducted under this sub-program will be used to benefit the existing and future fleet of fossil fuel power generating facilities by developing tools to increase our understanding of geologic reservoirs appropriate for CO_2 storage and the behavior of CO_2 in the subsurface.

The Regional Carbon Sequestration Partnerships, which unite more than 400 public and private entities in an effort to complete and evaluate small- and large-volume CO_2 injection tests across the nation, are an essential piece of this program. Large-volume injections are needed to demonstrate the formations selected for storage are capable and have the capacity to store supercritical carbon dioxide. They are also needed for the development of technology that can safely and economically store CO_2 from coal-based energy systems.

In FY 2012, projects will focus on the development of innovative, advanced technology and protocols for the monitoring, verification, accounting, and assessment of CO_2 storage

in geologic formations as well as simulating the behavior of geologically-stored CO_2 will continue all of which will culminate in a set of best practices for CCS deployment.

Additionally, work on carbon storage will continue to be coordinated between the U.S. and China with the aim of leveraging each country's investment and accelerating carbon storage technology deployment through sharing of experiences. This coordination will be done under the U.S.-China Clean Energy Research Initiative.

Advanced Energy Systems. The President's Budget requests $64.2 million for Advanced Energy Systems research. This sub-program focuses on improving the efficiency of coal-based power systems, enabling affordable CO_2 capture, increasing plant availability, and maintaining the highest environmental standards. The program supports gasification-related R&D to convert coal into synthesis gas (syngas) that can in turn be converted into electricity, chemicals, hydrogen, and liquid fuels. In addition, this sub-program advances hydrogen turbine designs to improve the performance of pre-combustion capture systems and supports the development of Advanced Combustion Systems through research focused on new high-temperature materials and the continued development of oxy-combustion technologies.

Advanced Combustion Systems R&D will continue laboratory through pilot scale testing of advanced chemical looping and oxy-combustion as an option for lower cost and more efficient CO_2 capture systems. Work will also include the use of computational techniques to design and develop materials for use in advanced combustion systems.

The Gasification Systems research effort will continue to develop technologies for gas stream purification to achieve near-zero atmospheric emission goals and to meet syngas quality requirements; enhance process efficiency and availability; reduce costs for producing oxygen; and develop advanced gasification technologies. The Advanced Turbines activity will implement projects to enable efficient, clean and cost effective hydrogen fueled turbines for coal-based IGCC power systems that capture and store CO_2.

Cross-Cutting Research. The FY 2012 budget requests $42.8 million for Cross-cutting Research. This sub-program serves as a bridge between basic and applied research by fostering the development and deployment of innovative systems for improving efficiency and environmental performance through the research and development of instrumentation, sensors, and controls targeted at enhancing the availability of advanced power systems while reducing costs of CCS and Power Systems. This program area also develops computation, simulation, and modeling tools focused on optimizing plant design and shortening developmental timelines. The Cross-cutting Research activity also addresses advanced and cross-cutting issues, including plant optimization technologies, environmental and technical/economic analyses, coal technology export, and integrated program support.

Unconventional Natural Gas R&D

The Natural Gas Technologies program developed scientific information and advanced technologies to increase environmentally responsible supplies of natural gas through

research and development. Consistent with Administration policy to phase out inefficient fossil fuel subsidies, the program is requesting no funding in FY 2012 for R&D to increase hydrocarbon production.

Petroleum Reserves

The Office of Petroleum Reserves manages the Strategic Petroleum Reserve and Northeast Home Heating Oil Reserve programs, which provide strategic and economic protection to the Nation from disruptions in foreign and domestic petroleum supplies; and the Naval Petroleum and Oil Shale Reserves, involving the Department's environmental legacy responsibilities from the sale of the Naval Petroleum Reserve No. 1 (NPR-1) in California and the operation of the NPR-3 stripper oil field and Rocky Mountain Oilfield Testing Center, both located near Casper, Wyoming.

Strategic Petroleum Reserve. The Department of Energy is requesting $121.7 million for the SPR in FY 2012. This decrease from FY 2011 funding assumes a cancellation of $71 million in balances from prior year appropriations for a 1 billion barrel expansion at the Richton, Miss., site and the use of these balances to partially fund operations and management activities of the SPR.

The FY 2012 budget also proposes a $500 million non-emergency sale of SPR oil for operational purposes. The sale of approximately 6 million barrels will reduce import protection from 75 days to 74 days. Additionally, the request includes funding to continue completion of a replacement cavern at the Bayou Choctaw, La., site as well as for degas operations to begin at the West Hackberry, La., site.

Northeast Home Heating Oil Reserve. The Northeast Home Heating Oil Reserve, established in 2000, is capable of assuring a short-term supplement to home heating oil supplies during times of very low inventories or in the event of significant threats to immediate energy supplies. The Reserve provides a buffer for the Northeast against a supply disruption for approximately 10 days, the time required for ships to carry heating oil from the Gulf of Mexico to New York Harbor.

In FY 2011, the program sold 1,984,253 barrels of heating oil for approximately $227 million and will use the receipts to purchase 1 million barrels of ultra low sulfur (ULS) distillate to serve New England and comply with new state environmental requirements; the program will also award new storage contracts. The reduction of reserve inventory due to the sale is offset by a regional increase in the use of natural gas for residential heating. In addition, the New York Harbor area has abundant commercial stocks available, as well as connections to local refineries and the Colonial Pipeline for resupply.

The FY 2012 request is $10.9 million for heating oil storage leases and will be offset due to excess net balances estimated in the 2012 Budget to be $79.0 million from the sale, which are proposed for cancellation in FY 2012.

Naval Petroleum and Oil Shale Reserves. Three of the four original Naval Petroleum Reserves (NPR-1, NPR-2, and NPR-4) have been sold or transferred to the Department of the Interior. Environmental remediation and equity finalization continues at NPR-1. The only remaining oil reserve managed by the DOE is the Teapot Dome field (NPR-3) in Casper, Wyo., which is now a stripper field that also serves as an oilfield technology testing center (Rocky Mountain Oilfield Testing Center).

Since production costs are expected to exceed oil revenues, production operations at NPR-3 are no longer economic and will be discontinued except for incidental oil production associated with produced water needed for geothermal testing (funded by DOE's Energy Efficiency and Renewable Energy's Geothermal Technology Program or by test users). Accelerated environmental remediation will continue and a plan will be developed for the sale or disposition of NPR-3. The FY 2012 budget request for this program is $14.9 million, which will fund the environmental remediation of NPR-1 and activities at NPR-3.

Conclusion

The Office of Fossil Energy is committed to developing the science and technology that will allow the Nation to use its abundant fossil energy resources in a way that balances the energy needs for sustaining a robust economy with a clean environment. Our FY 2012 budget request will help maintain DOE's leadership role in addressing issues of energy and environmental security. We believe this budget, targeted as it is toward these essential objectives, will provide the resources needed to achieve these goals while providing maximum benefit to U.S. taxpayers.

Mr. Chairman, and members of the Committee, this completes my prepared statement. I would be happy to answer any questions you may have at this time.

Mr. WOMACK. This budget request includes billions of dollars in increases for clean energy research and development, including hundreds of millions for new or greatly expanded activities. At a time when funding increases absolutely must be reversed for the most worthy and well-planned programs, I believe this Committee will expect rigorous planning and detailed justification for those proposed increases.

But here is the problem: As an example, the $203 million tenfold increase to vehicle technologies deployment, a half-page justification; new and advanced biofuels reverse auction, $150 million, to defend that action, an activity never before conducted by the Department, a half-page of justification; $185 million for commercial building efficiency, little justification; and a hundred million for next generation materials, little justification.

So the question, a two-part question, Secretaries Kelly and Hoffman, what planning and analysis have you done to ensure these increases would be well spent? And, really, can they be spent in a year?

And part 2, where is the evidence of this planning with such little justification in the budget request?

Mr. KELLY. Well, as I said in my statement, we have tried to put this budget together based on a very careful analysis of where energy is used in the U.S. and what our opportunities are for providing it. The programs that you suggested all grew out of that analysis, and we would be happy to share that in detail with you.

One of the problems we have in EERE is that it is a very complex program, and the budget document that we submitted to you was already quite lengthy. So we have tried to run a balance between providing lots of detail on each program and having something brief enough for people to read. So we would be very happy to provide you any level of detail you want.

Most of the programs you mentioned would be done on a large national competition. For example, the electric vehicle infrastructure that you described would be funding that would go out to communities to build charging infrastructure on a competitive basis. So the issue here is how do we structure those competitions? There certainly is a need around the country for a massive new infrastructure to charge electric vehicles, and this would help provide the planning and support services to cities around the country to do exactly that. We hope that we could stimulate innovative ideas in each one of these—in each city that we would then be able to pick the most powerful and productive.

Mr. WOMACK. Madam Secretary.

Ms. HOFFMAN. Thank you, sir. For our energy storage program, we are asking for $57 million, which is a four-times increase over what was in 2010. The strategy that we put together in looking at energy storages, we broke it into three components. We looked at it for R&D requirements, for reducing the cost of energy storage, and how to improve the performance of energy storage. We looked at the system requirements. So what does the electric system need today with respect to bulk energy storage? We need a system that provides energy management to reduce the peak, we need energy storage technologies to provide regulation, which is that fast response, we need energy storage to provide ramping.

We have looked ahead to the future and really analyzed the requirements of the system. Now, those requirements will vary from regions of the country, but we went through and did the analysis of the types of applications that are required for energy storage.

The third component is actually looking at successful demonstrations, to be able to justify the cost and benefit. We have goals that we are going after with respect to energy storage, a 30 percent reduction in cost and other goals. We have developed an energy storage program plan, and we have done some of this as a model for most of our programs in our organization. Thank you, sir.

Mr. WOMACK. Thank you. Doctor Kelly, the budget request proposes $150 million for an advanced biofuels reverse auction. It is my understanding that four and a half million dollars was made available within fiscal year 2008, that this request increases funding by more than 30 fold while that funding from 2008 still has not been used. Now, that is a large number, but, again, a little justification in the write-up. How did you arrive at $150 million and how do you know if it would be enough to get the auction off the ground?

Mr. KELLY. So the advanced biofuels are really a key part of our program to try to get America off of petroleum. They are one of the ways of—together with efficient vehicles, finding alternative fuel for a vehicle is one of the key things too—offsetting the something like $400 billion we are going to spend importing oil this year.

So one of the features of our program is to try to find a way to jump start the new generation of biofuel production, that is, turning cellulose, not just corn, but cellulose into diesel fuel.

We have referred to in the past, a lot of these firms unfortunately have run into financing problems here in the last two years just because—not because the technology has a problem, but this has been a very tough year to find financing, particularly for innovative new programs that look more risky to the banker.

So we have a program to try to get these off the ground. It will include working with the Defense Department that wants to buy the fuel. It will be working with our loan guarantee program. But we feel that this volume that we would be able to produce basically with this reverse auction is at the level that would be appropriate for DOE's contribution in a joint effort to get these really important plans online quickly.

Mr. WOMACK. What would the impact be on food prices?

Mr. KELLY. Well, we have looked at this, and the analysis that—we have worked jointly with the USDA on this, they have done some careful analysis that shows that the impact of the large ethanol production in the U.S. on world food prices is small, certainly less than ten percent. Roughly one percent of our land is used to produce fuel.

Most of the increases in food prices we see around the world are not due to our biofuels, but they are things like droughts and shortages in Russia and China and in other places. So we think that it's possible, particularly if you use feed stocks like corn stover and wood chips and waste. They have a very rapidly growing biomass supply without effecting food prices in a significant way. We have to keep careful watch, obviously.

Mr. WOMACK. I may come back to that line of questioning a little later. At this time, I will turn it over to the ranking member, Mr. Pastor.

Mr. PASTOR. Thank you, Mr. Chairman. I want to go back to that energy storage. In another part of the department, you have a Hub being proposed for energy storage, then you have your particular programs, your desires, and it is my belief that the objectives that you have in your program are very much the objectives of the Hub. And I guess the question is, how much redundancy will there be in their efforts?

Ms. HOFFMAN. First of all, sir, thank you for your question. The department is coordinating all the energy storage activities in the Office of Science, the RBE Program, and then the Applied Office with the Office of Electricity. The RBE and the Science Program, let me start with the Science Program, they are looking at very new materials and new concepts, looking at the use of nano materials for devices. RBE is looking at new systems, transformational storage systems, they are looking at metal error, they are looking at other technologies.

Our program is focusing on the flow batteries, more of some of the existing technologies to do the cost reductions, but also do significant energy improvements within those technologies. Also, we are looking at how do we apply those technologies best to grid applications so we can feed those requirements back into the fundamental science and the developing technologies that we would look at.

In addition, we are planning on running a solicitation that will take some of those concepts, prototypes that are being developed in the RBE Program, and actually looking at trying to demonstrate those in our program, and so that is how the flow will be put together.

Mr. PASTOR. In the grid system, one of the things that, in the past, this subcommittee has funded, I see where this Administration has diminished that effort, siting of poles is always a problem, and so that brings it, you know, political consideration in terms of the local communities and to the power plants.

And for a while there, we were very much interested in how do you transmit the electricity and minimize the resistance of the wires or whatever, and I thought there were some promising results in terms of different composites that were being developed.

In fact, in some areas, the composites were used, and at least the companies that were involved found that capacity had increased and they were able to minimize the public outcry of why are you siting new lines, and yet they were able to increase their capacity. Why is that no longer a priority with your department?

Ms. HOFFMAN. We have had two successful efforts within the department. We have had the 3M composite conductor, which looked at higher transmission, well, medium transmission voltages that has been successfully demonstrated and actually is being deployed by 3M in the industry. The other effort that you are referring to is our super conducting effort, which is actually looking at additional through put at lower voltages. And we have run at least six demonstrations on the technologies. We have spent close to $500 million in the development of that technology.

So what we did was, we brought that technology to a successful demonstration point with these demonstration projects. That is where we thought was a nice closure point for the program for the amount of money that we have invested in the program to bring that technology to a point that the industry should be able to pick it up from here and do further demonstrations.

Mr. PASTOR. But as we know, sometimes the industry does not pick it up, so they may take the new technology, but I would think that this research in finding the different composites that would minimize the resistance and increase the transfer is something that we would continue. And so I would disagree with you saying that we have reached the technology and, therefore, we are going to quit, it is not a good idea. If you were successful getting to this point, well, there must be other successes you can achieve.

Ms. HOFFMAN. There are other successes we can achieve, and that is one option or avenue for the HUB that we are proposing in 2012, to take a holistic look at the system and actually look for some of those gaps and some of those new technologies that could be developed, and so that would be an opportunity for new research in that area, in addition to looking at AC–DC systems and other things that will improve the performance of the system.

Mr. PASTOR. I have one more question, and this goes to Doctor Der. What percentage of our electricity in this nation is produced by coal generating—coal burning plants?

Mr. DER. The actual electrons that are produced? Roughly half.

Mr. PASTOR. About half the electricity today?

Mr. DER. Yes.

Mr. PASTOR. And that infrastructure as a coal burning plant, power plants, is—how old would you say if we look at that infrastructure, is it ten years old, 30 years old, 50 years old?

Mr. DER. It ranges quite a bit.

Mr. PASTOR. But what would be probably the figure that you would—50 years old?

Mr. DER. Somewhere between 40 to 50 and some much older, some a little newer.

Mr. PASTOR. And many of our electricity producing plants use coal, and yet they have been used for 50 years, and at least from what I have seen is that in many of these cases, natural gas conversion would probably be something that you would want, but these plants are so old that that may be impossible.

But also a lot of these coal burning power plants are located in an area where you have shale oil. You look at Pennsylvania, you look at Ohio, that whole Midwest, I know that you are concerned about capturing carbon dioxide, but sometimes I think, we go way out there and fail to address in a shorter trend, the problems that we may have in terms of mitigating the amount of carbon dioxide that is going in the air. Have you worked with the industry or—what has been your dialogue with the industry in terms of a conversion of some of these plants to—less carbon dioxide emission, or what assistance, because that is our problem right now. I mean that is our immediate problem, but no one seems to be wanting to address it.

Mr. DER. The conversion of a coal plant to a gas plant is very doable by industry if they choose to do that. I think there are prob-

ably several parameters that enter into their decision. Part of it has to do with the added investment versus a fully depreciated coal plant, the other one has also to do with the stability and reliability of that gas supply for the long term. But, again, that is something that is doable by industry in terms of what they can choose to do, whether to convert or to continue. What we are trying to do here is, recognizing that half of our electricity still comes from coal, that is quite a big chunk for this nation, that we do something about the carbon issue associated with it, and this is why we have been working on our research program on carbon capture and storage, to dramatically reduce the emissions from coal plants.

Mr. PASTOR. Well, that is part of my argument. My argument is, this infrastructure is 50 years or older, and they are very inefficient, and probably produce more carbon dioxide than we want or need, and yet the incentive would be to assist the industry to move to a lesser carbon dioxide emitting fuel, which would be natural gas, and I would think that this would be a priority or at least a concern or a desire that the Department of Energy would create programs that would provide incentives so that we would. I know that carbon capture is very important, but also mitigation is very important, and so I would hope that you would, have some attention to what the situation is today and what we could do in the future.

Mr. PASTOR. Well, we will see what industry has to say. We will work with them to see what we can do. Thank you.

Mr. WOMACK. Thank you, Mr. Pastor. Mr. Simpson.

Mr. SIMPSON. Thank you. I would suggest, as Ed was just saying, that one of the things that may be holding back some companies from updating or increasing the efficiency or reducing pollution of the older coal fired plants is the new source review rules by the EPA, which really discourages, in my opinion, some of these companies from making cleaner facilities because of the impact the EPA is going to have on the subject for another hearing.

Dr. Kelly, you said this budget is based on where energy is used in this country and how it is produced. You also said during your testimony that the President's ambitious goals are generating 80 percent of America's electricity from clean energy sources by 2035. Could you give me a brief definition of what clean energy sources are—what is your definition?

Mr. KELLY. Well, interestingly, they do include partial credit for natural gas and clean coal and of course all of the renewable resources and nuclear.

Mr. SIMPSON. So, clean coal. Is hydro in there also?

Mr. KELLY. Yes, all—that is certainly in there.

Mr. SIMPSON. I have noticed that your budget, if you look at it, and this kind of taking your first statement of where energy is produced in this country and how it is used and how it is produced—if you look at fossil energy, which produces 83 percent of the total energy in this country by just $520 million, a decrease of 44.5 percent; nuclear energy 9 percent of our total energy supply total budget is 853 million or a .6 percent decrease. The EERE budget is 3.2 billion. Wind produces .72 percent of our energy supply, $127 million; solar produces .08 percent of our energy supply, $457 million or an 87.8 percent increase in this budget; geothermal, .4 per-

cent of our total energy supply, $102 million dollars or 135.5 percent increase in the budget. How can you say that this budget was based on how energy is produced and where it is used in this country when you look at the increases and the percentage of increases for such a small percentage of the total production of wind, solar, and geothermal?

Mr. KELLY. Well, clearly you do not want to be putting federal money where the industry has already been highly successful. So, the priorities that we have been setting are areas where we believe that while they are small they are going to grow rapidly and in all the areas that you have just mentioned we are convinced have potential for very large international markets and domestic markets. They are exactly the areas that——

Mr. SIMPSON. When you say very "large," very large—as an example, wind .72 percent currently, what could that grow to? I mean, I have noticed in my local area now——

Mr. KELLY. Um-hmm.

Mr. SIMPSON [continuing]. The county commissioner is saying eh, we do not want you siting any more wind towers out here——

Mr. KELLY. Um-hmm.

Mr. SIMPSON [continuing]. Because residents are getting a little bit upset about them. What do you think the potential is in wind production in this country, realistically?

Mr. KELLY. Well, we have been looking very hard at that. The offshore siting, by the way, is very attractive. It creates——

Mr. SIMPSON. For everybody except those people living on the shore.

Mr. KELLY. Well, except that the only trouble they are facing is maybe they can see them, but even that we can solve by going slightly further. A lot of our work is actually in the very deep ocean.

Mr. SIMPSON. Um-hmm.

Mr. KELLY. So, we have been looking, actually, at the level of penetration that would make sense. Clearly, none of these things by themselves can solve it, but if you take together wind, solar, geothermal, the biomass, they can certainly provide a very significant fraction. The wind alone, we have looked at penetrations of 20 percent. Solar could go up to 20 percent.

Mr. SIMPSON. What does that do to the electrical grid in trying to deliver energy? As I talk to energy companies, one of the real problems they have is the unreliability of wind, not just—you know, it blows 10 miles an hour for an hour and 5 miles an hour for the next hour. I mean, it is the microsecond in trying to deliver power to the grid.

Mr. KELLY. So, the easy answer would be to blame all of this on the unreliability of wind, but in fact we have been working very closely with offshore electricity on these problems, an interesting problem. And what you have got already, of course, is variable demand.

Mr. SIMPSON. Um-hmm.

Mr. KELLY. You have these phenomena where you get a sudden cold snap and everybody's heaters turn on.

Mr. SIMPSON. Right.

Mr. KELLY. So, there is a lot of variability already there. But we are making the problem even more challenging by putting intermittent, like, solar and wind, onto the grid.

Mr. SIMPSON. Right.

Mr. KELLY. But we also have some interesting other things that are happening at the same time. A lot of electric vehicles coming on that are going to create additional strange patterns. But you have also got new opportunities and storage that help you mitigate this, and storage needs to cover everything from the microseconds to days.

Mr. SIMPSON. Right.

Mr. KELLY. And smart buildings, because smart buildings can shed load or—very, very quickly, in fact move load for several hours and people in the buildings do not even know it is happening. So, taken together, we think that we can manage growth of a very diverse shed of new energy technologies and actually prove their reliability.

Mr. SIMPSON. We went out to NREL and visited some of the work they are doing out there. They are doing some fantastic work. I mean, they have built zero energy use houses, which are fascinating. They are just too expensive right now, and trying to bring the cost down for the public is something that, you know.

I think everybody agrees that conservation and trying to improve the energy efficiency is probably the biggest source of energy that we would have in this country.

I question somewhat the—I guess the overall budget priorities of the administration in that they are putting a lot of money into those sources that I mentioned that are not large producers of energy, and they will grow, certainly, and leaving out some of the energy sources that we know are going to be in demand in the future, such as nuclear energy, the research and development that needs to be done in nuclear energy.

There is still a lot to be done and a lot for the government to do. It is not all being done by private industry. In fact, the majority of it is being done by government.

The President's budget includes, as I said, a 44.4 percent increase in the proposed EERE funding, bringing the total of $3.2 billion. This is in addition to the National Science Foundation in the same area of at least 576 million. The Department of Agriculture funds bio-energy research and loan guarantees. The Commerce Department has its own rebate and incentive programs. Additionally, the DoD spends considerable amounts of money on research and deployment in the same area. DoD totals are difficult to ascertain even for the Congressional Research Service, which indicates that it would require a line-by-line analysis of the defense budget.

The goal of all these programs and probably some that I have not mentioned is to promote the use of renewable energies. It would seem to me that to be effective and prevent waste, there should be coordination between these different departments. Since the underlying goal is energy policy, it would seem that that would lead department should be the DoE.

Are there other funding avenues for renewable energy research and development in the federal government that I have missed?

Mr. KELLY. I think you probably have hit on a lot of it. We have partnered with many different agencies, and you mentioned biofuels. That is a place where we actually have a formal Memorandum of Understanding between the Department of Energy and the Department of Defense, which includes a lot of activities in fuel.

The biggest contribution, of course, DoD can make on this is as a consumer. They have set a goal of getting half of their fuel from nonpetroleum sources. So, they are looking at everything. They are looking at increased nuclear power. They are looking at all manner of fuels, but of course one of the things they are interested in is biologically produced fuel.

Mr. SIMPSON. Right.

Mr. KELLY. So, their role is to try to find a way to be a reliable consumer, and I believe they have talked to the Congress about ways that they can have longer-term contracts for purchasing fuels that would provide a stable income that the people who own these facilities could take to the bank.

Mr. SIMPSON. How does coordination work between your department and the other agencies, whether it is the Department of Agriculture, as I said, that has a bio-energy research and loan guarantees program, Department of Commerce with the rebate program. How is the coordination governmentwide?

Mr. KELLY. Well, with the USDA, on biofuels we have a very tight coordination, and as I said we have been doing the research.

Mr. SIMPSON. Is there a formal sort of coordination or——

Mr. KELLY. There is a——

Mr. SIMPSON [continuing]. Just a shake of the hand.

Mr. KELLY. Well, there is certainly a formal MOU with the Department of Defense. With AG, we are across the street from each other, and so we meet repeatedly with them.

One of the things that has happened—so we have moved some of our biomass production research over to them, because they had a hunger to do things that look like farming they are very good at and so we decided collectively that that was the sort of thing that they could do well. The work on testing engines with different kinds of fuels was something DoD is already set up to do, so they are doing it. So, we actually have a joint plan that we are working on.

We have announced a goal to get three large new technology biofuel plants online in the next couple of years. They are going to fund one where we hope that we can find ways of funding the other.

Mr. SIMPSON. Should there be somebody within the federal government, some agency, that is in charge of renewable fuels, research development deployment overall?

Mr. KELLY. Um-hmm.

Mr. SIMPSON. And the reason I ask this is the subcommittee that I am chair of is Interior. Let me explain it this way. Right after 9/11, everybody that came into my office, everything they wanted, every spending proposal was related to homeland security. That was the key phrase at the time. If you were going to grow corn in Iowa, you were doing it for homeland security. It did not matter what the subject was. Homeland had to be the type—key phrase.

Now it is climate change. And everybody that comes in wants climate change.

Every agency within the Interior budget gets money for climate change, and my concern is that there is no coordination between all of this. Do they talk to each other? Yeah. But there is no coordination. And I have sat and wondered if there ought to be someone that you fund climate change money for and they have the ability to use, as an example, the USGS, to do certain things or the Smithsonian to do certain things or the Forest Service to do certain things, but there is a central coordinating agency in order to prevent duplication. Do we have that within the federal government in terms of renewable energies? And I thought, really, that was kind of what the energy Czar was all about.

Mr. KELLY. Well, the Office of Science Technology Policy has pulled together for many years teams of people who have worked on climate change issues broadly for everything from the computer science of predicting the changes to the technologies of mitigating it.

On the specific issue of biomass, there actually is a formal coordination of all the R&D activity under a company call the Biomass R&D Board. It is chaired by——

Mr. SIMPSON. Who is in charge of it?

Mr. KELLY. USDA is in charge of it. That is just the research part.

Ms. HOFFMAN. If I may add, sir.

Mr. SIMPSON. Sure.

Ms. HOFFMAN. The President's Council on Science and Technology asked the Department to undertake a quadrennial energy review, which is across the federal government, and our Undersecretary of Science, Dr. Koonin, is looking at a quadrennial technology review for the Department, which will show basically some of the strategic directions that should occur in the technology area.

Mr. SIMPSON. Having been a biology major and a chemistry major, how long is it for a quadrennial review?

Ms. HOFFMAN. It is my understanding that we are going to try and accelerate the process to get it——

Mr. SIMPSON. About how often is quadrennial?

Ms. HOFFMAN. Every four years.

Mr. SIMPSON. Four years? Okay. I did not know that.

All right, thank you.

Mr. WOMACK. Mr. Olver.

Mr. OLVER. Thank you very much. I really understand what Mr. Simpson is struggling with here. I struggle with the same thing, you know.

First of all, I want to thank all of you for translating the science and technology of energy policy into plain English, or trying to, for America in general, and I look at this and I am going to ask about some science items and some Hub issues here if I may.

Essentially I think I see a pattern here of you are doing so much across everything that relates to energy policy. That is entirely legitimate. And it starts with the Office of Science, where research is done.

Pure research is intended to be done within the Office of Science or under the Office of Science, but then as you get deeper into de-

velopment and the advancement of technology, then it comes more under your three operations. I think I am seeing that pattern in the way the Hubs are put together. And eventually, if one has good and successful development and development of the technologies, then you have commercialization, which is jobs and job growth and economic growth, which is what we hope to have out of all of this effort. You keep a lot of balls in the air because you are never quite sure. In these sorts of situations about one out of five or ten sometimes is going to really get a home run, and a bunch of the others may huddle along and some of them are going to be failures, but you are never sure. You do not know which one is going to do what. And so you try to keep a range of things going.

Dr. Der, I understand that the methane clathrate issue has been under fossil energy. Now, most of methane clathrates, at least as I understand them, are found in deep ocean locuses and in the permafrost, and these are tough areas to work with. We do not know very much about that, and I think up to now you have had research programs going on there and it seems—the Department wants to move that over to the Office of Science, which would imply to me, at least, that there is fundamental research that has to be done that is well before the development stage.

Do we know how much methane increase there has been over the time that we have really been worried about methane? Because it is such a strong greenhouse gas, how much has been released out of the oceans in that time? But more likely out of the movement of the tree line, the movement of the permafrost further north or the thinning of the permafrost? How much more methane is in the atmosphere? Can you give me any sense of how much——

Mr. DER. I do not have that number. There are many sources of methane releases around the world.

Mr. OLVER. There are lots of them, but those are huge ones.

Mr. DER. Agricultural ones are big ones too.

Mr. OLVER. Yes.

Mr. DER. But those I do not have the number for because that is more in the science area. But to get back to your question, there are fundamental challenges to looking at the clathrates on methane, to see what are those challenges in terms of its behavior and how we could best extract that so that we can look at that resource potential——

Mr. OLVER. It would be nice if that methane clathrate could be slow released into a way that would produce the energy—the electricity—rather than just going into the atmosphere and raising the temperature in that way.

Now, do you agree that it is appropriate to move that to—which is under Dr. Koonin, the Office of Science. Do you agree that that is appropriately changed to there? I do not want to cause a fight here.

There must be a policy that's sort of agreed to, and if so, just why, shortly?

Mr. DER. I think given where the state of development of methane hydrates is, I think there is certainly an argument to be made that more fundamental scientific research needs to be done on how the methane hydrates are latched in those deep depths of thousands and thousands of feet underground, and one of the things

that they need to understand is, its behavior and adhesion into the clathrates or hydrates, and looking at potentials as to whether or not we cannot extract that by using CO_2 and a little bit of heat, into those deep depths so that we exchange CO_2 from the atmosphere produced——

Mr. OLVER. As part of the carbon capture and——

Mr. DER. Yes.

Mr. OLVER [continuing]. Sequestration, you are capturing the carbon and then sequestering it there——

Mr. DER. For the long term.

Mr. OLVER [continuing]. And it will release slowly the methanes——

Mr. DER. Yes.

Mr. OLVER [continuing]. Out of the hydrates.

Mr. DER. So, you can use that as a fuel.

Mr. OLVER. Wow.

Mr. DER. But we are pretty far——

Mr. OLVER. All of it in the Arctic, what is left of it?

Mr. DER. Well, some of it is in the Arctic. In fact——

Mr. OLVER. The easiest to get at is up there.

Mr. DER. I don't know.

Mr. OLVER. The hardest to get at is in the really deep oceans.

Mr. DER. Yes, there are different problems and it is a different technology, I would imagine, that would have to access that. But——

Mr. OLVER. Eventually it does get to technology, eventually, but there is some science—underlying science that has to be settled first.

Mr. DER. Yes, and if you understand the fundamentals of the science you can get to the technology, and once you understand the technology you can move on to the economics and recovery.

Mr. OLVER. Okay. I do not know how much time—I must have already passed, but I will continue this one because I want to get to the Hubs.

Mr. WOMACK. Actually, you are doing quite well comparatively to a couple of others, but that is——

Mr. KELLY. Mr. Chairman, could I—I just want to correct one thing that I said. This biomass R&D board is co-chaired by DOE and USDA. So, we jointly chair it.

Mr. WOMACK. I want to go to the—I want to go to the electric vehicle discussion for just a minute. Dr. Kelly, several companies are releasing electric and electric hybrid vehicles this year. Is there anything that would prevent this 2011 class from succeeding in the market? And why does our department need to provide so much assistance when so many companies are releasing electric or hybrid cars?

Mr. KELLY. Well, the short answer is that the reason they are able to produce these electric and hybrid cars is largely because of the research support and Recovery Act support that these companies have gotten, particularly in battery manufacturing.

We have been able to move the U.S. into the lead, actually, or certainly greatly increase our presence. We have moved from something like 2 percent of the world market to, hopefully, 20 percent of the world market in lithium ion batteries which are the key com-

ponent of these electric vehicles, though we think that our work in the past has made the current production possible, but we need to drive the cost of batteries down to around $300/kilowatt hour, which we think we can do if we're going to really enter these very large markets that we think are possible in the near future.

Mr. WOMACK. In my district and scattered across our country there are a number of logistics carriers or freight carriers and I am curious, having had conversations with many of the executive leadership personnel of these companies, so far it has been in passenger cars. Do you see this technology infiltrating, if you will, the logistics market from the carrier perspective? And just a comment about that?

Mr. KELLY. Yes, actually, we are going to have an event actually later this week at a major delivery truck operation and one of the things that you will see is the people who have large interest in delivery trucks like UPS and FedEx are experimenting with a lot of different hybrid possibilities.

Delivery trucks, in particular, are well suited to hybrids because they start and stop a lot, so you have the opportunity to capture a lot of the energy, and we have been working very closely with them.

Mr. WOMACK. Our available reserves of domestic natural gas have skyrocketed with the refinement of our shale gas extraction. The budget request says this, and I quote, "Natural gas currently provides 25 percent of the U.S. energy and is a clean, low carbon energy source. The use of natural gas could be expanded for both stationary power and as a transportation fuel."

Now, this seems like a reasonable idea. However, it was made in the budget request for ARPA-E but the budget request for energy efficiency and renewable energy we are discussing takes somewhat of an opposite direction by reducing what little support it offers for natural gas vehicles. What is that rationale?

Mr. KELLY. Well, this is an area where we think there is not a lot of R&D involved at this point. It is a well-understood technology. There are a lot of vehicles out there. Our interest in this has been primarily in providing the infrastructure; our Clean Cities program has supported natural gas infrastructure for fueling vehicles for some time.

Mr. WOMACK. And on the subject of hydraulic fracking in the natural gas industry, in my area there have been reports of small tremors in area where shale gas is being extracted and I guess my question is more for Dr. Der. In these areas, is it possible that such geological phenomena are occurring as a result of that? Or are we just getting better at the detection scenario?

Mr. DER. I think if you ask the folks who are in the oil and gas industry, any time you do some kind of development and production, there are micro sized—that occur.

If you, in fact, do your homework using the geophones and the seismometers and do the site characterization and understand the formation to the point where you have the site well characterized, you understand where and how the shale gas is located in the formations, I think that you could minimize any of these issues associated with the production of hydrofracting using the technologies

that we have today, including horizontal drilling that was developed many years ago by the Department of Energy.

Mr. WOMACK. The budget request eliminates two fossil energy research programs, Natural Gas Technologies and Unconventional Fossil Energy Technologies. To justify it, the Administration states in their report, "Consistent with Administration policy to phase out inefficient fossil fuel subsidies, the program is requesting no funding for R&D to increase hydrocarbon production," but several weeks ago the Secretary of Energy was quoted as implying that DoE could offer some assistance to industry for shale gas drilling saying that, "I think we can help the industry improve what they have."

Do you see, as the Department of Energy's role to improve our nation's use of our vast natural gas resources? And how do you reconcile the secretary's statement with the Department's proposed elimination of those programs?

Mr. DER. First of all, the subsidies I believe the secretary is talking about were tax credits. In the research area the large companies in oil and gas here, I think, are very well able to fund research in this area on their own. Five of the major largest companies made $75 billion last year, so I think they are capable of doing that.

That having been said, I think that, although industry should fund it, a lot of the research work should be vetted and I think that the Department of Energy through its national laboratories, as evident from its assistance that it provided during the BP oil spill, is in a position to provide advice on what the priorities should be both in terms of safety and environmental development of shale gas and other hydrocarbons.

Mr. WOMACK. Okay. Mr. Pastor.

Mr. PASTOR. I want to talk about SunShot. It is an initiative, I guess, that is several months in the making and being implemented, so what is different with this initiative than the programs you have currently existing in solar energy?

Mr. KELLY. Well, this one has the virtue of focusing our attention very specifically on a goal. We are trying to get down to a dollar a watt within this decade, a dollar a watt installed. And so what we have been able to do is to put together industry and university and lab teams to find out how we can refocus our existing programs on meeting that goal and what is missing. We have brought in a superb person to lead this effort, he has extensive experience in moving not only in the semiconductor industry, in photovoltaics, but in getting things actually into the market place.

One of the things——

Mr. PASTOR. Why wouldn't that be an ARPA–E?

Mr. KELLY. Well, the program is actually jointly managed by a team with the Office of Science, Bill Brinkman, the head of ARPA-E, Arun Majumdar, and now the Undersecretary for Energy, who is also Arun Majumdar. I guess he gets two votes at this point.

Mr. PASTOR. Good. He may go a long way then.

Mr. KELLY. Yes. So, what we have done is allocated the work carefully to each one of these organizations; the Office of Science has a number of research centers focused on areas directly relevant to the long term success of the arrays. It turns out when you really

start saying what is the cost barrier, the high-tech stuff, which is the arrays, is only half the problem. A big chunk of the problem with the power electronics we needed to break through, APRA-E said: we are going to stand up, we think we have got some great ideas on power electronics, we can defeat this. So, they are running with that.

Mr. PASTOR. Well, I always thought that reducing the cost of solar energy was always one of the objectives of all your other projects, whether it be new materials or photovoltaic, I thought that was always an overriding objective to make solar energy affordable so we could take it out to the masses. And so maybe I was wrong because as we looked at a new material, you know, new research, this, that, and the other, I always thought that the objective was, reduce the cost of solar energy.

So, I do not see how this is much different other than you focused on it.

Mr. KELLY. Well, it is one thing to have a vague goal about——

Mr. PASTOR. A vague goal? It's always been—I thought it was pretty precise, it has been to reduce the cost of solar energy. That is pretty——

Mr. KELLY. Yes, but in this case we have a very precise goal, which is——

Mr. PASTOR. Okay, how is it more precise?

Mr. KELLY. It is making photovoltaics competitive with the conventional alternatives within the decade.

Mr. PASTOR. That was not the goal before?

Mr. KELLY. It was never a specifically focused goal, no. It was, obviously, to make solar energy competitive. That is competitive without subsidies. And so that is a tough goal. It is five or six cents a kilowatt-hour. It is an ambitious goal and the virtue of having something like this is that you can take all of your programs and ask tough questions about, are you contributing to this or not, and if not, why not.

So, it has helped us sort out high performers, helped us locate places there were defects in our program where we were not supporting things. We were able to find things that were not able to make this goal and were able to ask, why are we doing that?

Mr. PASTOR. So, then you are going to eliminate some programs just because they do not contribute to this new objective.

Mr. KELLY. If they cannot get to this, if they cannot help us meet this goal, then we have to ask some tough questions about why we would want to support them. There are some really long-term things, of course, we want to keep supporting in the Office of Science and other places, but anything that is an applied project that does not focus on this particular objective we have to ask if you are never going to get below $2 a watt for example, we would say, you know, this is not something we should continue to support, and we have done it.

Mr. PASTOR. Mr. Chairman, maybe for the record they could provide us what programs are in existence today that may be reduced or diminished or eliminated under this new objective.

Mr. WOMACK. Without objection. Mr. Simpson.

Mr. SIMPSON. Secretary Hoffman, on a limited budget your office has a very significant responsibility. As you prepare to address cur-

rent and future Smart Grid challenges, is the lack of a dedicated full-scale test and evaluation facility a challenge, and can you give me your sense of the value of a dedicated loop like the folks at the National Laboratory have proposed, and the unique capabilities that they have there?

Ms. HOFFMAN. The challenging thing about Smart Grid is it means many things to different folks.

Mr. SIMPSON. Right.

Ms. HOFFMAN. And we have struggled with what are the core components of what are we trying to do with Smart Grid. So it is engaging consumers. It is looking at better asset utilization on the system. It is being able to manage the system differently.

And so, through the Recovery Act, we pretty much have about 130 projects where we are actually going forth with real utilities and consumer engagements to really test out the different concepts of Smart Grid. Test beds are quite important when you have a specific objective that you really need to test out. So there are maybe some applications where we may want to test some of the components out, especially with a cyber security——

Mr. SIMPSON. Right.

Ms. HOFFMAN [continuing]. Piece to it. But as an overall full-scale test bed, it will be difficult to accomplish because there are so many different objectives, whether you are trying to reduce the peak, whether you are trying to do a consumer engagement. It is going to be very hard to capture all the different architectures that are out there on the system in one test bed.

Mr. SIMPSON. But it is important probably for cyber security more than——

Ms. HOFFMAN. Yes.

Mr. SIMPSON [continuing]. The other things?

Ms. HOFFMAN. Yes.

Mr. SIMPSON. I appreciate that.

Dr. Kelly, the Recovery Act provided $11.3 billion for weatherization assistance. Of that amount $6.7 billion is still unspent. Under the terms the Department set with state and local recipients, all of these unspent funds will expire by March of 2012 or about a year from now. The current rate of execution, approximately $3 billion in stimulus funds, will expire at that time. Will you return that money to the Treasury or will you ask for an extension of the deadline?

Also in that question comes the fact that the budget request increases weatherization to 320 million, an increase of 120 million over the current FY '11 budget. Given the large unspent balances from the Recovery Act, is it prudent to ask for a 52 percent increase in '12? And how can you spend all that money if you cannot spend all the EERE funds for weatherization?

Mr. KELLY. Well, first of all, this program has been enormously successful in going into low-income homes and achieving cost-effective energy savings.

Mr. SIMPSON. No doubt.

Mr. KELLY. And we, in fact, are on a track to spend the money in the time allocated. We are now weatherizing something like 25,000 houses a month. We have gone up—we have completed

300,000. We think that we can complete 300,000 more, perhaps 400,000 more. So we will have come up with a spend plan.

Mr. SIMPSON. Right.

Mr. KELLY. But we have a plan that will, in fact, result in spending all of that money by——

Mr. SIMPSON. Do you think you will have it all spent within the next 12 months?

Mr. KELLY. Yeah. We are on a track to do that and, if you can imagine, it has not been an easy task. I am really proud of our guys for putting together this very large program so quickly. We think it has generated something like 15,000 jobs because—and these are all local jobs in places in the cities and in countryside that—you cannot export these retrofit jobs. These are guys who are being trained to do interesting work and we hope setting up businesses that are going to continue long after this.

The FY–12 budget does, in fact, build on this. We think we can get another 15,000 homes retrofit with that money. It is a pay-through. We think the program has been successful and deserves continued support.

Mr. SIMPSON. It is about a $110 million increase in the '12 budget? You are going to be spending this out by what you currently have in EERE funds by March of '12.

Mr. KELLY. Right.

Mr. SIMPSON. Which means that we will have about 6 months left in the '12 budget year that you are asking for $110 million above the current levels. That is a hell of an increase for 6 months of the budget.

Mr. KELLY. Well, of course we are operating at a much higher level under the Recovery Act. So we are going to, at the end of '12, we are going to end up back at——

Mr. SIMPSON. The end of March or the end of '12?

Mr. KELLY. Well, the end of '12. So the unmet need here is very, very large. So we are certainly not running out of projects where we can make cost-effective investments in these structures.

Mr. SIMPSON. Okay. One other question I want to ask you is the budget request purposes to increase the commercial building integration initiative to $224 million. That is a 474 percent increase over the current funding level, and much of this increase, $100 million of it, is for the proposed new Race to the Green, which is interesting I guess.

Unfortunately, for a new program of this magnitude, the budget request, as the Chairman said during his statement, does not leave much justification. It is only a one-page paragraph for a $100 million program called Race to the Green. There are not many specifics in the justification. It seems that the program is intended to encourage local communities to impose energy efficiency mandates on commercial buildings, is that correct? If not, what is the program exactly?

Mr. KELLY. Well, clearly we would be willing to sit down and explain this program in much greater detail.

Mr. SIMPSON. Sure.

Mr. KELLY. The reason we chose this is that the Recovery Act allowed us to go in and mount some very aggressive residential retrofit activities and hopefully building businesses that will continue.

First of all, buildings use about 40 percent of all energy and over 70 percent of all electricity.

Mr. SIMPSON. Right.

Mr. KELLY. So what happens in buildings is a big deal. Commercial buildings are some of the most cost-effective ways to save electricity around, and that is why we picked this as a target this year. What we are trying to do is to find a way—you say, well, if this is so cost-effective, why are commercial firms in business not doing this?

Mr. SIMPSON. Right.

Mr. KELLY. And it turns out there are a lot of complicated answers to that question. There are regulations. A lot of them are local, or programs that could be mounted by the local utilities. So what this program is trying to do is just say, hey, we want to sort of challenge communities around the country to figure out how to solve this problem. How do you streamline your own regulations in permitting? How to use your local utility to tap into this huge potential market.

Mr. SIMPSON. So you are not trying to mandate the local communities to do anything, but you are trying to give them recommendations on how they could?

Mr. KELLY. Well, basically we will go out with a call for proposal that will say—what we want to do is to jumpstart businesses that can go after this market. You come to us with your proposed solutions and tell us what you want to do. Do you want to work with your utility? Do you want to streamline regulations? There is no way of predicting in detail what these people will come up with.

Mr. SIMPSON. How——

Mr. KELLY. But, you know, we want this to be performance based.

Mr. SIMPSON. Right. How could we, with this or the Integrated Commercial Building Research and Demonstration program——

Mr. KELLY. Mm-hmm.

Mr. SIMPSON [continuing]. Or some of the new things that have been proposed in this budget, how can this Committee next year, when we are sitting here in this same spot asking questions, know whether that program was worth the investment we had made? What measure can we put on it?

Mr. KELLY. Well, some of them, of course, they are not going to pay off for many years. The Recovery Act effort that is going on now, we are trying very hard to put together measurement verification programs to collect data on what things cost and what energy was actually saved, and in many cases we are going to be able to get utility bills before the retrofit, utility bills after the retrofit. And in many cases, local utilities are working with us on this.

This will take some year to get all the data in and analyzed.

But we are acutely aware of the fact that we want to have our program data-driven, and we want to have the best possible data resource for all of us to look at and see what is working and what is not. None of us have any interest in pursuing things that are not working.

Mr. SIMPSON. Right. Well, I appreciate the work you do and thank you for being here today. And we look forward to working with you on the expanded justifications so the Committee knows

exactly why we are doing some of these new programs being proposed. Appreciate it.

Mr. WOMACK. Thank you, Mr. Simpson. Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman. I said I was going to return to Hubs, and I want to clarify in my own mind. The three energy Hubs that we created, that Congress created in the 2010 budget; that 2010 budget passed I think in December of '09. I think that was correct. And so we are less than 15 months into that. After creation, those Hubs have to be stood up somewhere.

Now, if I understand it correctly, there is an energy efficient building Hub which is you, Dr. Kelly. The fuels from sunlight is under science. So that would be under Dr. Koonin. And the third one of the originals is the modeling and simulation Hub; that is under nuclear energy, and that is under the Secretary that also falls under the Office of the Under Secretary, which is Arun Majumdar. So I cannot get into any questions there.

But the proposals here now are just SunShot. It is sort of an aside. SunShot is a photovoltaic advancement. You are trying to reduce the cost by three-quarters essentially, reduced to about one-quarter of what the cost has been for solar panels and things of that sort, which is itself complicated, but it is mostly technology, except that we might find in the process that you have got to come up with new photovoltaic materials, which is serendipitous perhaps to what else you are doing. But that issue might be taken up in pure science I suppose. So I think that one separates quite well it seems, according to my understanding at least.

Now, is it critical materials that is the new Hub that is under you, Dr. Kelly?

Mr. KELLY. Yes, sir.

Mr. OLVER. And the Smart Grid technology is under Secretary Hoffman?

Ms. HOFFMAN. Yes.

Mr. OLVER. Now where is the batteries and storage Hub?

Ms. HOFFMAN. Office of Science.

Mr. OLVER. That is under Office of Science, also.

Ms. HOFFMAN. Yes.

Mr. OLVER. So those two are under Koonin.

Now, do you have a sense of how quickly you can stand up a Hub in effect? We have no way here at 15 months of evaluating but the degree to which it is put together and beginning to run. We cannot assess in such a short time. I mean, the SunShot thing is an effort like a mini Manhattan project or a mini mission to the moon that took 10 years to do, and I think it might take 10 years to get that. You are giving yourself probably 10 years to advance to get yourself to that.

Everybody is looking for a silver bullet here because so much of how we use and waste energy is a question of our national security, because we use so much fossil fuel from dangerous places, essentially. Much of this comes from national security issues, in my view, at least.

Can you tell me something about how, since you are the one that has one of those Hubs that was stood up last year, how it is going?

Mr. KELLY. Well, we are actually very pleased with the building Hub that we are putting together. It is on the Philadelphia Naval

Yard. The City of Philadelphia has been a very active participant in this and has made facilities available to us. They have a detailed plan. They have an advisory board, and it takes a while to get the thing up and running. You cannot evaluate their research performance. But in terms of management performance, they have certainly fulfilled all of their obligations.

The one place where you can have several years of data is from something that was sort of a pre-Hub, which is a joint biological research center out in Berkeley, California. They——

Mr. OLVER. They will be a part of this?

Mr. KELLY. They are——

Mr. OLVER. They are a Hub?

Mr. KELLY. No. They have started 4 or 5 years ago, and we have expanded them. They have been operating like a Hub, a bunch of people together trying to solve the tough problem of turning plant material into fuel.

Mr. OLVER. Well, will they not immediately become part of this Hub as a formal Hub——

Mr. KELLY. No, they——

Mr. OLVER [continuing]. Along with others that are doing work in similar areas or that you are contracting with to get work done?

Mr. KELLY. Well, they have—what I am saying is they have been in place for some time. We continue to support them. They behave like it.

Mr. OLVER. In a separate—where do they get their support? From which?

Mr. KELLY. From Office of Science and now from EERE, so we have joint activity there at that site. So there is a—on the same site——

Mr. OLVER. This is not one of the Frontiers of Science Centers?

Mr. KELLY. I do not think that they were formally called that, no. But the experience has been what you are trying to do is get a commercial operation that can use microorganisms, algae, other things that actually produce direct drop-in fuels, like jet fuel, from——

Mr. OLVER. Where is the work that this Hub is going to do? Is it spread out? Is it contracted out to other research entities or corporations, industry——

Mr. KELLY. The biology one——

Mr. OLVER [continuing]. Or the science labs?

Mr. KELLY. No, the biology one I am talking about, for which we have some experience, almost all their work is done in one building.

Mr. PASTOR. I do not think they have the efficiency.

Mr. KELLY. But the efficiency one, if you are talking about the efficiency Hub——

Mr. OLVER. That is the only one that was stood up by funding——

Mr. KELLY. Right, though I am——

Mr. OLVER [continuing]. That we have before us here——

Mr. KELLY. I apologize for confusing it.

Mr. OLVER [continuing]. That I can ask about.

Mr. KELLY. No, you were looking for a track record. The only place where we have a track record on a Hub-like activity is this

biology one. The building form that we are running as a formal Hub is set up. If you want to go——

Mr. OLVER. But the work is not all going to be done at the Philadelphia Navy Yard, is it?

Mr. KELLY. No, some of it will be——

Mr. OLVER. How many places would you say in terms of universities or industrial labs or national science labs will be involved in the work of that Hub?

Mr. KELLY. I cannot give you a number, but I know that the proposal came in with a number of different organizations. Certainly, you know, Penn State is the lead, but they have University of Pennsylvania, Sandia Labs is bringing some computational resources, and they are going to be working closely with dozens of different——

Mr. OLVER. So they are a way of pulling together for a purpose people from all over who have something to offer in that and it is a matter of making them work together collaboratively——

Mr. KELLY. Exactly. It is a unique——

Mr. OLVER [continuing]. For a goal which you have defined as being to get yourself down to one-quarter of the cost of solar panels because the sun is an almost unlimited source of energy.

Mr. KELLY. Sure.

Mr. OLVER. I give up. [Laughter.]

Mr. PASTOR. Where are they?

Mr. OLVER. What?

Mr. PASTOR. After 10 months where are they?

Mr. OLVER. Well, I yield to you. Ask him.

Mr. PASTOR. Well, the question is after 10 months where are you on this Hub?

Mr. KELLY. Well, for one thing, I would be delighted if you wanted to visit the site. I mean, they are——

Mr. PASTOR. No, that is all right.

Mr. KELLY. They have got a team together. They are developing their research plan. They have a building that they are moving into. Actually we just awarded this, what was it, four months ago? Something like that.

Mr. PASTOR. Well, it was funded in 2010.

Mr. KELLY. It was funded, but then we went out in a competitive solicitation and——

Mr. OLVER. So it was actually only awarded four months ago.

Mr. KELLY. I——

Mr. OLVER. Okay, well, that makes——

Mr. KELLY. I will have to get back to you on the exact number.

Mr. OLVER [continuing]. Even better my point that one cannot even begin to evaluate——

Mr. KELLY. Yeah.

Mr. OLVER [continuing]. What can it produce, but it has a very good broad goal, an important goal.

Mr. SIMPSON. Will the gentleman yield for just a minute?

Mr. OLVER. Yes, of course.

Mr. SIMPSON. These Hubs are kind of interesting because they were proposed and what we were told as a committee is that we would be bringing all of the top people together under one roof

where they could walk together, talk together, interact, all this kind of stuff.

Mr. KELLY. Right.

Mr. SIMPSON. And now you are telling me it is going to be diverse out——

Mr. OLVER. Well, I may——

Mr. SIMPSON [continuing]. It is Philadelphia, out in Tempe.

Mr. OLVER. I may have gone that way, but with photo-conferencing and so forth you can do a huge amount of that without having everybody working right together under each other's arms.

Mr. SIMPSON. Which kind of makes me wonder what the goal of the Hubs was that is different than our national labs and some other things other than a different name.

Mr. KELLY. Well, I do not want to get people confused. The idea of getting a team together under one roof is key to all of this, so you need to have a critical mass of smart people, and that is the Hub concept, that is what we are doing. But we mean——

Mr. SIMPSON. That is what we have here on this Committee.

Mr. KELLY. What?

Mr. SIMPSON. That is what we have here on this Committee. [Laughter.]

Mr. KELLY. Yes, exactly.

Mr. SIMPSON. A critical mass of smart people.

Mr. KELLY. Teamwork is all, right. That is right, an Appropriations Hub is what you can start.

Mr. SIMPSON. Yes.

Mr. KELLY. So—but that does not mean that they are going to isolate themselves from the rest of the world, you know. So they need to be the intellectual Hub and have their guys together in the Naval Yard. But they are going to be using a computer in Livermore, for example. And so it will be a partnership, but the whole idea is that you need a team in order to do this effectively.

Mr. SIMPSON. Thank you.

Mr. WOMACK. Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman. A couple weeks ago, Secretary Chu came before this Committee and outlined that selling oil from the Strategic Petroleum Reserve was one option available. Obviously there has been a lot of significant world events that have occurred since that testimony. I just would be very much interested to get an update on the Department's thinking on selling that oil from the strategic reserve.

Mr. DER. What we are doing right now is that we are monitoring the situation in the Middle East on a day-by-day basis. We have been in close contact at least on a weekly basis with the International Energy Agency and other producing countries to see where we are. And we continue to believe that the global system has the tools to react should there be a major supply disruption. And by statute that is what the Strategic Petroleum Reserve is designed to address. And price is one of the factors to go into looking at what constitutes a major supply disruption.

So we are evaluating the Strategic Petroleum Reserve option on an ongoing basis. We have also stood it up to what we call the level 1 readiness, meaning that we have it in a state of readiness to respond should the President make such a decision to release oil from

the SPR. So level 1 is having the systems tested in a state of readiness, the level 2 is making sure the paperwork is there for the signature to occur, and level 3 is the actual release. So it is one of the things that we constantly monitor and stay in touch with on a global basis.

Mr. NUNNELEE. What have we learned from the previous times that we have released oil from that reserve?

Mr. DER. Well, generally when we released oil in past times there have been some dampening of the price on the market, but that sort of comes back up. And the extent to which these impacts on prices have have been sort of varied over the years and we have a historical map of that if we could provide it for the Committee.

Mr. NUNNELEE. All right. Thank you, Mr. Chair.

Mr. WOMACK. I see the gentleman from Pennsylvania has arrived. Mr. Fattah.

Mr. FATTAH. Thank you. And let me note for the record that I serve as ranking on the Commerce, Justice, Science Subcommittee. We had a hearing at the same time, unfortunately, so my arrival was delayed, but it is not by a lack of interest. And let me thank you for recognizing me.

Dr. Kelly, let me ask you, I have been the leading proponent of the Energy Efficiency Block Grant Program which has helped over 1,040 communities around the country address, through a multibillion-dollar appropriation and obviously, a set of energy efficiency and conservation efforts. So, for instance, in Philadelphia, the city changed out the light bulbs in some 90,000 traffic lights to energy-efficient light bulbs. Through this feature, local taxpayers save a million dollars a year on the electric bill of the city. And obviously, retrofitting places like police stations and other public facilities has lowered cities' and counties' costs. This work, these decisions are made at a local level. The Department has done, I think, an extraordinary job in administering a program in terms of the scope and the breadth of it. However I note in the President's budget that there is no appropriations for the program beyond the ARRA's initial funding.

So I want, first of all, if you could talk a little bit about the program and what the Department believes it has learned and second whether or not such a program would be desirable going forward because the Committee might want to consider whether or not we want to continue to engage local communities and local governments around energy efficiency issues. I know you have a degree in physics from Harvard and this is a little different process here. It is political in nature, but it is also policy-driven and we want to help local communities combat some of these high energy bills. So if you could comment.

Mr. KELLY. Well, the kinds of programs that we ran through the EECBG program you are describing have been—in our view, are very effective. They have stimulated a lot of innovative local programs as one of the lowest cost ways of saving energy is to go into retrofitting. A lot of it was put into public buildings and public infrastructure, so, we do not have all of the data in, but what we see so far makes us very pleased.

As you mentioned, all of that money came through the Recovery Act. What we have elected to do in this budget is to fund similar

kinds of activities, but in different areas. You will see that we have a strong state program that we continue to fund. We have a big new program in commercial buildings which is focused on cities and communities that will be bidding—coming up with ideas about how they can stimulate commercial building retrofit programs in their area. That is a very large new program. It is actually built in many ways after the successful version of this we ran through the EECBG for residential houses. Obviously you have to change it a bit to do commercial buildings. We are very satisfied with what we have learned from the Recovery Act investments and have put together a strong program in weatherization and—state programs and this new commercial buildings program that we think will draw on those lessons and build a lot of creative programs in cities around the country.

Mr. FATTAH. Well, one is that if we could request that you supply to the Subcommittee information about how successful this program has been and anything else about it that you think will be useful for us to know as we consider whether or not we might want to find some other mechanisms. Commercial buildings are great, but they are on the kind of private side of the ledger. However, on the public side of the ledger, police stations, firehouses, traffic signals, these are the things that lower costs for our constituents back home. And they are the ones who pay the electric bill and the power source bill for the local community. So it helps lower local tax rates or frees up, for instance, in Philadelphia's case, a million dollars more a year that could be spent on police officers or other needed kinds of local initiatives.

So Assistant Secretary Hoffman, your testimony around the goals related to clean energy, I know there has probably already been some previous discussion, I will not belabor it. I am of the belief that nuclear has to be a part thereof. Obviously we want it to be safe. The President's ordered a safety review of all of the facilities, the 100+ facilities, nationwide. That review is being conducted by the Nuclear Regulatory Commission. But, you know, and we had Secretary Chu before the Committee who talked a little bit about this. But, you know, I assume in your testimony, if I had a chance to read it all the way through, that if you agree with our goal of generating a very high percentage of our electricity through clean sources over the long term, then nuclear has to be a part of that goal.

Ms. HOFFMAN. Nuclear is a part of the clean energy resources that we look to develop a portfolio in the United States.

Mr. FATTAH. Now, we have shown a pattern at least in previous years to invest both in renewable, which I am a strong supporter—but also in nuclear. And I think that we are going to end the loan guarantee side of this. And I know that the Department, really for the first time in 30 years now, seems to have some movement around new nuclear. It will probably be stymied a little bit given Japan's circumstances and the need to pause and take a look. But also because the deal flow on the renewable side is starting to move in terms of the use of the loan guarantees.

Can you comment at all about that?

Ms. HOFFMAN. Yes, I do not have any specifics on the loan guarantee program to present to you today, but we can get you more

information for the record on the deployment and the use of that program for those technologies.

Mr. FATTAH. Thank you very much. Thank you, Mr. Chairman, for recognizing me.

Mr. WOMACK. Well, from the clock I know our time is getting short and I think it would be practical to begin the process of winding down the hearing and because there is not enough time to go for a complete round again, the Chair would ask if there are any other Members, any of my colleagues, that wish to provide another question. And Mr. Pastor, I recognize you.

Mr. PASTOR. In the Vehicle Technology Deployment Program, as I read the material, basically these are going to be grants that are going to be competitively given out to cities and towns so that they could, I think, create a system of charging stations throughout the cities and towns.

Mr. KELLY. Correct.

Mr. PASTOR. Correct.

Mr. KELLY. Mm-hmm.

Mr. PASTOR. Since the power will be provided by existing utilities, there is an incentive for the auto companies to also have more and more of these charging stations available so that they could sell more cars. Why is this not a private industry initiative rather than a public initiative?

Mr. KELLY. Well, like most things in transportation—for one thing, you know, electric vehicles are one of the key ways we can get off of petroleum. We think we can get a big chunk out——

Mr. PASTOR. No, I understand. No, I understand all that. That was not the question.

Mr. KELLY. And the——

Mr. PASTOR. The question is—and the power companies are going to sell the electricity.

Mr. KELLY. Right.

Mr. PASTOR. They are going to make money. So why is this not a private venture rather than a public venture and why are we in it to begin with?

Mr. KELLY. Well, the problems associated with putting in this electric charging infrastructure make you confront a lot of complicated permitting problems working with the utilities, finding out who is going to actually buy the equipment in commercial buildings. Do you want to have public charging stations? Do you want to have incentives for people to put stations in their homes? We are not sure what these cities are going to come up with, but there are a lot of regulatory and permitting and other issues that they are all going to have to confront. We are——

Mr. PASTOR. So from your answer——

Mr. KELLY [continuing]. Hoping it will be hugely cost-shared, by the way.

Mr. PASTOR. But from your answer you may have different systems. If we are talking about individual houses, we are talking about out on the street corner, we are talking about other buildings, you may end up with a system that is mish-mash. Since you are planning this, what is your idea in terms of what it is going to look like and where it is going to be started and how you are going to get the biggest bang for your dollar?

Mr. KELLY. Well, in addition to the program you described we have a project where we have been working in cooperation with NIST, the National Institute for Science and Technology, to try to get standards for electric vehicle charging. You want to make sure the charging equipment meets safety standards, but also that you can pull into any charging station and plug your vehicle into it. It turns out to be a non-trivial problem technically. So in terms of having technical interoperability problems, we have a big——

Mr. PASTOR. Okay. Where is the technology today?

Mr. KELLY. Hmm.

Mr. PASTOR. Where is that technology today?

Mr. KELLY. Well, the——

Mr. PASTOR. Where will it be on October 20, 2011?

Mr. KELLY. Well, there has not been agreement on a standard way of plugging these vehicles in. There are many different voltages that are going to be available, so we have to stay on top of this. It is not going to be easy. And then we are moving to a next generation of technology in this area, which is the wireless charging, where you might be able to charge vehicles without actually plugging anything in. so this is a continuing standardization effort.

But the program that we started talking about is basically the regulatory side of things. Each city needs to work out how it wants to encourage the introduction of this equipment into the city. Do they want to put it into public charging stations that are publicly owned or do they want to have incentives for businesses to install things in the parking lots of commercial buildings. That is——

Mr. PASTOR. Are there current deployment programs in place right now?

Mr. KELLY. We have a Clean Cities Program that has been doing this on a smaller scale for some time and we are greatly expanding this because we expect a million vehicles to be on the road in 2015 and want to be prepared for it.

Mr. PASTOR. And what has that program showed you in results?

Mr. KELLY. What has it shown us?

Mr. PASTOR. Yeah, right.

Mr. KELLY. Well, they have been.

Mr. PASTOR. What problems do you have and——

Mr. KELLY. Well——

Mr. PASTOR [continuing]. Why could it not be a private sector venture?

Mr. KELLY. Well, most of the money is going to come from the private sector, there is no question. This is helping—the particular program we are talking about here is setting up the policy infrastructure. You know, making sure that the utilities are prepared for it, that the utility regulations are upgraded as needed to make sure that they are able to support this, make sure that they are not surprised. So this is not actually spending a lot of money buying a bunch of equipment primarily to be experimental equipment. And we expect the private sector and the homeowners and the building owners to provide by far the bulk of the investment in this. This is to jump start the process.

Mr. WOMACK. Further questions. Mr. Olver, did you have something?

Mr. OLVER. I would just like to ask each of you who has a request for a Hub—in the one case the Critical Materials Hub and in the other case the Smart Grid—if you could give us 1 minute, maybe 1½ if I shut up quickly, of the overriding goal that you can see we have a chance of achieving within a 10-year period out of the work of each of those Hubs, the critical materials one and then the—I am doing it in that order just to make certain—and the Smart Grid Hub?

Mr. KELLY. So our Hub is critical materials, which includes rare earth. There are several focuses. One is finding ways of using the rare earth and critical materials much more efficiently, so one goal would be to have an order of magnitude decrease in the amount of materials you need for any particular performance goal.

Mr. OLVER. So it is a matter of technology at issue.

Mr. KELLY. Yeah, it is making more effective use of the material, almost certainly using nanotechnology. The second goal is to find a complete substitute for this material. One of the things is the transparent conducting materials that are pervasive in our economy from everything from TV sets to photovoltaic film. I would like to see a way to make this stuff with other critical material.

Mr. FATTAH. Will the gentleman yield for a minute?

Mr. KELLY. Yeah.

Mr. FATTAH. These rare earth materials, China has control of over 95 percent of this material?

Mr. KELLY. It is rare earth in particular. They control a very large portion.

Mr. FATTAH. Right. Well, they have 35 percent domestic, but they have now secured 95 percent of what is available in the world. So we either have to develop some ability to use a lot less of these materials for the same purposes or we have to create some alternative to it.

Mr. KELLY. Yes, and in addition we closed down the one mine we had for environmental reasons. We are probably going to find ways of opening up more mines as this stuff becomes more widely available. One material we are worried about is lithium because we are putting it all in the batteries. It turns out that we found a way to extract lithium from our geothermal resources. So as you pull the hot brines out, you can extract a huge amount of lithium, so that is part of what we are doing. Good news.

But you would like to be able to find ways of saying if you are using a rare earth, is there a way just to avoid using it altogether? Can you find some better idea? And there are some very clever design ideas out there, including the use of superconducting materials.

And I have used up more than my 90 seconds here, I am afraid. I can go on on this at great length. It is an exciting area, so.

Mr. OLVER. Yes, thank you. Thank you very much.

Ms. HOFFMAN. If I may have an opportunity, respectful of the Committee's time, with the Smart Grid Hub what we are looking at is trying to really accelerate the development and deployment of new architectures, new innovative technologies on the electric grid. We realize that this industry is quite complicated in structure. We need to bring together the power engineers, the cyber experts, the

system modelers, the planners and start looking where we can find solutions that solve problems within the scenes in the industry.

So what are our goals? Our goals are to improve the performance of the grid, which may be comprised of increasing asset utilization, optimization and use of assets so we can make sure that we have the right amount of storage with renewables, that we have the right generation mix as we look at supporting a generation in the United States and the right amount of transmission on that is required. In addition, it is improving the resilience of the system. That could be comprised of, say, a lower number of outages, faster time for restoration, those types of metrics are what we are going after.

Mr. OLVER. Thank you. Thank you, Mr. Chairman.

Mr. WOMACK. Any further? Not recognizing any additional questions, I want to thank the witnesses that were here today. I remind my colleagues and the witnesses that the milestones and the timelines that we established in my opening remarks for questions for the record, supporting documentation, and other materials, please meet those promptly.

And I want to thank again the witnesses for not only their testimony today, but their service to our great country. Madam Secretary, Dr. Kelly, Dr. Der, thank you so much for being with us.

And at this time I will declare this hearing adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

ENERGY EFFICIENCY AND RENEWABLE ENERGY, ELECTRICITY DELIVERY AND ENERGY RELIABILITY, AND FOSSIL ENERGY RESEARCH AND DEVELOPMENT FISCAL YEAR 2012 BUDGET HEARING

MARCH 30, 2011

PROPOSED INCREASES TO CLEAN ENERGY PROGRAMS

Subcommittee. The budget request includes billions of dollars in increases for clean energy research and development, including hundreds of millions of dollars for new or greatly expanded activities. At a time when funding increases absolutely must be reserved for the most worthy and well-planned programs, we expect rigorous planning and detailed justification for proposed increases.

Unfortunately, we do not see that for many areas we're considering today. For example, to justify a $203 million, tenfold increase to Vehicle Technologies Deployment, the Department provides barely one half page of explanation. To defend $150 million in funding for a new advanced biofuels reverse auction—an activity never before conducted by the Department—the request provides a half page of justification. To justify $185 million for new activities on commercial building efficiency, the Department provides just more than one page of description and analysis. And the Department provides only half a page of justification to explain more than $100 million for a new Next Generation Materials program, including a five to ten year funding commitment for a new innovation hub.

Secretaries Kelly and Hoffman, what planning and analysis have you done to ensure these increases would be well spent—and could even be spent in one year?

Dr. Kelly and Ms. Hoffman. In the State of the Union address, President Obama laid out his vision for winning the future by investing in innovative clean energy technologies and doubling the share of electricity from clean energy sources in the United States by 2035. To meet this goal, the Office of Energy Efficiency and Renewable Energy (EERE) has crafted a balanced portfolio of research, development, demonstration and deployment (RDD&D) programs aimed at improving the energy efficiency of our economy and increasing the productive use of domestic renewable energy resources.

For example, the FY 2012 Vehicle Technologies Deployment (Clean Cities) Presidential budget request includes $200 million for the expansion of electric drive vehicle (EV) deployment efforts and related infrastructure development activities. This funding will be used to support the President's goal to put one million electric vehicles on the road by 2015. Through

expanded transportation electrification efforts, vehicle deployment, and infrastructure development activities. This includes competitive awards to help deploy electric vehicles and install charging infrastructure – electric vehicle supply equipment (EVSE). Examples and rationale for priority activities include:

- Critical EV infrastructure planning and implementation steps must be coordinated among various government agencies, public safety officials, and city planning organizations that each have local regulatory authority to approve or enforce zoning & construction practices. This funding would be used to incentivize local groups to work together to streamline EVSE approval and installation procedures.
- Complicated electrical permitting processes and codes & standards that were never designed with EVs in mind are significant deployment barriers while new codes and standards can take several years to adopt and approve. Community priorities established by these projects would be expected to significantly shorten project installation time.

The $200M budget is anticipated to provide 20-30 competitive awards in the range of $5M to $10M each. Pending timely budget approval, the open solicitation would be held and all awards made by the end of FY 2012. The example below illustrates how a $10 million DOE grant could help leverage community activities to plan and execute comprehensive local and regional infrastructure initiatives.

- Up to 20% of the DOE funding ($2 million) may be spent on areas to enable the placement of thousands of electric vehicles such as:
  - A strategic infrastructure placement plan that assesses the best locations for public charging based on where people live, work, shop and recreate;
  - Development of training programs for local first responders and inspectors;
  - Training for the green work force such as technicians to install and maintain electric vehicle related equipment;
  - Streamlining of local permitting processes to handle thousands of new electric vehicle infrastructure installations;

  - Development of codes and standards including upgrades to new buildings' electrical systems to include wiring for electric vehicle recharging options; and
  - Community outreach and education and community-based incentives.
- The other 80% ($8 million) would be spent on equipment and installation of charging points for residential, fleet and public recharging. For example, a DOE investment of $5 million in residential (single family and multi-unit) and commercial fleet depot charging can fund approximately 3,000 charging points in a community (with 50% cost share). In addition, the remaining $3 million in government funding can be used to provide up to 200 publically available quick charge points (with 50% cost share).

Successful deployment of EV technologies and infrastructure will require effective collaboration between locally-based public and private sector partners. Public policies that make these efforts a top priority and incentivize private investment are critical. DOE anticipates that projects funded under this program would create community based partnerships that leverage resources and establish EV enterprise zones. The ability for these partners to leverage DOE funding with non-federal funds would be one of the criteria for grants.

The initiative is seeking community based partnerships that can serve as EV pace setters for other communities to emulate. Lessons learned, EV implementation strategies, model permitting procedures, innovative incentives, and workforce training can be shared with other communities to leverage / jumpstart similar efforts in multiple locales.

Subcommittee. Where is the evidence of this planning, when such little justification is included in the budget request?

Dr. Kelly and Ms. Hoffman. In the State of the Union address, President Obama laid out his vision for winning the future by investing in innovative clean energy technologies and doubling the share of electricity from clean energy sources in the United States by 2035. To meet this goal, EERE has crafted a balanced portfolio of research, development, demonstration and deployment (RDD&D) programs aimed at improving the energy efficiency of our economy and increasing the productive use of domestic renewable energy resources.

For example, through the Commercial Buildings Initiative, "Race to the Green", the Department proposes to competitively award approximately 10-20 grants (totaling $100 million) to state and local governments for the purpose of implementing innovative approaches to increasing private-sector investment in commercial building retrofits in their jurisdictions. Much of the authority to alter codes, regulations, and performance standards relating to commercial energy efficiency lies in the jurisdiction of states and localities. These grants would help states and local governments catalyze activities that will work to streamline standards, encourage upgrades, and attract private sector investment. These approaches may include (but are not limited to):

- Streamlining the permitting process and other regulatory barriers;
- Updating and harmonizing building energy codes;
- Implementing building energy disclosure policies;
- Standardizing actuarial data collection on building performance;
- Providing limited loan loss reserve funds; and
- Bundling existing utility rebates with private financing to enhance leverage.

Applicants for these funds would be required to estimate in their applications the amount of private-sector financing they will be able to leverage under the program, with a recommended target for at least a ratio of 10:1 leverage. DOE's experience with state and local grant programs shows this is a reasonable target.

DOE expects a large number of applications for this funding. Under the American Reinvestment and Recovery Act (ARRA)-funded Better Buildings Program (which targets residential retrofits), DOE received over 100 applications, for 8 times more funding than it was able to award. Based on discussions with state and local governments, financial institutions, and the commercial real-estate sector, a program focused on commercial building retrofits would likely be even more oversubscribed. The competitive grants would range from $5 million to $10 million. Based on DOE's experience in state and local grant programs, this amount can be spent by state and local governments in a reasonable time frame.

The Department is also proposing the Better Buildings Initiative ($60 M) to drive innovation in the design and implementation of buildings and

integrated building systems. The Better Buildings initiative would attract investment from industry by running a competitive solicitation for R&D of advanced tools, resource development and sub-metering techniques to drive down the cost of commercial building retrofits. For example, retrofits with integrated design concepts balance systems -- higher efficiency windows and skylights can reduce electric lighting needs and decrease the size of the HVAC equipment. To identify and diagnose energy waste and improve energy efficiency, as part of its Better Buildings Initiative, DOE would also develop low cost advanced energy audits.

The Challenge part of this program is to obtain commitments from public and private officials responsible for new and retrofitted buildings to publicly commit to making significant improvement in how their buildings are designed or retrofitted. The program would also provide technical and analytical support, best practices, guides, and technology options that would allow for a significant improvement in the energy efficiency of retrofitted and new buildings, with a positive life cycle cost benefit. This integrated systems approach starts with energy modeling that aligns with the expected use of the building, and includes installation and commissioning of the systems that should be integrated to maximize performance in a building (sensors, controls, software, inexpensive metering devices, etc). The result would be specific examples of buildings in many of the building types (municipal, large retail, office, etc.) that have demonstrated and measured the improved energy efficiency. As a result of this work, we intend to develop and disseminate business models for buildings that have successfully implemented cost effective whole building or system energy efficiency improvements.

Additionally, the Building Construction Technology Extension Partnership ($25M) proposes to pilot a small scale commercial building extension program with National Institute Standards and Technology (NIST) and selected universities across the United States, resulting in building specific training and coursework to existing programs. This would allow university students and professors to work within their local communities to grow and improve the quality of the auditing, operations, and commissioning activities in support of local businesses. It would also provide a national network for easily disseminating up to date best practices, information and data regarding commercial building retro-commissioning and retrofits.

These funds would need to be leveraged with funds from local businesses, existing state programs, and utilities at a ratio of 2:1. A network of 30 commercial building extension centers (i.e. relationships with universities and non-profits) will be established in partnership with industry, trade, and professional organizations. The extension centers would provide direct assistance to business to help them reduce their energy consumption, educate and train university students in energy efficiency auditing, operation, and implementation, and provide a network of partners with access to the best available technologies, know-how, expertise, and resources to conduct deep energy efficiency retrofits.

Using this approach, regional extension centers would be better able to address issues important to their local construction and retrofit market. In addition, specialty-focused extension centers would develop and maintain core competencies in energy efficiency construction, management, workforce training/re-training or education.

Subcommittee. In the budget request, Dr. Kelly, you have proposed steep increases for programs like Solar, Vehicle, Building, and Industrial Technologies, while holding back other programs like Water Power and Hydrogen and Fuel Cell technology research. How were the decisions made to focus the increases on some programs and not on others?

Dr. Kelly. In the State of the Union address, President Obama laid out his vision for winning the future by investing in innovative clean energy technologies and doubling the share of electricity from clean energy sources in the United States by 2035. The FY 2012 budget request supports the President's goals to develop America's competitive edge through strategic investments in our nation's clean energy infrastructure. The need to exercise budget restraints forced some tough decisions across the Department in FY12. DOE undertook a thorough analysis to determine what levels of funding could be supported across the complex. With regard to EERE in particular, we rebalanced investments in our FY12 request to reflect a very clear and deliberate strategy to support those areas of science with the most direct impact on the energy, security and environmental missions of the Department. To meet this goal, EERE has crafted a balanced portfolio of research, development, demonstration and deployment (RDD&D) programs aimed at improving the energy efficiency of our economy and increasing the productive use of domestic renewable energy resources.

PROPOSED INCENTIVE AUCTION FOR ADVANCED ETHANOL

Subcommittee. Dr. Kelly, the budget request proposes $150 million for an advanced biofuels reverse auction. It is my understanding that $4.5 million was made available from within fiscal year 2008 funds, and this request increases funding more by than thirty-fold when that funding from 2008 has still not been used.

$150 million is a large number. Unfortunately, the Department's request only provides about a quarter page of justification. Dr. Kelly, how did you arrive at $150 million? How do you know if it would be enough to get the auction off of the ground? How do you know it wouldn't be too much and would be a waste of taxpayer dollars?

Dr. Kelly. The authorization for the reverse auction falls under Section 942 of the Energy Policy Act of 2005. The authorization allows up to $1 billion to be applied to Reverse Auctions. The statute limits the DOE to $100 million for each auction. The $150 million requested would permit two auctions to be conducted. DOE determined the amount of the request based on an anticipated 170 million gallons of advanced cellulosic biofuels that could be produced annually from the existing awards it has made for pilot, demonstration and commercial scale biorefineries.

During the rule making process for the reverse auction regulations, DOE held workshops with stakeholders. These workshops helped DOE determine the level of support needed during the early years of operation. Additionally, the Biomass Program ran scenario models to predict the outcome of the auction and will later conduct a cost benefit analysis based on the results of each auction. The Department anticipates it will support additional auctions only if the cost benefit analysis validates continued funding requests.

Subcommittee. Dr. Kelly, food prices have been rising recently, in large part due to the pressures of both corn ethanol and rising energy prices. I've seen this happen in my own district, where rising food prices have made it harder on both homes—and especially hard on businesses. What impact would this auction have on food prices in the United States and abroad? What assurances do you have that this auction wouldn't make the problem worse?

Dr. Kelly. The Reverse Auction is for cellulosic (non-food sources) – based biofuels and would not have any impact on food prices. It would not increase any biofuels production from current biofuels facilities producing starch-based ethanol or biodiesel. Through its implementation, the Reverse Auction could enable up to 200 million gallons of cellulosic biofuels by making them more competitive with conventional fuels.

Subcommittee. Can you clarify what types of fuels and crop sources this auction would support, in relation to fuels and sources supported by Department research? What differentiates this from tax credit policies currently being given out for ethanol?

Dr. Kelly. The auction would not increase any biofuels production from current biofuels facilities producing starch-based ethanol or biodiesel.

The Reverse Auction would only support cellulosic biofuels produced from approved cellulosic feedstocks. The acceptable feedstocks proposed would be required to be domestically available in sufficient quantities to contribute meaningfully to the Renewable Fuels Standard of 21 billion gallons of advanced biofuels by 2022. The acceptable feedstocks would also need to meet the definitions of "renewable biomass" as stated in the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the Food, Conservation, and Energy Act of 2008, Title IX, Sec. 9001.

The types of fuels eligible for consideration as cellulosic biofuel may include cellulosic ethanol, butanol or other alcohols, green gasoline and diesel produced via Fisher-Tropsch synthesis, pyrolysis or other means and other novel fuels derived from cellulosic biomass or algae. The reverse auction, if combined with other policy incentives (i.e. tax credits, etc.) would enable more rapid finance of premiere biofuels plants. Currently, there is not enough access to private capital to build these first-of-a-kind biofuels plants.

Subcommittee. The proposed biofuels auction would be a substantial one-time injection of funding into the biofuels market. And I would hope that this $150 million would not simply be wasted, but would advance biofuels that don't compete with food sources to a point that these fuels are competitive. At the same time, we hear much about advances with a next generation of superior biofuels in the laboratory—for example, biofuels that could replace gasoline and diesel. I understand that the Department of Energy's Office of Science is working to develop those next generation

biofuels. Given those programs, are we "jumping the gun" on this auction? In these times of tight fiscal constraints, would we be better off waiting for the Office of Science to get next generation fuels out of the lab?

Dr. Kelly. The Department does not believe it is "jumping the gun" with a Reverse Auction in 2012. The Reverse Auction is expected to have a significant impact on the operational costs of biorefineries to improve the cost competitiveness of the fuels. It is estimated that the auction would enable up to 200 million gallons of cellulosic biofuel production – and pave the way for investments in the next generation of biofuels.

The Biomass Program has invested more than $1 billion in 29 integrated biorefinery projects at various stages of development – R&D, pilot, demonstration, and commercial scales – that could generate a total of more than 170 million gallons of potential biofuels production capacity. Industry partners are matching these federal funds for these projects at an estimated $1.7 billion. These deployment projects cover a range of advanced cellulosic biofuels, including cellulosic ethanol, butanol, green gasoline and diesel produced via Fisher-Tropsch synthesis, pyrolysis and other novel fuels derived from algae.

In addition, applied research into advanced biofuels, such as diesel and jet fuel, has advanced over the past several years building on fundamental research conducted by the Office of Science. Specifically, the Department supports a significant applied research portfolio in its Energy Efficiency and Renewable Energy's Biomass Program with projects involving renewable diesel, gasoline and jet fuel including algae-based fuels, as well as through the Advanced Research Project Agency-Energy. Our goal is to bring these fuels into a cost competitive range as early as 2017, and facilitate meeting the volumetric goals of the Renewable Fuels Standard.

Subcommittee. What is the cost today of the biofuels that the auction would support? Are these fuels competitive with conventional fuels now, and would they be competitive after this auction?

Dr. Kelly. Based on preliminary data from our $1 billion in investment in 29 integrated biorefinery projects, the cost of these advanced biofuels are $0.75 - $1.50 per gallon higher than conventional fuels. The Reverse Auction would have a significant impact on the operational costs of

a biorefinery. The subsidy would be expected to reduce the per gallon cost for the six years of implementation – until the facility can implement lessons learned to reduce the cost of production and be competitive without a subsidy.

ELECTRIC VEHICLES AND FREIGHT

Subcommittee. Much of the increased funding proposed in the budget request goes towards research to advance electric vehicles. While, in theory, these vehicles can reduce our dependence on the fluctuations we've seen in the oil markets, I have serious concerns that the technology can be adopted to a degree that makes a difference in a timeframe soon enough to matter.

Dr. Kelly, several companies are releasing electric or electric hybrid vehicles this year. What would prevent this 2011 class of cars from succeeding in the market, and why does the Deparment need to provide so much assistance when so many companies are releasing electric or hybrid cars?

Dr. Kelly. The bulk of the FY2012 Vehicle Technologies budget request increase would focus on overcoming initial market barriers for those electric vehicles (EVs) now entering the commercial market. The proposed $200 million competitive grant program would award cost-shared funds to community-based partnerships to help accelerate the rate of EV adoption by deploying public charging points, streamlining permitting processes, and implementing other incentive strategies to encourage consumer acceptance. Federal funds would be highly-leveraged by local and private investment and focused on effective strategies that overcome initial market penetration barriers and move EVs very quickly from early adoption to mainstream use.

Subcommittee. One common challenge businesses across the country share is the transport of goods. Whatever they produce, the cost of freight transportation can hit businesses and consumers hard—especially when oil prices rise, like they have this month. Dr. Kelly, how are the Department's proposals for electric vehicles going to help to reduce the cost of freight and trucking in the United States—an advance that could make our goods cheaper, tighten up our supply chains, and help American businesses compete?

Dr. Kelly. It is true that vehicle electrification primarily benefits light-duty vehicles, which account for 76% of U.S. highway transportation energy use. The Department does have several major activities to address the heavy-duty vehicle sector, however. For example, SuperTruck projects, which collectively total $240 million with cost-shared funds, are using improved combustion efficiency, aerodynamics, hybridization, and lightweight materials to improve the efficiency of class 8 trucks (note that

the majority of Federal funds for these projects were provided under the Recovery Act). In addition, the Department's new National Clean Fleets Partnership, announced on April 1st, 2011, will assist large national fleets – including those involved in freight and trucking – reduce their fuel use, transition to cost-effective alternative fuels, and achieve greater efficiency and cost-savings by offering specialized resources, technical expertise, and support.

NATURAL GAS VEHICLES

Subcommittee. Our available reserves of domestic natural gas have skyrocketed in recent years with the refinement of shale gas extraction techniques. The budget request, in fact, says the following:

"Natural gas (methane) currently provides 25% of U.S. energy, and is a clean, low carbon, energy source. The use of natural gas could be expanded for both stationary power and as a transportation fuel."

This seems like an important and reasonable idea. That idea, however, was made in the budget request for ARPA-E. Unfortunately, the budget request for Energy Efficiency and Renewable Energy we're discussing today takes the opposite tack by reducing what little support it offers for natural gas vehicles.

Dr. Kelly, what is the rationale for putting almost all of the Vehicle Technologies program increases into electric vehicles, rather than putting some work into the natural gas option? Why is your office putting all of its eggs in one basket, by ignoring natural gas?

Dr. Kelly. Although the Vehicle Technologies budget request does include a significant increase for the electric vehicle community grant program, it also includes funds for advanced combustion, materials technologies, and fuels technologies, as well as deployment efforts for alternative fuel vehicles, including natural gas. Natural gas is a relatively mature technology, so the emphasis is on deployment activities that support the expanded use of natural gas, including efforts under the program's Clean Cities initiative or new National Clean Fleets Partnership.

SMART GRID RECOVERY ACT GRANTS

Subcommittee. Assistant Secretary Hoffman, the Recovery Act gave $4.5 billion to the Department of Energy for smart grid demonstration and investment grants. I understand these grants are funding the first large-scale deployment of smart meters into American homes, and demonstrating other smart grid technologies across the country.

What is the status of those two grant programs? Have all projects been completed? If not, by when will they be done?

What will be different after these grants are completed? How will the power grid be different?

Some folks are concerned that this widespread deployment of smart meters is now happening before meter companies, utilities, and grid operators have cyber security safeguards in place. This could put the grid, homes, and businesses at risk of cyber attacks. Are we putting the cart before the horse? Do you see risks here, and what is the Department doing to address them?

Ms. Hoffman. The two programs you referenced are the Smart Grid Investment Grant Program (SGIG) and the Smart Grid Demonstration Program (SGDP). First let me address the SGIG program. The Department completed the award of 99 grants in June of 2010. The total Federal funding is slightly over $3.4 billion. This is being matched by over $4.4 billion from the grant recipients, for a total of over $7.8 billion of electric grid upgrades and improvements. All the projects funded under the SGIG program are planned for completion within 3 years of the award date. Many of these projects are quite large and may be installing hundreds of thousands to millions of devices like new electric meters on various utility systems. All 99 of the SGIG projects are underway and are on track to complete their work in 2013. As of the end of March, over $1.85 billion worth of work has been accomplished and three projects have effectively completed their work. Once the SGIG projects have finished installing the smart grid technologies, there will be a one-to-two year data collection phase to gather detailed information on how these devices and systems are impacting grid performance.

All 32 Smart Grid Demonstration Program (SGDP) awards, 16 of which primarily support smart grid projects and 16 that support grid-scale energy

storage demonstrations, have been made and the projects are progressing. The $620 million in Federal funds is matched by more than $1 billion from the grant recipients. Most are 4-to-5 year projects, and all projects will be completed by September 30, 2015. The purpose of the SGDP projects is to demonstrate how a suite of existing and emerging smart grid technologies can be innovatively applied and integrated to prove technical, operational and business-model feasibility. Therefore, each of the projects will result in a "smart grid" or an energy storage demonstration for the target area but more importantly, collectively they will provide models, lessons-learned and data for future smart grid and energy storage projects across the country.

There will be many changes to the power grid once these projects are completed. In general, the grid will be more reliable because new sensors and automated equipment will allow for quicker identification of problems and automatic response to those problems. It will be more flexible and therefore allow large quantities of electricity from variable renewable generation sources to be moved across the grid. It will be much more consumer friendly and allow consumers of electricity to see how much power they are using in near real time. This will give consumers better control over their energy usage. Lastly these projects seem to be spurring interest and investment in the industry, and we expect that many more utilities will perform these kinds of upgrades well into the foreseeable future.

Regarding cyber security and cyber vulnerabilities, the Department is quite focused on ensuring that the power grid is secure. We have a broad based research and development effort in cyber security that has been in place for a number of years and is producing results. For example, we have conducted assessments of power grid control systems, identified vulnerabilities, and worked with vendors to correct the deficiencies. We have also worked with industry partners to develop and commercialize several advanced technologies including the secure SCADA communications protocol, software tools to audit and verify the security configuration of control systems, and an interoperable gateway to provide secure communications between substations and utility control centers. We also worked with industry partners to develop security profiles for three smart grid applications - advanced metering infrastructure (AMI) technologies, 3rd party data access, and distribution automation. In addition, we required all of the recipients of Federal funds for the Recovery Act programs to develop and implement a comprehensive cyber security plan for their project. The

Department reviewed and approved these cyber security plans and is monitoring the projects to ensure the plans are being implemented.

SHALE GAS AND HYDRAULIC FRACKING

Subcommittee. In just a few years, the development of shale gas resources has dramatically increased projected reserves of natural gas in the United States. We, of course, want to harness this vast resource responsibly and safely, but it has the potential to significantly shift our nation towards more domestically-produced energy resources.

I've heard reports about the increasing detection of small tremors in areas where shale gas is being extracted. Dr. Der, is this because shale gas extraction is causing these tremors, or simply because we're getting better at detecting them?

Dr. Der. On March 30, 2011 at Georgetown University the President stated, we must proactively address concerns that have been raised regarding potential negative impacts associated with hydraulic fracturing and we are taking steps to address these concerns to ensure that natural gas production proceeds in a safe and responsible manner. As part of these efforts, we are currently analyzing the issue of induced seismicity.

Subcommittee. The budget request eliminates two Fossil Energy research programs, Natural Gas Technologies and Unconventional Fossil Energy Technologies. To justify this change, the Administration only states: "Consistent with Administration policy to phase out inefficient fossil fuel subsidies, the program is requesting no funding...for R&D to increase hydrocarbon production." But several weeks ago, the Secretary of Energy was quoted as implying that the Department of Energy could offer some assistance to industry for shale gas drilling, saying that, "I think we can help the industry improve what they have."

Dr. Der, what do you see as the Department of Energy's role to improve our nation's use of our vast natural gas resources, and how do you reconcile the Secretary's statement with the Department's proposed elimination of these programs?

Dr. Der. Natural gas is an important element in this Administration's strategy to increase economic prosperity and energy security, protect the environment, and create American jobs using American technology. In his March 30, 2011 "Plan to Strengthen America's Energy Security" Speech, the President tasked Secretary Chu to conduct research to improve the safety

of hydraulic fracturing related to water resources. The Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program is addressing technical, economic, risk, safety, and environmental challenges associated with domestic oil and gas production. The current focus of the program is on identifying and quantifying potential risk, safety, and environmental impacts associated with the production of domestic unconventional resources, and on developing technologies to mitigate them. Currently, there are over 80 projects in place under the program. This work is being conducted with funding the Department received in FY 2010 and FY 2011.

Subcommittee. What are other relevant federal agencies doing to help develop this relatively new natural resource?

Dr. Der. Several agencies have taken active roles to ensure that shale gas resources are developed in a safe and environmentally sustainable way. The U.S. Department of Energy's (DOE) Office of Fossil Energy is sponsoring research and development to find improved ways to treat fracture flowback water so that it can be reused or easily disposed. This process will reduce the "footprint" of shale gas operations so that there is less disruption of the surface during drilling and completion operations. One current project involves DOE's National Energy Technology Laboratory collecting data of baseline environmental conditions at a Range Resources test well site in the Marcellus Shale play. Data collection and environmental monitoring for this project will start this year in coordination with other Federal agencies (e.g., Environmental Protection Agency (EPA), U.S. Geological Survey, and U.S. Army Corps of Engineers). This will lead to evaluations of the possible impacts to soil, air and water quality from shale gas drilling and hydraulic fracturing (fracking).

In addition, the EPA is conducting a study of the possible impacts from hydraulic fracturing on drinking water resources. DOE and other Federal agencies are participating in the study. The initial results from this study are expected by late 2012.

In President Obama's *Blueprint for a Secure Energy Future*, the Administration outlined upcoming activities that the Federal Government will do to address concerns associated with natural gas development and ensure that production proceeds in a safe and responsible manner. In April 2011, the Department of the Interior (DOI) will hold a series of regional

public meetings to discuss the potential for expanding shale gas production on Federal lands. These events will provide a forum to develop a framework for responsible production on public lands. In addition, the Secretary of Energy Advisory Board (SEAB) has been tasked to form a subcommittee (supported by DOE, EPA, and DOI) to examine fracking issues, identify any immediate steps that can be taken to improve the safety and environmental performance of fracking, and to develop recommended advice to the agencies on practices for shale extraction that ensures the protection of public health and the environment. This subcommittee will have members from the SEAB, industry, the environmental community, and the states. DOE and EPA will also establish a mechanism to provide technical assistance to states to assess the adequacy of existing state regulations regarding shale gas production.

Subcommittee. If the Department has concerns about shale gas extraction or sees additional opportunities, why would it not invest in that area?

Dr. Der. The Department is addressing the technical, economic, risk, safety, and environmental challenges associated with domestic shale gas production. The current focus of the program is on identifying and quantifying potential risk, safety, and environmental impacts associated with the production of domestic unconventional resources, and on developing technologies to mitigate them. This work is being conducted with funding the Department received in FY 2010 and FY 2011.

ENERGY EFFICIENCY AND RENEWABLE ENERGY

TYPES OF INVESTMENTS: RESEARCH VERSUS DEPLOYMENT

Subcommittee. Dr. Kelly, the budget request proposes large increases for biomass, solar, vehicle, building, and industrial technologies, and emphasizes deployment of existing technologies—rather than research and development of new ones. For example, the increase for the biomass program is entirely for the deployment of biofuels through a reverse auction. The increase in vehicle technologies is mostly for grants to cities to deploy electric vehicle technologies and infrastructure. And the increase for building technologies is likewise to deploy existing energy-saving measures.

With so much of the increase going to deployment, are we forgetting to keep American companies at the leading edge of innovation by supporting activities that actually develop new technologies?

Dr. Kelly. Our planned FY12 investments in R & D are more than $1.4 billion (40% above our FY 11 request of $0.97 billion) and our planned FY 12 deployment investment including the proposed increases in biomass, solar, vehicle, building, and industrial technologies are half that. EERE takes a balanced portfolio approach to addressing the nation's energy solutions analyzing options, timeframes, pathways, scenarios and markets to develop and deploy technology pathways that address current and likely futures with options and information to keep American companies at the leading edge of innovation and to provide consumers with a complete array of energy and energy service choices to meet their needs. The increases in biomass, solar, vehicle, building, and industrial technologies do not come at the expense of technology development, they supplement thetechnology investments by providing the experience and insights necessary to help American technology investments enter global markets at the faster pace and greater scale needed to help meet the Congress' and Administration's energy goals.

In addition, data and lessons learned from carefully planned demonstration and deployment programs provide critical feedback to inform our research and to keep it working on the most relevant areas. The focus of most EERE programs is to conduct research aimed at overcoming technical challenges. Moving to demonstration and deployment enables the programs to also address market challenges.

ARRA WEATHERIZATION, STATE ENERGY PROGRAM, AND BLOCK GRANTS

Subcommittee. Dr. Kelly, the Recovery Act provided $11.3 billion for Weatherization Assistance, the State Energy Program, and Energy Efficiency and Conservation Block Grants. Of this amount, nearly $6.7 billion is still unspent. Under the terms the Department set with state and local recipients, all of these unspent funds will expire in March of 2012. And at current rates of execution, approximately $3 billion in stimulus funds would expire at that time.

These programs got off to a slow start, and the current rates of execution do not appear to be sufficient to meet the Department's deadline. Dr. Kelly, what is the Department doing to accelerate these programs further?

Dr. Kelly. DOE has taken extensive action to increase grantee spending and spur payments. Each program has designed a targeted outreach and assistance strategy to work directly with each individual grantee, address issues and identify action items.

- The Weatherization Assistance Program (WAP) completed a series of "Green Light" calls to the 26 lowest performing grantees. In these calls, grantees discussed obstacles and solicited assistance from DOE HQ staff. WAP also increased training and technical assistance to target grantees and implemented management plans in several states, including Delaware and New Jersey.
- The State Energy Program (SEP) completed its fourth round of "QuickDraw" calls in February and will begin a fifth round in May. These calls focus on actions needed to accelerate projects and payments. In each round of calls, program leadership contacted all states and territories. Actions identified in these calls are underway and over 80 percent of the Quick Draw phone calls have been completed.
- DOE made nearly 3,000 phone calls to Energy Efficiency and Conversation Block Grant (EECBG) grantees and at least as many emails as part of "Operation Clear Path", an effort to spur spending among the more than 2,000grantees. EECBG project officers also visited 68 grantees in person to provide targeted assistance.

In addition to these enhanced outreach efforts from senior DOE leadership, Project Officers for all three programs are in constant communication with grantees by phone and travel regularly for monitoring visits. Project Officers are aggressively and diligently working with grantees to ensure they are prepared for this last summer of construction before grant performance periods expire: Since nearly 100 percent of WAP, SEP and EECBG grant recipients have building-related projects, spending is expected to increase as the winter months come to a close.

DOE's Technical Assistance team has also hosted a series of regional meetings across the country to provide an opportunity for grantees to share best practices and workshop issues. All three programs continue to develop and issue program guidance needed to assist grantees with project implementation.

Thanks to these efforts, spending for these programs is now on-track. OWIP achieved FY10Q4 and FY11Q1 targets, and is on pace to hit FY11Q2. Both SEP and EECBG are on-track to meet the June milestone of 50% spent.

Subcommittee. Because $3 billion of funds for these three programs may expire in March of next year, will you de-obligate this funding and return it to the Treasury to pay down the deficit because the recipients are underperforming and moving too slowly? Or will you extend the expiration date to allow these programs to use funds into the fourth and fifth years after the stimulus Act passed?

Dr. Kelly. DOE selected the 2012 deadlines in order to expedite spending, with the objective of supporting rapid economic recovery. The Weatherization Assistance Program (WAP) grants expire March 31st, 2012; the State Energy Program (SEP) grants are set to end on April 31st, 2012, and the Energy Efficiency and Conservation Block Grant (EECBG) deadlines are staggered based on the original contract signing dates (all in 2012). DOE is closely monitoring the progress of each and every grantee in all three programs, providing technical assistance and addressing obstacles to spending funds both efficiently and effectively. Spending across programs has significantly increased and most grantees are on-track to meet deadlines. As of April 6, 2011, approximately 53% of WAP funds had been expended, and SEP and EECBG are on-track to meet June deadlines of 50% spent.

Despite this progress, DOE recognizes that unforeseen complications delayed many projects in the early months of ARRA and slowed spending. For instance, WAP faced obstacles in the form of Davis-Bacon and Historic Preservation requirements; SEP and EECBG were additionally slowed by NEPA and Buy American. Circumstances outside of the grantees' control, such as local bidder availability and determinations of project ineligibility, further impeded payments. Due to these factors, there is a risk that certain grantees will struggle to meet the 2012 deadline.

At this time, no exceptions or grant extensions have been made. The DOE is currently focused on helping grantees adhere to their spend plans and meet their goals. However, the Department has not ruled out the option of granting extensions, taking into account the varied situations that state and local governments are facing in working to meet the 2012 deadlines.

Subcommittee. The budget request increases funding for weatherization to $320 million, an increase of $110 million over the current 2011 level. Given the large unspent balances from the Recovery Act, is it prudent to ask for this 52 percent increase in 2012?

Dr. Kelly. All ARRA funds have been obligated for projects in operation and, as of April 10, 2011, approximately $2.6 billion (53%) of the funds have been spent. Spending has steadily increased after overcoming early set-backs that included the integration of Davis Bacon wage determinations, Historical Preservation 106 reviews, the HUD MOU expansion of new service to multi-family buildings, and development of training resources for the expanding crew base. These have now been largely resolved and DOE anticipates that the program will exceed its productions targets.

The WAP network has already surpassed DOE's internal 2010 production goal by more than 55,000 homes completed (275,000 goal versus 330,000 completions). Over the last 13 months the network weatherized an average of 25,000 per month, reaching its maximum run rate of 30,000 homes in June of 2010. Those production levels equate to 1,100 - 1,300 homes weatherized a day.

The network has demonstrated a capability under ARRA to spend approximately $200 million a month, which would result in spending out all of funds by the March 31, 2012 deadline. DOE is providing technical

assistance and on-site monitoring to ensure that this acceleration continues, given the program's dual benefit of job creation and reduced energy costs for homeowners, which has a positive and immediate impact on the economy at large.

At current demonstrated capacity under ARRA, the network would spend out the 2012 request in less than two months. The $320 million requested in FY 12 represents less than 20 percent of the approximately $1.66 billion provided in each of the three years under ARRA. In addition, WAP historically does not have a significant amount of unspent funds from year to year. For example, in the past five years, grantees have reported an average of approximately six percent carry over from previous funding years.

The need for a 2012 funding increase is more vital than ever to cushion the ramp down of production and employment in the network. Under the Recovery Act, WAP currently supports 58 grantees, 1,007 subgrantees, and over 4,000 contractors. WAP has been ranked eighth in overall jobs production among the 200 programs that received Recovery Act funds. Over 25,000 staff work for WAP (funded by both ARRA and annual appropriations), and in the last quarter of CY 2010, ARRA funds alone supported over 15,400 of these jobs. Additional funding will ease the network's adjustment back to pre-Recovery Act funding levels, reducing the need for aggressive lay-offs. Without the increase in 2012 DOE funds, there will be insufficient funding to maintain the network infrastructure that allows for added leveraged funds from federal and non-federal sources and thousands of jobs will be lost as a consequence.

COMPARATIVE ADVANTAGES FOR DIFFERENT TECHNOLOGIES

Subcommittee. The Department has long maintained that efficiency and conservation are the cheapest way to make strides in reducing our reliance on imported oil.

Do you personally agree with this and if so, how does this guide your budget decisions?

Dr. Kelly. Energy efficiency is the cheapest and fastest resource available and it can help homeowners and businesses save money, energy and reduce our reliance on imported oil. Our commitment to energy efficiency is reflected in our budget request for the Office of Energy Efficiency and Renewable Energy (EERE). The additional funds we have requested for EERE in recent years continue to deliver more value to the American people each and every year.

Subcommittee. What weight should this factor—the cost-effectiveness of each technology—be given in the applied energy programs? I'll give you an example: I've been told that a relatively modest investment to improve the technology and manufacturing capabilities over the next couple of years in the area of solid state lighting would save some $100 billion in energy savings if you assume oil at $100 a barrel. In contrast, federal dollars spent on, for example, weatherization, may not be leveraged as well.

Dr. Kelly. Since one of the missions of the EERE is to save energy, the focus on efficiency (and in the case of lighting, efficacy) must be very high. The Solid-State Lighting (SSL) program is marching toward a goal of 243 lumen/Watt in 2020, relative to the best efficacy of today's traditional sources (linear fluorescent and HID lamps) in the 115 to 125 lumen/Watt range. By funding R&D projects that improve the efficacy of SSL, DOE creates the capability for manufacturers to offer products that save more energy. Saving energy is important; but to save the energy, someone must buy and use the lamp. Thus, the quality of the lighting (such as color rendition) must also be retained. The SSL program supports the efficacy improvements coupled with desirable lighting quality. According to a 20 year forecast prepared for Building Technologies Program entitled *Energy Savings Potential of Solid-State Lighting in General Illumination Applications 2010 to 2030*, the cumulative energy savings from SSL over

twenty years are estimated to total about 1,488 terawatt-hours, representing about $120 billion at today's energy prices.

The FY2010 Appropriations Bill's Conference Report* provided $30 million from within available funds for the development of a pilot project that would increase the leverage of Federal funding through the formation of partnerships between the Department and traditional and/or nontraditional weatherization providers. *("Conference Report to Accompany H.R. 3183," Report 111-278," at page 105).

Consistent with the report language, DOE introduced a competitive funding opportunity, a new Weatherization Innovative Pilot Program (WIPP), to select the applications that met these goals of increased leverage and the formation of new innovative partnerships. The first round of WIPP grantees included organizations that have not historically been a part of the Department's Weatherization Assistance Program, including private companies, non-profit organizations, universities, city governments, and national organizations like Habitat for Humanity and YouthBuild USA. WIPP projects are expected to help build the local capacity of new weatherization providers and are expected to allow DOE to rigorously test the cost-effectiveness of a range of new weatherization approaches that have the potential to accelerate efforts to build an efficient and sustainable weatherization and retrofit market. Projects include:

- New technologies, such as solar, efficient hot water systems, and in-home energy devices, that hold the promise of increased energy savings and cost-effectiveness
- Innovative financing, loans, and revolving funds to increase leveraging of federal funds
- Healthy homes approaches that streamline health interventions with weatherization and produce better energy and health outcomes
- Volunteer-based national organizations that have legacies of strong corporate funders and in-kind donations, which both increase the level of non-federal funds into the program and decrease direct labor expenses

Additional funding for the WIPP program will help DOE to achieve the program's goals of leveraging federal grant dollars 3-to-1 with non-federal funds, attracting new partnerships with both traditional and non-traditional weatherization providers, and increasing effectiveness through more

efficient delivery of services and higher energy and dollar savings for clients.

http://apps1.eere.energy.gov/news/progress_alerts.cfm/pa_id=384

See the full list of selected awardees:
http://www.eere.energy.gov/wip/pdfs/grantees_selected_wipp_awards.pdf

Description of 16 funded WIPP Projects, which is generally indicative of the type of things we would like to fund in 2012:
http://www1.eere.energy.gov/wip/wipp_projects.html

Subcommittee. How would the example I just mentioned rate relative to the solar or wind program in terms of return on investment?

Dr. Kelly. Wind power is an alternative energy *source* that competes with non-renewable fossil fuels like coal and natural gas. Solid state lighting is a lighting *technology* that can reduce overall electricity use because it is more efficient than lighting alternatives. Wind power does not "save" energy from being used in the same manner as lighting technology, but it does reduce the need for energy from other sources, and has numerous other benefits. Each gigawatt[1] (GW) of land-based wind power added in the United States produces the following benefits versus electricity generation from fossil fuels such as coal and natural gas:

- 1.4 million tons avoided coal consumption per year[2,3] or 21.2 billion cubic feet avoided natural gas consumption per year[4]
- 2.1 million metric tons of avoided carbon dioxide (CO2) emissions per year[5] when compared to coal
- $44 million in avoided social cost of carbon per year[6]

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[1] One gigawatt (GW) = one million kilowatts (kW) of electrical generating capacity.

[2] CO2 reduction is based on offsetting the national average marginal power generation mix. NREL memo to DOE, *Onshore wind emissions savings analysis*. January 11, 2011.

[3] *Retrospective Benefit–Cost Evaluation of U.S. DOE Wind Energy R&D Program: Impact of Selected Energy Technology Investments*. U.S. Department of Energy. DOE/EE-0348. June 2010.

[4] *Op. cit.* 2, 3

[5] *Op. cit.* 2

[6] The US Interagency Working Group on Social Cost of Carbon puts central value of carbon at $21 per metric ton of CO2 ($2007) in 2010. Here we calculate that (2.1 million tonnes CO2 avoided/year) x ($21/tonne CO2) = $44.1 million/year. Social costs of carbon include changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Human health damages include vector-borne diseases, heat waves, catastrophic events, and

- Wind power also provides significant benefits in the form of avoided health costs from criteria pollutants. About 43% of U.S. wind power offsets coal generation.[7] In 2009, 35 GW of wind power offset roughly 32,000 million kWh of coal generation[8], providing a benefit of $1.0 billion in avoided health costs that year[9]

The benefits of investment in the EERE Wind Program are reductions in the cost of wind energy and reductions in market barriers, both of which hinder deployment of wind power onshore and offshore. Proposed budget levels ($122 million per year) are targeted at specific cost of energy technology development and market barrier removal activities that will achieve large scale wind deployment, such as that described in the 2008 DOE report "20% Wind Energy by 2030,"[10] in which 300 GW of wind power provides 20% of U.S. electricity by 2030, up from current levels of 40 GW[11] (with a projected 13 GW added per year). The annual and cumulative benefits of this scenario would include:

- $100 billion in avoided health costs from coal per year in 2030 and ongoing annually[12]
- $155 billion in avoided social cost of carbon per year in 2030 and ongoing annually[13]
- Electric sector CO2 emissions reduced by 825 million metric tons in 2030 and ongoing annually[14]

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cardiovascular and respiratory mortality related to carbon emissions. *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866*. February 2010. http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf

[7] *Op. cit.* 3

[8] The US produced 74,000 million kWh of electricity from wind in 2009. *Electric Power Annual 2009*. November 23, 2010. http://www.eia.doe.gov/cneaf/electricity/epa/epaxlfile2_1_a.xls

[9] According to the U.S. National Academies of Science, the non-climate damages caused by criteria pollutants from coal-fired power plants in 2005 were estimated at $62 billion per year, or about 3.2 cents per generated kWh. Here we calculate that (73,886 million wind kWh/year) x (43% coal fuel mix avoided) x ($0.032 health benefit/kWh) = $1,024 billion/year in 2009. More than 90% of monetized damages were associated with premature human mortality. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*. National Research Council of the National Academies. 2010.

[10] *20% Wind Energy by 2030. Increasing Wind Energy's Contribution to U.S. Electricity Supply*. U.S. Department of Energy. DOE/GO-102008-2567. July 2008.

[11] *Fourth Quarter 2010 Market Report*. American Wind Energy Association (AWEA). 2011.

[12] *Op. cit.* 9

[13] *Op. cit.* 6

[14] *Op. cit.* 10

- Cumulative total of 7,600 million metric tons of CO2 emissions avoided by 2030, and more than 15,000 million metric tons of CO2 emissions avoided through 2050[15]
- In 2030, annual water consumption in the electric sector reduced by 17% and ongoing annually[16]
- Cumulative water use in the electric sector reduced by 8% (4 trillion gallons) from 2007 through 2030[17]
- Additional ancillary benefits are expected to be produced. For example, public investment in DOE's Wind Program from 1976-2008 has already generated 122 DOE-attributed patent families[18] and these knowledge benefits are likely to continue.

Through the DOE's SunShot Initiative, the DOE is supporting research, development, demonstration, and deployment of solar energy to make it cost competitive with fossil fuels without subsidies by the end of the decade. This will require approximately a 75% reduction in costs from today's levels for utility scale PV systems, from roughly $3.80/Wdc to $1/Wdc. Preliminary analysis by NREL of the impact of achieving these goals indicate that U.S. PV use could grow very rapidly to a cumulative installed capacity of 375 GW by 2030 and 607 GW by 2050. Under this scenario, PV would provide 13% of U.S. electricity by 2030 and 18% by 2050. The increased deployment of PV in the $1/W scenario could reduce retail electricity rates by 1%–3% below the reference scenario projection, representing annual customer savings of $9 billion to $17 billion per year (2009 U.S. dollars) from 2030 through 2050. This would translate into cumulative savings of roughly $80 billion through 2030 and $300 billion through 2050. Economic opportunities resulting from the $1/W scenario could create up to 200,000 gross new full-time jobs by 2030 and 325,000 gross new full-time jobs by 2050. This estimate of gross jobs includes direct and indirect jobs in the solar sector but does not include induced jobs.

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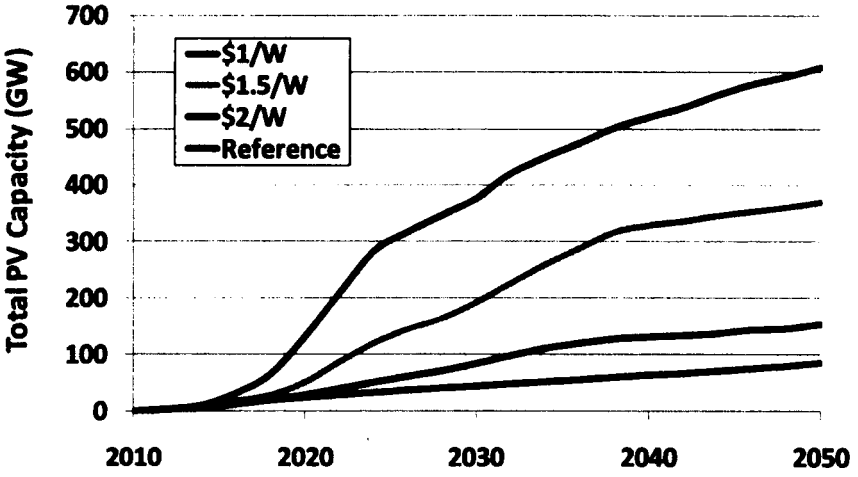
[15] *Ibid.*

[16] *Ibid.*

[17] *Ibid.*

[18] *Op. cit.* 3


Total PV Capacity (GW)
700
600
500
400
300
200
100
0
2010
2020
2030
2040
2050
$1/W
$1.5/W
$2/W
Reference

WINNERS AND LOSERS IN AUTOMOBILE MANUFACTURING

Subcommittee. Car manufacturers have made great progress in the last couple of years to increase the efficiency of their vehicles—and not just through deploying hybrids and electric cars. Today there are several all-gas models on the market with as good, or better, gas mileage as hybrid vehicles. This says to me that the private sector can respond without government subsidies, if it is given the proper incentives. Yet your budget is built around supporting specific solutions, such as electric vehicles, rather than focusing on outcomes, such as efficiency, that may have multiple solutions.

Why is your strategy built around picking technology winners and losers? What if you pick wrong?

Dr. Kelly. The Department's Vehicle Technologies Program supports the development and deployment of technologies that increase vehicle efficiency and reduce dependence on petroleum. Each key activity is focused on specific outcomes, with R&D activities working toward specific technical targets and deployment efforts working toward petroleum reduction targets. The Program supports a broad portfolio of vehicle technologies including advanced combustion, lightweight materials, and fuels technologies, as well as electric-drive technologies for battery-electric and plug-in hybrid electric vehicles. All of these advanced vehicle technologies contribute to petroleum reduction by either improving vehicle efficiency or by fuel substitution with alternative fuels such as biofuels, natural gas, or electricity. Although improved efficiency can help to reduce our dependence on petroleum, we cannot eliminate it by efficiency alone – we must replace petroleum with domestically-produced fuels such as electricity, biofuels, or natural gas. The Department's support for vehicle technologies aligns with this portfolio of solutions.

Subcommittee. Why have you chosen to focus so strongly on electrified vehicles while reducing funding for combustion engine efficiency research, when increasing the efficiency for gasoline and diesel vehicles can yield such impressive results?

Dr. Kelly. The Vehicle Technologies budget includes robust support of a broad range of advanced vehicle technologies that can significantly improve vehicle efficiency and reduce petroleum consumption, such as advanced combustion, materials technologies, and fuel and lubricant

technologies. Although these solutions are critical to reducing our dependence on imported oil in the near term, ultimately, we cannot eliminate our dependence on imported oil without fuel substitution, either through vehicle electrification or the use of biofuels, natural gas, or hydrogen produced using biofuels, natural gas, or renewable electricity.

INCREASE FOR BIOMASS SKEWED TOWARDS DEPLOYMENT

Subcommittee. Dr. Kelly, the budget request increases funding for Biomass and Biorefinery Systems R&D, but that increase includes $150 million of new funding for a biofuels reverse auction which gives incentives for companies to sell biofuels—advanced biofuels, but something these companies can do today. Given that new program, the request actually decreases funding for biofuels research, development, and demonstration projects.

At face value, the request is a shift from research to deployment of advanced biofuels. Do you believe that cellulosic and other advanced biofuels are now mature enough to shift the Department's programs from research to deployment incentives, as your request has done?

Dr. Kelly. The Biomass Program has invested more than $1 billion in 29 integrated biorefinery projects at various stages of development – R&D, pilot, demonstration, and commercial scales – that could generate a total of more than 170 million gallons of potential biofuels production capacity. Industry partners are matching these federal funds for these projects at an estimated $1.7 billion.

DOE anticipates that by the end of this fiscal year, several commercial and demonstration scale projects selected in 2007 and 2008 will be in construction and operational within 18-24 months after construction commences.

The goal of the Reverse Auction is to assist these facilities by reducing their operation and maintenance cost so that they can be cost competitive with conventional fuels. It is estimated the auction will enable more than 50 million gallons of cellulosic biofuel production by 2014.

The Department continues to support research and development activities that emphasize advanced biofuels beyond cellulosic ethanol – including renewable diesel, gasoline and jet fuel from cellulosic materials as well as from algal feedstocks. The DOE goal is to bring these fuels into a cost competitive range as early as 2017, and facilitate meeting the volumetric goals of the Renewable Fuels

REDUCTION FOR HYDROGEN AND FUEL CELL TECHNOLOGIES

Subcommittee. For the third year in a row, the President's request proposes to reduce funding for the Hydrogen and Fuel Cell Technologies program. Reducing our transportation sector's dependence on oil is an important goal, and we currently have three ways to do it: replacement fuels like biofuels, electric vehicles, and hydrogen fuels.

What is your reasoning for reducing support for one of these pathways while increasing support for the others?

Dr. Kelly. The Department's strategy is to sustain a balanced research and development (R&D) portfolio, with an emphasis on nearer-term priorities, such as batteries, advanced vehicle technologies, and technologies for renewable power and energy efficiency. Fuel cell electric vehicles (FCEVs) are still part of the portfolio of options under development. In fact, DOE's increased funding for battery R&D will also be beneficial for FCEVs which rely on batteries in addition to fuel cells.

The Department will continue its critical efforts in hydrogen and fuel cell R&D, which have already reduced the cost of fuel cells by more than 30% since 2008 and 80% since 2002.[19] In fact, DOE's hydrogen and fuel cell program has been extremely successful, resulting in approximately 200 patents, 30 products being put on the market, and industry currently pursuing development of more than 50 emerging technologies.[20] The FY12 budget sustains DOE's core R&D efforts which will continue to advance the technologies and improve the likelihood of a successful rollout by automobile manufacturers in the coming years.

Subcommittee. What are other countries doing to advance hydrogen technologies, and does the United States risk falling behind by pulling back support for this area?

Dr. Kelly. The United States continues to lead in the development of fuel cell and hydrogen technologies. The Department has invested more than $2 billion over the last decade in fuel cell and hydrogen technologies.[2, 3] Europe and Asia are planning similar levels of investment through 2016,

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[19] http://hydrogen.energy.gov/pdfs/10004_fuel_cell_cost.pdf
[20] http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pathways.pdf

focused on deployment and demonstration of fuel cells and related infrastructure.[4] Department of Energy funding has already enabled fuel cell cost reductions of more than 80% since 2002 and 30% since 2008;[21] and continues to focus on research and development to further improve technology and enable domestic leadership.

Subcommittee. While there are significant market barriers for hydrogen transportation, the technology may lend itself to fleet vehicles. Why is the Department not pursuing that as a way to keep the technology alive and the United States in the lead?

Dr. Kelly. The FY12 budget sustains DOE's core R&D efforts which will continue to advance the technologies and improve the likelihood of a successful rollout of fuel cell electric vehicles (FCEVs) in the coming years. The Department agrees that fleet vehicles offer an opportunity to demonstrate advanced technologies and accelerate early market penetration. For example, DOE has worked with United States Postal Service (USPS), the Environmental Protection Agency (EPA) and the United States Department of Agriculture (USDA) to demonstrate up to six FECVs for potential fleet applications. In fact, USPS gained experience delivering mail using a FCEV and data were collected to validate FCEV technology. The Department also collaborates with the Department of Transportation (DOT) efforts in fuel cell bus fleets to assess critical data that identifies additional R&D needs. Recently, DOE, the Department of Defense (DOD), and other stakeholders partnered to identify opportunities for FCEVs and infrastructure in Hawaii, including fleet vehicles.

Subcommittee. In addition to reducing the overall funding level for hydrogen, the budget request eliminates funding for Market Transformation—a subprogram designed to help get hydrogen vehicles out onto the streets by overcoming infrastructure barriers like the availability of

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[21] http://www.hydrogen.energy.gov/pdfs/10004_fuel_cell_cost.pdf

[2] DOE Hydrogen Program Budget," http://hydrogen.energy.gov/budget.html

[3] Dr. Shailesh D. Vora, "Office of Fossil Energy Fuel Cell Program—Solid State Energy Conversion Alliance (SECA): Clean, Economic Energy for a Carbon Constrained World," National Energy Technology Laboratory, July 2010, www.netl.doe.gov/publications/proceedings/10/seca/Presentations/Vora%20_Presentation.pdf.

[4] http://iphe.net/docs/Resources/IPHE_FINAL_SON_press_quality.pdf)

charging stations. At the same time, the request increases a similar activity for electric vehicles by nearly 800 percent. Why the discrepancy?

Dr. Kelly. The Department agrees with the importance of continued investment in clean energy technologies, including fuel cells, and recognizes the benefit of market transformation activities. In fact, although not reflected in the FY 2012 budget request, the Department invested $43 million under the Recovery Act to enable the deployment of up to 1,000 fuel cells for early market applications such as forklifts and backup power. This additional funding will allow the Department to collect data on the performance and cost of fuel cells for early market applications, deferring market transformation funds until this data becomes available. A number of domestic companies, including the one mentioned above, were recipients of Recovery Act funding. In the mean time, funding is invested in critical research and development to ensure that domestic companies continue to develop their technologies. Other mechanisms such as the investment tax credit and grants in lieu of tax credit (section 1603) allow companies to take advantage of incentives available for commercial deployments.

PRESIDENT'S GOAL FOR 1 MILLION ELECTRIC VEHICLES BY 2015

Subcommittee. The President put forth a goal of 1 million electric vehicles on the road by 2015. While this is certainly a large increase over the current number of electric vehicles, it will barely put a dent in the 135 million automobiles and more than 250 million passenger vehicles on American roads today.

How many electric vehicles need to be on our roads to make a significant dent in our dependence on imported oil, and by what year could that happen?

Dr. Kelly. The one-million vehicle goal is an important milestone for growth of the electric vehicle (EV) market, but it is not considered the end point. Significant additional market penetration is required to realize the technology's full potential and wholly address petroleum consumption and greenhouse gas reductions across the nation's vehicle fleet. Although new vehicles account for more vehicle miles traveled than older vehicles (a vehicle travels nearly 50% of its lifetime miles in the first five years of life), one million vehicles would represent just 0.4% of the vehicle fleet in 2015. If those one million EVs were a 50/50 mix of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles with a 40-mile all-electric range (PHEV40), they would save approximately 11.5 million barrels of oil per year in 2015; twenty million vehicles of the same mix would save approximately 250 million barrels. A number of consumer research organizations, financial institutions, universities, and national laboratories have published studies projecting EV market penetration rates. As noted in a compendium of such studies published by Oak Ridge National Laboratory and Sentech, Inc., the U.S. EV market could reach 20 million vehicles in the 2020-2030 timeframe.[22]

Subcommittee. How much would the funding increases proposed in the Department of Energy's budget request accelerate that timeline?

Dr. Kelly. The goal to have one million electric vehicles (EVs) on the road by 2015 is an important milestone for our national effort to eliminate our dependence on imported petroleum, significantly reduce greenhouse gas emissions, and secure U.S. leadership in the development and use of

[22] Oak Ridge National Laboratory and Sentech, Inc., "A Comparative Study of Emerging Vehicle Technology Assessments," February 2011 (http://info.ornl.gov/sites/publications/Files/Pub27187.pdf).

innovative clean energy technologies. One million EVs is not the end point, however. EVs must achieve market penetration and mainstream consumer use in order to realize those national objectives. The $200 million competitive community grant program included in the Vehicle Technologies budget request would help to overcome initial barriers to early market acceptance and the one million vehicle goal. The increase for electric-drive research and development also included in the Vehicle Technologies budget request is needed to overcome longer-term cost barriers and enable the move from early adopter to mainstream consumer after.

VEHICLE TECHNOLOGY DEPLOYMENT INCREASE, FOCUS ON ELECTRIC VEHICLES

Subcommittee. Among the large clean energy increases requested in the budget, there is a proposal to increase Vehicle Technologies Deployment to $229 million—an 800 percent increase over previous levels. This proposal would focus exclusively on community grants to support the deployment of electric cars, towards the President's goal of putting 1 million electric vehicles on the road by 2015.

The proposed increase focuses not on improving the technologies, but specifically on deployment. Are electric vehicle technologies mature enough for such a focus on getting them out onto the streets?

Dr. Kelly. The proposed competitive community grant program aligns with auto manufacturer decisions to move their electric vehicles from demonstration to commercial sale. General Motors and Nissan began selling the Volt and Leaf, respectively, at the end of last year based on their assessment of technology maturity, and other manufacturers have announced similar commercial rollouts over the next couple of years. The community grant program would support strategic local partnerships to deploy public charging points, streamline permitting processes, and administer local incentive strategies that overcome early market barriers and lay the foundation for continued, robust market growth. By establishing a strong foundation and enabling lasting, local partnerships, the Department believes its support for EV deployment can revert back to traditional levels post-fiscal year 2012.

Subcommittee. If, as you say, electric cars are mature enough for the Department to push onto the streets, then why not propose a corresponding decrease to the research portion of this program?

Dr. Kelly. Although electric-drive vehicles are commercially available today and an increasing number of auto manufacturers have formally announced plans to introduce additional models to the consumer market, these vehicles have a significant price premium. The Department's battery research and development (R&D) activity has made tremendous progress over the last decade, and over the last several years, in particular – decreasing the cost of lithium-ion batteries from $1,300 per kilowatt-hour (kWh) in 2007 to $800/kWh in 2010. We must continue to reduce costs for

electric-drive vehicles to penetrate the market at a level that will contribute significantly to national goals for petroleum use and greenhouse gas reductions. The Department is on track to meet its goal of further reducing battery cost to $500/kWh by 2012 and $300/kWh by 2015. A decrease in R&D funds would slow that pace and hinder the emergence of a mass market for electric-drive vehicles.

Evaluating proposals and choosing regions:

Subcommittee. How will you evaluate proposals for this funding—are there enough markets in the US where deployment on any meaningful scale is possible? Will this be a scattered deployment or will you focus on a limited number of geographic areas?

Dr. Kelly. The Department will select proposals for award using a robust merit review process that involves an independent panel of subject matter experts who carefully evaluate each proposal against the specific criteria published in the funding opportunity announcement. While the specific selection criteria have not been finalized, we envision the following factors as being important to a successful application:

- Does the community have credible plans to overcome permitting barriers?
- Has the community engaged the right partners and key stakeholders to be successful?
- Has the community proposed innovative incentives to promote adoption?
- How is the community using local and private funds to highly leverage the available Federal funds?
- Does the total number of charging points proposed represent a very high value for the funding?

With the amount included in the budget request, we plan to award up to 30 grants to strategic, local community partnerships across the country. Given auto manufacturers' plans to sell electric vehicles in cities across the country, we do not expect to focus on a limited number of geographic areas and instead select projects based on their merit using criteria such as those listed above.

Total investment required to 1 million electric vehicles:

Subcommittee. What is the total cost estimate for the infrastructure necessary to support 1 million electric vehicles? How does that compare to the cost for the infrastructure necessary to support 1 million vehicles of some other technology, such as natural gas?

Dr. Kelly. A number of variables affect the cost of infrastructure for alternative vehicle technologies. Costs vary not only by technology but also by factors including the type of vehicle (light-duty vs. heavy-duty), number of vehicles that can be fueled and the volume of fuel available or type of electric charging (Level 1, Level 2, or DC fast charging), public accessibility (vs. private- or home-access only), and the location in a community and site preparation requirements. In addition, the deployment strategy – regional clusters vs. scattered, nationwide deployment, for example – can affect total cost estimates for national infrastructure deployment. Initially, the focus for electric vehicle (EV) charging will be home charging, for example. If all one million vehicles were consumer vehicles that use Level 1 home charging, which ranges from $800-$1,200 per installation, the total infrastructure cost would be between $800 million and $1.2 billion.

The many variables affecting infrastructure cost also make it difficult to accurately compare costs across different vehicle technologies. However, consumers that choose natural gas vehicles can install home fueling if they have access to natural gas at home, which allows for a cost comparison with EV home charging. Estimates for the purchase and installation of home fueling equipment for a single natural gas vehicle are in the $6,400 range (for new equipment); accordingly, the home-fueling infrastructure to support one million natural gas passenger vehicles would cost approximately $6.4 billion.

Costs for public access stations for multiple light-duty vehicles are much more difficult to compare accurately. Cost estimates for public EV charging equipment and installation can vary widely, from $5,000 to $50,000 per charging point, depending on the type of charging (Level 2 vs. DC fast charging), the location and any required site preparation, as well as other factors. Public natural gas fueling stations, which can support the refueling of multiple vehicles simultaneously, can cost anywhere from $25,000 to more than $1 million, depending on the number of and type vehicles to be fueled/volume of fuel available, required site preparation, and other factors.

Subcommittee. As the Department heard through this month, the Subcommittee is unlikely to have extra funding to add to programs this year. Given that likely constraint, what is the right balance with the Vehicle Technologies program between R&D, and deployment?

Dr. Kelly. Historically, the balance between R&D and deployment has strongly favored R&D. We have departed from tradition with the fiscal year (FY) 2012 budget request and the significant increase for Vehicle Technologies Deployment. We have planned for this level of funding to apply to 2012 only, helping local communities remove initial market barriers and lay the foundation needed to accelerate market acceptance from early adopters to mainstream consumer use. With these strategic community partnerships and a strong foundation in place, however, we expect to revert to out-year budgets with a more traditional balance between R&D and deployment.

VEHICLE IDLING REDUCTION

Subcommittee. One of the focus areas under the Vehicle Technologies Deployment request is idling reduction for commercial trucks and buses.

What exactly does DOE do on this issue? How are DOE's activities distinct from EPA's activities under its SmartWay Transport and National Clean Diesel Campaign programs?

Dr. Kelly. Within the Vehicle Technologies Deployment activity, the Clean Cities initiative promotes a variety of petroleum reduction measures. Typically, in the area of idling reduction, Clean Cities has focused on education, outreach, and tools, while EPA programs have provided grants for equipment and diesel retrofits to address emissions reduction. Local Clean Cities coalitions hold workshops for fleets and transportation managers to raise awareness of idling reduction and available idling-reduction technologies. Clean Cities also publishes the National Idling Reduction Network News, a monthly electronic newsletter with information about related funding opportunities, updates on regulatory matters, news from idling reduction equipment manufacturers, and other related articles of interest. The newsletter reaches more than 1,500 subscribers nationwide; EPA not only provides input to the newsletter but also subscribes and distributes it to stakeholders. In addition, DOE's Alternative Fuels and Advanced Vehicle Data Center includes a truck stop electrification locator to help truck drivers and others find truck stops where they can plug in their vehicles and not idle. Clean Cities and EPA staff meet periodically to share information and have worked together to hold joint workshops. Coordination also takes place at the local level with Clean Cities coalition coordinators who are involved in both Clean Cities activities as well as related EPA programs.

In addition to education and outreach, DOE also supports research and development (R&D) of idling-reduction technologies. Two of the DOE-funded SuperTruck projects are incorporating idling reduction as part of their hybrid systems, and the third SuperTruck team plans to integrate a solid-oxide fuel cell auxiliary power unit into its vehicle system. DOE shares R&D progress achieved through SuperTruck and other heavy vehicle projects primarily through the 21st Century Truck Partnership. The Partnership, which includes four Federal agencies (DOE, DOT, EPA's

SmartWay Partnership, and the Army) and 15 industry members (truck manufacturers, engine companies, and first-tier suppliers), provides a valuable forum for government-industry collaboration and technical information exchange on advanced heavy vehicle technologies, including idling reduction.

BATTERIES RESEARCH OVERLAPPING ACROSS THE DEPARTMENT

Subcommittee. Dr. Kelly, within your office, the budget request increases funding for battery research to $136 million, a $60 million increase, and adds funding in the Solar Energy program for work related to energy storage. Assistant Secretary Hoffman, your office also proposes to increase funding for energy storage research and development to $57 million, more than quadruple its current level. ARPA-E is also funding many projects focusing on batteries and energy storage. And finally, the Office of Science conducts battery-related research across many labs, universities, and Energy Frontier Research Centers, and even proposes a new Energy Innovation Hub on this topic.

Redundancy has been an historic problem across offices at the Department. So has missing opportunities to work together across technologies and across the basic and applied offices. Obviously, change for the better is a tough challenge within this context. Can you describe how you are working to overcome these challenges, using batteries and energy storage as an example?

How were the various levels of funding for each office determined?

Assistant Secretary Hoffman, could you speak to this issue as well?

Dr. Kelly. Speaking for both our offices, the Department of Energy engages in several cross-cutting activities involving collaboration and cooperation between multiple offices and programs. One such activity is research into batteries and energy storage. DOE offices involved with research in energy storage issues have well defined areas and are working in close coordination with each other. For example, with regard to batteries for vehicles, the Office of Science (SC) focuses on the underpinning science that governs the mechanisms of ion and charge transport, chemical reactions, and structural changes in the electrodes, electrolytes, and interfaces of advanced energy storage systems. In addition, SC-supported user facilities develop capabilities for characterizing these phenomena with x-rays, neutrons, electrons, and scanning probes that are then available to the broad research community. The applied energy offices focus on improving the efficiency of lithium-ion batteries via different configurations and materials for cathodes, anodes, separators, electrolytes for automobile market.

Advanced Research Projects Agency-Energy (ARPA-E) directs projects researching new metal-air (lithium-air, zinc-air, etc) battery devices and systems for the automobile market that are ten times better in cost-performance metrics than the lithium-ion batteries of today's vehicles.

The central mechanism for coordination of battery and energy storage-related R&D efforts is the DOE-wide Energy Storage Working Group. Representatives from each program supporting batteries or other energy storage research participate in the group, including the Office of Electricity Delivery and Reliability (OE), which focuses on storage for electricity grid applications, Energy Efficiency and Renewable Energy (EERE), SC's Basic Energy Sciences, and ARPA-E. The group's primary functions are coordination of current research, strategic planning, and linking existing researchers to facilitate information sharing and coordination across the basic science-technology-deployment continuum. This group, which is led by OE's Assistant Secretary Hoffman, meets regularly and supplements the collaboration between the various programs, which has included joint workshops, mutual participation in peer reviews, cooperation/coordination of Small Business Innovative Research Program solicitations, and joint principal investigator meetings. All of these actions ensure a thorough mutual understanding of the work funded by each office and drive proper delineation and separation of research and goals.

The Batteries and Energy Storage Hub will also provide a nucleus of activity for the entire fundamental energy storage research community. Establishing a focused energy storage research effort with the size, scope, and duration of an Energy Innovation Hub will garner long-term commitment from the most innovative researchers in this field. The DOE Energy Storage Working Group will help facilitate the flow of data and information from the technology programs to the Hub. To ensure integration within the broader DOE-supported community, the Hub will be a full participant in principal investigator meetings focused on energy storage and related scientific topics. In addition, the Hub will be managed by the same team that manages the Energy Frontier Research Centers (EFRCs) focused on energy storage, enhancing technical interactions with the EFRCs.

In formulating the FY 2012 request, the Department undertook a thorough analysis to determine what levels of funding were appropriate. Investments in the FY 2012 request reflect a clear and deliberate strategy to support the areas with the most direct impact on the energy, security and environmental

missions of the Department. Energy storage research and development is one of those areas that can achieve the Department's goals by buffering the electric grid, maintaining its stability and increasing its reliability. Energy storage can also help integrate variable renewable generation into the grid and can help facilitate wide deployment of electric vehicles.

SUNSHOT INITIATIVE

Subcommittee. The Administration has made many announcements about its Sunshot initiative in the last couple of months. I understand that the initiative aims to reduce the cost of solar energy, but what's unclear is whether this initiative constitutes a real change to Department of Energy programs or just a new name for ongoing work.

Can you clarify how this program changes the Department of Energy's programs? Is it simply a name put to existing programs and activities? Or is it a name put to funding increases proposed in the budget request?

Dr. Kelly. The SunShot Initiative represents a significant change to the Department's pursuit of photovoltaic (PV) and other advanced solar technologies and reduction of electricity from these technologies. To date, significant progress has been made in PV module cost reduction as a direct result of DOE funding. However, even at the current rate, it is projected that full unsubsidized cost parity of electricity from complete PV systems could require 10 to 20 years to achieve. This is partially due to the fact that the cost of non-module or balance of system (BOS) components of PV systems has not kept up with PV module cost reductions. At the same time, the U.S. has lost significant global share for the manufacture of PV cells and modules, falling from approximately 45% of the world market to 5% over the last 10 years. In some cases, innovative new technologies developed here in the U.S. have ended up being manufactured overseas, preventing the U.S. from taking part in the job growth from this new industry.

The SunShot Initiative has been designed to address these issues with a renewed focus on cutting edge R&D across multiple technologies and all parts of the research and development spectrum. Specifically, the goal of the SunShot program is to reduce the total cost of installed solar systems by 75% by the end of the decade to enable electricity from solar to be competitive with that from conventional generation ($0.05 - $0.06 / kWh) sources without subsidy. Unlike previous DOE programs, the SunShot Initiative stretches across the Department, linking relevant research activities in the Office of Science and ARPA-E with those within the Solar Energies Technology Program to ensure all the Department's resources are efficiently focused on this important goal. Intradepartmental SunShot activities are guided by a SunShot board consisting of Assistant Secretary or equivalent representatives from each relevant DOE office. The SunShot initiative is

also placing a strong emphasis on BOS cost reductions, both those related to hardware and installation improvements as well as those related to permitting, inspection, and interconnection (i.e., "soft"costs) of solar systems. The SunShot Initiative is also working to address critical issues related to U.S. manufacturing competitiveness and ensuring that the U.S. establishes a robust solar manufacturing industry. The Administration recently announced over $100M in awards for SunShot Advanced Manufacturing Partnerships that would establish a series of industry consortiums, partially modeled after the highly successful SEMATECH consortium for the U.S. semiconductor industry. As part of the SunShot Initiative, communication with industry is being accomplished through a series of workshops that allow intense discussion and rapid feedback on important topics. Since August of 2011, the SunShot Initiative team has held 6 of these workshops which have resulted in a number of new funding opportunities with industry.

To lead the SunShot initiative, Secretary Dr. Steven Chu has personally selected Dr. Ramamoorthy Ramesh from the University of California, Berkeley. Dr. Ramesh is the Plato Malozemoff Chair Professor in Materials Science and Physics. He has made landmark contributions in the field of ferroelectric thin films and in 2009 was elected Fellow of the Material Research Society. He is the recipient of the 2010 American Physics Society's McGroddy New Materials Prize and was recently elected into the National Academy of Engineering.

Subcommittee. How much funding is the Administration proposing to spend on Sunshot across the Department of Energy in fiscal year 2012?

Dr. Kelly. To reach these very aggressive goals and to help US companies compete in the global market, activities are being coordinated across the DOE between the Solar Energy Technologies Program (SETP) within Energy Efficiency and Renewable Energy (EERE) as well as the Basic Energy Science (BES) and the Advanced Research Projects Agency Energy (ARPA-E). The FY12 budget request for SunShot activities includes the entire budget request for SETP of $457M. BES work that is directly related to SunShot is about $8M. ARPA-E activities related to SunShot are about $10M in FY12. In aggregate this is about $475M dedicated to SunShot activities at the DOE.

Within the SETP budget request contains $125M for manufacturing focused activities such as the SunShot Advanced Manufacturing Partnerships (formerly named PV Manufacturing Initiative) aimed at strengthening domestic PV manufacturing technology. Also included in the budget request is $26M for the Incubator Program. This very successful program has made a total of $59M in awards to 24 companies since it was started in 2007. Those companies have been able to raise and leverage a total of over $1.3B in private capital and have created over 1,200 direct jobs in the US. These are precisely the types of programs that can help create new jobs and new manufacturing capacity in the US to reinvigorate the economy.

Subcommittee. How are other federal agencies participating? How much funding are they requesting, in addition to Department of Energy funding?

Dr. Kelly. As stated under section a), the SunShot Initiative stretches across the Department of Energy, linking relevant research activities in the Office of Science and ARPA-E with those within the Solar Energies Technology Program to ensure all the Department's resources are focused on this important goal. DOE is also reaching out to other Federal agencies to leverage their related activities within the SunShot Initiative. As an example, NSF has currently committed to $6M in funding over the next 3 years to support early stage research that will be conducted principally through colleges and universities. DOE is also exploring activities within the Department of Defense, National Oceanic and Atmospheric Administration, the National Institute for Science and Technology, and the General Services Administration that could support the SunShot Initiative. At this time, none of these potential activities are anticipated to require separate budget requests from these agencies but rather be accomplished through their existing funded programs.

INCREASE FOR SOLAR PHOTOVOLTAIC RESEARCH AND DEVELOPMENT

Subcommittee. Dr. Kelly, the Administration's 2012 budget request for Solar Energy nearly triples Photovoltaic Research and Development, a $211 million increase, while it increases a different kind of solar technology, concentrating solar power, by only about, well, $1 million. This strikes me as strange, since when we look at the 2011 budget request, it does the opposite: Photovoltaic R&D sees only an 18 percent increase, but you nearly double concentrating solar power.

With the same Administration, the same Secretary, the same President, and no enormous breakthroughs for either of these technologies that I know of, what changed? Why did your priorities within the Solar Energy program reverse?

Dr. Kelly. The Administration's 2011 budget request for CSP included $50M for a Solar Demonstration Zone which would help validate cutting edge Concentrating Solar Power (CSP) and other concentrating solar technologies. This was in addition to a base CSP R&D program of approximately $50M. As of January 2011, the Congress had not acted on the Administration's request nor passed its own budget for 2011. The Administration therefore did not seek additional funding for the Solar Demonstration Zone project in 2012 as it is unlikely that these funds could be fully utilized in 2012 if funds were also provided through the 2011 budget. The request for base CSP R&D for 2012 is consistent with the request in 2011. As part of the 2012 budget request, the Administration announced also its SunShot Initiative which seeks to reduce the cost of electricity from solar technologies by 75% without subsidy by the end of the decade to be competitive with conventional generation sources of electricity. The Administration believes this is an ambitious but achievable goal if supported by adequate funding. For 2012, the Administration's funding request for the SunShot Initiative has been largely designated through the Photovoltaic Research and Development subprogram. We believe, however, that CSP technologies also represent the potential to reach the SunShot Initiative goals and are assessing this as part of our future budget requests.

ENERGY INNOVATION HUB FOR CRITICAL MATERIALS

Subcommittee. Dr. Kelly, the budget request proposes to establish in 2012 a new Energy Innovation Hub focusing on critical materials.

The request proposes $20 million for the Critical Materials Hub, a lower amount than the $34 million requested for the first year for previous Hub proposals. What rationale did you use to request a lower amount for this particular Hub?

Dr. Kelly. The three original hubs were funded at $22M in the initial year, and DOE has requested the Critical Materials Hub be funded at a similar level.

Subcommittee. As proposed, the hub will focus both on enhancing the production of critical materials, and on developing clean energy technologies that do not rely on these materials at all. These two focuses seem to be entirely different, from a technological standpoint. Do you risk diluting each effort by trying to accomplish both? Will $10 million be enough for each task, or are you biting off more than you can chew?

Dr. Kelly. The Hub will solicit proposals on ways to reduce the use of critical elements in existing components and to identify new compositions and approaches that are not reliant on them. DOE also plans to solicit proposals on technologies that decrease the cost of separating critical elements from recycle streams and ores. The Hub will be awarded through a competitive process, and it is expected that it will focus on a single approach to addressing our reliance on critical materials for clean energy technologies.

Subcommittee. There are many, many technological applications for this broad category of materials that affect energy technologies, defense technologies, and the computer industry, among others. Will the Hub focus on materials only as they apply to renewable energy and energy efficiency applications—such as those used in motors and batteries?

Dr. Kelly. While the Hub will focus on critical material dependencies related to clean energy technologies, the research done within the Hub will be applicable across many manufacturing industries.

Subcommittee. Within the clean energy—your purview—how will you choose critical materials to focus on, and therefore which clean energy technologies to help?

Dr. Kelly. The Department recently released a Critical Materials Strategy. The strategy analyzed fourteen elements, identifying five rare earth metals (dysprosium, neodymium, terbium, europium and yttrium) as well as indium as most critical based on importance to clean energy technologies and supply risk. These six elements were identified as "critical" with supply disruptions possible within the next 5 years. The DOE Critical Materials Strategy will serve as a logical foundation for the new Hub.

OFFSHORE WIND FUNDING INCREASE

Subcommittee. Dr. Kelly, the Department proposes to increase funding for Offshore Wind to $63 million—and according to the Department's budget request, Offshore Wind received no funding in fiscal year 2010. That increase is in fact the entire increase proposed for the Wind Energy program.

What is the current state of offshore wind? Do we have any offshore wind projects either in operation or under construction in the United States?

Dr. Kelly. There are currently no offshore wind projects in operation or under construction in the United States, although 13 commercial projects in nine states, representing a cumulative generating capacity of 2.5 gigawatts, are planned and have made significant progress through pre-construction planning, siting, and permitting processes.

Offshore wind energy technology has been successfully demonstrated and commercially deployed in Europe for over a decade. A robust offshore wind energy industry has arisen in Northern Europe, where over 900 offshore wind turbines representing a cumulative generating capacity of close to 3 gigawatts have been installed, 3 gigawatts of capacity is under construction, and 20 gigawatts of capacity has been permitted, representing a total investment of approximately $105 billion. China's first offshore wind facility, a 102 megawatt capacity project using domestically-produced turbines, entered service in 2010. China and South Korea have both made commitments for large-scale offshore wind development in the coming decade. The strong growth in this sector over the past few years has triggered substantial economic activity in these countries through the manufacturing, construction, and maintenance of offshore wind power projects. At least 11 U.S. states, aware of the potential to realize similar economic benefits in conjunction with sustainable energy goals, have developed aggressive offshore wind energy initiatives.

The United States has considerable market potential for offshore wind energy, as evidenced by strong stakeholder interest in the National Offshore Wind Strategy released by the Department of Energy and Department of the Interior on February 7, 2011. DOE's National Renewable Energy Laboratory has found that developing the nation's offshore wind energy resources could deliver substantial amounts of clean electricity to U.S. consumers, especially

in transmission-constrained coastal areas with high energy costs, while creating thousands of jobs and stimulating billions of dollars in new economic activity.

Subcommittee. What are the main barriers to harnessing offshore wind energy? How does the budget request target those specific barriers?

Dr. Kelly. The Department of Energy's National Offshore Wind Strategy identifies three main barriers to the large-scale deployment of offshore wind energy in the United States: the relatively high current cost of offshore wind energy due to lack of market volume and technology refinement; technical challenges surrounding development of the new infrastructure needed for installation, operations, and grid interconnection of offshore wind systems; and the lack of site data and experience with project permitting processes.

The Technology Development section ($28 million) of the Department's Offshore Wind budget request will focus primarily on reducing the cost of offshore wind energy by funding the development of innovative wind turbine design tools and hardware needed for the long-term development of optimized, cost-competitive offshore wind systems. These activities are expected to help lower offshore wind project capital costs, maximize energy capture from offshore turbines, increase the reliability of offshore wind operations, and facilitate the development of integrated offshore wind systems optimized for U.S. offshore conditions.

The Market Barrier Removal section ($8 million) of the Department's Offshore Wind budget request will focus on the technical infrastructure challenges facing offshore wind deployment and on increasing the efficiency of the offshore wind deployment timeline. For example, the Department plans to undertake studies on the integration of offshore wind power into the bulk electric power system, conduct assessments of the nation's port infrastructure and its suitability for offshore wind construction, gather baseline environmental data needed for efficient project permitting, and gather meteorological data to better understand offshore winds and waves and their effects on turbine operation and energy production.

The Advanced Technology Demonstration Projects section ($27 million) of the Department's Offshore Wind budget request is expected to help address the lack of site data and experience with permitting processes by providing

funding and technical assistance to accelerate the responsible deployment of competitively-selected offshore wind projects. The Department also plans to implement a testing and analysis initiative at the chosen demonstration project sites that will enable rigorous prototype testing and performance validation of wind turbines and support structures in an offshore environment.

Subcommittee. There has been some intense debate about the location and siting of offshore wind projects in the last ten or more years. The budget request proposes $12 million for demonstration projects—does the Department intend to wade right into these debates?

Dr. Kelly. The Department's proposed offshore wind demonstration projects are intended to validate the technical and commercial viability of offshore wind technologies in U.S. waters. The Department plans to provide funding, technical assistance, and government coordination to advance innovative designs such as floating platforms for deepwater deployment. The success of these demonstration projects is expected to contribute to stakeholder understanding and acceptance of offshore wind and help improve industry familiarity with the regulatory regimes for planning, siting, and permitting offshore wind projects. The Department plans to strongly consider the degree to which the project has already made progress in siting, permitting, and environmental compliance during the selection of potential demonstration project partners. Partnering with projects that have made demonstrable progress in siting and permitting would help ensure that the Department's funds and assistance are used to accelerate projects in the most rapid and responsible manner possible. The Department also plans to create a testing and analysis program at the chosen demonstration projects to collect data and validate the performance of new technologies in a real-world environment. As a result, these demonstration projects would provide real-world data that stakeholders can use to evaluate other potential offshore wind projects in U.S. waters.

INCREASE FOR INDUSTRIAL TECHNOLOGIES NEXT GENERATION MATERIALS

Subcommittee. Dr. Kelly, the budget request creates a new $100 million Industrial Technologies program called "Next Generation Materials" to develop new materials that use less energy or can withstand extreme conditions. Unfortunately, the budget request only includes about half a page of text to explain and justify this new program.

Can you please explain the goals of this program, and the specific types of materials it will develop?

Dr. Kelly. This activity has the potential to achieve breakthroughs in materials science and engineering to enable engineered material properties to deliver order-of-magnitude improvements (e.g., tenfold lifetime extension) in components; and invent novel, cost-competitive materials and products (e.g., nanomaterials, new cements) to support the low-carbon economy. Low-embedded energy materials are a key enabler for the development of clean energy technologies and other products with low life cycle energy requirements. The development of novel materials with unique performance properties, as well as materials that can be produced at very low cost will open up new markets for clean energy technologies and other products.

This activity would provide funding for new R&D to develop the novel materials required to support next-generation energy-efficient manufacturing processes and clean energy (green) manufacturing. New projects would be selected competitively to develop key materials and processes that are central to energy systems, such as inexpensive carbon fibers, new cement technologies, low-cost titanium fabrication, and biomimetic materials. Projects would focus on coatings, thin films, and electrochemicals that require functional surface interactions; other high-performance materials, such as ceramics, engineered polymers, and metallics that operate in extreme environments; and multi-materials, such as composites and smart materials, for incorporation into energy systems.

The funding request also includes support for an *Energy Innovation Hub* ($20.0M) on critical materials which would focus on reducing U.S. reliance on materials like the rare earth elements needed in today's advanced electric motors and the phosphors needed for solid-state lighting. The Hub team would focus on finding ways to reduce use the content of such critical

elements in existing components and to identify new compositions and approaches that are not reliant on them. DOE intends also to pursue technologies that decrease the cost of separating critical elements from recycle streams and ores. This proposed Hub is a logical response to the DOE Critical Materials Strategy document released in December 2010, which provided a foundation for future action.

Subcommittee. What types of organizations will receive these grants? Industrial companies? Universities? National laboratories? If a mix, what proportions of each?

Dr. Kelly. Multiple types of organizations are envisioned to receive grants under this new subprogram, and awardees may include industrial companies, universities, national laboratories, and research institutes. Grants would be competitively selected from Funding Opportunity Announcements with limited eligibility restrictions. While industrial participation may be encouraged, no specific distribution of performers is predetermined. The proposed Critical Materials Hub would be a collaborative team comprised of multiple types of organizations.

Subcommittee. Developing materials that can handle extreme conditions, such as ceramics, seems like a very different goal than developing materials that use less energy to produce, such as cements. Why is this program proposing to do both?

Dr. Kelly. Materials are a key enabler for industrial productivity, providing breakthroughs which contribute to American manufacturing processes that are better, faster, less expensive, and therefore more competitive. Novel, cost-competitive manufactured products are also necessary to support the low-carbon economy.

Regardless of the material solution being developed, cost and performance characteristics will not be compromised. The focus of the Next Generation Manufacturing sub-program is to develop new ways of making materials. Some of these new routes will be to enhance performance of the final product (e.g., result in materials suitable for extreme environments), while others will be to drive down cost and lower embedded energy of existing products.

Subcommittee. For this program, the budget request emphasizes "breakthroughs in materials science and engineering". Would this program be a better fit in the Office of Science or ARPA-E, accounts that focus on more basic innovations and breakthroughs? What thought process did the Department use to place this program in this office—an office that focuses more on incremental technological improvements rather than in other possibly more appropriate Department accounts?

Dr. Kelly. EERE is constantly working to deliver breakthroughs to the market in order to save energy, create jobs, and enhance U.S. competitiveness. The next generation materials subprogram will build on recent ITP materials work funded by the Recovery Act and the Industrial Energy Efficiency Grand Challenge research solicitation. ITP's Next Generation Materials sub-program is different from activities in Office of Science and ARPA-E in that it focuses on new materials that have unique performance characteristics, are economically viable, and have low embedded energy. Particular emphasis will be placed on lifecycle energy requirements; for example, on reducing the amount of embedded energy in high performance materials used for vehicle light weighting and other applications that improve energy efficiency at the end use stage. EERE recognizes the importance of other materials work being conducted within the Department, and the ITP materials efforts will be managed in close collaboration with DOE's Office of Science and ARPA-E to maximize effectiveness and impact.

NEXT GENERATION MANUFACTURING PROCESSES

Subcommittee. The Administration proposes a new Industrial Technologies program, Next General Manufacturing Processes, for which the budget requests $129 million, a 143 percent increase over comparable activities currently funded at the Department.

As with the proposed Next Generation Materials program, this new program only gets about half a page of justifying explanation in the budget request. Can you explain the goals of this program?

Dr. Kelly. In his recent State of the Union speech, President Obama laid out a plan for the United States to win the future by out-innovating, out-educating and out-building the rest of the world. The EERE FY 2012 budget request is aimed at accelerating innovation and change in the Nation's energy economy, and the Next Generation Manufacturing Processes program is a major component of the Industrial Technologies Program's (ITP's) expansion within the EERE FY 2012 request; which supports revitalization of the manufacturing sector.

This activity includes a refocusing of existing Industries of the Future Crosscutting activities and the initiation of new R&D to provide energy-intensive industries with accelerated access to Next Generation Manufacturing Processes. This activity has the potential to develop next-generation technologies that enable companies to rapidly produce energy-efficient, competitively priced, high-quality products that would rejuvenate U.S. manufacturing and stimulate job growth.

R&D will focus on developing new production systems, including innovative bioprocessing techniques that mimic the low-emission, low-temperature fabrication methods of living systems; high-performance catalysts and separations; nano-scale manufacturing and processing; next-generation computational tools, including computational modeling, advanced characterization, and integrated sensor and process control systems; and smart process manufacturing.

Subcommittee. What types of organizations will receive these grants? Industrial companies? Universities? National laboratories? If a mix, what proportions of each?

Dr. Kelly. Multiple types of organizations are envisioned to receive grants under this new subprogram, and awardees may include industrial companies, universities, national laboratories, equipment suppliers, and research institutes. Grants will be competitively selected from Funding Opportunity Announcements with limited eligibility restrictions. While industrial participation may be encouraged, no specific distribution of performers is predetermined.

WATER POWER PROGRAM REDUCTION

Subcommittee. Dr. Kelly, within your office, the Water Power research and development program is one of the few research programs whose funding is reduced in the budget request. And yet we hear that other countries are moving forward developing ocean-based energy technologies and constructing pilot plants. We even hear that ocean-based energy could account for up to 10 percent of United States electricity if we overcame technological hurdles.

Why reduce this program when proposing record increase for nearly every other program under Energy Efficiency and Renewable Energy?

Dr. Kelly. The Department remains optimistic about the opportunities to further develop the full range of water power technologies, including both emerging marine and hydrokinetic (MHK) energy technologies as well as increasing generation from our nation's hydropower resources. We believe that the $38.5 million requested for water power research in FY2012 is sufficient to continue the program's ongoing efforts to advance these technologies and accelerate their greater market adoption. We are currently completing a comprehensive set of water power resource assessments and undertaking detailed techno-economic assessments of emerging MHK technologies, which will help us to effectively determine the opportunities and costs associated with these new technologies. These important analyses will help the Department determine what funding levels are necessary and appropriate to realize the full potential of MHK in the United States.

Subcommittee. Why is ocean-based energy different than, for example, offshore wind power or geothermal power that warrants you to reduce its funding while increase support for those others?

Dr. Kelly. The FY 2012 request upholds the President's goals to develop America's competitive edge through strategic investments in our nation's clean energy infrastructure. The need to exercise budget restraint forced some tough decisions across the Department in FY12, as well as in the Water Power Program. Although the funding request for the Water Program was reduced from FY11, the Department is optimistic about the opportunities to further develop emerging marine and hydrokinetic (MHK) energy technologies, including wave and tidal energy technologies. We believe that the $38.5 million requested for water power research in FY2012

is sufficient to continue the program's ongoing efforts to advance industry development and export capability of MHK technologies. We are currently completing a comprehensive set of resource assessments and undertaking detailed techno-economic assessments of emerging technologies, which will help us to effectively determine the opportunities and costs associated with these technologies. These important analyses will help the Department determine what funding levels are necessary and appropriate to realize water power's potential.

Subcommittee. What percent of our nation's electricity do you believe could come from ocean-based water power?

Dr. Kelly. Marine and hydrokinetic (MHK) energy technologies present a substantial opportunity for the United States to develop a new suite of renewable technologies. In a March 2007 report, the Electric Power Research Institute (EPRI) conservatively indicated that MHK power from wave and tidal resources (not including ocean thermal energy) could provide an additional 13 GW of capacity by 2025.[23]

DOE is currently completing a comprehensive set of ocean-based water power resource assessments, as well as undertaking detailed techno-economic assessments of emerging technologies. These assessments are to help us to effectively determine the opportunities and costs associated with these technologies. DOE is currently funding detailed MHK resource assessments for wave, tidal, ocean current, in-stream hydrokinetic, and ocean thermal energy resources. These assessments, which are being reviewed by the National Academy of Sciences, are to help us determine the maximum extractable energy (theoretical limit), and to calculate the technically extractable energy (based on key parameters such as achievable energy conversion rates, current and/or future technology performance, and device spacing), while also considering seasonal variability of resources and critical site-specific characteristics. Although the initial data are preliminary, DOE is encouraged by the initial findings of these assessments. The preliminary findings support our initial assumptions that MHK can be an effective contributor to Nation's clean energy goals. We do not yet have the data necessary to accurately predict the percent of the Nation's electricity that could come from ocean-based water power resources.

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[23] http://www.aaas.org/spp/cstc/docs/07_06_1ERPI_report.pdf

Subcommittee. What are the major barriers that prevent us from harnessing ocean-based energy? How could Departmental support help us overcome these barriers?

Dr. Kelly. Ocean-based energy technologies represent a still-nascent and evolving industry sector. With well over 100 different and distinct technology types, it is difficult to accurately assess the cost of electricity, and as such it is unclear how the eventual technology leaders will compete with other energy generation options. Furthermore, we need to accurately assess the potential ocean-based energy resource in the United States. The Department of Energy is currently funding five national resource assessments to better quantify the potential size of the ocean-based energy resource, and is undertaking a comprehensive technical and economic assessment of marine and hydrokinetic (MHK) technologies to help us best determine the appropriate role for MHK technologies in our domestic renewable energy portfolio.

Considering the wide range of potential technologies, the consideration and assessment of potential environmental impacts are also important. The Department is sponsoring numerous environmental studies and assessments to ensure that we develop this technology in an environmentally sustainable manner.

Given the nascent state of the industry, developers also face a regulatory and permitting framework in the United States that is evolving over time and is different from the framework in place in other countries. The Department of Energy is working with MHK project developers and appropriate agencies to provide data to help inform and, where appropriate, assist in increasing the efficiency of these regulatory processes.

WATER POWER OVERLAP WITH FEDERAL WATER AGENCIES

Subcommittee. The Army Corps of Engineers and the Bureau of Reclamation own and operate a significant portion of the nation's hydroelectric facilities and have worked on environmental mitigation issues, such as fish ladders, as well as analyzing the potential for expanding generation.

What kind of coordination exists between DOE, the Corps and the Bureau to ensure that DOE's water power activities are complementary rather than duplicative?

Dr. Kelly. In March 2010, a Memorandum of Understanding (MOU) for Hydropower was signed by the Departments of Defense (Army Corps of Engineers), Interior (Bureau of Reclamation) and Energy to promote collaborative efforts focused on increasing energy generation from Federal hydropower facilities while reducing environmental impacts. The three agencies have a close working relationship and participate in a bi-weekly phone conference to coordinate efforts and keep all parties up to date on the MOU activities and establish partnerships aimed at advancing opportunities to maximize hydropower generation at federal facilities.

Coordination and communication allow the agencies to avoid redundancies and duplication in their work. For example, the Inland Federal Hydropower Working Group, which includes DOE, the Corps, and the Bureau as well as other governmental parties, establishes coordinated research efforts in order to avoid duplication. Furthermore, DOE and the Bureau co-funded a topic in a Funding Opportunity Announcement for Advanced Hydropower Development (DE-FOA-0000486, released on April 5, 2011) for cost-shared advanced technology system testing of new small hydropower technologies at Bureau of Reclamation sites.

Subcommittee. Are you planning any work on Federal dams?

Dr. Kelly. Yes, DOE is working with the Department of Defense's U.S. Army Corps of Engineers and the Department of the Interior's Bureau of Reclamation in a cooperative and coordinated effort to identify hydropower resource potential and promote hydropower technology research, development and deployment at existing federal facilities under the framework of the Memorandum Of Understanding (MOU) for Hydropower

signed in March 2010. The three agencies are working in a collaborative manner to help develop hydropower resources at federally-owned dams and waterways. While the owners and operators of such facilities (including the Corps of Engineers and Bureau of Reclamation) have ultimate responsibility for final plans and developments at their respective locations, DOE works closely with them when it is appropriate. For example, on April 5, 2011, DOE released a Funding Opportunity Announcement for Advanced Hydropower Development (DE-FOA-0000486) that seeks to promote advanced technology system testing at Federal and non-federal sites including Federal Dams and constructed waterways.

Subcommittee. If so, why? Shouldn't that be a responsibility of either the Corps or Reclamation?

Dr. Kelly. DOE's role in conventional hydropower is to sponsor critical research, development and deployment of advanced hydropower technologies to maximize generation at federal and non-federal facilities. This responsibility, combined with the fact that the Corps and the Bureau manage about 1/3 of the nation's hydropower capacity, provides a unique opportunity to leverage our collective assets and abilities in order to maximize hydropower generation in the United States. DOE's involvement is expected to catalyze development at near-term opportunity sites within the federal infrastructure owned by the Corps and Reclamation that may otherwise go unrealized, with the full recognition that the Corps and Reclamation have full jurisdiction over all work performed at their respective facilities.

ENERGY SYSTEMS INTEGRATION FACILITY AT NREL

Subcommittee. The budget request does not propose any funding for the Energy Systems Integration Facility at the National Renewable Energy Laboratory.

Dr. Kelly, I assume this means that the facility has been fully funded and no further appropriations are required for construction to be completed and the building to be fully equipped?

Dr. Kelly. With the operating plan for FY11, DOE intends to provide the final funding installment necessary to complete the facility. Construction has begun and the facilityshould be completed by the end of 2013.

Subcommittee. What is the status of this project? Has construction begun? By what year will the facility be finished?

Dr. Kelly. The preliminary design for the ESIF project is complete; $9m has been invested in the design phase. The project's cost, scope, and schedule baselines were validated by DOE's Office of Engineering and Construction Management. Accordingly, the EERE recommended approval of Critical Decision-2/3, Final Design and Construction Start to the Under Secretary of Energy who serves as Acquisition Executive for the project. The Under Secretary approved Critical Decision-2/3 authorizing construction start contingent upon resolution of the FY11 budget. The contractor plans to break ground in early May and the ESIF could be completed in late calendar year 2013.

Subcommittee. Why has the Department not begun construction of this facility? When roughly $100 million of funding has previously been appropriated for this purpose, why is the Department not moving forward?

Dr. Kelly. With the operating plan for FY11, DOE intends to provide the final funding installment necessary to complete the facility. Groundbreaking is scheduled for early May 2011, and the facility should be completed by the end of 2013.

Subcommittee. Can you give the Subcommittee an idea of what types of research will be performed at this facility? What kinds of innovations can we expect to come out of the ESIF?

Dr. Kelly. ESIF would be the nation's primary systems testing, validation, and integration laboratory that would enable the capability critical to identifying, assessing, and mitigating the technical and financial risks inherent to a high percentage of renewable energy into the grid. ESIF's design, which couples advanced computing simulations with hardware testing and validation will significantly reduce EERE's experimental cycle time and better focus and leverage R&D investments nationwide. Currently, no such capability exists in the nation to evaluate integrated systems (electricity, thermal and fuels) at a scale commensurate with the nation's energy needs. Without ESIF transformation of the nation's energy infrastructure to include the widespread deployment of domestic, secure renewable resources will be severely impacted.

BUILDING EFFICIENCY ENERGY INNOVATION HUB

Subcommittee. Dr. Kelly, your office oversees two of the three Energy Innovation Hubs first funded by the Congress in fiscal year 2010. The hub I'd like to discuss for a moment focuses on Energy Efficient Building Systems Design. The Congress first funded the Hub in October of 2009. It's currently the end of March, 2011—17 months later. As many would say the Hubs have been one of the Department's top-priority proposals, I'm sure the Subcommittee looked forward to swift and significant progress.

When did the Hub's staff move into their final office building?

Dr. Kelly. The Buildings Hub is a consortium of 22 organizations (universities, companies, and National Laboratories) led by the Pennsylvania State University, known as the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings. The primary staff who conduct the work of the Hub are lead investigators (at least one from each participating organization), supplemented by other researchers, students, technicians, and support staff. Many (though not all) of these individuals currently work in the Hub's temporary headquarters, Building 100 at the Philadelphia Navy Yard. One of the Hub's primary tasks during FY11 will be to retrofit an adjacent abandoned building (Building 661) to serve as the permanent Hub headquarters, while demonstrating advanced, integrated energy-efficient retrofit design. Design is underway and this is scheduled to be completed in Q1 2012.

Subcommittee. How many employees have been hired at the Hub? How many will ultimately be there once it is fully staffed?

Dr. Kelly. The Buildings Hub is a consortium of 22 organizations (universities, companies, and National Laboratories) led by the Pennsylvania State University, known as the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings. The primary staff who conduct the work of the Hub are lead investigators (at least one from each participating organization), supplemented by other researchers, students, technicians, and support staff. These individuals are employed by their respective organizations, but spend significant amounts of their time working on Hub tasks.

Subcommittee. How many different organizations employ the staff that have or will join the Hub? Will all of these people be located at the hub 100 percent of the time? What percentage of their time, on average, will be spent at the Hub?

Dr. Kelly. The Buildings Hub is a consortium of 22 organizations (universities, companies, and National Laboratories) led by the Pennsylvania State University, known as the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings. The primary staff who conduct the work of the Hub are lead investigators (at least one from each participating organization), supplemented by other researchers, students, technicians, and support staff. These individuals are employed by their respective organizations, but spend significant amounts of their time working on Hub tasks. On average, the lead investigators will spend 60-80% of their time (3-4 days a week) at the Hub, with their remaining time at their home organization.

Subcommittee. One of the Secretary's main selling points for Hubs was that they would locate top experts from all types of science and technology areas "under one roof" to solve a common problem. It seems like that particular vision is not being implemented with this Hub. When did that vision change?

Dr. Kelly. The Secretary's vision is being fully implemented by the Energy Efficient Building Systems Design Hub. The Buildings Hub is a consortium of 22 organizations (universities, companies, and National Laboratories) led by the Pennsylvania State University, known as the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings. Many (though not all) of these science and technical experts involved in the Hub currently work in the Hub's temporary headquarters, Building 100 at the Philadelphia Navy Yard. One of the Hub's primary tasks during FY11 will be to retrofit an adjacent abandoned building (Building 661) to serve as the permanent Hub headquarters, while demonstrating advanced energy-efficient retrofit design. This facility will locate these experts "under one roof." This is scheduled to be completed in Q1 2012.

Subcommittee. Dr. Kelly, the goals of some of the Hubs are easy to point to. The Fuels from Sunlight hub aims to make a device you put in sunlight and drips car fuel out the other end. Though increasing energy

efficiency of our buildings is important, it's a little less clear what the Hub actually aims to do. What one real thing is this Hub aiming to produce?

Dr. Kelly. While a number of individual energy technology components for buildings are currently available, they are rarely used by architects and builders in an optimal way. This is because the process by which buildings are designed, built, operated, and retrofitted is disjointed; there is a lack of computer-design tools and data systems to integrate this process and ensure that individual technology components (HVAC, lighting, wall systems, etc) work together to achieve their design efficiencies. Using advanced computer modeling capabilities originally developed at Lawrence Livermore National Lab (a Hub partner) for nuclear weapons simulation, the Hub will develop computer-design tools to enable both designing and operating buildings in a fully integrated manner. In FY11, the Hub will demonstrate an initial use of these tools by retrofitting an abandoned, 30,000-square-foot building at the Philadelphia Navy Yard (Building 661), which will then serve as the permanent Hub headquarters. Beginning in FY12, the Hub will conduct retrofit demonstrations at other buildings in the Philadelphia Navy Yard, using increasingly advanced technology components. Ultimately, the Hub will provide the design tools and demonstrated processes to enable the architectural and engineering community to routinely design, build, operate and retrofit buildings in a fully integrated manner.

Subcommittee. The Administration decided to associate the Hubs with a federally funded Regional Innovation Cluster. How has this changed the goals and approach of the Hub? Hubs are meant to perform nationally-beneficial research, while the clusters are meant to develop local economies. Are these two concepts compatible?

Dr. Kelly. The Buildings Hub is a consortium of 22 organizations (universities, companies, and National Laboratories) led by Pennsylvania State University, known as the Greater Philadelphia Innovation Cluster for Energy-Efficient Buildings. It serves as the anchor of a larger federal initiative, the Energy Regional Innovation Cluster (E-RIC). Under this initiative, three other federal agencies (the Department of Commerce's Economic Development Administration, the Department of Commerce's National Institute of Standards and Technology, and the Small Business Administration) awarded a total of approximately $7.5 million in additional funding to organizations affiliated with the Buildings Hub, to support

technology transfer and small-business development based on the work of the Hub. This additional funding will help the Hub better transfer the results of its efforts to the private sector. It will also help the Hub achieve both the national goal of enabling the architectural and engineering community to routinely design, build, operate and retrofit buildings in a fully integrated manner, and have a positive impact on the regional economy around the Hub's location.

"RACE TO THE GREEN" PROPOSED INITIATIVE

Subcommittee. Dr. Kelly, the budget request proposes to increase the Commercial Buildings Integration initiative to $224 million—that's a 474 percent increase over the current funding level. And much of this increase, $100 million, is for a proposed new "Race to the Green" program. Unfortunately, for a new program of this magnitude, the budget request only provides one paragraph.

There aren't many specifics in the justification, but it seems this program is intended to encourage local communities to impose energy efficiency mandates on commercial buildings. Is that correct? If not, please describe what this program will do and why it's needed.

Dr. Kelly. In his State of the Union, President Obama laid out his vision for winning the future by investing in innovative clean energy technologies and doubling the share of electricity from clean energy sources by 2035. Alongside that effort, the President is proposing new efforts to improve energy efficiency in commercial buildings across the nation. Last year, commercial buildings consumed roughly 20 percent of all energy in the U.S. economy. Improving energy efficiency in our buildings can create jobs, save money, reduce our dependence on foreign oil and make our air cleaner.

DOE has had extensive discussions with financing entities that are interested in investing in commercial building retrofitting. However, these organizations consistently cite uncertainty about the regulatory landscape, and about predicting energy-saving impacts, as barriers to increased investment. DOE believes that the proposed "Race to the Green" program could remove some of these barriers and allow this private capital to move into the commercial building retrofit marketplace

The Race to the Green program would competitively award approximately 10-20 grants (ranging in size from $5-10M) to state and local governments for the purpose of implementing innovative approaches to increasing private-sector investment in commercial building retrofits in their jurisdictions. Much of the authority to alter codes, regulations, and performance standards relating to commercial energy efficiency lies in the jurisdiction of states and localities. These grants would help states and local governments catalyze activities to streamline standards, encourage upgrades,

and attract private sector investment. These approaches may include (but are not limited to):

- Streamlining the permitting process and other regulatory barriers;
- Updating and harmonizing building energy codes;
- Implementing building energy disclosure policies;
- Standardizing actuarial data collection on building performance;
- Providing limited loan loss reserve funds;
- Bundling existing utility rebates with private financing to enhance leverage.

This program would also require a large amount of private-sector financial leveraging. The recommended target is at least 10:1 leverage. DOE's experience with state and local grant programs shows this is a reasonable target.

Subcommittee. Will this program result in changes just in the communities receiving grants or will the funded activities be transferrable to other communities without further federal funding?

Dr. Kelly. The Department proposes to competitively award approximately 10-20 grants to state and local governments for the purpose of implementing innovative approaches to increasing private-sector investment in commercial building retrofits in their jurisdictions. Much of the authority to alter codes, regulations, and performance standards relating to commercial energy efficiency lies in the jurisdiction of states and localities. These grants would help states and local governments catalyze activities to streamline standards, encourage upgrades, and attract private sector investment. These approaches may include (but are not limited to):

- Streamlining the permitting process and other regulatory barriers;
- Updating and harmonizing building energy codes;
- Implementing building energy disclosure policies;
- Standardizing actuarial data collection on building performance;
- Providing limited loan loss reserve funds;
- Bundling existing utility rebates with private financing to enhance leverage.

These efforts would create best practices, becoming case studies for other locales which seek to improve efficiency. Many of these efforts, including but not limited to streamlining of permitting processes, updating and harmonizing building energy codes, and standardizing actuarial data collection could be easily transferrable with no further investment by the Department.

Subcommittee. With such little documentation of the goals and plan for this program, I can imagine it going many different ways if funded. How can the program be more accountable to this Committee and more specific in its goals?

Dr. Kelly. As the Race to the Green program is contingent on DOE receiving FY2012 funding, a detailed solicitation has not yet been developed. However, this proposed initiative is based on discussions with technical experts and local stakeholders to address current challenges faced at the state and local level with commercial building retrofits.

Per the House Water and Development Subcommittee request, EERE provided additional information on the proposed Race to the Green program on 4/12/2011. If additional information is required, my staff is happy to provide a follow up briefing.

Subcommittee. How would you measure how well the program is working?

Dr. Kelly. The metrics for this program are to be included in the detailed solicitation that outlines the program scope and expectations of grantees. All federal financial assistance agreements require monitoring in accordance with DOE's monitoring guidelines, which incorporate requirements for quarterly reporting, monitoring-focused site visits, adherence to funding requirements for the use of money on eligible expenses, and in some cases, annual financial audits. An award recipient would be assigned a DOE project officer who has been delegated responsibility for ensuring the proper use of funds and adherence to all relevant rules and regulations throughout the award period.

INTEGRATED COMMERCIAL BUILDINGS RESEARCH AND DEMONSTRATION

Subcommittee. Dr. Kelly, I understand that, $60 million of the proposed $185 million increase for the Commercial Buildings Initiative would be for integrated buildings technical research and demonstration. According to the Department, this work could range from technical research, to financial support for the Clean Energy Ministerial, to industry grants to develop building energy efficiency tools. This seems like a lot of possible activities with very little public planning and justification, and so we have a hard time figuring out from the Department's justification documents exactly what we might get out of these activities.

In a few words, Dr. Kelly, what would we get out of this piece of the Commercial Buildings Initiative?

Dr. Kelly. The Department is proposing to fund the following activities with the $185 M increase in the FY12 budget for commercial buildings integration:

- Race to the Green program ($100 M): As this program is contingent on DOE receiving FY12 funding, a detailed solicitation has not yet been developed. The Department proposes to competitively award approximately 10-20 grants (totaling $100 M) to state and local governments for the purpose of implementing innovative approaches to increasing private-sector investment in commercial building retrofits in their jurisdictions. Much of the authority to alter codes, regulations, and performance standards relating to commercial energy efficiency lies in the jurisdiction of states and localities. These grants would help states and local governments catalyze activities to streamline standards, encourage upgrades, and attract private sector investment. These approaches may include (but are not limited to):
    - Streamlining the permitting process and other regulatory barriers;
    - Updating and harmonizing building energy codes;
    - Implementing building energy disclosure policies;
    - Standardizing actuarial data collection on building performance;
    - Providing limited loan loss reserve funds;

- Bundling existing utility rebates with private financing to enhance leverage.

DOE would expect that applicants would need to demonstrate the amount of private sector financing that would be leveraged under the program, with a recommended target for at least 10:1 leverage based on DOE's experience with state and local grant programs.

- Better Buildings Challenge ($60 M): The Better Buildings Challenge is a program to drive innovation in the design and implementation of buildings and integrated building systems. The primary component of this Challenge would be to obtain public commitments from public and private officials responsible for new and retrofitted buildings to make significant improvement in how their buildings are designed or retrofitted. DOE would provide technical and analytical support, best practices, guides, and technology options that would allow for a significant improvement in the energy efficiency of retrofitted and new buildings. This integrated systems approach starts with energy modeling that aligns with the expected use of the building, and includes installation and commissioning of the systems that should be integrated to maximize performance in a building (sensors, controls, software, inexpensive metering devices, etc). The result would be specific examples of buildings in many of the building types (municipal, large retail, office, etc.) that have demonstrated and measured the improved energy efficiency. As a result of this work, DOE would develop and disseminate business models for buildings that have successfully implemented cost effective whole building or system energy efficiency improvements.

- Building Construction Technology Extension Partnership ($25 M): The Building Construction Technology Extension Partnership proposes to pilot a small scale commercial building extension program with National Institute Standards and Technology (NIST) and selected universities across the United States, resulting in building specific training and coursework to existing programs. This would allow university students and professors to work within their local communities to grow and improve the quality of the auditing, operations, and commissioning activities in support of local businesses. It also would provide a national network for easily disseminating up to date best practices, information and data

regarding commercial building retro-commissioning and retrofits. It is expected that these funds would be leveraged 2:1 from local businesses, existing state programs, and utilities. A network of 30 commercial building extension centers (i.e. relationships with universities and non-profits) would be established in partnership with industry, trade, and professional organizations. The extension centers would provide direct assistance to business to help them reduce their energy consumption, educate and train university students in energy efficiency auditing, operation, and implementation, and provide a network of partners with access to the best available technologies, know-how, and resources to conduct deep energy efficiency retrofits.

Using this approach, regional extension centers would be better able to address issues important to their local construction and retrofit market. In addition, specialty-focused extension centers would develop and maintain core competencies in energy efficiency construction, management, workforce training/re-training or education.

Subcommittee. Do you have more detailed plans for the large increases requested for this initiative? If so, can you share them with the Subcommittee?

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ENHANCED GEOTHERMAL SYSTEMS

Subcommittee. Dr. Kelly, the budget request increases funding for Geothermal Technologies to $101.5 million, a 131 percent increase. This increase includes a 40 percent increase for enhanced geothermal systems—a technology that could let us extract heat from much broader regions of the country.

With such a large increase, we'd expect that the program has met with some major successes recently. Can you explain some of those successes?

Dr. Kelly. The Geothermal Technologies Program has a long history of developing high-impact technologies. Since 1999, eight technologies developed by the program have received R&D 100 Awards, including: high-performance well cements; the recovery of silica from geothermal brines; high temperature batteries; and low temperature power conversion.

Recently, the program has also developed an advanced drilling technology that has demonstrated a threefold increase in the rate of drilling penetration over current methods. This technology has the potential to significantly reduce drilling costs, which account for about 40% of geothermal development costs.

In addition, in 2010 the program demonstrated motor windings that can reliably withstand very high temperatures (up to 250°C) for more than 1,000 hours. This technology will enable more robust down-hole- pumps and reduce well operation and maintenance costs.

Subcommittee. How close to commercialization do you believe enhanced geothermal systems might be?

Dr. Kelly. A major milestone on the road to commercialization begins with demonstrating the technical feasibility of a reservoir capable of producing 5 megawatt (MW) of electricity by 2015. Once feasibility is proven, the reservoir will be flow tested for at least five years. After 2020, Commercial demonstrations can then be carried out in five to ten different geological environments to show the replicability and scalability of the technology. Throughout this process the Department intends to support the development of game-changing technologies to ensure that EGS becomes cost competitive with coal and natural gas.

Subcommittee. How much do you believe they will contribute to U.S. electricity generation in the next 5, 10, or 20 years? How much would you expect funding at the budget request level would increase geothermal's contribution to U.S. energy production?

Dr. Kelly. Current installed geothermal power capacity is just over 3 gigawatt electrical (GWe). This number could quadruple by 2020 through expanded use of hydrothermal and coproduced resources. Innovative exploration technologies have the potential to confirm another 30 GWe of undiscovered hydrothermal resources over the next 10-15 years, and enhanced geothermal systems could contribute an additional 25 GWe by 2025 and expand geothermal resource use to new areas of the country.

NEW ACTIVITIES PROPOSED FOR GEOTHERMAL TECHNOLOGIES PROGRAM

Subcommittee. The budget request proposes four new programs within the geothermal systems program that focus on things like low-temperature resources, sedimentary rock resources, and exploration technologies.

The Department explicitly only requested funding for Enhanced Geothermal Systems last year. What changed to warrant funding for these other geothermal areas?

Dr. Kelly. Additional funding from the American Recovery and Reinvestment Act enabled the Geothermal Technologies Program to diversify its R&D subprograms. Investment in R&D for Enhanced Geothermal Systems (EGS) is high risk; however this technology has the potential to bring thousands of megawatts of capacity on-line in the long-term. Until the technical and economic feasibility of EGS is proven DOE should continue to support lower risk technologies in its portfolio. By developing innovative exploration technologies, the U.S. could tap 30 GWe of undiscovered hydrothermal resources identified by the U.S. Geological Survey over the next 10-15 years.

PROGRAM DIRECTION INCREASE LOWER THAN 2011 REQUEST

Subcommittee. The budget request proposes $177 million for Energy Efficiency and Renewable program direction, which funds employees to oversee the office's many grants and programs. The fiscal year 2011 budget requested a substantially higher amount, $200 million. This is somewhat confusing, since the overall 2012 request for Energy Efficiency and Renewable Energy is much higher—$845 million—than the 2011 request.

Why do you need fewer people to oversee more activities? Was your 2011 request too high?

Dr. Kelly. EERE will require fewer people in FY 2012 due to the decline in residual Recovery Act activities and will be able to shift resources to oversee the base program. The FY 2011 request was not too high. In FY 2009 and FY 2010, EERE operated with both base and Recovery Act Program Direction appropriations. In FY 2011, EERE is expected to continue the combined workload with only the base appropriation. EERE expects to achieve substantial cost savings to absorb the reductions in its FY 2012 request. Salaries and benefits are reduced by implementing the Federal pay freeze, and reducing planned FTE. EERE's travel will be reduced in anticipation that electronic media will, in large part, replace personal interface. Contract support services are reduced as a result of the planned decline in advisory and assistance services. Lastly, other related services are reduced due to less infrastructure needed to house a smaller workforce, and restrictions placed on purchasing, supplies, and materials.

ELECTRICITY DELIVERY AND ENERGY RELIABILITY

SMART GRID ENERGY INNOVATION HUB

Subcommittee. Secretary Hoffman, the Department proposed an Energy Innovation Hub under its Smart Grid Research and Development program in fiscal year 2010, a hub that was not ultimately funded. The Administration is once again proposing a Smart Grid Hub in the 2012 budget request.

How is this year's proposal different than the Hub proposed in fiscal year 2010?

The budget in 2010 requested $35 million for the smart grid hub, while this year's request only proposes $19.4 million. Can you explain the difference in proposed budgets?

Why are smart grid technologies well-suited for an energy innovation hub, rather than for other research models like industry or university grants?

Ms. Hoffman. The Smart Grid Technologies and Systems Hub proposed for FY 2012 will focus on addressing the specific technical, regulatory, and economic challenges located at the interface between transmission and distribution in the electrical infrastructure. A multi-disciplinary, multi-stakeholder, coordinated research, development, and demonstration effort will facilitate grid modernization while supplementing the on-going transformations in the electric industry. In order for smart grid technologies to fully realize their benefits, the barriers at this interface need to be overcome in a practical and financially sound manner. The proposed hub in FY 2010 focused primarily on developing improved materials for power electronics, conductors, and insulators, as well as employing "smart" materials broadly across a wide range of smart grid technologies.

The request for the Smart Grid Technologies and Systems Hub is in line with the funds provided for comparable Hubs in the FY 2010 appropriation, and reflects the successful start-up experience with those hubs. The Department believes this level will provide sufficient resources to attract the expertise and interest we are looking for to support the effort.

Smart grid technologies are well-suited for a hub because of the complexities associated with acceptance, adoption, implementation and deployment of these technologies. Modernization of the electric grid will require markets, policies, regulations, communications, standards, security, and business cases aligned in conjunction with technology development to be successful. The hub concept will allow for a systems-level, integrated approach that ties in various stakeholders and communities to arrive at applicable solutions, while also establishing a center of excellence to cultivate leaders for the power systems of tomorrow.

PUBLIC CONCERNS ABOUT SMART METERS

Subcommittee. As utilities in some parts of the countries install smart meters, many with the ability for wireless communication, there have been reports of people being concerned on two fronts: that these meters could expose people to harmful radio waves, and that these meters could violate people's privacy by giving electric companies information about their households.

Do you believe these fears of health or privacy risks are justified?

If you don't believe the risks are present, could there be better communication in order to answer people's fears?

Ms. Hoffman. Concerns over health effects are not justified based upon current information, and privacy risks are present, but sufficiently addressed from both technology and regulatory perspectives for personal information as it is collected and disseminated today. Both issues could be handled more effectively with better communication, with special emphasis on timeliness and details.

In the case of purported harmful radio waves, responsible surveys of current scientific literature by both the Maine Centers for Disease Control and the California Council on Science and Technology have found no basis for the health claims made by complainants in those states, and generally support the Federal Communications Commission's current safety standards. Comparative data illustrate that radio wave emissions from a transmitting smart meter at a distance of three feet are 100 times less than from an operating microwave oven at a distance of two feet, and 1000 times less than from a cell phone held to the ear during a call.

Utilities have been entrusted with information consumers consider private (billing information, credit history, address and other personal information) for years. In almost all cases, state regulations govern the management of that information, and apply to the new types of information available from smart meters. As the availability and value of this information increases for consumers, utilities and interested third parties, regulatory protections in particular will need to evolve to ensure that increased availability is flanked by enhanced protections. From a technology standpoint, smart meter

communications are encrypted and protected in order to protect operational performance, and confer the same protections on customer energy data.

The Department's Office of Electricity Delivery and Energy Reliability is assisting in improving communications efforts on both fronts with the dissemination of scientifically sound information from credible sources regarding radiofrequency health claims, and by engaging in stakeholder dialogues on privacy through Requests For Information and in industry and White House sponsored forums.

NEW PROPOSAL FOR ADVANCED MODELING GRID RESEARCH

Subcommittee. Assistant Secretary Hoffman, the budget request proposes $19 million to start an Advanced Modeling Grid Research effort. I understand that this work would attempt to allow grid operators to better understand what's going on in our power grid, and to plan expansion of the grid more effectively. But I also understand that this would not let operators control the grid—rather, work proposed at ARPA-E, the advanced projects agency in DOE, would do that.

Can you explain what piece of the modeling pie you are proposing to bite off, what future efforts you could envision happening and why you haven't instead proposed to do the pieces that ARPA-E believes are important?

Ms. Hoffman. The activities under the Advanced Modeling Grid Research effort will enable improved control of the electric system. The projects will result in algorithms and system-level understanding that can accelerate operator tool performance, allow for predictive control capabilities, and integrate across model seams. ARPA-E's projects are relatively discrete and near-term (~18-24 months). To ensure that the transformational impact of ARPA-E's high risk, high reward research efforts is realized, it is important that complementary programmatic activities (such as those under Advanced Modeling Grid Research) are in place to work with stakeholders to adapt the modeling approaches over the mid-term and to enhance the robust, reliable control of the electric system (under continually evolving operational conditions) in the long-term.

LARGE INCREASES FOR GRID-SCALE ENERGY STORAGE R&D

Subcommittee. Energy storage is an area the Department of Energy has emphasized in both its 2011 and 2012 budget requests. And this year we see a proposal that would increase energy storage research for the power grid to $57 million, a 300 percent increase.

Assistant Secretary Hoffman, a 300 percent increase is large and extremely ambitious any year, in any environment. Is your team prepared to execute and spent this funding well in one year, if it received the request?

How expensive is grid-scale energy storage currently? How much cheaper must it get to be economically feasible?

How much private funding is going into this kind of research currently? Is this research something not already taken care of by the private sector?

Your proposal aims to reduce the cost of grid-based storage by 30 percent in 5 years. Would it be cheap enough for the private sector to use this technology on its own?

How much more funding would this technology need to become competitive? By increasing this program, are we signing up to pay a research bill over the next ten or more years that we can't afford?

Ms. Hoffman. Utility interest in energy storage has been developing rapidly in recent years. Interest is also growing among renewable developers such as wind and solar energy, who see in storage a way to increase the value of their product by enabling the energy to be used whenever it is needed. In FY 2012, in addition to accelerating applied research into storage technologies, the Department's Office of Electricity Delivery and Energy Reliability (OE) will also be investing more heavily in technology maturation such as demonstration projects, inherently more costly than fundamental scientific studies. OE has established research and development (R&D) targets, in conjunction with industry[24,25], and has well

24Electric Power Industry Needs for Grid-Scale Storage Applications, Nexight Group, for U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, December 2010. http://www.oe.energy.gov/DocumentsandMedia/Utility_12-30-10_FINAL_lowres.pdf

established relationships and a history of collaboration with industry and state R&D organizations. OE also works closely with other DOE offices to coordinate programmatic activities and take advantage of synergistic research topics.

Energy storage capital cost for grid applications are generally in the range of $1000-$4000/kW and $100-$9000/kW-h. The wide range of costs represents the broad array of technologies and the many varied applications within the grid. Some relatively narrow, niche applications are already economical for storage technologies, but broad deployment, and the widespread benefits associated with such deployment will only be realized through substantial cost reductions, generally to half of current values.

The amount of private sector funding in R&D for grid energy storage is not readily available, but clearly the capacity to draw over $500 million in cost share for the energy storage projects funded by the American Recovery and Reinvestment Act, suggests considerable private sector activity. Venture capital investment in the area has been growing rapidly. However, many of the new private sector entrants are relatively small companies with limited resources, both in staff expertise and development funds, for grid energy storage R&D, particularly for the diverse suite of promising technologies ranging from redox flow batteries, to high-temperature sodium beta metal halide, to flywheels. OE invests primarily in pre-competitive and common-use R&D and in characterization of institutional barriers to commercialization, areas not typically supported by individual companies.

The reduction of costs by 30 percent will undoubtedly increase deployment of grid energy storage. It will enable wider scale penetration of selected grid applications (such as spinning reserve, transmission and distribution deferral and power quality support), and increase the number of applications for which storage is the most economic alternative. While a 30 percent cost reduction is our near-term goal, recent research has revealed approaches that further reduce costs and improve performance. The full benefits of grid energy storage are unlikely to be realized unless greater cost reductions are achieved.

25Advanced Materials and Devices for Stationary Electrical Energy Storage Applications, Nexight Group, for U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, December 2010. http://www.oe.energy.gov/DocumentsandMedia/AdvancedMaterials_12-30-10_FINAL_lowres.pdf

It has been estimated that the grid energy storage industry could grow from $1.5 billion today to $35 billion in 2020[26]. R&D supported by OE is an investment to enable this market to be realized and to help ensure that U.S. based companies are the preferred provider. As the storage industry becomes established, further research developments can be expected to be borne increasingly by the industry itself. Early Government investment will help U.S. companies overcome technical hurdles enabling them to lead the world in this growing market.

26Pike Research, "Energy Storage on the Grid," August 2010

CYBER SECURITY RESEARCH

Subcommittee. Funding for cyber security research has increased substantially since 2009—the Department requested $30 million, up from barely more than $10 million in 2009. And given the increasing level of technology on the power grid and in use connecting Americans' homes to the grid, the Committee has supported this research to understand and address growing cyber security risks. We do, however, want to ensure that the work performed at the Department is getting us somewhere.

Assistant Secretary Hoffman, can you describe the work that the Department is currently conducting, and how the work proposed in fiscal year 2012 is different?

What organizations across the federal government work on power grid and related cyber security issues, and how does the Department engage with them?

When and how can we expect to see measurable results from this work?

I would suspect that there is a lot the Department would be doing to development strategies to implement security standards, but the Department cannot do everything. How are you choosing wisely and making sure that your work addresses the most pressing risks?

Ms. Hoffman. The Department's Office of Electricity Delivery and Energy Reliability (OE) mission to modernize the electric grid cannot be achieved without the research, development and integration of secure control and communications systems. OE's cybersecurity objective is to enhance the reliability and resiliency of the Nation's energy infrastructure by reducing the risk of energy disruptions due to cyber attacks. Key benefits include improved reliability and availability of the energy delivery system, increased adoption of renewable technologies through the application of secure smart grid technologies, and the development of a resilient energy infrastructure that can withstand cyber attacks without loss of critical services.

OE is currently conducting research and development (R&D) of cybersecurity capabilities tailored to the unique needs of energy delivery systems that control real-time physical processes and deliver continuous and reliable power to support national and economic security. With the FY 2012

request, OE will continue these efforts, as well as increase its efforts in smart grid cybersecurity solutions. These and other ongoing projects are discussed below.

OE works closely with academic and industry partners through the Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) which is a University led public-private research partnership supported by the DOE, the Department of Homeland Security (DHS) and industry for frontier research that supports resilient and secure smart grid systems. TCIPG leverages and expands upon previous research funded primarily by the National Science Foundation. Selected examples of TCIPG research include an automated intrusion detection and response; new mathematical methods that quantify economic benefits of investment in energy-sector cybersecurity technologies in terms of risk mitigation; self-configuring resilient energy delivery control systems network architectures; and research that enhances distributed power system algorithms and integrates these with secure data sharing protocols. TCIPG prolific high-risk/high-payoff research activities support many of the efforts discussed below.

OE conducts cyber-vulnerability research using the National SCADA Test Bed (NSTB) that partners with control system vendors in the electric, oil, and natural gas sectors to identify and mitigate energy delivery control system vulnerabilities in fielded systems. The NSTB laboratories, with academic and energy-sector industry collaborators also conduct frontier research in quantum information science; innovative mathematical methods and advanced computer science such as bio-inspired lightweight, mobile agents—digital ants—whose correlated activities produce emergent behavior that can raise early awareness to cyber-attack; trust anchors, independent monitoring and control devices that sit at the lowest levels of a computer, but maintain independence from the system and so can detect the deceptive malicious actions of a cyber-attack; supply chain risk mitigation; building trusted energy delivery control systems from un-trusted components; and novel intrusion detection tailored to the unique constraints of energy delivery control systems.

We transition frontier research from academia and the national laboratories into next-generation technologies that will strengthen our Nation's critical energy-sector infrastructure against cyber-attack. OE is funding eight industry-led R&D projects of next-generation cybersecurity technologies that will: (1) allow only expected central control system computers

communications content and patterns, and raises an alarm upon detecting unexpected behavior; (2) prevent unexpected cyber-activity on substation computers (this protects against Stuxnet-like cyber-attacks); protect field device communications, and alarm on physical tampering; (3) build a tightly-secured communications gateway between central control systems including innovative fast encryption and decryption techniques to protect high-rate smart grid data; (4) provide a near-real-time cyber-physical security situational awareness capability that informs operator cyber-incident response decisions and includes a cyber-incident training simulator; (5) create role-based access control tailored to the energy sector; (6) secure data traveling multi-party smart grid networks; (7) develop cryptographic key management for millions of smart meters; and (8) secure energy-sector communication protocols, including smart grid.

The funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA) accelerated the rate of smart grid deployment, and each ARRA grant recipient was required to submit and implement a robust cybersecurity plan for each OE-funded project. R&D of next-generation cybersecurity technologies that protect modern smart grid devices from cyber-attack must continue to keep pace with the accelerated rate of smart grid deployment. In FY 2012, we will continue and increase its efforts to address smart grid cyber-security research needs. This will further strengthen the cybersecurity protections of next-generation smart grid devices such as smart meters that enable energy-consumer response to price-signals, and phasor measurement units (PMUs) that provide the energy-sector with wide area situational awareness of power grid operations.

OE, as the Federal Government's sector specific agency for the energy sector with the mission to modernize the power grid, has the lead responsibility to coordinate and leverage activities with industry, academia and other Federal organizations. By taking this lead role, we ensure that cybersecurity for energy delivery systems, which is critical to our mission, is a focused, collaborative activity among the organizations, benefits from the expertise of each organization, and avoids duplication. Several agencies across the Federal Government work on cybersecurity for the power grid within their broad-based cybersecurity programs, including Department of Homeland Security (DHS), the National Institute of Standards and Technology (NIST), the Federal Energy Regulatory Commission and the Department of Defense. OE participates in the Networking and Information Technology Research and Development team which co-ordinates

cybersecurity research priorities across multiple Federal agencies. The TCIPG consortium was originated by the National Science Foundation and is now supported collaboratively by both OE and DHS. NIST is actively engaged in standards development needed for smart grid success, and OE is funding the Advanced Security Acceleration Project for the Smart Grid that works closely with NIST in this effort.

OE's cybersecurity efforts have already produced measurable results. Over the last several years, our efforts have produced a number of tangible products now deployed in the energy sector. NSTB vulnerability assessments have hardened 38 SCADA/EMS vendor control systems and components against cyber-attack. OE has funded cost-shared R&D projects with industry to successfully commercialize the capability to secure serial communications for both legacy and present-day power system devices, and to secure routable communications between central control systems and substations. We have also developed publically available security audit tools for most of the major SCADA/EMS vendors that assist utilities to configure their energy delivery control systems in the most secure way. The most recent addressed the Inter Control Center Protocol that is used for communications among control centers and was highlighted in the last Cyber-Storm exercise. In addition, we expect that the eight OE-funded industry-led projects awarded in 2010 will result in cyber security capabilities that will enter the energy sector during 2013.

The Department has funded advanced hands-on team training using simulated real-world cyber attacks and trained more than 2100 representatives from the energy sector on techniques to identify, implement countermeasures, and protect control systems against sophisticated cyber attacks.

To ensure that the Department is addressing the most pressing risks, in 2005, OE, as the Federal Government lead for securing energy delivery systems from cyber attack, collaborated with private-sector energy owners and operators to develop the Roadmap to Secure Control Systems in the Energy Sector that lays out a vision to research, develop, deploy and maintain energy delivery systems that can survive an intentional cyber assault without the loss of critical function. The Department is currently updating this plan . DOE's R&D efforts align with the Roadmap strategy. DOE also funds national laboratory common vulnerability analyses that prioritize cybersecurity risks found in SCADA/EMS control systems, as well as

supply chain integrity risk research and energy-sector integrated threat analyses to maintain awareness of the real and evolving cyber-threat to our nation's energy-sector.

CYBER SECURITY PRIVATE SECTOR ORGANIZATION

Subcommittee. Assistant Secretary Hoffman, the fiscal year 2010 appropriations Act directed the Department to establish a private sector cyber security organization. I believe that it has announced the selected organization—two organizations, actually, recently.

What organizations were chosen by the Department, and what are these groups aiming to accomplish?

Is the Department planning to supplement these organizations with future funding, or will they be self-sustaining?

How are you ensuring that these organizations work closely with the Department and with the private sector, as intended, to make real inroads towards securing the grid?

Ms. Hoffman. In response to direction in the Energy and Water Development and Related Agencies Appropriations Act, 2010, the Department conducted a competitive solicitation, resulting in awards to two organizations. EnergySec was selected to form the National Electric Sector Cybersecurity Organization (NESCO). The Electric Power Research Institute (EPRI) was selected as a research and analysis resource to this organization, which is called the National Electric Sector Cybersecurity Organization Resource (NESCOR). The mission of NESCO/NESCOR is to lead a broad-based, public-private partnership to improve cybersecurity for electric sector energy systems. The Department's vision is to develop a self-sustaining, industry owned and operated group that supports electric sector response efforts to address cyber events. Their goals are as follows:

- Identify and disseminate cybersecurity best practices to the sector
- Analyze, monitor and relay infrastructure vulnerabilities and threat information
- Review standards and identify areas where additional standards may be needed
- Improve testing practices for the sector, e.g. test plan generation, test witnessing
- Work with federal agencies to improve electric sector cybersecurity
- Encourage key electric sector supplier and vendor support/interaction

The Department is providing $10 million over 3 years to EnergySec and EPRI, with the recipients providing more than $6 million in cost share. The contract is designed to ensure that NESCO/NESCOR can engage in activities such as membership building so that they will be self-sustaining at the end of the 3 years.

The Department is ensuring these organizations work closely with the Department by maintaining close oversight of NESCO/NESCOR activities and ensuring that contractual obligations, developed by a multidisciplinary group that included experts in cybersecurity, electricity infrastructure, and control systems, are met.

In addition, Department representatives coordinate with NESCO/NESCOR on a regular basis. The Department held kick-off meetings with NESCO and NESCOR in November 2010. The meetings included an interagency session, including the National Institute of Science and Technology (NIST), the Federal Energy Regulatory Commission (FERC), and the Federal Bureau of Investigation (FBI) to introduce EnergySec and EPRI as NESCO and NESCOR, respectively, discuss the NESCO/NESCOR mission, and ask for feedback on areas that will complement, overlap or conflict with ongoing work. The Department will participate in NESCO/NESCOR events to promote the public-private partnership and encourage greater participation in NESCO/NESCOR. DOE has also advocated partnerships with Department of Homeland Security (DHS), FERC, NERC, FBI, and NIST to NESCO/NESCOR. Both NESCO and NESCOR have developed relationships or begun to develop those relationships. For example, NESCO is involved with DHS' Industrial Control Systems-Computer Emergency Response Team, and NESCOR is participating in NIST's Cyber Security Working Group (CSWG).

Finally, in order to ensure that NESCO/NESCOR would work closely with the private sector, their work includes several outreach tasks. Both EnergySec and EPRI were selected in part because of their strong relationships with the private sector. NESCO has begun a series of "Voice of Industry" workshops at technical conferences, and is gathering input from the private sector to improve their products and ensure that private sector feedback is provided to DOE. EnergySec's flagship information sharing service, portal.energysec.org, has been in use since 2008. This secure communications portal has become the home for the Industrial Control Systems Joint Working Group, NERC Hydra, Critical Intelligence and asset

owner communications. This service will continue to mature and EnergySec is working on increasing functionality in future releases. NESCO is leveraging the portal to work closely with the private sector. At the beginning of the contract in November 2010, EnergySec had 360 members. As of mid-April 2011, NESCO/EnergySec has grown to 542 members, a good indication of industry support. NESCOR has also established working relationships that include a mix of academia, National Laboratories, and industry. This strategy ensures close ties to the private sector and relevancy to electric systems operations.

FOSSIL ENERGY

FOSSIL ENERGY OMITTED FROM CLEAN ENERGY INCREASES

Subcommittee. Dr. Der, would you count fossil energy as clean energy?

Dr. Der. Clean energy, in the President's Clean Energy Standard proposal, is defined to include a large number of existing and emerging technologies including natural gas as well as coal with carbon capture and storage.

Subcommittee. Given that, the budget request fossil energy research, development, and demonstration is $183 million below the current funding level. If the budget request reflects the Administration's strong support for clean energy innovation, why have you not included an increase for this notable clean energy area?

Dr. Der. The Fossil Energy (FE) FY 2012 Budget Request upholds the President's goals to develop America's innovative competitive edge through strategic investments in our Nation's clean energy Research Development and Demonstrations (RD&D). FE's budget request takes into consideration the need for budget restraint, forcing us to make tough choices across all DOE Research and Development (R&D) program areas. So we are investing in only the key enabling technologies that are on critical paths and that show the highest potential impacts on achieving the program goals and benefits in the timeframe needed for deployment. In addition, the Recovery Act provided funding for front-end investments in carbon capture and storage RD&D ($3.4B from Recovery Act Funds).

Subcommittee. With half of our electricity coming from coal, isn't it only responsible to invest more in making this source of energy cleaner?

Dr. Der. In pursuing the goal of timely, material, and efficient transformation of the Nation's energy system, it is important to try to avoid costly and disruptive changes to the existing system, which has served us well in the past. The carbon capture and storage (CCS) option for coal (and eventually natural gas) offers the potential, providing the cost can be sufficiently reduced, to allow the continued use of our vast, low cost domestic fossil fuel resources until that time when other energy options can

be economically phased into the energy mix. Prominent energy models suggest that competitive CCS technologies will need to emerge in the 2020's for both new plant and retrofit applications to ensure the lowest cost energy system transformation is achievable. Consistent with this timing, DOE's clean coal technology research and development program is focusing on completing development of cost effective second generation CCS technologies by 2015 to enable demonstration in that timeframe.

FALLING BEHIND IN COMPETITIVENESS FOR FOSSIL ENERGY TECHNOLOGIES

Subcommittee. The Administration has emphasized the importance of clean energy's role in American competitiveness. Other countries like China are moving forward with massive coal plant expansions and technology development. Half of our electricity comes from coal, and if we lose the innovation edge in that area, fifty percent of our nation's power could be dependent on imported technologies.

In this context, why has the Department omitted fossil energy area from its proposed increases in the budget request?

Dr. Der. The Fossil Energy (FE) FY 2012 Budget Request upholds the President's goals to develop America's innovative competitive edge through strategic investments in our Nation's clean energy Research Development and Demonstrations (RD&D). FE's budget request takes into consideration the need for budget restraint, forcing us to make tough choices across all DOE Research and Development (R&D) program areas. So we are investing in only the key enabling technologies that are on critical paths and that show the highest potential impacts on achieving the program goals and benefits in the timeframe needed for deployment. In addition, the Recovery Act provided funding for front-end investments in carbon capture and storage RD&D ($3.4B from Recovery Act Funds).

REDUCTION FOR FOSSIL ENERGY RESEARCH AND DEVELOPMENT

Subcommittee. The budget request reduces funding for Fossil Energy Research and Development by $183 million below the current level, a 29 percent decrease.

When coal accounts for 50 percent of our nation's electrical power, what is your rationale for reducing funding for research ensuring that we use that vast domestic resource as well as possible?

Dr. Der. The Fossil Energy (FE) FY 2012 Budget Request upholds the President's goals to develop America's innovative competitive edge through strategic investments in our Nation's clean energy Research Development and Demonstrations (RD&D). FE's budget request takes into consideration the need for budget restraint, forcing us to make tough choices across all DOE Research and Development (R&D) program areas. So we are investing in only the key enabling technologies that are on critical paths and that show the highest potential impacts on achieving the program goals and benefits in the timeframe needed for deployment. In addition, the Recovery Act provided funding for front-end investments in carbon capture and storage RD&D ($3.4B from Recovery Act Funds).

Subcommittee. The vast majority of the funds requested for Fossil Energy Research and Development focus on carbon dioxide capture and storage. Why does the Department not see value in research aiming to increase the efficiency of or otherwise improve coal power technologies?

Dr. Der. The Department values research aimed at increasing the efficiency of and improving coal power technologies. The Office of Fossil Energy (FE) has invested $635 million of American Recovery and Reinvestment Act (ARRA) funds to accelerate innovative and critical research, demonstration, and development on clean coal technologies. FE's budget request takes into consideration the need for budget restraint, forcing us to make tough choices across all DOE Research and Development (R&D) program areas. We are investing in only the key enabling technologies that are on critical paths and that show the highest potential impacts on achieving the program goals and benefits in the timeframe needed for deployment.

COAL BECOMING AN EXPORT COMMODITY

Subcommittee. The United States exports a portion of its coal resources to other nations, but China's massive expansion of coal power generation may change the game significantly.

How do you see coal exports to China changing the energy equation in the 5, 10, or 20 years?

Dr. Der. Coal currently supplies the vast majority (approx. 70%) of China's total energy consumption. In 2009, China consumed an estimated 3.5 billion short tons of coal, representing over 46% of the world total and a 180% increase in domestic consumption since 2000. Source: DOE's Energy Information Administration (EIA) Country Analysis Brief on China: http://www.eia.doe.gov/countries/cab.cfm?fips=CH

China's overall coal consumption is expected to nearly double over the next 20 years as a result of projected robust economic growth. China is the world's largest producer of coal, but imported coal prices have become competitive with domestic production prices, and China's coal industry has suffered from frequent bottlenecks in transmission to consumer markets. As a result, China has become a coal importer and currently imports coal from Pacific Rim countries (i.e., Australia, Indonesia, Vietnam, and Russia). China's coal imports are expected to grow in the coming years. This will likely create new export market opportunities for U.S. coal producers and technology developers both in China and in regions that now import Pacific Rim coal.

FUTUREGEN

Subcommittee. The Department of Energy is devoting over $1 billion to FutureGen, and we are obviously interested in tracking this project closely.

The Department obligated Recovery Act funds for FutureGen just days before unobligated funds would have expired in September of last year. How well thought out was this multi-billion dollar project, if it appears to have been signed in a rush at the finish line? What led to the last-minute nature of the agreement?

Dr. Der. Prior to Secretary Chu's August 5, 2010, announcement of the intent to award $1 billion to the FutureGen 2.0 program, DOE's Office of Fossil Energy had been evaluating the merits of repowering an existing coal plant with advanced oxy-combustion technology coupled with carbon capture and storage (CCS) at a significantly lower cost than the original FutureGen program, which had an estimated cost in excess of $2 billion. DOE was familiar with the performance and cost of the Babcock & Wilcox's oxy-combustion boiler and AirLiquide's air separation and carbon dioxide (CO_2) purification technologies through previous solicitations and studies. DOE was also interested in taking advantage of the extensive work of the original FutureGen project on sequestering CO_2 in the Mt. Simon saline formation beneath Illinois. DOE determined that FutureGen 2.0 represented a cost effective alternative to the original project, while still focusing on achieving the original project objective, which was to develop innovative, cost effective CCS technologies.

Due to the requirement in the American Recovery and Reinvestment Act (ARRA) to obligate funds by September 30, 2010, two *conditional* cooperative agreements were awarded. These awards required that a number of mandatory conditions be satisfied prior to authorization of full-scope cooperative agreements. This approach allowed for obligation of ARRA funding, but minimized risk by limiting the recipient's ability to perform limited tasks while negotiations were being conducted. The full-scope cooperative agreements also contain a number of "decision points" that require demonstrated progress towards achievement of the program's objectives before DOE allows the recipients to proceed to subsequent phases of the program.

Subcommittee. The scope of FutureGen is scaled back significantly from its original vision, and retrofits an existing plant rather than constructing a new, more complicated power facility. How is this incarnation of the project advantageous compared with the original vision?

Dr. Der. The scope of FutureGen 2.0 is similar to the original, including the integration of advanced coal-based electricity generation with carbon capture and storage (CCS). FutureGen 2.0 involves the repowering of an existing coal-fueled power plant with advanced oxy-combustion technology coupled with CCS in a deep saline formation, which was not previously represented in the Office of Fossil Energy's (FE) Research and Development (R&D) portfolio. FE is currently funding two integrated gasification combined cycle (IGCC) plants integrated with CCS similar to the original FutureGen project, but at a much lower Federal share. DOE concluded that repowering an existing plant would add to DOE's CCS technology portfolio and create the world's first, commercial-scale, oxy-combustion power plant with CCS. A significant advantage of FutureGen 2.0 is its ability to help open the over $300 billion market for coal unit repowering, and position the United States as a leader in an important part of the global clean energy economy.

Subcommittee. If construction proceeds and FutureGen begins operating according to plan in 2015, what can we and industry expect to gain from this demonstration project?

Dr. Der. Under the current schedule, FutureGen 2.0 would start operation in early 2016 and would be the world's first, commercial-scale, oxy-combustion power plant. In the near term, project partners estimate the program will bring 900 jobs to downstate Illinois and another 1,000 to suppliers across the state. In the longer term, lessons learned in the design, permitting, construction, and operation of the power plant and the CO_2 pipeline, along with permanent storage in a deep saline geologic formation, will lay the groundwork for subsequent deployment of the technologies proven in the FutureGen 2.0 program.

More broadly, FutureGen 2.0 will ensure that the United States remains competitive in a carbon constrained economy, creating jobs while reducing greenhouse gas pollution. FutureGen 2.0 will provide an option for new near zero emission coal-fueled power plants as well as economic repowering

of the existing coal fleet with oxy-combustion technology and carbon capture and storage.

Subcommittee. Are the benefits of FutureGen, both to scientific knowledge and as a demonstration to industry, expected to be predominantly in power generation and carbon capture, or in carbon storage?

Dr. Der. Benefits resulting from FutureGen 2.0 will be applicable to both power generation with carbon capture, and other industries that may require carbon dioxide transportation and storage. FutureGen 2.0 will facilitate: 1) the validation of the technical feasibility and economic viability of near-zero emission energy from coal; 2) the technical and economic facets of pipeline transport of supercritical CO_2; and 3) verification of the effectiveness, safety, and permanence of CO_2 sequestration in saline formations, including the establishment of standardized technologies and protocols for CO_2 measurement, monitoring, and verification. The Department of Energy is devoting over $1 billion to FutureGen, and we are obviously interested in tracking this project closely.

Subcommittee. Are the cost share arrangements on the project the standard ones for the Department or was a waiver granted for any portion of the project?

Dr. Der. Recognizing the first-of-a-kind nature of the repowering and storage portions of the FutureGen 2.0 program, the Office of Fossil Energy (FE) determined that both of these were research and development projects, which under EPAct 2005 require a minimum 20% non-Federal cost share unless a waiver is granted. DOE also recognized that the uncertainties and risks associated with these projects would not be fully identified prior to the completion of a Project Definition Phase, which focused on finalizing design and developing a more accurate cost estimate. As a result, FE petitioned the Under Secretary, under authority provided by EPAct, to reduce the 20% cost share if exceptional need could be demonstrated.

The program is funded under two separate cooperative agreements, one for the repowering project, and one for the storage project. In the Ameren cooperative agreement, the agreement calls for a 20% non-Federal cost share unless DOE determines it to be "necessary and appropriate" to reduce the

cost share. Consistent with the approved waiver from the Under Secretary, the non-Federal cost share cannot less than 17%.

In the case of the FutureGen Alliance cooperative agreement, DOE determined that a reduction in the cost share requirement of EPAct was "necessary and appropriate." The Under Secretary determined that : 1) a 1% non-Federal cost share for the 12 month Phase 1 activities (site selection and preliminary engineering) would be appropriate; 2) a 19% non-Federal cost would be appropriate for the remainder of the project, including construction of a pipeline and storage facility; and 3) DOE would fully fund the visitor and educational facilities. As a result, the non-Federal cost share for the total project will not be less than 17%.

KEYSTONE XL GREAT PLAINS OIL PIPELINE EXPANSION

Subcommittee. Rising oil and gasoline prices due to events overseas remind us of the importance of ensuring our nation's access to petroleum resources. At the same time, the administration appears to be dragging its feet in granting permits for the expansion of the Keystone pipeline from Alberta, Canada to Port Arthur, Texas. This pipeline would bring up to 700,000 barrels of oil per day from Canada into the United States, and would potentially displace oil imports from unstable regions.

Given that energy security is one of the Department of Energy's core missions, what is your position on this and similar projects?

Dr. Der. As part of its contribution to the State Department's environmental review of the proposed pipeline, DOE commissioned a study by consultancy EnSys Energy and Brookhaven National Laboratory to analyze how the presence or absence of the Keystone XL pipeline would affect U.S. petroleum imports, exports of Canadian oil to other markets, and greenhouse gas emissions through 2030. The study indicated that whether or not the Keystone XL pipeline is built, there is a U.S. market demand for the expected increase in Canadian oil sands production. This incremental U.S. demand for oil sand crudes could potentially displace U.S. crude oil imports from other regions.

Subcommittee. What are the main concerns over the pipeline expansion, and how are those being balanced against the clear benefits to national security and prosperity?

Dr. Der. The State Department is responsible for determining whether the proposed cross-border pipeline would be in the National Interest, and for preparing the Environmental Impact Statement. The State Department is consulting with a number of other agencies as part of this process, including the Department of Energy.

The chief objection among environmental groups to the Keystone XL pipeline is that it will facilitate an increase in Canadian oil sands production, which will increase greenhouse gas emissions. There are also other concerns about safety and environmental impacts along the proposed route of the pipeline. The State Department is considering all of these issues as it prepares the Environmental Impact Statement.

Subcommittee. I understand the State Department has primary jurisdiction over siting the pipeline. Given that this is not their primary expertise, how has your Department supported their efforts?

Dr. Der. DOE is supporting the Presidential Permit process on the proposed Keystone cross-border pipeline by contributing to the Draft and Supplementary Environmental Impact Statements. DOE commissioned a study by consultancy EnSys Energy and Brookhaven National Laboratory to analyze how the presence or absence of the Keystone XL pipeline would affect U.S. petroleum imports, exports of Canadian oil to other markets, and greenhouse gas emissions. In addition, DOE's Western Area Power Administration contributed to parts of the Environmental Impact Statements that impact its facilities.

DOE will also comment on the Final Environmental Impact Statement and the National Interest Determination, when appropriate.

MOVING METHANE HYDRATES RESEARCH TO OFFICE OF SCIENCE

Subcommittee. Dr. Der, once again, the Department is proposing to move the methane hydrates work that it conducts to the Office of Science. The Department claims that what's needed is basic science, but the Fossil Energy team seems to be doing fine with their work. Everything we've heard would point to this being incredibly inefficient, since the activities remain mostly the same but the team of experts resides in your office, not the Office of Science.

How do you justify moving the methane hydrates program to the Office of Science?

Dr. Der. The Office of Science will direct resources to address the fundamental scientific challenges in establishing methane hydrates as a potential source of energy for the American economy. Fossil Energy will collaborate with the Office of Science in these efforts.

NAVAL PETROLEUM AND OIL SHALE RESERVES

Subcommittee. The budget request proposes to end production operations at Naval Petroleum Reserve No. 3 (NPR-3) in anticipation of production costs exceeding oil revenues.

Could you please discuss the estimates used to make this determination? Obviously oil prices haven't decreased over the past year. So what are the estimates of production levels and production costs that make NPR-3 no longer economic next year?

Dr. Der. The margin between making a profit and being uneconomic is very narrow for this stripper oil field due to naturally declining production rates in the field. For FY 2011, based on the forecasted production of 173 barrels of oil per day and production costs (including overhead) of $4.8 million, the net cash flow of the production operation would be negative $804,000. FY 2012 and the outyears would have yielded similar negative results.

The revenue forecasts for NPR-3 utilized the Energy Information Administration's (EIA) low-sulfur oil price projections, found in its Annual Energy Outlook (AEO) publication, adjusted for the Rocky Mountain market and for the sour crude oil percentage of the total amount of oil produced at NPR-3. Now that the oil prices have risen over the past several months, revenue is increasing. However, caution must be taken when escalating the NPR-3 oil price forecast. Even assuming that these prices can be sustained at the current level, we have found that the difference between the EIA price and the NPR-3 sales price will also become larger, resulting in lower than expected prices.

A formal economic analysis for NPR-3 will be conducted this year as part of the required Continued Production Determination that must be performed every three years. This report will be submitted to Congress before the end of the calendar year.

ROCKY MOUNTAIN OILFIELD TESTING CENTER

Subcommittee. The fiscal year 2010 budget request stated that funds provided for the Rocky Mountain Oilfield Testing Center would be used to identify and analyze options for becoming a self-sustaining user facility.

What was found to support the proposal in the fiscal year 2012 budget of no funding for the Testing Center?

Dr. Der. All funding for testing at the Rocky Mountain Oilfield Testing Center (RMOTC) will be supplied by the entity conducting the testing; thus no appropriation is requested. While there is no model within the Department for a successful user facility being self-sustaining, the oil and gas companies that can afford it will pay to test their technologies at RMOTC through 100 percent funds-in arrangements, where the company will provide for 100 percent of all testing costs. Inventors and technology developers are likely to strike strategic partnerships with the end users of the technologies funding the testing. The Department is exploring creative methods to provide RMOTC with the proper business support systems and agreements with partners to maximize the use of non-appropriated funds in a manner that will allow RMOTC to operate as a viable and successful testing center. Funding of geothermal and other renewable energy technology testing is expected to follow a similar path.

NORTHEAST HOME HEATING OIL RESERVE

Subcommittee. The budget request proposes to reduce the size of the Northeast Home Heating Oil Reserve from two million barrels to one million barrels. It also states that "two million barrels is sufficient to supplement commercial stocks for approximately 10 days, the time required for ships to carry heating oil from the Gulf of Mexico to New York Harbor."

What is the practical impact on the government's ability to help mitigate a severe energy supply interruption if the reserve is reduced to 1 million barrels?

Dr. Der. Consumption of heating oil has been declining with increasing use of natural gas and the impact of increasing conservation and efficiencies related to technological advances in heating units and weatherization. We believe that a smaller heating oil reserve, strategically placed, will be a sufficient supplement to supplies in the Northeast.

SELLING OIL FROM THE STRATEGIC PETROLEUM RESERVE

Subcommittee. When Secretary Chu testified before this subcommittee two weeks ago, he indicated that selling oil from the Strategic Petroleum Reserve was one tool the Administration could use in response to a significant disruption in supply, but that there was also excess capacity that could be brought to market instead. Obviously, there have been some significant developments in world affairs since that hearing.

Could you please update us on the current status of world capacity and the Administration's position on selling oil from the SPR?

Dr. Der. The Administration is monitoring the oil markets and the situation in the Middle East and North Africa very carefully. Any decision to release the SPR would be based on the possibility of a major disruption to oil supplies.

Subcommittee. Are any discussions focused on a unilateral draw on U.S. stocks or on a coordinated international drawdown?

Dr. Der. The Administration is monitoring the oil markets and the situation in the Middle East and North Africa carefully. Any decision to release the SPR would be based on the possibility of a major disruption to oil supplies.

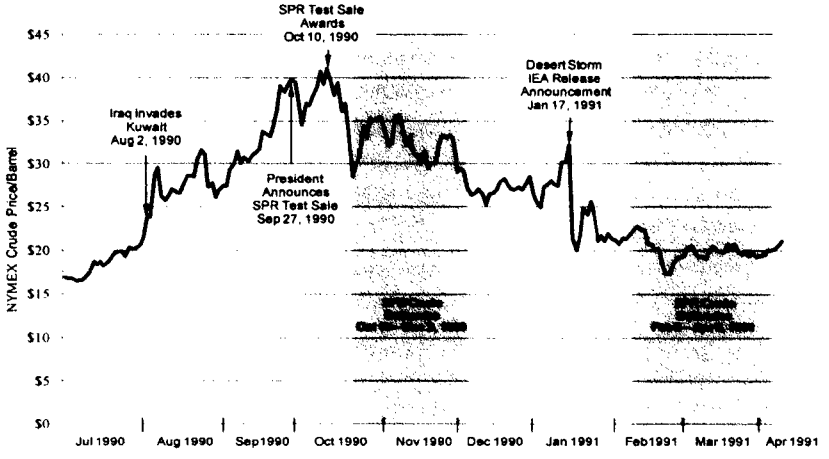
Subcommittee. Are you getting a clear signal from economists as to what the impact of selling oil from the SPR would be?

Dr. Der. DOE continues to monitor the domestic and global markets carefully in conjunction with other U.S. Government agencies. In addition, the International Energy Agency (IEA) is looking at what response might be appropriate in the interest of all member countries.

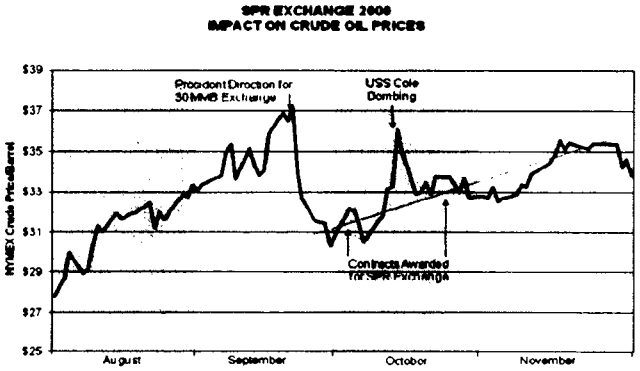
Subcommittee. What historical lessons can we learn from? When sales from the SPR were used to increase supply, what impact did the sale have on price and how long did that impact last before prices rose again?

Dr. Der. Historically, the announcement of a sale from the SPR has had an immediate impact on prices (West Texas Intermediate), which then have leveled off as the physical deliveries are made. For example, prices

after the 1990 Test Sale following the Iraqi invasion of Kuwait and subsequent Desert Storm drawdown in 1991 in coordination with the International Energy Agency (IEA) are illustrated below. (Since announcement of the Desert Storm draw down was made in conjunction with initiation of U.S. military action it is difficult to precisely say to what extent the oil price impact was caused by the coordinated IEA oil sale.)



Similarly, in 2000, the exchange of crude oil from the SPR resulted in an immediate drop in price of almost 20 percent, followed by a gradual rise in response to seasonal demand.



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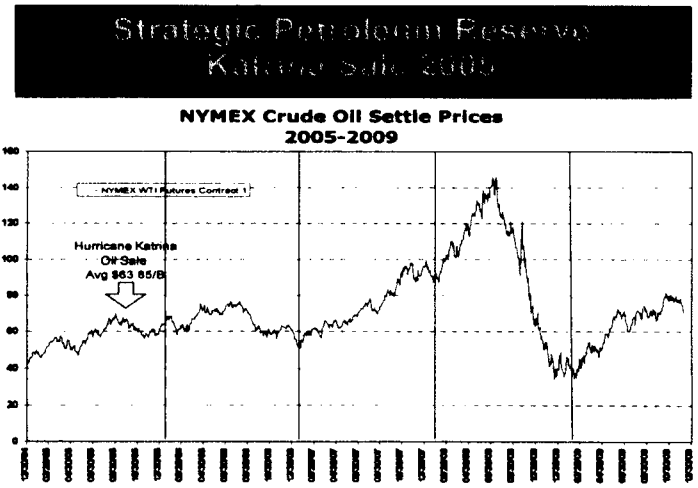
Finally, prices fell approximately 10 percent immediately following the Hurricane Katrina release and stayed relatively stable until the spring of 2006.



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Subcommittee. What would the sale of SPR oil do to the Reserve's inventory? If inventories went down due to this sale, what would we do if a serious disruption occurred to global oil supply?

Dr. Der. Major impact of the sale of 6 million barrels, as proposed in the Administration's FY 2012 budget request, is that it will reduce the strategic stocks from 75 days to 74 days of import protection. The sale of 6 million barrels from the SPR would reduce the Government strategic stocks from 726.6 million barrels to about 720 million barrels.

Subcommittee. We've heard that OPEC has met to consider increasing its production to compensate for decreased production from Libya and other nations. How is the Administration involving OPEC as it considers taking action?

Dr. Der. The Administration would welcome increased production from other OPEC nations.

Subcommittee. If the United States sold oil from the SPR, is it possible that OPEC would hold back production to keep prices high?

Dr. Der. It's not possible to know what actions OPEC would take if the United States sold oil from the SPR.

Subcommittee. How does the planned sale of oil proposed in the 2012 budget request to abandon one of the oil caverns fit into your decision-making?

Dr. Der. The 2012 Budget SPR sale would afford operational flexibility in managing the Reserve. The sale would provide an opportunity to free up space necessary to perform mandatory cavern inspections and workovers, and to optimize site operations for cavern maintenance and on-site oil movements that could be required.

Subcommittee. Is the Administration considering moving that sale earlier to ease the oil market?

Dr. Der. No, the Administration is not considering moving the 2012 Budget SPR sale to FY 2011.

Subcommittee. The budget proposes to repeal the authorities to fill the SPR through Interior's royalty-in-kind program. That leaves direct purchase as the means to replace any oil sold. Why not use the money from the sale to refill the reserve instead of spending it?

Dr. Der. The receipts from the sale proposed for FY 2012 will not be used for the SPR. The receipts from the sale will be deposited into a general fund receipt account and go to the U.S. Treasury. It will not be available for DOE's use.

PROGRAM MANAGEMENT

COMMITMENTS TO PRIOR AWARDS

Subcommittee. Part of our oversight here is to identify inconsistencies across programs, and to understand whether those inconsistencies are purposeful or signify a lack of uniform management.

Among the energy programs, several of the offices award multi-year grants that are paid out using funds from future fiscal years, creating so-called "mortgages" in future fiscal years on past awards. This is true in Energy Efficiency and Renewable Energy, Science, and other accounts. Under this practice, a large portion of fiscal year 2012 funds are tied up in past grants even before the year is started.

In other programs like Nuclear Energy, by contrast, the program awards each grant fully with currently available funding, and so each year is entered "mortgage-free", so to speak. We also hear that ARPA-E would intend to operate like this in 2012 and therefore avoid making commitments with future funds.

Given this inconsistency across programs, is one practice better than the other?

Dr. Kelly. EERE finds it advantageous from a program management standpoint to not fully fund outyear commitments until the recipient is able to demonstrate acceptable performance. Most EERE projects are reviewed on a quarterly, semi-annual or annual basis. These performance reviews often form the basis for proceeding to the next year of phase of the research and for providing incremental funding obligations. If a project is stalled or not performing, then no additional funds are obligated or tied up until there is a "go-forward" decision by the program manage. Under financial assistance rules, recipients must agree to de-obligate funds. There is typically no incentive for non-performing grantees to give up the Federal funds; in short, when all of the funds are obligated up front, the Federal manager loses leverage in managing, the grantee's performance and schedule. For EERE programs, we typically want no more than one-third of the budget mortgaged.

Partial funding of a multi-year project also allows more competitive ideas to be funded in parallel; downselects are then made in subsequent phases which results in some projects not proceeding. Full payment of multiple years of fewer ideas locks up fewer options. On higher ricks R&D, probability of success increases if more alternative approaches can be funded.

Subcommittee. If both practices have merits, what justifies the difference between the energy programs? What is unique about each account that justifies its different treatment of multi-year awards?

Dr. Kelly. Both practices have merit. If the project is fully funded in the outyears, the researchers have a sense of greater job security that their project will not end prematurely.

THE L-PRIZE AND FUNDING OPPORTUNITY ANNOUNCEMENTS

Subcommittee. Dr. Kelly, the Subcommittee has noticed many occasions when the Department of Energy has announced programs or funding opportunities that rely on funds not yet appropriated by the Congress. For example, in 2008, the Department announced the Bright Tomorrow Lighting Competition— or "L Prize"—which announced a substantial cash prize to the first organization that submits a light bulb meeting specific requirements.

My understanding is that there are no funds currently set aside or appropriated for this prize. If an entry qualifies, the prize money may be much lower than expected or simply not available. Simply putting "Subject to Appropriations" in the announcement's fine print is simply not adequate, as this practice misleads the public and can stimulate private investment with potentially false promises.

I understand that the Department has not set aside funds for the L Prize, but is currently testing one or more entries. If an entry wins, do you have funding set aside for the prize? If so, how much?

Dr. Kelly. DOE has set aside funds from previous appropriations to fund that award at the Congressionally-mandated amount of $10,000,000. The Bright Tomorrow Lighting Competition (L Prize™), as authorized in the Energy Independence and Security Act of 2007 (EISA); Subtitle E; Section 655, is intended to encourage development and deployment of highly energy efficient solid-state lighting (SSL) products to replace several of the most common lighting products currently used in the United States. To significantly impact the national market and lighting use, the SSL products selected must perform similarly to the incandescent lamps they are intended to replace in terms of color appearance, light output, light distribution, and lamp shape, size, form factor, appearance and operating environment. They must be reliable, available through normal market channels, and competitively priced.

The Department has one entry in the performance testing process, and one letter-of-intent. Both are for the replacement lamp for the 60 Watt incandescent. Upon the completion of meeting the criteria set for the L Prize, the Department will award the entrant a monetary award as set forth in Section 655. Bright Tomorrow Lighting Prizes.

Subcommittee. From what program would you take that funding, since no funding was requested by the Administration and none appropriated for the prize?

Dr. Kelly. The Bright Tomorrow Lighting Competition (L Prize™), as authorized in the Energy Independence and Security Act of 2007 (EISA); Subtitle E; Section 655, is intended to encourage development and deployment of highly energy efficient solid-state lighting (SSL) products to replace several of the most common lighting products currently used in the United States. To significantly impact the national market and lighting use, the SSL products selected must perform similarly to the incandescent lamps they are intended to replace in terms of color appearance, light output, light distribution, and lamp shape, size, form factor, appearance and operating environment. They must be reliable, available through normal market channels, and competitively priced.

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Subcommittee. Speaking more generally for a moment, do you think the Department should be announcing funding opportunities before appropriations are finalized?

Dr. Kelly. Due to the time required to develop funding announcements, give interested parties sufficient opportunity to draft well documented applications, engage in merit review of those applications and award funding to successful applicants, the Department (DOE) often has little choice but to announce a funding opportunity prior to completion of the appropriations cycle. However, DOE has a number of measures in place to ensure that, while acting in a timely manner to carry out its programs, DOE does not spend funds ahead of the appropriation process.

First, DOE does not release any Funding Opportunity Announcements (FOAs) involving new starts before completion of the appropriations process. Next, for ongoing initiatives, DOE conducts advance work to

ensure continuity of the programs and allows funds to be awarded within a reasonable time period after completion of the appropriations process. For these ongoing initiatives, DOE may release FOAs before the appropriations process is finalized, but conservative numbers are used, derived from indications from Congress. Additionally, DOE states in many locations throughout the FOA that any DOE funding "is subject to annual appropriation." This language emphasizes to prospective applicants that actual award of DOE funds is dependent on Congressional appropriation and all funds may not be secured at the time of issuance of the FOA. The FOAs also make clear DOE could cancel a funding opportunity and that the Department would not be liable for any funds spent by potential applicants in preparing applications. Finally, DOE advises its Congressional appropriators of these initiatives in advance of the release of a FOA.

With regard to the L-Prize award, DOE has set aside $10,000,000 to make such an award.

Subcommittee. Wouldn't these announcements, at best, risk misleading the private sector or other potential recipients, and possibly damaging the Department of Energy's credibility? Couldn't the Department of Energy become the federal version of The Boy Who Cried Wolf?

Dr. Kelly. Due to the time required to develop funding announcements, give interested parties sufficient opportunity to draft well documented applications, engage in merit review of those applications and award funding to successful applicants, the Department (DOE) often has little choice but to announce a funding opportunity prior to completion of the appropriations cycle. However, DOE has a number of measures in place to ensure that, while acting in a timely manner to carry out its programs, DOE does not spend funds ahead of the appropriation process.

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appropriation." This language emphasizes to prospective applicants that actual award of DOE funds is dependent on Congressional appropriation and all funds may not be secured at the time of issuance of the FOA. The FOAs also make clear DOE could cancel a funding opportunity and that the Department would not be liable for any funds spent by potential applicants in preparing applications. Finally, DOE advises its Congressional appropriators of these initiatives in advance of the release of a FOA.

With regard to the L-Prize award, DOE has set aside $10,000,000 to make such an award.

Subcommittee. How will each of you ensure that this does not happen in your respective offices?

Dr. Kelly. Due to the time required to develop funding announcements, give interested parties sufficient opportunity to draft well documented applications, engage in merit review of those applications and award funding to successful applicants, the Department (DOE) often has little choice but to announce a funding opportunity prior to completion of the appropriations cycle. However, DOE has a number of measures in place to ensure that, while acting in a timely manner to carry out its programs, DOE does not spend funds ahead of the appropriation process.

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PROPOSAL FOR NEW ENERGY INNOVATION HUBS

Subcommittee. Assistant Secretaries Kelly and Hoffman, two of the proposed new Energy Innovation Hubs at the Department of Energy are in your areas, and I'd like to hear your thoughts on them as good investments.

Hubs were first funded in fiscal year 2010. Back then, the Committee funded three Hubs and told the Department to give them a shot, show us they work, and then we can talk about funding more. We need a track record before we can commit more funding to new Hubs.

Well, the first Hubs have not yet moved into their buildings to start their work, and the Department's request proposes three new Energy Innovation Hubs. It's somewhat of a concern that the Department has changed its tune to sidestep the track record issue by claiming that the Bioenergy Research Centers are actually the first Hubs and demonstrate that the model works. This is of concern because the Bioenergy Center most talked about, the Joint BioEnergy Institute, locates researchers under one roof, while the three Hubs first funded in 2010 are shaping up to be under two, nine, or far more roofs across many states.

Under how many "roofs" do you expect each of your proposed new Hubs to be? Given that most of the real "Hubs" are under many roofs, would you expect the same for yours?

Given the lack of a track record for Hubs under many roofs—as the Hubs are shaping up to be—how can you justify proposing these new Hubs now?

Even the roofs issue aside, we still have no track record yet for Hubs in the applied energy R&D programs—we're still waiting for them to start up. How do you expect the challenges awaiting applied research and development Hubs to be different than the science-focused initiatives like the Bioenergy Research Centers?

Dr. Kelly and Ms. Hoffman. The "one roof" concept emphasizes the importance of research integration to the success of a Hub. In order to be successful, a Hub must achieve a high level of R&D integration and synergy among its researchers, who will span multiple scientific and engineering disciplines. Each of the current Hubs has the three key elements needed for success: a clear lead institution with strong scientific leadership for the

Hub a clear commitment to the use of state-of-the-art technology and frequent virtual meetings to enable meaningful long distance collaboration; and a clear organization and management plan for achieving the collaborative and synergistic goals of a Hub and infusing a culture of empowered central research management throughout the Hub. In one of the three Office of Science DOE Bioenergy Research Centers (BRCs), this communication and management is enabled through co-location of researchers "under one roof." In each of the other two, there is a broader geographical distribution of the center's activities, but each still maintains effective communication and management. In all three BRCs, and similarly for a successful Hub, active management by the lead institution is critical in achieving the desired R&D integration and synergy among research efforts

Three Hubs were funded in FY 2010: the Modeling & Simulation for Nuclear Reactors Hub is the Consortium for Advanced Simulation of Light Water Reactors (CASL) led by Oak Ridge National Laboratory; The Fuels from Sunlight Energy Innovation Hub is the Joint Center for Artificial Photosynthesis (JCAP) led by the California Institute of Technology; and the Energy Efficient Building Systems Hub is the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings led by the Pennsylvania State University. All three Hubs have moved rapidly following the award into operations. As dictated by the three funding opportunity announcements, no new construction is allowed under a Hub award and each Hub is utilizing existing laboratory and office space at its host and partner institutions. In cases where the permanent Hub facility is undergoing renovation, the Hub institutions are providing temporary lab and office space that has allowed each Hub to "hit the ground running," as required by the Department. The level of commitment from the host and partner institutions in each Hub has been remarkable—all are dedicated to the success of the Hub.

The outstanding community response to the Hub concept (as indicated by significant number of excellent proposals submitted in response to the funding opportunity announcements), the excellent rate of progress of the initial Hubs, and the establishment of robust Hub management framework within DOE provide a firm foundation for moving forward with additional Energy Innovation Hubs.

The Hubs were based on the BRC concept. The three established Bioenergy Research Centers have performed very well in meeting their scientific and

technical milestones, with significant high-impact publications and a strong record of intellectual property generation. The BRCs have also demonstrated success in effective center management and scientific integration. Because we are taking the same management model for the Energy Innovation Hubs we expect the same level of success.

HUBS OR OTHER PROGRAMS?

Subcommittee. We've heard said in this room at hearings all month that the Subcommittee is unlikely to have funding to add this year.

If your accounts only see an increase of $25 million, would you rather we fund a new Energy Innovation Hub, or another activity?

Dr. Kelly. We appreciate the committee's recognition of the importance of both our basic science and applied energy programs. The President's Budget proposes the funding needed to make advances in science and achieve a clean and secure energy future. To the extent that the committee wishes to include additional funds, we would be pleased to work closely with members of the committee to identify the appropriate recipient.

UNIVERSITY PARTICIPATION IN APPLIED RESEARCH AND DEVELOPMENT GRANTS

Subcommittee. Cost-share requirements can be a barrier preventing universities participating in grants from the applied research offices. Put simply, your offices require recipients to contribute a dollar for each dollar they receive from you, and universities often can't afford this arrangement.

Is this a problem that has prevented university involvement where it would have otherwise been appropriate?

Dr. Kelly. 50:50 cost shares are required only for demonstration projects. Universities typically compete for applied R&D where a 20% cost share is required. We believe that even 20% cost share holds many universities back from applying and it is in the public's best interest to waive this cost share. Typical examples in the past are analysis projects and modeling topics. We waive cost share if "open source" code is used. Two recent Sunshot funding opportunity announcements waived cost share for early stage R&D.

Subcommittee. Have you waived cost share requirements for any university recipients in the last two years? If so, what are some examples?

Dr. Kelly. 50:50 cost shares are required only for demonstration projects. Universities typically compete for applied research and development where a 20% cost share is required. We believe that even 20% cost share holds many universities back from applying and it is in the public's best interest to waive this cost share. Typical examples in the past are analysis projects and modeling topics. We waive cost share if "open source" code is used. Two recent Sunshot FOAs waived cost share for early stage R&D.

Subcommittee. ARPA-E has allowed universities, national labs, and industry to partner together for grants, therefore allowing universities to participate while their partners shoulder the cost-share burden. Have you considered this approach?

Dr. Kelly. EERE also allows universities, national labs, and industry to partner together for grants, therefore allowing universities to participate while their partners shoulder the cost-share burden.

ADMINISTRATIVE TAX ON PROGRAMS

Subcommittee. Dr. Kelly, as you know, the Congress appropriates funding for the Department of Energy, and specifies funding levels for programs as part of that process. Still, we've heard accounts where by the time funding gets to some Energy Efficiency and Renewable Energy programs, the Department has taken a percentage of the funds for other purposes. So Congress specifies an amount for a research program, but the Department takes its own "tax", often as much as 10 or 11 percent.

Dr. Kelly, are you aware of this practice in the Office of Energy Efficiency and Renewable Energy?

On what exactly was this "taxed" funding spent and under whose authority?

Dr. Kelly. Cross-cutting activities that DOE funds are often statutorily driven and amount to approximately 5% of the EERE budget.

All of the funds appropriated for EERE programs are implemented in a manner that is consistent with the Congressional intent. Some activities, such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) program, are required by law which provided an assessment of 2.8% in FY 2010 of R&D (including basic and applied research and development) to support the U.S. Small Business Administration (SBA) SBIR and STTR Programs. Other activities are specific, focused crosscutting activities that are in direct support of the programs' mission objectives. The crosscutting activities include a limited number of studies and evaluations that characteristically apply to two or more programs.

The enclosed table displays the FY 2010 funding for SBIR, STTR, and crosscutting activities which range from 0 to 4.7% of the program's funds. SBIR and STTR only apply to EERE's research and development activities and therefore the percentages are higher for those accounts.

Crosscutting activities include:

International - This international effort supported a joint research center (JRC) to promote clean energy innovation including cooperative efforts to accelerate deployment of clean energy.

Defense Contract Audits - The Department requires program offices to pay for the estimated cost of closing out completed contracts and grants by the Defense Contract Audit Agency. Therefore, these costs are paid by the EERE programs as a normal cost of doing business. The estimates are calculated by the DOE Office of Procurement and the DCAA audit activities are conducted under the authority of that office.

Renewable Electricity Study - Evaluated to what extent, how effectively, and at what cost renewables are able to supply a major portion of the power for the grid, and how rapidly this supply can be ramped up. The five EERE programs whose mission objectives benefited from this study shared in the cost.

Hawaii Clean Energy Initiative - Supported the Hawaii Wind Initiative including: Outreach Marketing; Technical Assistance in Development; and Oahu Wind Integration and Transmission Study. The work focused on technology R&D collaborative partnerships with industry that target reliability and performance issues associated with large land-based wind turbine technology.

Greenpower - Provided for green power data collection and analysis activities and technical assistance to policy makers and the industry at large to disseminate accumulated knowledge that will lead to increased customer access to green power producers. Included operation and maintenance of the DOE Green Power Network Web Site and organization and administration of the Tenth National Green Power Marketing Conference.

SBIR Phase III - Supported the Small Business Innovation Research (SBIR) Phase III program to provide for demonstration and deployment of SBIR activities.

Subcommittee. What percentage of funding specified by the Congress for a specific program actually makes it to that program.

Unfortunately, we're told by people across the program office that this practice has happened more than once in the last two years. I would hope that you look the issue.

Dr. Kelly. Corporate taxes are not a practice in EERE. All of FY10 dollars went to programs, as directed by appropriations.

ADDITIONAL MEMBER QUESTIONS

ADDITIONAL QUESTIONS FROM MR. SIMPSON OF IDAHO

Mr. Simpson. The President's budget includes a 44.4% increase in proposed funding for EERE, bringing the total to $3.2Billion. This is in addition to the NSF funding in the same area of at least $576Million. The Department of Agriculture funds bioenergy research and loan guarantees. The Commerce department has its own rebate and incentive program. Additionally, DoD spends considerable amounts of money on research and deployment in the same area. DoD totals are difficult to ascertain even for the Congressional Research Service, which has indicated that it would require a line-by-line analysis of the Defense budget. The goal of all of these programs and probably some I have not listed is to promote the use of renewable energy. To be effective and prevent waste, that there should be coordination. Since the underlying goal is energy policy, it would seem that the lead department should be DoE through EERE.

Please submit for the record an accounting of all current year federal funding spent on renewable energy research, development and deployment.

Dr. Kelly. The following table provides an accounting of the Office of Energy Efficiency and Renewable Energy proposed FY 2011 research, development, and deployment funding.

FY 2011 Full Year CR - RD&D Funding		
-	**Total R&D**	**Deployment and Construction**
Approp	**$**	**$**

	Hydrogen & Fuel Cell Technologies		
2	Fuel Cell Systems R&D	38,700	0
1	Hydrogen Fuels R&D	31,350	0
1	Hydrogen Production & Delivery R&D	0	0
1	Hydrogen Storage R&D	0	0
2	Fuel Cell Stack Component R&D	0	0
2	Transportation Fuel Cell Systems	0	0
2	Distributed Energy Fuel Cell Systems	0	0
2	Fuel Processor R&D	0	0
1	Technology Validation	0	0
1	Safety and Codes and Standards	3,500	3,150
1	Hydrogen Education	0	0
1	Hydrogen Systems Analysis (Includes PAE for FY05)	0	1,500
1	Market Transformation	0	0

1	Manufacturing R&D	2,850	0
	Total, Hydrogen Technology	**76,400**	**4,650**
	Biomass and Biorefinery Systems R&D		
1	Feedstocks (formerly Feedstock Infrastructure)	24,440	0
1	Conversion Technologies (formerly Platforms R&D)	75,200	0
1	Utilization of Platform Outputs R&D	0	0
1	Integrated Biorefineries	6,400	0
	Analysis and Sustainability	0	0
1	Large Scale Biopower	1,875	0
	Total, Biomass and Biorefinery Systems R&D	**107,915**	**0**
	Solar Energy		
1	Photovoltaic R&D (formerly Photovoltaic Energy	92,400	39,600

	Systems)		
1	Concentrating Solar Power	24,000	19,200
1	Systems Integration	16,500	16,500
1	Market Transformation	0	22,500
1	Solar Electricity Energy Innovation Hub	0	0
	Total, Solar Energy	**132,900**	**97,800**
	Wind Energy		
1	Technology Viability	42,839	17,356
1	Technology Application (formerly Technology Acceptance)	560	19,245
	Total, Wind Energy	**43,399**	**36,601**
	Water Power		
1	[illegible]	28,500	0
	Total, Water Power	**28,500**	**0**
	Geothermal Technology		

1	Enhanced Geothermal Systems	15,203	800
1	Low Temperature Coproduced Resources	3,800	200
1	Systems Analysis	4,750	250
1	Innovative Exploration Technologies	12,350	650
1	Permeable Sedimentary Resources	0	0
	Total, Geothermal Technology Development	**36,103**	**1,900**
	Vehicle Technologies		
2	Batteries & Electric Drives (formerly Hybrid Electric Systems)	101,135	0
2	Vehicle & Systems Simulation & Testing	20,749	0
2	Advanced Combustion Engine R&D	57,600	0
2	Materials Technology	49,123	0
2	Fuels Technology	11,000	0

2	Outreach Deployment & Analysis (formerly Technology Integration)	0	27,410
	Total, Vehicle Technologies	**239,607**	**27,410**
	Building Technologies		
2	Residential Buildings Integration	27,300	7,800
2	Commercial Buildings Integration	27,300	7,800
2	Emerging Technologies	68,800	4,200
2	Technology Validation and Market Introduction		
2	Equipment Standards and Analysis	0	35,000
	Total, Building Technologies	**123,400**	**54,800**
	Industrial Technologies		
2	Industries of the Future (Specific)	5,944	0
	Manufacturing	9,800	0

	Energy Systems		
	Next Generation Manufacturing Process	0	0
2	Industries of the Future (Crosscutting)	61,924	30,761
	Total, Industrial Technologies	**77,668**	**30,761**
	Strategic Programs		
3	Communication and Outreach	0	10,000
	Innovation and Deployment	0	8,000
1	International	0	7,000
3	Strategic Priorities & Impact Analysis	0	0
	Planning, Analysis and Evaluation	0	
	Total, Strategic Programs	**0**	**25,000**
TOTAL		**865,892**	**278,922**

Mr. Simpson. Please provide a similar breakdown for the President's proposed FY2012 budget

Dr. Kelly. The following table provides an accounting of the Office of Energy Efficiency and Renewable Energy proposed FY 2012 research, development, and deployment funding.

FY 2012 EERE - RD&D Target								
						Research and Development Analysis	Total R&D	Commercialization	Deployment
Legacy Approp	Program	Sub-program	Activity	Sub-activity			$	$	$
							9	17	19
						Hydrogen & Fuel Cell Technologies			
1						Fuel Cell Systems R&D	40,905	0	0
1						Hydrogen Fuels R&D	33,250	0	0
1						Hydrogen Production & Delivery R&D	0	0	0
1						Hydrogen Storage R&D	0	0	0
1						Fuel Cell Stack Component R&D	0	0	0
1						Transportation Fuel Cell Systems	0	0	0
1						Distributed Energy Fuel Cell Systems	0	0	0
1						Fuel Processor R&D	0	0	0
1						Technology Validation	400	0	0
1						Safety and Codes and Standards	3,500	0	3,150
1						Hydrogen Education	0	0	0
1						Hydrogen Systems Analysis (includes PAE for FY05)	0	0	1,500
1						Market Transformation	0	0	0
1						Manufacturing R&D	1,900	0	0
						Total, Hydrogen Technology	**79,955**	**0**	**4,650**
						Biomass and Biorefinery Systems R&D			
1						Feedstocks (formerly Feedstock Infrastructure)			
1						Feedstock Infrastructure	0	0	0
1						Sustainable Production	940	0	0
1						Logistics	4,700	0	0
1						Algal Feedstocks	9,400	0	0
1						Conversion Technologies (formerly Platforms R&D)			
1						Thermochemical (formerly Platform R&D)	54,520	0	0
1						Biochemical (formerly Biochemical Platform R&D)	55,460	0	0
1						Algal Conversion Technologies	0	0	0
1						Cross-cutting, Planning, Evaluation, and Analysis	0	0	0
1						Utilization of Platform Outputs R&D			
1						Utilization of Platform Outputs R&D	0	0	0
1						Integration of Biorefinery Technologies	0	0	0
1						Products Development	0	0	0
1						Integrated Biorefineries	5,000	0	18,500
1						Analysis and Sustainability			
1						Systems Analysis	0	0	0
1						Cross-cutting Sustainability	0	0	0
1						Systems Integration	0	0	0
1						Large Scale Biopower	6,750	0	0
1						Cellulosic Ethanol Reverse Auction	0	0	0
						Total, Biomass and Biorefinery Systems R&D	**136,770**	**0**	**18,500**
						Solar Energy			
1						Photovoltaic R&D (formerly Photovoltaic Energy Systems)	134,640	33,860	18,830
1						Concentrating Solar Power	27,500	0	2,500
1						Systems Integration	8,680	4,340	6,510

1	Market Transformation	0	0	24,300
1	Solar Heating and Cooling Systems	0	0	0
1	Solar Electricity Energy Innovation Hub	0	0	0
	Total, Solar Energy	**170,820**	**38,000**	**50,140**
	Wind Energy			
1	Technology Development and Testing (formerly TV)			
1	Utility-Scale Systems RD&T (Formerly LWST)	10,000	0	0
1	Small & Medium Systems RD&T (formerly DWT)	3,300	0	0
1	Advanced Components RD&T (Formerly SR&T)	28,524	0	0
1	Offshore Wind	32,250	0	0
1	Technology Application			
1	Renewable System Interconnection (formerly SI)	2,400	0	1,600
1	Wind Resource Characterization	1,800	0	5,400
1	Manufacturing and Supply Chain	133	0	1,201
1	Technology Acceptance	0	0	6,500
	Total, Wind Energy	**78,407**	**0**	**14,701**
	Water Power			
1	Water Power	36,575	0	0
	Total, Water Power	**36,575**	**0**	**0**
	Geothermal Technology			
1	Technology Development			
1	Enhanced Geothermal Systems	58,212	0	0
1	Oil and Gas Well Co-Production and Resource Assessment	0	0	0
1	Technology Application			
1	Technology Verification	0	0	0
1	Low Temperature & Geopressured Systems	13,244	0	0
1	Permeable Sedimentary Resources	5,676	0	0
1	Innovative Exploration Technologies	14,190	0	0
1	Systems Analysis	4,740	0	0
1	Strategic Planning, Analysis, Geothermal Informatics, Internatio	0	0	0
1	Alternative Sedimentary Geothermal Systems	0	0	0
	Total, Geothermal Technology Development	**96,062**	**0**	**0**
	Vehicle Technologies			
2	Batteries & Electric Drives (formerly Hybrid Electric Systems)			
2	Vehicle and Systems Simulation & Testing	0	0	0
2	Technology Validation (from Hydrogen in FY)	0	0	0
2	Battery/Energy Storage R&D	136,080	0	0
2	Advanced Power Electronics & Motors R&D	51,920	0	0
2	Vehicle & Systems Simulation & Testing			
2	Vehicle & Systems Simulation & Testing	23,850	0	0
2	Non- and Off-Highway Vehicles	0	0	0
2	Innovative Concepts			
2	Graduate Automotive Technology Education (GATE)	0	0	0
2	Cooperative Automotive Research for Advanced Technolog	0	0	0
2	Advanced Combustion Engine R&D			
2	Combustion and Emission Control	40,824	0	0
2	Solid State Energy Conversion (Waste Heat Recovery)	8,176	0	0
2	Materials Technology			
2	Propulsion Materials Technology	9,720	0	0
2	Lightweight Materials Technology	26,244	0	0
2	High Temperature Materials Laboratory (HTML)	2,036	0	0
2	Fuels Technology			
2	Advanced Petroleum Based Fuels	18,503	0	0
2	Non-Petroleum Based Fuels and Lubricants	0	0	0

2	Outreach, Deployment & Analysis (formerly Technology Integration)			
2	Graduate Automotive Technology Education (GATE)	0	0	0
2	Advanced Vehicle Competitions and GATE	0	0	0
2	Education	0	0	0
2	Safety Codes and Standards	0	0	0
2	Legislative & Rulemaking	0	0	0
2	Vehicle Technologies Deployment	0	0	229,000
2	Biennial Peer Reviews	0	0	0
2	Commercial Vehicle Integration (Supertruck)	0	0	0
2	VMT Reduction & Legacy Fleet Improvement	0	0	0
	Total, Vehicle Technologies	317,353	0	229,000
	Building Technologies			
2	Residential Buildings Integration			
2	Residential Buildings Integration	34,300	0	9,800
2	Residential Building Energy Codes	0	0	0
2	Research and Development: Building America	0	0	0
2	Commercial Buildings Integration			
2	Research and Development	0	0	0
2	Commercial Building Energy Codes	0	0	0
2	Commercial Buildings Integration	156,800	0	44,800
2	Emerging Technologies			
2	Lighting R&D	21,957	3,875	0
2	Appliances and Emerging Technologies R&D	0	0	0
2	Space Conditioning and Refrigeration R&D	19,517	0	2,169
2	Building Envelope R&D			
2	Thermal Insulation and Building Materials	13,811	0	1,535
2	Windows Technologies	9,000	0	1,000
2	Analysis Tools and Design Strategies	4,353	0	484
2	Technology Road Maps	0	0	0
2	Solar Heating and Cooling	0	0	0
2	Energy Efficiency Buildings Hub	22,500	0	2,500
2	Pioneering Technologies	0	0	0
2	Technology Validation and Market Introduction			
2	Retrofit America	0	0	0
2	Energy Star	0	0	10,000
2	Building Energy Codes	0	0	10,000
2	Solar Decathlon	0	0	5,000
2	Equipment Standards and Analysis	0	0	70,000
	Total, Building Technologies	282,238	3,875	157,288
	Industrial Technologies			
2	Industries of the Future (Specific)			
2	Forest and Paper Products Industry	0	0	0
2	Steel Industry	0	0	0
2	Aluminum Industry	0	0	0
2	Metal Casting Industry	0	0	0
2	Glass Industry	0	0	0
2	Chemicals Industry	0	0	0
2	Inventions and Innovations	0	0	0
2	Cement	0	0	0
2	Mining Industry	0	0	0
2	Supporting Industries	0	0	0
2	Petroleum Vision	0	0	0
2	Grand Challenge	0	0	0
2	Next Generation Buildings Simulation Tools	0	0	0
2	Industries of the Future (Crosscutting)			
2	Industrial Materials of the Future	0	0	0
2	Combustion	0	0	0
2	Gasification Programs	0	0	0

2	Robotics	0	0	0
2	Sensors and Automation	0	0	0
2	Industrial Technical Assistance			
2	Industrial Assessment Centers	0	0	0
2	Best Practices	0	0	0
2	Energy-Intensive Process R&D	0	0	0
2	Fuel and Feedstock Flexibility	0	0	0
2	Combined Heat & Power	0	0	0
2	Interagency Manufacturing R&D	0	0	0
2	Energy Efficiency Information Technologies	0	0	0
2	Industrial Distributed Generation	0	0	0
2	Nanomanufacturing	0	0	0
2	Desalination	0	0	0
2	Industrial Technical Assistance (formerly Efficiency and Carbo			
2	Energy Services Development	0	0	0
2	Save Energy Now Leaders Partnerships	0	0	0
2	ISO/ANSI Standards Certification	0	0	0
2	Manufacturing Energy Systems Partnerships			
2	Manufacturing Energy Systems	0	0	0
2	Material Science Focus Centers	0	0	0
2	Next Generation Manufacturing Processes	0	0	0
2	Next Generation Materials	0	0	0
	Total, Industrial Technologies	0	0	0
	EE Strategic Programs (formerly Program Support)			
3	Planning, Analysis and Evaluation	0	0	0
3	Communication & Outreach (formerly Technology Advancemen	0	0	11,559
3	Strategic Priorities & Impact Analysis	0	0	0
3	Innovation, Training & Deployment (formerly Commercializatior	0	0	15,145
1	International	0	0	0
	Total, Strategic Programs	0	0	26,704
TOTAL RD&D		1,198,180	41,875	500,983

Mr. Simpson. Please explain the coordination between these programs and an explanation of how we ensure that there is no duplication of efforts.

Dr. Kelly. In each case the Administration and respective Departments have interagency coordinated planning activities and roadmaps created in cooperation with all the major stakeholders in government and the private sector specifically designed to craft integrated workplans that leverage each others work, combine resources on larger more daunting common tasks that require interdisciplinary skills and resources and define specifically the roles, responsibilities, expectations and areas of focus to ensure productive investment and no substantive duplication of effort.

ADDITIONAL QUESTION FROM CHAIRMAN ROGERS, OF KENTUCKY

Chairman Rogers. Please provide a status update on the so-called Quadrennial Energy Technology Review. How will "clean coal" technologies be incorporated into the review?

Dr. Kelly. The Quadrennial Technology Review (QTR) will include a focus on stationery power technologies, with special emphasis on the development and deployment of technologies that reduce the environmental impacts of electricity generation. Therefore clean coal technologies are included in the review and there is a recognition in the QTR and in the President's Budget of the importance in furthering the development of this technology.

ADDITIONAL QUESTIONS FROM MR. REHBERG OF MONTANA

Mr. Rehberg. The President continues to push for a clean energy economy, yet it seems the Department of Energy is not even using existing authorities to achieve this goal. As you know, Section 1222 of the Energy Policy Act of 2005 would allow the Department of Energy's Power Marketing Administrations to partner with the private sector to develop new or upgrade existing transmission facilities. These partnerships would be at no cost to the taxpayer, would promote new jobs, and would speed the development of renewable energy in a free market manner. That being said, I understand that DOE has at least two 1222 applications that have been pending for over nine months.

Why has DOE not acted upon these applications?

Does this inaction conflict with the President's goals of creating jobs and moving toward a cleaner generation mix?"

Dr. Kelly. The Department of Energy (DOE) has been very supportive of expanding the transmission grid to facilitate the integration of renewable resources, and on June 10, 2010, published a *Federal Register Notice* requesting project proposals from entities interested in providing contributed funds under the provisions of Section 1222. In response to this notice, DOE received two proposals from Clean Line Energy Partners (Clean Line) to construct facilities for the transmission of wind generated energy. After extensive review of Clean Line's proposals, DOE decided not to pursue this project under the Section 1222 framework at this particular time. We will continue to monitor the project and look for potential opportunities for the Department of Energy to work with Clean Line to meet the goal of expanding the transmission grid to facilitate the integration of renewable resources.

The decision not to pursue Clean Line's transmission project at this time has not prevented DOE from continuing to seek potential renewable energy projects through other initiatives and authorities that meets the President's goals of creating jobs and moving towards a cleaner generation mix.

WEDNESDAY, MARCH 16, 2011.

DEPARTMENT OF ENERGY—SCIENCE

WITNESS

DR. STEVEN KOONIN, UNDER SECRETARY FOR SCIENCE, DEPARTMENT OF ENERGY

Mr. FRELINGHUYSEN. Good morning, everyone. I'd like to call this hearing to order. We have before us today Dr. Steven Koonin, Undersecretary for Science, to discuss the Department's fiscal year 2012 request for the Office of Science.

This subcommittee has long been a strong supporter of the Office of Science. I think everyone up here would agree that basic energy-related science is a core mandate of the Department. Much of the work that you and your associates perform every day is crucial for keeping our nation at the forefront of global technology and science.

As I have mentioned at all of our hearings this year, I want everyone who appears before this subcommittee to understand that it is highly unlikely there will be any new funding in fiscal year 2012 for our subcommittee. Our subcommittee must do its part to reduce spending and bring down our deficit.

Our task this year is really no different than any other year, however—we must find the right balance of investments into our most critical needs, with an eye towards those that protect our nation, and support and improve our economy and add jobs.

Dr. Koonin, your office has enjoyed record increases in recent years. If we were to appropriate your budget as requested, the Office of Science would increase by $1.4 billion since fiscal year 2008, a 35% increase. Increases such as these, as important as they may be, aren't going to occur.

Since they will not, we must work together to determine what are your top priorities, in every account. I am sure you will share them with us this morning.

Dr. Koonin, please ensure that the hearing record, the questions for the record, and any supporting information requested by the subcommittee are delivered in final form to the subcommittee no later than four weeks from the time you receive them. Members who have additional questions for the record will have until close of business tomorrow to provide them to the Subcommittee office.

At this point I'd like to yield to my ranking leader, Mr. Pastor, for any remarks he may wish to give.

Mr. PASTOR. Good morning, Mr. Chairman, and thank you very much for yielding, and good morning, Dr. Koonin. Welcome again to this Subcommittee hearing.

The requested level for science is a large increase over both the 2010 and 2011 requests, 10 percent and 6 percent, respectively, so

that shows you that the subcommittee supports strengthening American leadership in science and advancing energy innovation. However, in doing so we must ensure that we eliminate redundancy in order to maximize scientific and technological advances within tight fiscal constraints. While this committee has been supportive of both the Office of Science and ARPA–E, we continue to have concerns regarding the redundancy and interaction of several recent organizational initiatives: the Energy Innovation Hubs, ARPA–E and the Energy Frontier Research Centers.

Many areas of American science continue to be the best in the world. However, our margin of leadership is neither as wide nor as clear-cut as it has been in the past, and in others we have lost ground. Given the constrained fiscal environment, it is particularly important that we plan in each of the major program areas to ensure that we are proceeding in a deliberate and thoughtful manner, leading where we can and/limiting investment where we cannot. I will be interested in hearing your perspective on the 2012 budget.

Thank you, Mr. Chairman. I yield back the time.

Mr. FRELINGHUYSEN. Thank you, Mr. Pastor. Dr. Koonin, welcome and good morning. Thank you for being with us again.

Dr. KOONIN. Thank you. Happy to be here.

Mr. FRELINGHUYSEN. We appreciate the work you do and obviously the multitudes of those that you represent here as a strong advocate and leader. Thank you.

Dr. KOONIN. Chairman Frelinghuysen, Mr. Pastor, Mr. Womack, thanks for the opportunity on what I know is a very busy day to provide an overview of the President's fiscal year 2012 budget request for the Department of Energy's Office of Science.

We face great national and global challenges over the next several decades. Foremost among them are providing clean and reliable energy at affordable prices, maintaining the United States' competitiveness in a global economy through innovation and job creation, and enhancing nuclear security. Science and technology are central to the President's strategy for addressing these challenges. The President's budget request for fiscal year 2012 makes tough choices while focusing resources on innovation.

For the Department's fiscal year 2012 request, we aim to invest in science with the greatest timeliness, relevance, and impact, respecting the need to maximize the impact of every federal dollar that we are allocated. The Office of Science plays a unique role in the nation's science and technology enterprise not only through the mission-oriented research we support, but also through the suite of scientific user facilities we design, construct and operate. And I am pleased to see pictures of two of them in the room: the Advanced Photon Source at Argonne and the Fermilab tower behind me.

Mr. FRELINGHUYSEN. It has not been changed from last year.

Dr. KOONIN. The facilities are still there and they are doing just fine.

Mr. FRELINGHUYSEN. We were looking for the Princeton Plasma Physics Lab, but we did not have an up-to-date picture.

Dr. KOONIN. Actually, we have about 10 or 12 of them we can put up.

The $5.416 billion request for the Office of Science is an increase of $512 million, or as Mr. Pastor mentioned, 10.4 percent over the

fiscal year 2010 appropriation. That amount realizes the President's commitment to continue on a path that doubles funding for the Office of Science and other key basic research agencies, a journey that began with President Bush in his American Competitiveness Initiative.

Congress authorized $5.614 billion for the Office of Science in fiscal year 2012 through the America COMPETES Reauthorization Act of 2010 passed in the last session. The request before you is in line with that authorization.

Our fiscal year 2012 request reflects a very clear and deliberate strategy to support those areas of science with the most direct impact on the energy, security, and environment missions of the Department—those of materials, biology, and computation. Let me explain briefly why we are focused on those fields.

Materials make up everything in our world—from those in the chips in your cell phone to those that can withstand high temperatures in a power plant, to those in batteries for hybrid vehicles. What is so exciting now is that new tools are letting us understand and control what the atoms are doing inside materials to more rapidly discover or create better materials. Nanscience lets us create stuff almost atom by atom. Our light sources and neutron sources let us see what those atoms are doing and high-performance computer models let us predict the properties that result.

The U.S. is not alone in trying to accelerate the process of "make, measure, and model" for materials. In 1980, there were only 10 synchroton sources worldwide. Today there are more than 50; most of them outside of the U.S. and more are under construction.

The situation in biology is not much different. While there are millions of microbes in the world, greatest attention has been paid to the small fraction that are medically relevant. But the vast majority do amazing nonmedical things. They concentrate waste, they turn sunlight into fuel, they can capture carbon dioxide, produce hydrogen and they can live in places that we never imagined possible. Understanding how microbes do that and how we can harness those capabilities for practical application is a focus of the Department of Energy's efforts.

Toward those ends, we develop and field tools like high-throughput sequencing, gene chips, light sources, and computer tools that are broadly useful in biology. The President's budget request knits together all of those strands into a coherent systems biology effort.

Finally, you may have noticed that both the materials and biology efforts involve high-performance computing. Growing and utilizing our capabilities in that field is the third major focus of the budget proposal. Through major programs in the NNSA and the Office of Science over the past several decades, the Department of Energy leads the world in using computers to understand complicated systems ranging from nuclear weapons to proteins to climate. We see great potential in applying that expertise to address many important energy issues, optimizing designs and shortening the time it takes for a new technology to go from the lab to full-scale implementation.

The Department makes available for a broad range of users, the world's second-most-powerful computer. We were surpassed last November by a Chinese machine almost twice as fast as our fast-

est. We believe it is very important for the U.S. to maintain global leadership in high-performance computing and this budget's request puts us on a path to not only reclaim the top spot in a year or so, but to drive to a thousandfold improvement during the next decade.

Clear priorities mean tough choices for fields such as high-energy physics, my own field of nuclear physics and fusion energy. The Office of Science supports nearly 90 percent of U.S. research in elementary particle physics, yet we acknowledge that this budget climate forces us to make tough choices through flat funding in that area. And the Office of Science supports nearly 80 percent of U.S. basic nuclear physics research, yet we are proposing to redirect resources from operating current facilities to constructing the next generation of world-class facilities.

Finally, I would like to discuss briefly the performance of the Office of Science. Metrics for basic research are difficult but not impossible to develop. The easiest things to quantify are the performance of our construction projects and our facilities' operations. Over the past 5 years the Office of Science successfully completed 23 of 25 construction projects within scope, cost and schedule targets. Those projects would have cost a total of $3.11 billion and we delivered them for $3.22 billion in total, a difference of less than 5 percent. Of the three projects that overran on cost or schedule, we cancelled one, the National Compact Stellarator Experiment, when it became clear that it could not be delivered and before actual spending got out of control. In fiscal year 2010, our Scientific User Facilities delivered 113,000 hours of run time, 2½ percent more than had been planned.

Quantifying performance of the research component of the portfolio was tougher, but again can be done in some cases. The Bioenergy Research Centers, the model for our Innovation Hubs, are now in their third year of operation. Oak Ridge's Bioenergy Science Center just announced that its researchers have developed a microbe that could directly convert cellulose into isobutanol and so making an improved fuel from a broader range of feedstocks. That is a very good example of what the hubs are expected to do: tackle problems ripe for the integration of discovery-oriented research with translational engineering and so quickly develop opportunities for commercialization.

With that, thanks for your attention and I would be pleased to answer any questions that you might have.

Statement of Under Secretary Steven E. Koonin
U.S. Department of Energy
Before the
Subcommittee on Energy & Water Appropriations
U.S. House of Representatives
FY 2012 Budget Hearing
March 16, 2011

Chairman Frelinghuysen, Ranking Member Visclosky, and Members of the Committee, thank you for the opportunity to appear here today to provide an overview of the President's Fiscal Year 2012 budget request for the Department of Energy's Office of Science. I will describe a few of the highest priority research areas in the Fiscal Year 2012 Budget request, but first let me explain why the Office of Science and the basic research it supports matters.

Why Basic Research Matters

In his recent State of the Union address, President Obama said, "In America, innovation doesn't just change our lives. It is how we make our living." That's not just rhetoric – it is true. Scientific research is at the core of a high tech economy. Most directly, it increases our knowledge of Nature and integrates that knowledge in ways that are directly useable for practical engineering applications. And in the course of their work, as researchers develop new tools and techniques that allow us to discover and measure previously inaccessible physical phenomena, those tools form the basis of new technologies or solutions to long-standing technical barriers. Scientific understanding is at its most practical when it solves problems that arise in the design, manufacture or operations of complex technologies. Finally, research is a prime training ground – though not the only one – for a technically talented workforce that can drive future innovation.

The Office of Science provides 45% of Federal support for basic research in the physical sciences, and key components of the Nation's basic research in materials, biology, and computing. The Office of Science supports over 27,000 PhDs, graduate students, undergraduates, engineers, and supports staff at more than 300 institutions. Researchers supported by the Office of Science or making use of our scientific user facilities have won over 100 Nobel Prizes in the past 60 years – 22 in the past decade alone. The Office of Science provides the world's largest collection of scientific user facilities to over 26,000 unique users from universities, national labs, other federal agencies and businesses large and small each year. The Office has been the source of research funding for many of those who are now engaged in the national conversation on energy.

To help explain the research supported by the Office, I offer four stories that I believe illustrate the benefit we provide to the Nation; there are many others I could have chosen.

Environmental Microbiology. Microbes far outnumber all other forms of life on the planet. They and their biochemistries are far more varied than the plants and animals we are most familiar with. While some microbes are well-studied, particularly those that cause disease, we have a very limited understanding of how they do an amazing range of things, including

degrading biomass, transforming heavy metals at contaminated sites, and breaking down oil. One of the problems is that microbes exist naturally in communities of several interdependent species, so that they cannot be isolated and grown in the lab. To address this problem, our Biological and Environmental Research program supported development of a new technology called the GeoChip, which provides a rapid, real-time snapshot of an environmental sample that tells us what microbes are present and what they're doing. . The original GeoChip won an R&D 100 award in 2009; each new generation allows researchers to have an increasingly complete view of microbial activity. This small but powerful tool advances our understanding of environmental microbiology, letting us engineer more effective communities for contaminant mitigation, oil spill cleanup, or carbon sequestration.

A New X-Ray Laser. Since all material is made of atoms, we are driven to develop new tools that better see those atoms and what they're doing. The new Linac Coherent Light Source (LCLS) at Stanford University's SLAC National Accelerator Laboratory is the world's most powerful X-ray free electron laser. It creates flashes of light bright enough to make images of single atoms or molecules and fast enough, like a stroboscope, to capture their motion. The LCLS is opening new frontiers in economically relevant fields like materials science, electronics, energy research, and the life sciences. One of the first LCLS experiments showed for the first time that protein structures could be obtained from tiny nanocrystals otherwise too small to use. Since many medically-important proteins are difficult or impossible to crystallize, this novel capability can take years off the search for new drug targets. In a separate study, the same team reported making the first single-shot images of intact viruses, paving the way for snapshots and movies of viruses and microbes in action.

Smart Truck. A long-haul truck typically puts on five times as many miles as your car does in a year, yet gets only 1/5 the gas mileage. So improving vehicle efficiency matters a lot to truckers, with independent drivers getting hit particularly hard by rising fuel prices. Using the Office of Science's Jaguar supercomputer located at Oak Ridge National Laboratory (the world's second fastest), Smart Truck Brands, an engineering services firm in South Carolina, developed bolt-on fairings for trailers that substantially reduce fuel consumption. That small start-up developed the most detailed (and therefore the most accurate) numerical model of a Class 8 truck and trailer ever created. World-class simulation capabilities allowed them to rapidly refine designs for their UT-6 Trailer UnderTray System. These add-on parts can be easily retrofitted to existing or new trailers to improve MPG by 10% to 17%. If all 1.3 million Class 8 trucks in the U.S. were configured with these components, companies could achieve annual savings of 1.5 billion gallons of diesel fuel – approximately equal to $5 billion in costs – and reductions of CO2 by 16.4 million tons. The Office of Science developed its simulation methods and supercomputers for basic research, not to improve the efficiency of long-haul trucks. But as you can see, we actively reach out to people working on energy problems who can benefit from our expertise and our machines.

Creating a High Tech Workforce. Basic research supported by the Office of Science helps develop the skills and capabilities of the Nation's high tech workforce. Rudolph Technologies, a 550 employee New Jersey firm producing control sensors for semiconductor processing, is working with Brookhaven National Laboratory on a new tool for measuring materials properties at the Lab's National Synchrotron Light Source. Even though the work is not immediately related to the products Rudolph is developing today, the company uses the collaboration to

expand its own capabilities and to engage with the Brookhaven's student and postdoctoral researchers, a talent pool from which to recruit the next generation of company scientists.

The FY2012 Budget Request: Investments for the future

I would like to turn now to some of the highlights of the FY2012 Budget request. The President is requesting $5.416 billion for the Office of Science, an increase of $512 million or 10.4 percent over our FY 2010 appropriation. With your support, we will continue to make progress toward President Obama's commitment to double funding for key basic research agencies, a commitment that continues the prior Administration's American Competitiveness Initiative. This request has a clear investment strategy – to support those areas of science most directly impactful on the energy, security and environmental missions of the Department. These are materials and chemical sciences, biology, and computational sciences.

Such clear priorities meant some tough choices for fields such as high energy physics, my own field of nuclear physics, and fusion energy. The Office of Science supports nearly 90 percent of research in elementary particle physics in the U.S., nearly 80 percent of basic nuclear physics research, and 100 percent of fusion research. Yet in this budget climate, we propose to hold High Energy Physics flat, redirect resources in Nuclear Physics from operating facilities to construction of the next generation of world-class facilities, and reduce the top line for the fusion program. I will discuss those later.

Materials by Design. One of the reasons you hear us say materials over and over again is that the materials discovery and improvement drives many of the most significant technological innovations. Until today, those discoveries and improvements have almost always been the result of time consuming trial and error – "shake and bake." As part of an interagency effort, the President's FY 2012 Budget requests funding to support work that tightly couples materials synthesis, testing, and modeling to more rapidly explore and refine new substances for applications ranging from batteries and electronics to lightweight structures.

In the Office of Science, our focus is on materials useful in extreme circumstances, such as in nuclear reactors or other power systems where there are corrosive, high-temperature, and/or high-radiation environments. Corrosion costs about 3% of the U.S. gross domestic product every year, according to a Federal Highway Administration's study, "Corrosion Cost and Preventive Strategies in the United States" (Publication No. FHWA-RD-01-156). Some recent work convinces us that the simulation-based, materials-by-design approach we propose holds great promise. A research team using Argonne National Laboratory's supercomputers wanted an answer to the fundamental question of how materials become brittle. The researchers simulated the introduction of small amounts of sulfur into the grain boundaries of nickel, which is used in nuclear reactors for valve stems or control rod drive mechanisms. The surprising results let them understand exactly how sulfur impurities cause microscopic fractures to grow into the larger cracks that cause failure.

Biosystems by Design. Biological systems hold powerful capabilities that are already being tapped for clean energy and environmental solutions. Reengineered microbes and plants can harvest sunlight and store that energy in the molecules that they use to power metabolism or we can use as renewable biomass. To take fuller advantage of these bio-based capabilities we need to better understand the design principles that govern living systems and to systematize design rules for the rapid reengineering of microbes and plants. The Budget request provides funding

for new research to identify, characterize, and articulate general biological design principles, and to create new synthetic molecular toolkits to improve understanding of natural systems; the ultimate goal is computer-aided design and testing of natural and hybrid biological systems to rapidly develop multiscale natural and hybrid biological systems for clean energy and environmental solutions. This more systematic approach to bioengineering is poised to stimulate a new biotechnology revolution, much as DOE efforts fostered the genomic sequencing revolution more than two decades ago.

Energy Systems Simulation – Internal Combustion Engines. In 2008 the United States had some 300 million automobiles and light duty trucks on the road using approximately 130 billion gallons of gasoline per year. Yet there remain significant opportunities to improve the efficiency and cleanliness of internal combustion engines. Scientific simulations of what happens inside a cylinder can help us better predict, and optimize, engine performance. Of particular importance is understanding liquid fuel injection (where and when the fuel is placed in the cylinder) and fuel ignition and burn. The U. S engine industry has identified these as high-priority engineering science challenges as they move from hardware-intensive, experience-based engine design to simulation-intensive, science-based design. Coordinated efforts between the Office of Science and the Office of Energy Efficiency and Renewable Energy will result in tools to simulate combustion of diverse fuels in real engines; they will be broadly useful to any engine designer, rather than specific to one company or another.

Investments for Exascale Computing. A theme running through most of priorities is high-performance computer simulation. The U.S. has been a leader in high performance computing for decades. Recently, it is quite clear that other countries, having seen both the utility and promise of supercomputing to further their own economic, scientific, and security interests, are rapidly gaining ground, and have already surpassed the U.S. in some dimensions. Losing a competitive capability in this field would have far reaching consequences for the nation.

For more than twenty years, our supercomputers have been built from increasingly powerful commercial off-the-shelf components. But to realize the thousand-fold increase in capability we believe possible over the next decade, we must decrease power consumption, increase the number of processing units on a single chip, more tightly integrate memory and processors, and ensure that millions of processors work well together, even as some will inevitably fail. To begin attacking these problems, the FY 2012 budget proposes a joint activity between the Office of Science's Advanced Scientific Computing Research program and the National Nuclear Security Administration's Office of Advanced Simulations and Computing that will deliver the design for a cost effective, useable, and energy efficient exascale capability by the end of the decade.

New and Continuing Energy Innovation Hubs. The Energy Innovation Hubs are particularly promising ways for the Department to focus its research efforts on those problems where the close integration of discovery-oriented science with translational engineering research can accelerate commercialization of new technologies.

- ***Fuels from Sunlight Energy Innovation Hub.*** The FY 2012 budget requests the third year of funding in the Office of Science for the recently established Joint Center for Artificial Photosynthesis. The challenge is to design highly efficient, non-biological, molecular-level "machines" that generate fuels directly from sunlight, water, and carbon dioxide. The goal is to demonstrate a scalable, manufacturable solar-fuel generator that

produces fuel from the sun ten times more efficiently than current energy crops. The Joint Center's R&D focuses on accelerating the rate of catalyst discovery for solar fuel reactions; discovering earth-abundant, chemically and mechanically robust, inorganic light absorbers designed to use more sunlight than natural materials do; and providing system integration and scale-up.

- ***Batteries and Energy Storage Innovation Hub.*** This new Hub in the Office of Science will develop electrochemical energy storage systems that safely approach theoretical energy and power densities with that can be charged over and over without losing capacity. Improved energy storage is critical for enabling the widespread use of intermittent renewable energy, electric vehicles, and efficient and reliable smart electric grid technologies. These are systemic challenges requiring new materials, new systems, and new knowledge. The Hub will address key fundamental questions in energy storage including: How closely can we approach theoretical energy density? Can we safely increase the rate of energy utilization? Can we more efficiently move electrical energy in and out of storage?

With the support of this committee, the Department funded three Hubs in FY 2010 including the Office of Nuclear Energy's Modeling and Simulations Hub for Nuclear Reactors, which is using substantial computational resources provided by the Office of Science's Oak Ridge Leadership Computing Facility.

High Energy Physics. The High Energy Physics program seeks to understand how the universe works at its most fundamental level. The research focuses on the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time. The Tevatron Collider at Fermilab concludes its planned program in FY 2011. Its record-breaking performance in delivering data over the last few years is important, but the attention of the particle physics community is turning to the energy frontier now at Europe's Large Hadron Collider (LHC). The Tevatron dataset collected over the last few years will continue to be mined for discoveries while the LHC begins generating data. Strong support for neutrino physics and dark matter searches continues as the program concentrates its efforts on retooling our domestic facilities to exploit discoveries of rare processes at the intensity frontier.

Nuclear Physics. Our Nuclear Physics program is not solely a discovery-oriented fundamental research program focused on exploring and understanding all forms of nuclear matter. The program also has responsibility for the Isotope Production program, which has produced for over 50 years radioactive and stable isotopes used in research and commercial applications. The FY 2012 budget request terminates operations of the Holifield Radioactive Ion Beam Facility (HRIBF), a facility for studying nuclear structure and astrophysics at the Oak Ridge National Laboratory, in order to ramp up design work on the next-generation radioactive ion beam facility to be built at Michigan State University. The FY 2012 budget request supports operations at the three remaining nuclear physics national user facilities at levels that will allow continued scientific progress.

Fusion Energy Sciences. The Fusion program works to understand matter at very high temperature and so build the scientific foundation needed to develop a practical fusion energy source. The FY 2012 Budget emphasizes developing within the domestic program the science for predictive understanding of plasma properties, plasma dynamics, and interactions with

surrounding material. The Administration gained agreement from the ITER Council and ITER Organization to a range of U.S. initiatives that implement management reforms and accelerate ITER construction; the goal is to minimize the overall cost of the Construction Phase for the U.S. and other ITER Members. A decrease in proposed ITER funding reflects the Administration's assessment of the level of effort required to sustain U.S. commitments in FY 2012.

Bioenergy Research in Office of Biological and Environmental Research. Advanced biofuels are a critical component of a sustainable energy future, requiring innovative research strategies to support the aggressive production goals Congress has set in the Energy Policy Act of 2005 and help reduce our nation's dependence on oil. Our three Bioenergy Research Centers (BRCs) led by Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and the University of Wisconsin with Michigan State University are making the scientific breakthroughs that will allow us to more effectively convert the cellulose in plant fibers to biofuels and optimize those plants as clean energy crops.

A core capability provided by BER through its Joint Genome Institute (JGI) is high-throughput genome sequencing of non-medical microbes, microbial communities, plants, and other targets relevant to DOE missions in energy, climate, and environment. This work underpins modern systems biology research, providing fundamental data on key genes that link to biological function. Like all of our scientific user facilities, the resources of the JGI are made broadly available to researchers based upon scientific merit. For example, Dr. Daniel Peterson, a plant geneticist at Mississippi State University, was part of a team of USDA-funded researchers awarded time at JGI to sequence the loblolly pine, an important crop for the pulp and paper industries.

Climate Research in Office of Biological and Environmental Research. Starting in the mid 1940s, civil defense needs and the testing of nuclear weapons created an urgent need to understand the global distribution of radioactive fallout. That need drove the development of what became the first global circulation models and that expertise in climate modeling still contributes today to DOE's sophisticated nuclear nonproliferation programs. DOE's current climate models focus on understanding timescales from decades to centuries—information needed to plan for future energy use, land use, food production, and water resources and to help mitigate economic and finance risks in infrastructure planning. Work in the Office of Science focuses on two of the greatest uncertainties in climate modeling—clouds and aerosols. The BER-supported Atmospheric Radiation Measurement (ARM) Climate Research Facility is used by hundreds of scientists around the world to better understand the physics of sunlight in the atmosphere. Several ARM sites carefully located around the world study diverse atmospheric conditions, but the main 160-acre site just outside of Lamont, Oklahoma is one of the best instrumented columns of air on the planet. While carbon dioxide is a key contributor to climate change, water vapor is the dominant greenhouse gas in the Earth's atmosphere. ARM data and improved calculations during the past decade have reduced uncertainties in water vapor measurements from 13% to less than 4%, enabling better weather forecasts of temperature and humidity in the upper atmosphere.

In closing, I would like to recognize the efforts of our career Federal staff in the Office of Science and its service centers in Chicago and Oak Ridge. Implementing programs of the scale, pace and quality of the Office of Science takes remarkable dedication and concerted effort. I

thank you for the opportunity to appear today and look forward to further discussions of the Department's priorities.

Mr. FRELINGHUYSEN. Thank you. Mr. Secretary, we spent 2½ hours with Dr. Chu yesterday and I thought it was a pretty substantive hearing. You know just about anybody in the world has weighed in on what is going on in Japan. I wondered if you might like to give some of your own observations. I know that is perhaps not what staff expected I would use as a first script, but I think obviously our hearts go out to the Japanese people and we salute not only our men and women who are trying to provide humanitarian aid and those of other countries, but things are not always predictable here. We would appreciate any comments you might have, any perspective that you might have.

Dr. KOONIN. It is, of course, a horrible tragedy what is going on, broadly the impacts on Japanese society, but also particularly the reactor situation at Fukushima and some of the other sites in Japan.

It is a low-probability, high-consequence event. The Department is doing all it can to provide technical assistance. We have over 40 Department people deployed over in Japan right now, most of them radiological response folks who can help surveil and deal with radiological materials, but also some technical expertise in reactor engineering, and we are providing as much support as we can back home here in terms of technical understanding of how to manage the situation.

A couple of salient facts for me, one, is that these are old designs. Modern designs would not have had the problems that these have. A second point that sticks out in my mind is that the reactors themselves rode through the earthquake just fine; it was the tsunami that has caused all of the trouble that we are trying to manage. A third is that, as always, you design very complicated systems—whether they are aircraft or reactors or some of the facilities that the Department of Energy has—against a design basis threat and the reactors performed well against that threat, but the magnitude of what happened was outside of what had been designed for or expected.

This is the kind of thing that happens every several hundred years or a thousand years in terms of the earthquake and tsunami, and clearly it is causing us to rethink and reassess and make sure that our own facilities remain robust against all kinds of events.

Mr. FRELINGHUYSEN. The computers that you referenced—you have extraordinary capabilities that spread across all of these laboratories and they do all sorts of modeling. Obviously the nuclear piece is one thing and obviously people have already made some judgment calls there, but I would assume when things were designed, somebody must have taken tsunamis into consideration as well.

Dr. KOONIN. I do not know the details there. As I hope you know, we stood up one of the hubs recently on the modeling and simulation of nuclear reactors, where we hope to apply the best expertise now to the operation and extension of light-water reactors. But there are other areas in which similar expertise could be applied, in particular, understanding the consequences of accidents, understanding the release—the chemical form and rate of things that might be released under various scenarios, and tracking of releases through the atmosphere. As another part of the Department's as-

sistance, we have spun up at Livermore the National Atmospheric Release Advisory Center, which is a center that has the capabilities in real time to track and advise atmospheric releases of radiological, chemical, and biological matter, and they are working with the government to help provide the best information and predictions on what the consequences may be.

Mr. FRELINGHUYSEN. Just another question before I yield to Mr. Pastor. Today many of the iconic symbols of cutting-edge science are being built overseas, not all, but France is hosting the ITER and we are among many partners. I think the Japanese actually have a bigger stake in that than we do which is somewhat disturbing. France is hosting the ITER, the fusion experiment of unprecedented scale currently under consideration. Europe is hosting the Large Hadron Collider, the world's highest-energy particle accelerator measuring 17 miles around. And now China is hosting the fastest supercomputer in the world, which you referenced, announced late last year. Secretary Koonin, three of your major programs are now overseas. In this respect, how do other science programs fare and where in science do we actually hold the clear lead?

Dr. KOONIN. Look, it is a fact that the rest of the world is growing up, and has realized that investments and science are important. Scientific frontiers are expanding, and, of course, the forefront facilities in many fields is going up. And so we are learning, and I feel with good success, about how we can selectively leverage participation in these international projects, and at the same time, inside the U.S., keep the leads in things that we really need to be leaders in.

The things you mentioned specifically are, with respect to ITER. We are getting tremendous, or will get tremendous leverage, out of ITER. For a 10 percent stake, we will have full access to the science and operations of that facility, and we need to make sure that our program is best positioned to take advantage of that. With respect to——

Mr. FRELINGHUYSEN. Is it——

Dr. KOONIN. We are—the budget is targeted to let us do that. Of course, operations will not start until about eight years.

Mr. FRELINGHUYSEN. Yes.

Dr. KOONIN. So we put a lot of money into diagnostic simulation and building the human capability. With respect——

Mr. FRELINGHUYSEN. I would note just for the record, and I do not mean to be provincial here. Actually I do, because fusion energy and science mark is about 26—down to about 26, right?

Mr. KOONIN. Right. Some of it—a lot of that has got to do with the phasing of the ITER Project and how much money we need to expect to deliver when. With respect to the LHC that you mentioned, we are the largest—the Office of Science supports the largest international presence at the LHC, and we feel we are well positioned again to capitalize on the capabilities of that machine in getting the science done for U.S. researchers.

And then finally, with respect to the world's fastest computer. Executing simulation is, in part, about the hardware, but it is also about the software and the expertise to meld observations and experiment together with the codes, and, therefore, the U.S. is second to none in being able to do that.

Mr. FRELINGHUYSEN. I was in the company of Mr. Fattah and Mr. Simpson at NNSA, and I may not have a chance, because I am going to another hearing, to know how you work with the NNSA, but I must say, we were hugely impressed by their capabilities, and maybe before the hearing is over here, you could share with other members what our relationship is and how you share information. Mr. Pastor.

Mr. PASTOR. Thank you, Mr. Chairman. In response to the question from the Chairman, I heard you say that we have to keep a lead, so the question I have is, what is the department doing to identify promising discoveries and ensure that they are picked up by American industry or there is some protection so that we keep doing it?

Dr. KOONIN. In computing specifically or more broadly?

Mr. PASTOR. More broadly.

Dr. KOONIN. We have a renewed focus on technology transfer from the labs out into the private sector. The Secretary has appointed a technology transfer coordinator who is working with the Laboratories to move things more smoothly out of the Laboratories.

We have a host of cooperative research and development agreements that let the Labs interact with the private sector. And we are working very hard within the department to knit together activities in the Office of Science to smoothly hand off to the applied programs and then out into the commercial sector.

You know, the process of going from a laboratory discovery to a product with commercial impact can take a decade or more, and I can give you an example if you would like. And it involves many different kinds of researchers, and the better we can knit the activities of the Department together, the faster we are going to make that happen.

Mr. PASTOR. Well, wasn't that the intent of the Hubs?

Dr. KOONIN. The Hubs are one mechanism of doing that.

Mr. PASTOR. And essentially, I recall two years ago, when Secretary Chu talked about the lab where he was formerly employed, that we take basic research and then build a whole spectrum and end up with commercial activity——

Dr. KOONIN. That is right.

Mr. PASTOR. That seemed to be the objective of the Hubs. So, obviously, in basic research, you do not know what will be the result in terms of commercialization. But I guess my question leads to, what do you do to keep some protection over the stream—do you apply intellectual property laws at—I do not know at what point you can do it, but I am sure that it is something that you are looking at, because, again, it is this idea that we are investing in basic research and we are investing in the Office of Science, and you want to maintain a competitive edge and keep the lead.

Dr. KOONIN. The technology transfer, the competitive edge, comes in two forms. One is, as you mentioned, intellectual property, formal intellectual property, and we make sure that we are secured by patents on the research that we consider valuable. But it happens in another way, and that is the skills that we have. This is much more difficult to quantify, but probably more important than specific patents. And having industrial researchers working closely with laboratory folks or vice versa, or taking the students

that we train and moving them out into the private sector with the skills and materials, computers, whatever, is a very important way of maintaining U.S. competitiveness, also.

Mr. PASTOR. In my opening statement, I talk about the redundancy, but basically I was referring to the various programs you have: the Hubs, the Frontiers, et cetera. But as I looked at your budget, you are investing, I think it is $2 billion for research, and the end result is about $130 million of that $2 billion will be for new research at non-DOE facilities. That is about 6 percent—7 percent of the total $2 billion.

You already have funded research in the past, you are doing new initiatives, as you mentioned, materials and microbes, et cetera. How do you defend the programs or how often do you analyze the programs that you already funded as you go forward? And in the evaluation, is there a point where you say we are going to cut out some activity and go on and do something else, a key initiative, or yours is not working, or your research is not going to pay off? So you have that constant tension.

Dr. KOONIN. So the money really is in two broad buckets. One is funding to support the facilities that we run, the light sources—neutron sources, computers that we make available on an open peer review basis to the whole scientific community. And more than half of the users come from outside the DOE. NIH is a big user, for example.

So those are things we operate for the community. But then there is the research money—the programs that we execute—which take place both at the Laboratories and at the universities. And those programs are competitive and peer reviewed. We have independent panels that provide reviews of the programs. We do turn over the programs and try to allocate the money on the basis of merit and impact.

The materials and biology that I mentioned specifically, and you know also, are really intensifications and focusing of efforts to try to make a push towards doing materials by design, to doing synthetic biology, and so, build on existing programs rather than replace them.

Mr. PASTOR. Yesterday Secretary Chu was with us and he talked about the need for terminations, and I think he said that fiscal responsibilities demand shared sacrifice. And I know within the Office of Science, you are shutting down Tevatron and Holifield.

Dr. KOONIN. Right.

Mr. PASTOR. What other major facilities do you anticipate shutting down or terminating?

Dr. KOONIN. So those two, the Tevatron and Holifield are, again, well thought through. The Tevatron is already in a several year extension of Run II, and our sense is that those monies, about $35 million a year, can be better spent laying the groundwork for the next frontier. We have got the LHC, of course, where a lot of the action is right now.

With respect to Holifield, that termination is to make room to construct a new forefront facility at Michigan State University for rare isotope beams. The other major facilities are fully subscribed, over subscribed actually, and we have more users for the existing facilities and several new ones that have just come online: LCLS,

NSLS–II is just about to finish construction, or will finish construction soon, and those facilities are over subscribed. There are so many proteins in the world that people want to study for biological and medical reasons. There is so much material that we want to try to understand the properties of. There are so many simulations that we feel as though those facilities are absolutely essential.

Of course, we will phase them out as they become obsolete or as other facilities can be built to do the same job better, but right now we need those to do the science that we and other parts of the community want to do.

Mr. PASTOR. I yield back, Mr. Chairman.

Mr. WOMACK. Mr. Simpson.

Mr. SIMPSON. Thank you, and thanks for being here today, thanks for stopping in the office the other day and spending some time with me. I always like to come to this hearing because it tells me how much I do not know, which is just about everything you are talking about.

I'm pretty much convinced that the only person that actually understands what you are talking about is Mr. Olver up here, so we ought to all just yield the time and let him ask questions. But it is rather fascinating.

Let me ask you just a couple general questions. There is concern—first let me paraphrase it this way or preface it this way. Our Labs are somewhat in competition with each other, and that is understandable, and that is not a bad thing. There have been periods of time when there has probably been too much competition between the Labs and other times when there has been more cooperation, but still some competition. I think that is a healthy model.

There is concern that this Administration is so focused on science, and understandably, Dr. Chu coming from the science background, that we are focusing so much on science that we are overlooking that aspect of science which is deployment, meaning something that actually goes into the marketplace. And if you look at some of the labs, I was interested when we were down, and I will hold Rodney's question, but we were down visiting Sandia, and they were showing us some slides. It is pretty much a weapons lab, and if you look at the funding over the last several years, it was weapons activities, and that has gone down as weapons activities have gone down.

If you look at the percentage of their budget that was funded by weapons activities, it is now funded by other areas within DOE, particularly Science; that has gone up to where it is about 60 percent of their budget. It puts competition and pressure on the other Labs in that the weapons labs are essentially taking more and more of the budget.

How do you respond to the concerns that a lot of people have—that we are so focused on the basic science, which I think everybody agrees with, that we are forgetting about the science for a purpose, and that is to get something out the door that the American people can see?

Dr. KOONIN. Just a word on my own perspective first. My role is dual hatted, and I have particular responsibility for the Office of Science and the ten labs that it houses. But I also have a broad-

er role in playing chief research officer basically and have a deep knowledge and understanding of the other seven labs that we support.

I think all of us in the leadership team, Dr. Brinkman, Secretary Chu, myself, Dr. Majumdar and his predecessors—we all are here because we want to have impact. And that means in the end creating technology options that the private sector can pick up or ensuring the national security parts of what we do on a sound technical basis.

The Labs all have different characters and different missions. Sandia is mostly an engineering lab. If I go to the other end of the spectrum, Fermilab, which does some amazing engineering, but it does it in service of a very narrow interesting goal—finding out about elementary particles.

And so there is a spectrum of talents across the laboratories. We need to get them, and we are working hard so that they all play together. Some competition, as you know, is important, but some differentiation in mission is also essential.

Sandia is an engineering lab. Livermore, if you asked me, I would say excels in computation, inertial fusion. Berkeley in materials, biology. So, you know, you can go around and there are concentrations of expertise in all of the Labs together with some overlap, which, as you say, is not unhealthy. So I do not see them so much as competition for the Office of Science funds, but as other places in which we can draw on unique expertise.

Mr. SIMPSON. Do you think that the Labs—the roles and missions of each Lab are defined well enough?

Dr. KOONIN. No, and that is actually not such a bad thing. I want to take the NNSA knowledge, for example, I want to be able to in the NNSA, take some of that expertise and apply it to reactor modeling or climate modeling or modeling the electrical grid, because they have talents to bring to bear, and also because it helps keep folks sharp in the weapons world.

And similarly, some of the science labs have talents to bring to bear on national security matters. PNNL is a great example, INL has got some national security work, Oak Ridge—so some blurring is not at all undesirable. One thing I do know about the National Lab system—when I sit down with the Chinese science leadership, the first question out of their mouths is, we really are interested in your National Labs, and how can we create something that is like that.

Mr. SIMPSON. I think the National Labs are one of our real jewels in the work that they do, and we want to make them as effective and efficient as possible and use the resources of the taxpayer in as efficient a manner as we can. In light of your budget request this year, unlike other years, there are no performance targets. How do we know, as a committee, appropriating money for things we do not understand basically, how do we know that we are getting our money's worth? What measure do we use to say this is worth our investment or not worth our investment? Because I have got to tell you, you can pull the wool over this arena pretty easily.

Dr. KOONIN. So, you know, for 30 years I was at a university, and for the last 10 years, I helped manage it. And you know, you are constantly asking yourself the same question: how do we know

we are doing a good thing? I think there are several objective measures, I mentioned in my opening statement: did we produce the facilities on time, on budget, are we operating them well, what is the pressure to use those facilities?

We can look at other measures—patents, for example. The Bioenergy Research Centers have generated in their 3 years at least 66 patents, which suggest that we are getting something useful out of them.

There are other ways—you can look at publications. You can have independent panels come in and assess—people who are in the business and technically knowledgeable that you choose carefully for independence and no conflict of interest and so on. And so we do that, and we will do that very carefully as we manage the projects.

And then finally, one of the measures we use in the universities is, who is trying to hire your folks away. And the Laboratories look at that very carefully: Who are we able to attract, who is getting offers from elsewhere, and that is a very good measure also.

Mr. SIMPSON. You are partially a victim of, I think it was Einstein that said research is important, but I think he said, if we knew what the hell we were doing, we would not call it research, which is, you know——

Dr. KOONIN. Yeah, exactly.

Mr. SIMPSON. A lot of times we do research just to find things out. The difficulty for this committee is trying to say what is viable research, what is not viable research, and the only way I think that we ultimately make a determination is by what is produced, what the American taxpayer can see for their investment down the road, and that is sometimes very, very difficult to demonstrate.

Dr. KOONIN. We can—I mean there are specific examples of—you know, the battery story is a great story, the one that came out of Argonne recently. Where you know, in the late '90s, we started research on lithium manganese mixtures for batteries, and they realized they could make a piece of the battery, the cathode that would last longer and have a higher capacity. That was basic science—Office of Science supported.

We handed it off to an EERE supported program at Argonne, where they learned how to actually make the battery and package it and so on, hand it off to the private sector, LG Chem and other folks, and now it is starting to appear in the Chevy Volt. That's a 15–year process, and it does not always work that smoothly, but it is an example of how, when the system works, it can do amazing things.

Mr. SIMPSON. You explained to me the day before yesterday in my office when I asked you about high speed computing, why it was necessary for this country to take back the lead in high speed computing, could you explain that again for me?

Dr. KOONIN. Sure. When you try to describe a physical system, whether it is a component in an automobile engine or a piece of a reactor, you cut it up into lots of little pieces, pixels, if you like, and the computer figures out what is going on inside each pixel and then how the pixels talk to each other, how they influence their neighbors.

And a faster computer lets you put more pixels in and so you can get a more faithful representation, more active representation of what is going on. You can describe what goes on inside each pixel better, chemistry, for example, and then you can do more runs, you can change the conditions, change the assumptions. You know, if you can do 100 different runs in a day, that is a very different situation than if I have to do one run in a week. And so faster computers lets you do all of that. And if you look at the evolution, particularly inside the NNSA, but also now in the science field, you can see the fidelity or understanding increase with each factor of ten that the computers get better. Of course, there is a lot of other work, the software, the codes themselves and so on, but, boy, is it paying off. And it is so important for all fields of science and technology now over the next ten years that we stay in the lead to be able to explore the——

Mr. SIMPSON. Leads in terms of fast computers, is it going to lead in terms of research and development?

Dr. KOONIN. I believe so, because computing has become such an important part of research.

Mr. SIMPSON. I'd ask you some other questions, but, frankly, I do not understand the questions, so.

Mr. OLVER. Thank you, Mr. Chairman.

Mr. Secretary, I am sorry that I was unable to be present for Secretary Chu's remarks yesterday. I was directing member of my own Subcommittee on Transportation, Housing, and Urban Development, and those happened at exactly the same time. So, you are my target.

I have to say to Mr. Simpson that I come mostly to confirm what I suspect, but I do not know now, and my basic DNA is certainly supportive of energy research.

I am absolutely amazed at the things that the commercialization American science allows and has managed to produce in the 50 years since I earned my Ph.D., and I guess I would say—I am also amazed at the amount that you are doing in all these different areas. I think this is actually, a pretty modest budget for doing those things. I am just amazed that the research that then gets done, all the energy research and the innovation that breeds. That is our job future, really.

And also, to your comment, Mr. Simpson, that is going to be a bold statement that probably someone in the room will object to, but what the Hell, that—I had to write this down till you get this so that I did not have a double negative. My comment here is that nothing that science has not confirmed is possible can be commercialized by engineering. You have got to have your science before you can commercialize. And, as I said, I am just absolutely amazed at what has been done over that period of time.

Now, I would like to talk about a lot of different things. I am really very much interested in the combination of Bioenergy Research Centers and the Energy Frontier Research Centers and the Hubs and how those things are evolving. But I wanted to go back to something that you said in your very opening statement when you defined your role in theoretical physics and fusion energy.

And in preparation for the day, I got ahold of a document over your name, which is entitled "All Hands on Board for Fusion." It

was a document that basically laid out what I thought was your vision for how we ought to be evolving towards fusion energy, and yet it would appear that we are producing our own ITER.

We have a relatively small funding proportion of ITER and a fairly well-defined program for what we are supposed to put into the ITER. Someone else already has said that our contribution to the ITER project is less than the Japanese contribution. And our economy is larger than Japan's, particularly today, by several times probably, and I am concerned. When we get done with this, are we going to have any American scientists? Are we still doing our independent work, and what is your sense of how independent work on fusion fits with the work that is being done by the consortium? I do not know exactly how much that consortium is—who pays how much into that consortium and how that is supposed to evolve. I guess ours is supposed to increase over time.

Dr. KOONIN. So, let me talk about fusion first and the presentation which you looked through and I assume you found useful and interesting. It is a roadmap for what we think the Department could be doing, should be doing in fusion, not only magnetic fusion that this office supports but also the inertial fusion that NNSA supports.

In eight or nine other fields, I can give you similar roadmaps. And so we need to balance across the fields, trying under present circumstances to get the greatest impact in reasonably short term in the dollars that we are investing. ITER it is a very important project. It has been identified by the broad fusion community as the most important thing to be doing. We are trying to organize our program within fusion to take advantage of that opportunity when it becomes operational, which is not till FY18 or so, and then burning plasma not for another decade after that, and then perhaps power into the grid a decade or more after that.

So, at the best we are talking about an energy source that is——

Mr. OLVER. Forty or more.

Dr. KOONIN [continuing]. 30, 40 years away.

Mr. OLVER. Or more.

Dr. KOONIN. Or more. All right. We have real energy problems now—other problems as well that we have talked about—and we are trying to focus on the science that is going to get us solutions on a shorter time scale. That does not mean we abandon fusion of course, but it means that in terms of what we need to emphasize it is those fields I mentioned.

Mr. OLVER. There is a certain effective critical mass of what to do that is important if you really wanted to have progress if we are talking about 40 years or more. After all, when I was an undergraduate, the word was that it was going to take 50 years to bring full forward fusion. And I hear nowadays most of the time that it is sort of still going to take 50 years to bring it to commercialization. Is there not some way that we can commercialize that early—more quickly?

Dr. KOONIN. Tokamaks, which is what that machine is, a donut-shaped containment vessel, have the property that they get better as they get bigger. And commercializing something that costs a voter $10 billion for the first one, if we ever get to that stage, is going to be a really difficult challenge. I mean, it is very difficult

right now to get somebody to put down $8 billion for more or less proven technology, like fission, to build a power plant. So, I think the commercialization hurdles are significant but they are 20 to 25 years away. We need to demonstrate that this technology can work reliably first.

Mr. OLVER. Well, the document that I mentioned was written and I think was used and given in late '09 not long after you came on as the Deputy Secretary. Does this—does that document represent a sense that you thought we would be able to move more quickly and with a more independent program of fusion, or am I reading more into it than that? Because "all hands on board for fusion" suggest a drive, which I do not see happening.

Dr. KOONIN. So, that particular phrasing was mentioned or chosen for two reasons. One is to try to move the community off from a "just let us do science" mode, to let us actually focus on something that can have a tangible energy impact maybe 30 or 40 years out.

The other meaning of that is that we have two not quite well-connected fusion efforts in the Department, one within the NNSA, organized around inertial fusion, and one in the Office of Science on magnetic fusion. And there are many commonalities in that—in those programs that we——

Mr. OLVER. You mean that they were competing without talking to each other?

Dr. KOONIN. No, they were not even competing. They come out of different budgets. There is the NNSA budget and then there is the Office of Science budget.

The two communities are not as well connected as they should be. It has got to with historical reasons of where these efforts came from. And we are working very hard to work on common interests. Materials are common to these two. Simulation is common to these two.

Mr. OLVER. Now, that is a light bulb for me, because that goes back—were you merely trying to serve as the magnet that was being pulled under iron filings to get them all working in the same direction?

Dr. KOONIN. That is part of my job, to make those connections across disparate parts of the Department.

Mr. OLVER. I think the Chairman has allowed me much more time than I was allowed—than I was entitled to.

Thank you.

Mr. WOMACK. The gentleman from Mississippi, Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman.

Mr. Simpson, your comments caused me to have hope. I thought that my ignorance was due to the fact that I was new to the body.

Mr. SIMPSON. Been on this Committee eight years, and the Science budget is still the same.

Mr. NUNNELEE. Well, maybe my observation is that if I am here long enough and I move closer to the center of the table, then I will still be just as ignorant but I will be less inhibited about it.

Thank you, Mr. Secretary. Let us shift gears a little bit. Can you tell me from a science perspective what we learned from the Deepwater Horizon disaster?

Dr. KOONIN. I was—first of all, good to see you again in a more formal setting. I enjoyed our chat a couple of days ago.

From a science perspective, not a terribly large amount. That was an engineering issue, engineering problem. I think we have learned—and I am not fully up to speed on it, but the environmental impacts of those releases, their impact on the biosphere. But the problem in and of itself was an engineering problem and was, in the end, managed with a lot of help from the Department of Energy and by the private sector.

Mr. NUNNELEE. Do you have any thoughts about the Department of Energy's role in learning about technology gaps in the spill?

Dr. KOONIN. I think that someone in the Federal Government, and whether it is Interior or the Department of Energy, needs to have independent expertise in production technologies in order to advise the regulatory folks about the levels of risk and best practices and so on. That is true not only for deepwater offshore, but also for onshore, shale gas, and other related technologies.

The Department is a natural home for a lot of that expertise. We are called upon when there are national issues. We have already mentioned Deepwater.

Soon after the Christmas bomber incident more than a year ago, the President called on the Department to work with the Intelligence community to help better connect the dots and to work with TSA to improve screening technologies at the airports. So that,—the Deepwater, now the Japanese reactor situation—the Department is the home for a lot of that sort of engineering science expertise that can be brought to bear on significant national emergencies.

Mr. NUNNELEE. Well, just in general, my observation is that it is something we ought to learn from. There were some mistakes. There were some accidents to learn from, but it should not be a cause to just shut down deepwater production in the Gulf of Mexico.

Different subject. What is the rationale in awarding competitive block grants in the Better Buildings Pilot Loan Guarantee Initiative for universities, schools, and hospitals?

Dr. KOONIN. I think institutional buildings—universities, hospitals—are great test beds and demonstrations of what we can do in building efficiency. Forty percent of U.S. energy is used in buildings, and—for example, we built—or the Department built—a new office building at NREL in Golden, Colorado, which cost actually slightly less than a conventional building built in the same region but has greatly improved energy efficiency. It has got to do with how you design the building, what the control systems are, how you operate it, and how you commission it, and so on.

And so universities and hospitals are great examples where you can have some control over the function, design, operation of the building to not only reduce their own energy, but to demonstrate and more widely diffuse the technologies and expertise it takes to do that.

Mr. NUNNELEE. So, what are you looking for in terms of cost-effective technologies and measures that will save money within the government?

Dr. KOONIN. I think there are already best practices that have to do with the kind of lighting that you install, HVAC systems, how you exploit natural light, natural ventilation. We need to drive those into the design and construction activities, and the government buildings can help in that as we award these projects.

So, for example, at NREL in that building it was a challenge for the architectural and construction firm to design and build that building. I think they relished it. And we need to diffuse that out more and more in the private sector.

Mr. NUNNELEE. I look forward to working with you.

Dr. KOONIN. That would be great. Happy to do that.

Mr. NUNNELEE. Thank you, Mr. Chairman.

Mr. WOMACK. Thank you Mr. Nunnelee.

Mr. Secretary, an impressive background, to say the least. I was reading your biographical information here, and at the very end it says, "In particular for his breakthrough in nuclear shell model calculations centered on an ingenious method for dealing with the huge matrices of heavy nuclei by using path integral methods combined with the Monte Carlo technique."

I am very anxious to have that inner office visit. My Legislative Director Margo, will set that up, and you and I are going to get into a heavy discussion about that technique and——

Dr. KOONIN. Happy to do that. I think I still remember what——

Mr. WOMACK. Mr. Frelinghuysen, our Chairman, has said at many hearings this month that our Subcommittee is highly unlikely to have additional funding and that new programs have to be thoroughly justified—we can all understand that—carefully overseen, and comprehensively evaluated and most likely offset by cuts to other lower-priority programs, and at the same time the budget request for Science is nearly $600 million above the current level. Given, in your area, you guys deal a lot in theory and the expectations, unpredictable futures, and those sorts of things, but given the fiscal realities where we all sit today, where we are likely to operate, where would you propose to chop from this budget?

Dr. KOONIN. First, Mr. Lewis, it is good to see you. You and I intersected in at least my previous life when I was at Caltech and we had some interaction with you and your office.

The budget as proposed—you know, there is a wonderful quote from C.P. Snow, who was a British scientist and literary figure. He said that scientists have the future in their bones, and if we are going to have a prosperous future for this country, we need to accelerate the science and innovation activities in this country, even as we try to wrestle—and as a citizen I am fully supportive—of wrestling with the great fiscal funds we have. We will execute the best programs that we can with whatever funds we have available.

The priorities for the program are pretty clearly reflected in the budget, and you see large increases proposed for the three areas I outlined, and sustained programs in the others. If we have less money than we are proposing, we will make, of course, adjustments. But the priorities are pretty clear from the numbers.

Mr. WOMACK. What are the—and I know you have already articulated part of this in your testimony, but in those highest priorities, will there—in your criteria, in your calculus will you make

any cuts from those priorities, or will they be from the bottom up, from the lower priority scale?

Dr. KOONIN. Again, we will look in the end to try to create a balanced program and while we have not done scenarios yet at different levels of funding, obviously we will do that when the time comes. But there are, you know, such great opportunities to accelerate progress in material science, in the nonmedical biology that we do, and in the high-performance computing, which we have already talked about. We feel that those are the most important things we are proposing to do in the context of a balanced program in the other fields.

Mr. WOMACK. A substantial portion of the increase requested for the Advanced Scientific Computing Research program is to expand exascale research and supporting activities. If we are to increase our commitment to developing exascale supercomputers, it seems that we should have a plan to know where we are, how much we plan to invest, and what we plan to get out of it. China, which has already been discussed, previously announced the target date 2018 for an operational exascale computing system. First, do you believe this is a credible date? And if so, what is China doing to meet the 2018 date?

Dr. KOONIN. So, I do not know the Chinese plans in detail. We have a well-developed plan, which we will be happy to share at the right time that we have been developing between NNSA and the Office of Science, to map a road to an exascale capability within a decade. There are significant challenges in doing that, technically. We need to get the power consumption down.

If you took today's technology and tried to create an exascale computer, you would need a whole nuclear power station to run it. So we need to learn how to get the power consumption down as we increase the capability.

The second thing is that inside a big machine, the communication between the memory and the processor takes a lot of time and of course power. We need to get the memory right on top of the processor chip.

And then the third thing we need to do is learn how to make a hundred million processors run at once together. Some of them will be down at any given time. How do you build codes and systems that are robust against those failures? Those are the technical challenges. In part, they will be achieved by working in the universities and the laboratories on the software and working deeply with the vendors. We are in touch with all of them in the U.S.—IBM, Cray, NVIDIA, Intel, HP—about how we can bring the hardware into being.

It is an effort not unlike what was done from 1995 to 2003 or so in the ASCI program, but now we are going another factor of a thousand, on a factor of a million that that program executed.

We are—we, the U.S.—are uniquely positioned to do that with our hardware and software expertise. I do know from discussions with the Chinese that they are very serious about building their own capabilities in this field, and we need to keep moving.

Mr. WOMACK. My final question is more of an education/personnel question. You had mentioned earlier in your testimony or in response to a question that one of the barometers used to deter-

mine the quality of your programs is how many people are being recruited from your roster, and is this a real and ongoing problem for you? And is retention of highly trained, highly qualified personnel an ongoing issue?

And then my second part of the question is more down into the secondary education level. How are we doing as a country in filling the pipeline with aspiring scientists capable of performing the work, eventually at your level?

Dr. KOONIN. Any healthy research organization will always have recruitment and retention problems. You are supposed to. If you do not, again you are not operating the highest quality. That said, the Labs offer unique opportunities for people, both people who are there and the people we would like to attract. Important national missions, the ability to use unique facilities, access to a multidisciplinary, mission-driven environment—it is different than a university and very attractive to some talented people. That said, it is a healthy thing that some of the senior staff go off and have other careers at universities or, increasingly, that we do joint appointments with universities and the Laboratory, and we have seen that at the University of Chicago and Argonne National Lab, Livermore, Berkeley certainly. Many are like that. So, that is also another mode in which we can work.

With respect to the pipeline in the U.S. at the highest level, I think we are doing just fine.

Yesterday I was at a reception for the Intel Science Talent Search finalists here in town, and I have got to tell you those high school seniors just do amazing things, things I never could have imagined doing when I was at that stage, and that is exactly the way it is supposed to be.

What I worry about, though, is the broader class of folks and the pipeline for that, the people who will be equally important but not quite at the very highest levels, and we are not doing a very job of that. It has got to do with the cultural factors in the U.S. It has got to with the way in which we educate people. And it has got to do with the rewards that we give to people going into science or engineering relative to other professions. And it is a cause of great concern.

Mr. WOMACK. Appreciate your testimony.

Mr. PASTOR. Today the largest inertial fusion facility is at the National Ignition Facility at the Lawrence Livermore National Lab. It is the flagship of the National Ignition Campaign. Originally this device was estimated to cost $1.1 billion and to be completed in 2002. When it was finally completed in 2009, it cost $3.9 billion. While it has made amazing policy and progress, it has yet to receive ignition. I know that there were technological challenges that kept you and delayed a credible ignition for about a year. So what is the new timeline for the first attempt at ignition?

Dr. KOONIN. So I know the project well and have been involved with it in one way or another for about 20 years. My current involvement, just to give you where I stand so you know the credibility of what I am about to say. The National Ignition Campaign has been underway for not quite a year, and I personally review the progress every quarter, going out to Livermore and talking

with the scientific team. It is a challenge to do what they are trying to do, never been done before.

It is going to need to gather many different aspects of technology, the laser, the targets, the diagnostics. The laser is working well. It is performing on spec, delivering the beams with the timing, balance, energy, smoothness, and so on, as required. The diagnostics are also working very well. We are in the process over the next year and a half of successively putting in more and more sophisticated targets. For the first time in the last six months, we have started to shoot tritiated targets, not quite full up yet, but we are working our way up in a fairly systematic way. I am optimistic, but not sure that we will see ignition within the next couple of years. But it is research, and we are trying to do something nobody has ever done before. And I have got to believe there will be things we need to manage along the way—I can already give you some examples at a more technical level—of when you start to do these things, you say whoa, we did not think of that and let us find a fix to work around.

Mr. PASTOR. So the answer to the timeline is by a couple of years.

Dr. KOONIN. I would say a couple of years, yeah.

Mr. PASTOR. And the obstacle is the targets.

Dr. KOONIN. I would say right now, it is target fabrication.

Mr. PASTOR. Might there be other obstacles that you are anticipating?

Dr. KOONIN. We do not know. If we were anticipating them, we would have dealt with them already. This is research.

Mr. PASTOR. Yes, sir, I know.

Dr. KOONIN. So just to give you an example, the heart of the target is a little capsule, a couple of millimeters in radius. It needs to be smooth to the level of 10 or 100 atoms, so the surface needs to be very smooth. And they discovered as they were constructing these and preparing these, that there is dust that gets on the surface. And ordinarily, sir, that is not a big deal. But at the level of precision we are talking about, the dust is really important; keeping that clean is an issue.

Another issue is frost. The lasers need to get into the target and you can get condensation of gases on the walls where they need to come in, and that frost can mess things up. And they dealt with that one by putting in strong windows effectively, not a single layer of window, but two layers of window. There are issues like that that we are just discovering and working our way through. So far no show stoppers.

Mr. PASTOR. So once—two years from now, hopefully you are successful and you have ignition, will the information be useful for weapon stewardship purposes or will it be inertial fusion energy research or both?

Dr. KOONIN. All of the above and more. All of the above and more—if we do it. As I said, I am optimistic. It will be the culmination of a 40+ year effort inside the NNSA. Getting that many neutrons out, that much energy out in the form of radiation, will allow very interesting weapons physics experiments that will let us better understand the operation of the nuclear weapons, how they might age and how we can improve the computer codes that are

used to describe them. It will enable very interesting basic science, understanding the properties of materials at extremes of temperature and pressure, perhaps some nuclear physics with the neutrons. And then it is a benchmark to be able to go on to energy application. And as you may know, in anticipation of achieving ignition, I have spun up an Academy Committee—the National Academy of Sciences—to say assume that ignition is achieved on the NIF, what is a research roadmap to start to realize the energy potential of inertial fusion? There may be none. It may be in the end just too difficult or too expensive, but I think it is incumbent upon us to—having done this or assuming we will do it—we can look at the energy applications.

Mr. PASTOR. This effort started when I asked the question in 2002. We are now at 2011 and we think that maybe 2013 will possibly be ignition. And one of the things I have seen in the Subcommittee that sometimes we are making progress. It is not as quickly as we want. We have other factors that come in and then before we know it, it is taken away or diminished in terms of funding for it. How important is this initiative so if we continue it for the future?

Dr. KOONIN. Sir, let me be clear that that initiative is funded almost entirely out of the NNSA budget, not the Office of Science. Nevertheless, as I mentioned, it will have important implications for the Office of Science. It is the flagship science effort inside NNSA. I think failure to achieve ignition will cause people to rethink exactly what our capabilities are. On the other hand, the laser already is delivering very important weapons and basic science data. And in fact there were just some experiments done in the last couple of weeks where we have taken iron—I am sorry, diamond—and shocked it to 27 megabars, which is—well, we could go through the numbers—but it is a lot and conditions that you just could not get in any other way.

Mr. PASTOR. My last question deals with the National Research Council study. What is the mandate for the study, and what are you hoping to use—how do you plan to use its conclusions?

Dr. KOONIN. They are expected to deliver in about a year or maybe a bit more, a study that examines the roadmaps to getting energy out of this effort, making this practical energy effort. That involves alternate drivers: Do we use lasers? Do we use particle beams? Do we use a different kind of laser? Do we use pulsed power? All of these are potential drivers for an energy system.

What do we do about target fabrication? Most people think that that is the biggest problem. Right now the targets we use are handcrafted. They are extraordinarily time consuming, expensive. We need to make targets at a penny or two apiece if we are going to make energy out of this thing.

And then there is the balance of system materials issues and the chamber and so on, which will be exposed to intense radiation fluxes in a power plant.

So how do we—what is the sense that we should program to explore the different ways of tackling those problems? How do you down-select? What are the milestones? And can you ever imagine this thing being economic? My private sector experience tells me that unless this can be competitive with other forms of energy, it

is just not going to happen. So what are the estimates of what it might cost in terms of cost of electricity? That is what we are looking at for the Academy to come up with. They have a good committee set up and we are interacting—several parts of the Department are interacting with them continuously to make sure they do the job.

Mr. PASTOR. Thank you, Mr. Chairman.

Mr. WOMACK. Mr. Simpson.

Mr. SIMPSON. Thanks for clearing that up. I am going to have a whole bunch of questions that I will just submit for the record. It is the old do you want to open your mouth—do you want to close your mouth and be counted——

Let me ask you a question about a subject that has come up in conversations I have had with people about the pay freeze, the effect on our scientific community, what it is going to do to you and that environment, and the fact that an article that I read not too long ago about the Chinese coming over to the United States and learning the way of our scientists by essentially saying we will guarantee you funding for the next eight years or whatever. We are in an environment where funding is going up and down, mostly down now. What is the impact all of this is going to have on your agency?

Dr. KOONIN. For a while we can retain people because of the mission and a sense that things will return to allow the scientists to focus on their work. The turbulence that we have for funding reasons, programmatic reasons and so on, frankly does not enhance the attractiveness of the Laboratories. That the Chinese now can credibly cherry pick folks—I know of nobody out of a National Lab who has been cherry-picked, but I would not exclude it. I do know out of universities they are doing that. But in the end what drives scientists is not so much the personal compensation, but it is the ability to have the resources, equipment, people, freedom, to pursue what drives scientists: discovery, invention, and so on. And I think we need to make sure that the environments in the Laboratories and the universities let people be productive.

Mr. SIMPSON. One of the other questions that Mr. Olver was asking about, fusion energy; interesting, probably something important for the future. We are going to spend $400 million on fusion research. The whole—and as you mentioned—we have a more immediate problem with energy needs than this 50-year timestamp that we are looking at. The entire budget for nuclear energy is about $853 million or just slightly more than twice what it is we are spending on something that we hope to get results in 50 years. What is the appropriate balance there between addressing the needs today versus looking down the road 50 years?

Dr. KOONIN. One thing I would say on the specific numbers you have talked about is that the NE budget needs to be seen in the context of the broader industry, particularly in the energy technologies area. The Department's role is to catalyze, facilitate private sector spending and investment. And so I expect, and in fact I know, that that $800 million is highly leveraged by the private sector. It should be. If it is not, we are not doing the right thing.

Mr. SIMPSON. Along that same line, let me ask you—well, I know this is not under your bailiwick—NGNP. We are trying to develop

a private partnership, private-public partnership, to develop the NGNP. What are your thoughts on that on where we are? Do you have any thoughts on that that you could express? I mean, we seem to have hit this roadblock where industry is unwilling to put a lot of the money up front. Government is unwilling to put a lot of the money up front. And we have not been able to come to a deal yet.

Dr. KOONIN. So let me give you the academic answer first. I mean, I will switch into academic mode for a minute. The Department has essentially three interfaces with the outside world. NNSA with national security, the Pentagon. That is pretty orderly and well defined these days with our responsibility to keep the stockpile safe and secure, help with nonproliferation, help with naval reactors. We do that pretty well. Everybody understands what that is about. Similarly in basic research, the Office of Science: We also do that pretty well with the interfaces with the university community, research community, and international community. Everybody understands that. The interface in the middle, the energy technologies with the private sector, is the most turbulent because there are legitimate discussions about the role of the government relative to the private sector and so on. So it is a problem and unless it is defined and pursued consistently, we are not going to make any progress because energy takes a long time as we have discussed. My own take is that there are technologies and there is deployment that will just not happen unless the government facilities them in some way, and that is perfectly consistent with what the government did at the beginning of nuclear power. We would not have had a nuclear industry unless the government played a major role in getting it started. So I think we need to be working as well and as intensely as we can with the private sector to make sure that that gets done.

That said, economics is everything in energy and cheap gas is a challenge for large scale nuclear deployment. We are working on the small modular reactors as you know. If we can reduce the capital costs, that is a big business advantage. And so that is also our focus, what we are trying to do, but it is not Office of Science.

Mr. SIMPSON. Appreciate it. Thank you.

Mr. WOMACK. Dr. Olver.

Mr. OLVER. Thanks again. Mr. Simpson and I used to have rather good back-and-forths in the Interior Committee, which he now chairs. I think that is right, but I am unfortunately no longer on the Interior Subcommittee to have those kinds of discussions there. I would just like to suggest that the problem in part with our fusion effort is that I think we would find that we were spending $400 million now on the fusion effort and it probably is a similar, normalized set of dollars that are being expended on fusion going back at least 20 years. I do not know exactly what it was when I first came to the Congress. And I suspect that this rather low stabilized level of funding leaves us with the idea that we may not get there for 40 years or more. I think if we were to put three times that much money into fusion, we would probably make our chances of getting fusion energy, which has a lot of good potential, move much more quickly. We already have two competing mechanisms, the inertial fusion and the magnetic fusion program. We are sup-

porting those both at a modest level and that is what it is, a modest level in those three areas. So it really is a difficulty with the level of total money there. Mr. Nunnelee asked the question, where do you cut it? You have not cut. And, Mr. Secretary, you were exceptionally careful with your words there, which I think I got down pretty close to a quote toward the end of it, "priorities are pretty clear from the numbers." But that might be taken to suggest that you would, if cuts have to be made, that you would take them across the board. And I doubt if that is what you wanted as a conclusion. Would you comment on that briefly?

Dr. KOONIN. Right. I am sorry if I gave that implication. This team—it could be so used, and, so, I will amend my remarks. This team more than any other will not do across the board cuts. We are trying to carefully manage and optimize the programs that we are stewarding.

That said, the most important areas are those which have the greatest potential for impact in terms of materiality, timeliness, and economics in the next 10 to 20 years. We need to balance that against sustaining and capitalizing on the investments we are making in longer-term facilities right here. But the answer is with fewer funds, we will go back and try to create the best portfolio that we can.

Let me say a word about alternative energy sources. You mentioned fusion as an energy source. And I will come at it from a business perspective, now shifting out of academic mode. There are many energy sources that we can imagine that would contribute to the goals of security, environmental, stewardship and so on. Fusion might be one of them, but we have got wind, we have got solar, the power sector—carbon capture and storage. And it is not enough to simply demonstrate that any of these technologies are viable. From a business perspective, it is the reliability, it is the return on capital, it is the temporal characteristics of the power source, and so on, and all of those will play into getting the private sector to adopt one technology or another. And at the moment, it is not obvious to me that fusion would win on those business grounds.

Mr. OLVER. I can understand that. I wanted to just—we have Energy Frontier Research Centers, Bioenergy Research Centers. I understand there are three of those. So, if there are three of those, then they must not be the—what are the centers that we created or we gave large grants to a few years ago that I have not since heard much about—maybe I was not paying much attention, which were related to switchgrass. Maybe the concept of turning native grasses into ethanol, I think——

Dr. KOONIN. Right.

Mr. OLVER. Was part of that. Where are those at the moment? There were a bunch of them. Four or five of those, or I thought there were four or five fairly large grants that were given out. Those were not centers though.

Dr. KOONIN. So, we have a spectrum of bioenergy activities in the Department. They range from the Bioenergy Research Centers, which I will say more about in a moment, the three that you mentioned, two full-scale demonstrations and deployments of cellulosic feedstocks, like switchgrass, and production of fuels beyond ethanol. Those demonstration projects are housed in EERE, Energy

Efficiency and Renewables. And that is over in Dr. Majumdar's domain right now.

Mr. OLVER. Okay.

Dr. KOONIN. In the Office of Science, we are doing the basic science up through bench-scale and maybe a little bit into first laboratory demonstration. Of important technologies—how do we improve the feedstocks so we can grow more with less fertilizer or water? And then how do we turn the cellulose, the main material of plants, into a fuel that is better than ethanol? Those three centers—one at Berkeley, one in the Great Lakes area, Wisconsin, and one in Oak Ridge—are working on different aspects of those problems. Those basic technologies as developed then feed over into the demonstration projects that I think you are referring to.

Our goal in the biofuels is to build upon and improve what we do now with corn ethanol, a broader range of feedstocks and a broader range of fuel molecules, and things that can scale to material impact. Right now, we are doing only about 10 billion gallons a year of ethanol; that is 3 percent of total U.S. transportation energy. We need to find things that can grow much bigger within a decade or two.

Mr. OLVER. Those three Bioenergy——

Dr. KOONIN. Centers.

Mr. OLVER. Bioenergy Research Centers, those are separate from the three Hubs that are already out there. You made a comment early on in your testimony that you had stood up a Hub recently, which made me wonder if standing up might mean that you would be funding it or it might mean that you had actually launched——

Dr. KOONIN. I am sorry.

Mr. OLVER. Okay.

Dr. KOONIN. I meant in the launch, and let me——

Mr. OLVER. Yeah, I figured that.

Dr. KOONIN [continuing]. Try to clarify.

The three Bioenergy Research Centers were inaugurated three or more years ago, and they are the prototype in terms of organization funding model for the Hubs. We have stood up—inaugurated—three Hubs within the last year: one in the modeling and simulation of nuclear reactors at Oak Ridge, one in building efficiency and technologies in Pennsylvania, and one in turning sunlight into fuels in California.

Mr. OLVER. One of those, of course, might be Bioenergy. The other two are not.

Dr. KOONIN. So, a little more detail and clarification. That sunlight into fuels is meant to be done in a non-biological way—to mimic what plants do, but do it entirely with chemistry and materials.

Mr. OLVER. By pyrolysis?

Dr. KOONIN. No, catch the photons, turn them into electrons with a semiconductor receptor, and use that to catalyze the splitting of water into hydrogen. Great technical challenge.

Mr. OLVER. Okay, well, I——

Dr. KOONIN. Sorry.

Mr. OLVER [continuing]. I have a hard time keeping straight this family—these families which may overlap in some ways—of Centers that are somewhere in energy, all of which I think are impor-

tant, but the questions that have been asked earlier about how long they are intended to go and do they expect it to be contracted for 5 or 10 years, and how you evaluate those that have already been alluded to.

Dr. KOONIN. Let me distinguish the Hubs which we have talked about from the EFRCs, the Energy Frontier Research Centers, which are much smaller focused efforts around the country at universities and Laboratories at the level of several million dollars a year, where you have three or four faculty working on a basic science problem that is relevant to energy.

Mr. OLVER. And have you pulled some of these together at some point into it and made a Hub out of them at a later stage, in a later iteration——

Dr. KOONIN. They have certainly spawned Hub proposals, but we have not coalesced them into larger units yet.

Mr. OLVER. I cannot continue this.

Dr. KOONIN. Okay, sorry. Over a year and a bit, I have only got it myself under control. I think the point is that the research needs different kinds of funding and different kinds of people and different kinds of program management at different stages of maturity.

Mr. OLVER. Okay——

Mr. WOMACK. Let the record reflect that a couple of moments ago, something you said made absolute sense to Mike Simpson, and I want everybody to understand it.

Mr. SIMPSON. I was surprised on that, you know, and I have got to go.

Dr. KOONIN. Good to see you. Thank you.

Mr. WOMACK. A couple of final questions before we close, Mr. Secretary. The Department has conducted a small handful of advisory reviews—it can publicly and clearly give the Administration's priorities, and this has kind of a follow-up to what I asked earlier about prioritization, particularly in a budget planet like we are in. In one of those advisory reviews, the P5, which laid out some priorities for high-energy physics. In all of the other categories, nuclear physics, basic science, et cetera, do you anticipate, having similar reviews, that better find the priorities in those other categories?

Dr. KOONIN. So, in all of the fields that we support, we have committees analogous to HEPAP, which P5 is a subcommittee of, or NSAC, the Nuclear Science Advisory Committee. There are ones in basic energy sciences, fusion, and computing, all of these fields. We take their advice very seriously. The level of detail that we ask questions of in each of these committees is different in part because they span very different kinds of fields: high energy physics, nuclear physics—pretty focused. Basic energy science is much more diverse, and so harder to get a critical mass of people to provide advice, but we do draw on the Council and often ask specific questions of the community through this advisory process.

We have also done over the course of the last four or five years a series of studies of basic research needs in the energy-related areas, whether it is biofuels or photovoltaics and so on, that have been published—done by the community really—that outline the basic science needs for those energy areas.

Mr. WOMACK. The Energy Frontier Research Centers are one of the relatively new research models within the DoE's research and development programs, and I understand there are some 46 or so that have been established in late 2009 within university frameworks and other National Labs. Last year, in the 2011 budget, the Department requested $40 million to establish more of these Centers. This year's budget for Science is substantially greater than 2011's, and yet the 2012 request contains no funding beyond the $100 million that was already set aside, I suppose, for the 2012 request. What has changed and has the scale of priorities changed?

Dr. KOONIN. I think this team now has got a better sense of what needs to be done. The EFRCs are working fine, but we can see in these other opportunities other ways that we should be pursuing the materials, the biology, the computing. And so again, we are trying to suit the research model, the funding management to the problems that we are trying to tackle.

Mr. WOMACK. And then my last question is—for a moment I want to put you in the shoes of a member of Congress or a leader in our Federal Government. If you are back at home and you are in the presence of the lay citizen, the electorate. In just a few seconds, what would you say to them about the state of science today in the United States of America, our standing in the world, and from the governmental perspective—what we are doing or not doing that, shall we say, make an impact on the everyday lives of the common, ordinary citizen? And that is a really broad question, but put yourself in our shoes. We are back at home talking to our citizens about—we hear all the bad things about the economy, et cetera, but what are the good things from the scientific community?

Dr. KOONIN. The American scientific enterprise has led the world for more than 70 years. It is a part of a wonderful innovation system that has brought to the American economy and the American consumer so many advantages. That telecommunications equipment that you use in your everyday life, those medicines that are now able to address medical conditions we could not before, your ability to move from one place to another through aircraft, automobiles, and so on—all of that is the result of science and technology, and much of it developed here in the U.S.

The enterprise consists of many different parts—universities, laboratories, the private sector, venture capitalists—and we have by accident maybe, by design, fixed upon a system that has produced amazing things for us. That system is still very good, but it is fragile and our leadership is being challenged by developing countries, by people who have other models which seem to work pretty well, and by the fact that we are only 5 percent of the world's population, but we have enjoyed such disproportionate riches. If the U.S. is going to continue to be prosperous, we need to be smarter. We are not going to out-compete on mass, on numbers. And the way in which we are smarter is in part by boosting the science and technology enterprise that we have: Taking care that the researchers have the right environment, the right tools, the right funding, and that we bring young people into the enterprise both in the nonprofit sector and the for-profit sector, and that is why it is important.

Mr. WOMACK. Thank you very much for your testimony today. I think on that note, we will end this hearing. But, again, our thanks to your service to this country and for being with us this morning. We look forward to working with you as we move forward.

This meeting is now adjourned.

Dr. KOONIN. Thank you very much.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

DEPARTMENT OF ENERGY OFFICE OF SCIENCE BUDGET HEARING

MARCH 16, 2011

SCIENCE RESEARCH AND AMERICAN COMPETITIVENESS

Subcommittee. The 2012 budget request proposes a $590 million increase to Science programs at the Department of Energy, a 12 percent increase from the current level. The President made clear in January that the Administration's budget request will increase science and clean energy research and development to strengthen America's competitiveness, and we see that reflected in the proposed increases that we are examining in this hearing today.

Strengthening American competitiveness is critical to keeping our economy and national security strong. In support of this goal, however, government needs to know where to lends support, and when and where to get out of the way.

Secretary Koonin, how do choices among the programs in the budget request for the Office of Science most effectively develop the best scientists and engineers here at home?

Secretary Koonin. The Department of Energy has an over 50 history of supporting the education and training of scientists and engineers in the U.S., predominately through the support of undergraduate students, graduate students, and post-doctoral researchers on research awards at colleges, universities, and DOE national laboratories. The Department's FY 2012 request for the Office of Science has a clear investment strategy—increased support for those areas of fundamental science that most directly impact the energy, security, and environmental missions of the Department. The requested Office of Sciences increases related to transformational clean energy technologies are guided by the recent Basic Energy Sciences Advisory Committee (BESAC) report, *Science for Energy Technology: Strengthening the Link between Basic Research and Industry*, which stresses the importance of sustained efforts of testing new concepts, identifying roadblocks, and pursuing scientific and technical solutions to accelerate transformative advances for targeted impact on cost, reliability, and performance. These goals are achieved through fundamental research in the materials and chemical sciences, the biological sciences, and the computational sciences. These research communities, including those that work at the interfaces of these fields, recognize and are inspired by the emerging challenges and opportunities in clean energy areas where an understanding of the fundamental phenomena is necessary to achieve game-changing discoveries for mid- to-longer-term technological innovation. Likewise, students are most often drawn to a career in science and engineering by the prospect of contributing to the solution of problems of deep relevance to society or discovering the answer behind an abiding mystery of the physical world (or sometimes both). Through research awards and fellowships, the FY 2012 Office of Science budget request will support about 27,000 Ph.D.s, students, and technicians, including support for the development of over 5,100 graduate students as they conduct forefront research.

Subcommittee. Let's look at an example, Secretary Koonin. I have always been a strong supporter of fusion energy sciences, and believe it has the promise to drive the next-generation of

energy production, while at the same time developing the best scientists and engineers in America to keep us competitive. Secretary Koonin, how would decreasing Fusion Energy Sciences by $26 million while increasing Nuclear Physics by $70 million, as your request does, support the next generation of energy technologies and the goal of keeping America competitive?

Secretary Koonin. As we state in the Department's strategic plan, significant market penetration in the energy supply sector can take 20 years or more. Therefore, the Department will focus on technologies that can confidently be predicted to enter commercial application at a minimum of 1 quadrillion British thermal units (Quad) annually by 2030 (about 1% of current U.S. primary energy). Fusion will still be in the experimental stage by 2030. The Nuclear Physics increase is almost entirely due to the planned construction funding profiles for the 12 GeV Continuous Electron Beam Accelerator Facility and the Facility for Rare Isotope Beams. We believe the request across all of the Office of Science programs appropriately prioritizes research that will underpin the next generation of energy technologies and animate the next generation of scientific and engineering talent.

Subcommittee. Basic Energy Sciences is the largest and perhaps most fragmented program within Science, funded at nearly $2 billion in the request across more than 30 subprograms and a variety of facilities. With a proposed increase of $349 million—the single largest increase of any program in the Department's energy accounts—it seems appropriate to better understand that program's narrative and contribution to our nation's competitiveness. How does this very large increase strengthen our competitiveness?

Secretary Koonin. In FY 2012, BES continues to support fundamental research for scientific discovery, but today our country needs to move strongly to solve our energy problems. Therefore, the central theme of this year's budget in BES is research in new discoveries for a clean energy future that address competing demands on our environment. These efforts, coordinated with the DOE applied technology programs and with input from the scientific community and industry, will emphasize research underpinning advances in non-carbon emitting energy sources, carbon capture and sequestration, transportation and fuel switching, transmission and energy storage, efficiency, and critical materials for energy applications.

In the area of advancing non-carbon energy sources, the budget request will provide for new investments in the science of interfaces and degradation relevant to solar photovoltaics, the chemistry of basic actinides related to advanced nuclear fuel cycles, and the research of materials under extreme environments relevant to extreme nuclear technology environments. Carbon capture and sequestration research will focus on novel molecular design for materials and multiscale dynamics of flow and plume migration, respectively. BES will also initiate an energy systems simulation research effort focused on predictive modeling of combustion in an evolving fuel environment in support of the Department's efforts in transportation and alternative fuels.

Underpinning transportation and fuel switching, as well as energy storage, the request supports an Energy Innovation Hub for Batteries and Energy Storage. The Fuels from Sunlight Hub, established in FY 2010, as well as the Energy Frontier Research Centers will continue. Research in enabling materials sciences will support needs of future electricity transmission systems and novel building materials to improve building efficiencies.

Subcommittee. Why increase Basic Energy Sciences rather than other programs?

Secretary Koonin. It is essential to set priorities. The requested increases in BES take advantage of the established basic research activities that are most relevant to the President's clean energy goals and capitalize on the recommendations of the recent Basic Energy Sciences Advisory Committee report *Science for Energy Technology: Strengthening the Link between Basic Research and Industry*.

The basic research work within BES is selected in clean energy areas where an understanding of the fundamental phenomena will underpin mid-to-longer-term technological innovation.

PRIORITIES IN THE REQUEST AND CLIMATE SCIENCE

Subcommittee. Secretary Koonin, your requested increases are mostly in two areas, Biological and Environmental Research, and Basic Energy Sciences. You've been before this subcommittee in the past explaining how your program is building on American expertise, and doesn't attempt to compete with other countries in areas where they have the major pieces of infrastructure needed to really lead. How does your request reflect this approach?

Secretary Koonin. Scientific discovery feeds technology development and, conversely, technology advances enable scientists to pursue an ever more challenging set of questions. As stated in our Strategic Plan, the Department will strive to maintain leadership in fields where this feedback is particularly strong, including materials science research, bio-energy research, and high-performance computing. Maintaining U.S. global leadership in x-ray, neutron, and electron sciences provides a major competitive advantage for enabling the discoveries necessary for the innovative new technologies that will build our future energy independence.

The Department's basic research programs address fundamental questions in the physical sciences and produce novel hardware and theoretical and analytical tools with applications well beyond the specific science. Furthermore, this discovery-oriented research produces highly trained researchers who apply their research skills to more immediate problems. The Department invests resources so that the U.S. research community can maintain meaningful, and in some instances, world-leading research capabilities.

Maintaining U.S. global leadership in x-ray and neutron sciences in the future in the context of large investments abroad will be a significant challenge. Recently, the U.S. completed the Spallation Neutron Source, the most powerful pulsed spallation neutron source in the world. The completion of Linac Coherent Light Source (LCLS), as the world's first hard x-ray free electron laser (FEL), has exceeded expectations in terms of start-up performance and early experimental results, and it has opened the door to a new era of photon science based on x-ray lasers. The first experiments from LCLS have demonstrated the promise of x-ray lasers and have already established a strong user community.

To maintain global leadership in x-ray and neutron discovery science—and the technologies enabled by those discoveries—the U.S. must maintain and upgrade our existing facilities and plan for next generation user facilities. Competing with LCLS on the horizon as a high average power x-ray FEL is the European XFEL, currently scheduled to start operations in 2015, with other European and Asian nations following suit in the design and construction of XFEL sources in the coming decade. The European Spallation Source (ESS) is scheduled to be built in Lund, Sweden, starting in 2013. The facility is expected to open in 2019 and will be fully operational in 2025. The ESS will become 10 times more powerful than the SNS and facilities in Japan and it will provide the users with a 100 times better experience than present day neutron sources.

The Department's requested increases in Biological and Environmental Research build upon unique U.S. scientific expertise and research infrastructure investments. The proposed investments in Genomic Science to identify and articulate biological design principles to enable more effective carbon-neutral and renewable biological systems build upon existing strengths in systems biology and leverage knowledgebase activities in computational biosciences and capabilities at the DOE Joint Genome Institute in genome sequencing and analysis. The development of new synthetic molecular toolkits and computer-aided design testbeds to facilitate the design, construction, and testing of improved natural and hybrid biological systems also leverages the Department's investments in high-performance computational infrastructure. The requested increase in the Atmospheric Radiation Measurement Climate Research Facility (ARM) will develop new fixed site and mobile facility locations to augment existing capabilities for continuous field measurements to promote the advancement of atmospheric process understanding and climate models. The ARM facility provides unique resources used by hundreds of climate scientists around the world.

Subcommittee. I can understand why the Administration wants to invest scarce dollars in groundbreaking research that might advance our energy sector and reduce our dependence on foreign sources of fuel, but you're asking for a 23% increase in Climate and Environmental Sciences. This $342 million is proposed to be used for "understanding, predicting, and mitigating the impacts of energy production and use on the Earth systems". I've got to think that, in this time of reduced budgets, this money could be better used for research into potential energy sources. Could you explain how your office's objectives, the first of which is "unleash a clean energy revolution" support a 23% increase in better understanding the climate better?

Secretary Koonin. As identified in the 2008 U.S. Global Climate Change Research Program's Synthesis and Assessment Product 4.5 "Effects of Climate Change on Energy Production and Use in the United States," Among its findings, the report pointed out that climate change could affect energy production and supply:

- if extreme weather events become more intense,
- where regions dependent on water supplies for hydropower and/or thermal power plant cooling face reductions in water supplies,
- where temperature increases decrease overall thermoelectric power generation efficiencies, and
- where changed conditions affect facility siting decisions.

The report concluded that most effects are likely to be modest except for possible regional effects of extreme weather events and water shortages. The increased funding for Climate and Environmental Sciences addresses the urgent risk information needs of energy planners, by

advancing climate models more rapidly and providing improved information on future weather patterns and extremes with greater spatial resolution and confidence than is possible today. In my judgment, these enhanced investments in Climate and Environmental Sciences are essential to unleash a clean energy revolution and support of a broad range of U.S. innovation and economic competitiveness.

AMERICAN LEADERSHIP PROJECTS IN SCIENCE

Subcommittee. Secretary Koonin, in the science world, large science projects or notable industry leaders have often served as beacons of American leadership. The Tevatron, the space shuttle, and Silicon Valley all come to mind as symbols of historic American leadership. In all of these cases, America led the world towards great advances in science and technology, and in doing so created jobs for Americans back home.

Today, many of the iconic symbols of cutting edge science are being built overseas. France is hosting ITER, the fusion experiment of unprecedented scale currently under construction. Europe is hosting the Large Hadron Collider, the world's highest-energy particle accelerator measuring 17 miles around. And now China is hosting the fastest supercomputer in the world, announced late last year. Secretary Koonin, the leading facilities for three of your major programs are now overseas.

In this respect, Mr. Secretary, how do the other Science programs fare?

Secretary Koonin. It is clear that we have staunch, ever-expanding international competition for science leadership. Other countries are placing a significant emphasis on investments in science as a driver of economic growth, and it is imperative for the United States to continue making robust investments in science. Two of the examples you cite—the Large Hadron Collider and ITER—however, share a common trait in that the cost to construct each is beyond the resources of any single nation. The U.S. involvement with the LHC and ITER represent strategic choices that balance scientific opportunity with value to the taxpayer. The Office of Science supports the largest international presence at the LHC, and the U.S. high energy physics community will capitalize on the machine. Similarly we will get tremendous leverage out of ITER; for our $1/11^{th}$ share of the project cost—most of which will be spent domestically on hardware—we will have full access to the science output and operations of the facility. In both of these cases we are well-positioned to maintain U.S. leadership in high energy physics and fusion energy research.

With respect to the third example you cite—supercomputing—while the Chinese achievement is impressive, there is much more to high-value scientific supercomputing than the hardware alone. Development of the software to leverage a new machine and the expertise to meld observations and experiment together with the codes requires a depth of research experience not likely to be achieved overnight. The U.S. is second to none in being able to do this, due in large part to the successes of the Office of Science and the NNSA.

With regard to the other three Office of Science programs (Basic Energy Sciences [BES], Biological and Environmental Research [BER], and Nuclear Physics [NP]) each has a suite of facilities currently online, in planning, or under construction that are world-leading in driving

vanguard scientific research opportunities. These include, but are not limited to BES light sources and neutron scattering facilities, the BER Atmospheric Radiation Measurement Climate Research Facility (ARM) and Joint Genome Institute; and the NP Continuous Electron Beam Accelerator Facility, which is currently being upgraded, and planned Facility for Rare Isotope Beams.

Subcommittee. Where in Science do we hold the clear lead?

Secretary Koonin. The Department's facilities sustain clear leads in numerous areas, including, but not limited to, x-ray light sources, neutron sources, electron beam microcharacterization, nanoscience, atmospheric monitoring, genomic sequencing, open scientific supercomputing, nuclear physics, the intensity frontier of high energy physics, and in key areas of magnetic confinement fusion, including measurements, theory and predictive modeling, and control.

Subcommittee. The President's budget request focuses on competitiveness and leadership. How does it make strategic investments to maintain and regain the lead in these and other science research areas?

Secretary Koonin. The American scientific enterprise has led the world for more than 70 years. It is a part of a powerful innovation system that has brought to the American economy and the American consumer many advantages. The enterprise consists of many different parts: universities, government laboratories, the private sector, venture capitalists, and a legal and cultural framework that rewards entrepreneurship.

That system is still very good, but it is fragile, and our leadership is being challenged by developing countries, by people who have other models, which seem to work pretty well, and by the fact that we're only 5 percent of the world's population but we have enjoyed such disproportionate riches. If the U.S. is going to continue to be prosperous, we need to be smarter. We're not going to out-compete on numbers. And the way in which we can be smarter is in part by boosting the science and technology enterprise that we have, ensuring that the researchers have the right environment, the right tools, the right funding, and bringing young people into the enterprise, both in the non-profit sector and the for-profit sector. This is why the President has consistently made science a priority and why this budget keeps science on a growth path.

Subcommittee. How does this square with the fact that new awards would be less than 20% of your request? It seems to me that your request does more to protect the status quo than drive new ideas.

Secretary Koonin. While the budget request identifies which projects and subprograms will be new in FY 2012, it fails to capture the fact that there is a steady natural turnover that occurs among the awards that are made through the core research programs' periodic funding

competitions and through many user facilities' annual proposal solicitations. The rigorous peer review processes that govern these competitions ensure that, year after year, the highest impact proposals receive support and that the most promising new research ideas are given opportunities to flourish.

Subcommittee. The Department has conducted only a small handful of advisory reviews that can publicly and clearly guide the Administration's priorities. One example that comes to mind is the so-called "P5 Report", which set out clear priorities within Science's High Energy Physics program. However, no such clear list of priorities exists comprehensively across the Office of Science. In today's tight budget environment, the need to prioritize is stronger than ever. What steps have you taken to develop a clear list of priorities within each Science program, and across the Office as a whole?

Secretary Koonin. The 20-year Facilities Outlook developed by the previous administration has been overtaken by events. Current SC leadership has consciously chosen not to pursue this approach of developing a "hard list" of rank-ordered priorities because it inevitably becomes a self-imposed constraint that hinders DOE's abilities to address changing circumstances (witness the previous administration's need to issue a "revised" 20-year facilities outlook a short time after release of the original). One of the reasons for the revision was advances in technology that changed readiness for a particular facility technology and thus accelerated an individual's ranking on the list. For these reasons we no longer view the "20-Year Outlook" as a meaningful document to drive annual prioritization across the Office of Science.

Each of the six Office of Science core research programs engages its community, most formally through its cognizant Federal Advisory Committee, in extensive program planning activities that inform long-term prioritization. While the P5 report is a particularly high-profile example of an influential advisory committee report, each of the programs has recently solicited formal advisory committee or workshop reports on various research topics deemed essential to long-term planning.

Prioritization across the Office of Science as a whole demands balancing these diverse sets of priorities as a means to fulfilling the Department's broader mission objectives, and is the purview of the Office of Science, DOE, broader Administration offices such as OMB and OSTP, and Congress.

ADMINISTRATION PRIORITIES AND PROPOSED CUTS

Subcommittee. Secretary Koonin, as I have said frequently in hearings this month, the subcommittee is highly unlikely to have additional funding this year, and any new programs must be thoroughly justified, carefully overseen, and comprehensively evaluated and most likely offset by cuts to other lower-priority programs. At the same time, the budget request for Science is $590 million above the current level.

Given the fiscal realities in which the subcommittee is likely to operate, where would you propose to cut from the budget request?

Secretary Koonin. Re-optimization of the budget request for a reduced top-line funding level would depend on the magnitude of the reduction. It is unlikely that the Administration would suggest or endorse a uniform, "across the board" cut. As the request makes plain, the most important areas are those which have the greatest potential for impact in terms of materiality, timeliness, and economics, in the next 10 to 20 years. We need to balance these priorities, however, against sustaining and capitalizing on the investments we're making in longer-term facilities and capabilities deemed essential to the Department's mission.

Subcommittee. What are the highest-priority items in the budget request that you would propose to preserve?

Secretary Koonin. Again, the priorities depend on the magnitude of the proposed reduction.

SQUEEZING MORE OUT OF EXISTING SCIENCE PROGRAMS

Subcommittee. In context of our tight budget constraints, it is of the utmost importance that we do better with the money we have. Let me use a specific example. Of the more than $850 million in research proposed in Basic Energy Sciences, only $58 million in the budget request is for Energy Innovation Hubs. In other words, with all of the emphasis on Hubs and their promise for yielding results, only 7 percent of research requested in Basic Energy Sciences is proposed for Hubs. Rather than discussing what is promising about the Hubs, I'd like to turn our attention to what is or isn't working in 93 percent of the proposed research in this program.

Put simply, where does this research money in Basic Energy Sciences go?

Secretary Koonin. The BES program is one of the Nation's largest sponsors of research in the natural sciences. In FY 2010, the program funded research in more than 170 academic institutions located in 50 states and in 14 DOE laboratories located in 12 states. Thus, approximately 40 percent of the BES program's research activities are sited at academic institutions through over 1,200 research grants. The BES program employs 4,700 Ph.D. principal investigators, 1,300 post- doctoral associates, and 2,000 graduate students.

The research disciplines that the BES program supports—condensed matter and materials physics, chemistry, geosciences, and aspects of physical biosciences—are those that discover new materials and design new chemical processes. These disciplines touch virtually every aspect of energy resources, production, conversion, transmission, storage, efficiency, and waste mitigation. BES research provides a knowledge base to help understand, predict, and ultimately control the natural world and serves as an agent of change in achieving the vision of a secure and sustainable energy future.

The Basic Energy Sciences mission is to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support other aspects of DOE missions in energy, environment, and national security. The BES research program is organized into two subprograms. The Materials Sciences and Engineering subprogram supports research that explores the origin of macroscopic material behaviors and their fundamental connections to atomic, molecular, and electronic structures. At the core of the subprogram is the quest for a paradigm shift for the deterministic design and discovery of new materials with novel structures, functions, and properties. The Chemical Sciences, Geosciences, and Biosciences subprogram supports research that explores fundamental aspects of chemical reactivity and energy transduction over an enormous range of scale and complexity. Phenomena are studied over spatial scales from the sub-nanometer, as defined by the structure of atoms and molecules, to kilometers, appropriate to the behavior of subsurface geological structures, and over time scales

from those of the electrons' motion in atoms (attoseconds, or 10^{-18} seconds) to millennia, over which geological change must be understood.

Subcommittee. What would we get from the $164 million in proposed increases in this area—who will get it, and what will it accomplish?

Secretary Koonin. In FY 2012, BES will support expanded efforts in basic research related to transformational clean energy technologies. The requested increases in FY 2012 for clean energy are primarily guided by the recent BESAC report *Science for Energy Technology: Strengthening the Link between Basic Research and Industry.*

Our science based approach for creating transformational improvements in clean energy technologies consists of increasing basic research on a set of interrelated energy issues: non-carbon sources, carbon capture and sequestration, transportation and fuel switching, transmission and energy storage, and efficiency. These basic research efforts will be conducted in coordination with the complementary R&D activities in the following DOE programs: Office of Energy Efficiency and Renewable Energy, Office of Nuclear Energy, Office of Electricity Delivery and Energy Reliability, Office of Fossil Energy, and the National Nuclear Security Administration. The FY 2012 budget contains increases to initiate work in the following BES research areas.

- Solar Electricity from Photovoltaics—Fundamental Science of Interfaces and Degradation.
- Advanced Nuclear Energy—Basic Actinide Chemistry Research for Fuel Cycles.
- Materials under Extreme Environments.
- Carbon Capture—Novel Molecular Design
- Carbon Sequestration—Multiscale Dynamics of Flow and Plume Migration
- Energy Systems Simulation—Internal Combustion Engines (ESS-ICE).
- Batteries and Energy Storage Hub.
- Electric Power Grid—Enabling Materials Sciences.
- Power Electronics.
- Advanced Solid-state Lighting—Novel Light Emitting Diodes.
- Energy Efficiency—Enabling Materials Sciences.

- Basic Research in Methane Hydrates
- Research in support of two inter-agency coordinated initiatives—*Computational Materials and Chemistry by Design and Nanoelectronics.*
- Computational Materials and Chemistry by Design.

Subcommittee. How do you track the performance of these activities?

Secretary Koonin. All research projects supported by the BES program undergo regular peer review and merit evaluation based on procedures set down in 10 CFR Part 605 for the extramural grant program and in an analogous process for the laboratory programs. These peer review and merit evaluation procedures are described within documents found at http://www.science.energy.gov/bes/funding-opportunities/peer-review-policies. These evaluations assess: scientific and/or technical merit or the educational benefits of the project; appropriateness of the proposed method or approach; competency of personnel and adequacy of proposed resources; reasonableness and appropriateness of the proposed budget; and other appropriate factors established and set forth by the Office of Science in a notice of availability or in a specific solicitation. Past performance is a primary evaluation criterion for assessing the competency of the personnel and tracking the performance of the investigator(s) is a key factor in determining whether the research is terminated or receives further support.

The Basic Energy Sciences Advisory Committee reviews all elements of the BES program using Committees of Visitors (COVs) to assure that BES follows established procedures and properly assesses the performance of its activities. COVs are charged with assessing the efficacy and quality of the processes used to solicit, review, recommend, monitor, and document proposal actions; the quality of the resulting portfolio, specifically the breadth and depth of portfolio elements and the national and international standing of the elements; and progress toward the long-term BES goals. Since 2002, all elements of the BES program are reviewed once every three years on a rotating schedule. All COV review results are presented in public BESAC meetings and the final reports are available on the Office of Science web site (http://www.science.energy.gov/bes/about/bes-cov).

Subcommittee. What targets and milestones do you use, that we can understand, to track these $850 million in research projects?

Secretary Koonin. Basic research progress can be reported annually in terms of quality, leadership, and relevance to agency goals, but practical outcomes can be measured only against a far longer historical perspective.

The tracking of performance of basic research is performed through independent, external peer review procedures that are summarized in the response to the previous question. Using rigorous peer review in this way is a well established standard for all federally funded science programs.

The DOE Office of Science policy for evaluating basic research progress is carefully considered and is based on numerous recognized studies. For example, the National Academies Committee on Science, Engineering, and Public Policy report, "Evaluating Federal Research Programs: Research and the Government Performance and Results Act" in 1999, states that "the useful outcomes of basic research cannot be measured directly on an annual basis because the usefulness of new basic knowledge is inherently too unpredictable; so the usefulness of basic research must be measured by historical reviews based on a much longer timeframe."

Subcommittee. How long do grants in these areas last, and how often has the Office of Science cut funding off from a project due to low performance or finding a research dead end?

Secretary Koonin. Science is typically supported through three-year research grant. About a third of the on-going research program is up for "renewal" each year, when existing research competes with new proposals. This limits the maximum program portfolio turnover rate to about 33% per year. Research that has been funded for three years is quite competitive with new research proposals; so many first-time renewal proposals are funded, as are a lesser number of second-time and subsequent renewal proposals. Consequently, the average lifespan of a grant in BES is about 7–8 years and the annual turnover rate of research projects is 10–15%, depending on appropriations.

Subcommittee. The Department maintains that one of the important traits of a Hub is its ability to cut off research paths that aren't fruitful. How often have you done this in the $792 million in Basic Energy Sciences research that is not within a Hub?

Secretary Koonin. BES is a very dynamic program with respect to terminating support for dead-end research projects. All supported projects receive external peer review and merit evaluation generally once every three years, which determines whether the research is continued or terminated. Success rates vary, but typically 10-20% of all BES research projects are terminated over a three-year review cycle. University research projects are grants rather than contracts, so ongoing research projects also have the ability to discontinue research paths that are not fruitful within their stated research objectives.

As a result of project peer reviews, the program areas we support—our core research activities—are continually evolving.

Subcommittee. Does that mean that no or few research projects have ever failed, or does it indicate that you're not effectively tracking performance of research within this program, or are afraid to engage in tough oversight?

Secretary Koonin. BES research projects have been terminated after failing to achieve meaningful results or reaching a point of diminishing returns. Basic research seeks new knowledge, making it the highest risk of all R&D endeavors. Managing failure is an integral part of supporting high-risk, high-payoff basic research. The Office of Science is renowned for its tough oversight of fundamental research programs.

Subcommittee. One of the benefits of a Hub is its transparency and accountability: We can point to where the funding is going, for how long the funding is committed, and how well the recipient is performing. How do you propose to increase the transparency and accountability for the non-Hub research in Basic Energy Sciences?

Secretary Koonin. All research in Basic Energy Sciences is accounted for project-by-project as transparently as possible. External audits and well-established reviews scrutinize the program at all levels. All the results of BES research are published in the open literature and are frequently communicated in public meetings and on the Internet.

Subcommittee. How do we know what we're getting with this $850 million?

Secretary Koonin. The central tenet of the BES program is that discovery science is at the foundation of innovation and future technologies. The BES program supports basic research that underpins a broad range of energy technologies. Research in materials sciences and engineering leads to the development of materials that improve the efficiency, economy, environmental acceptability, and safety of energy generation, conversion, transmission, storage, and use. For example, advances in superconductivity have been introduced commercially in a number of demonstration projects around the country. Improvements in alloy design for high temperature applications are used in commercial furnaces and in green technologies such as lead-free solder. Research in chemistry has led to advances such as efficient combustion systems with reduced emissions of pollutants; new solar photoconversion processes; improved catalysts for the production of fuels and chemicals; and better separations and analytical methods for applications in energy processes, environmental remediation, and waste management. Research in geosciences results in advanced monitoring and measurement techniques for reservoir definition and an understanding of the fluid dynamics of complex fluids through porous and fractured subsurface rock. Research in the molecular and biochemical nature of photosynthesis aids the development of solar photo-energy conversion.

These activities represent comprehensive national programs and, in most cases, these are truly unique national programs. The energy systems of the future—whether they tap sunlight, store

electricity, or make fuel from splitting water or reducing carbon dioxide—will revolve around materials and chemical changes that convert energy from one form to another. Such materials will need to be more functional than today's energy materials. To control chemical reactions or to convert a solar photon to an electron requires coordination of multiple steps, each carried out by customized materials with designed nanoscale structures. Such advanced materials are not found in nature; they must be designed and fabricated to exacting standards using principles revealed by basic science.

STRATEGIC AND PROGRAM MANAGEMENT

DOUBLING OF SCIENCE FUNDING

Subcommittee. The Administration has previously expressed its intention to keep on the path towards doubling Science research funding.

Does this budget request keep to that path?

Secretary Koonin. Yes, the FY 2012 budget request keeps the Office of Science and the other basic research agencies that are part of the President's Innovation Agenda on the doubling path.

Subcommittee. Given the increases requested, in what fiscal year would Science research achieve its doubling goal, and how has that date changed since last year?

Secretary Koonin. The FY 2012 request of $5.4 billion represents annualized growth of 7.1 percent since the FY 2006 appropriation of $3.6 billion. Over 10 years, 7.1 percent growth would nearly double a budget, and over 11 years, it would surpass doubling. However, like Congress, the Administration determines budget requests one year at a time, and there is no specific outyear funding profile, nor year in which doubling will be reached, that has been committed to for the Office of Science.

Subcommittee. How do these substantial increases to Science fit within the incredibly tight fiscal constraints I have repeatedly said that we're working within, and within the President's plan to freeze non-defense funding?

Secretary Koonin. The President's FY 2012 budget request does indeed reflect an overall freeze on non-defense spending, but within that overall freeze, some priority programs still see growth, offset by reductions to other activities, both within and outside DOE. Federal support for groundbreaking basic science, research, and innovation is necessary to solve our energy challenges and ensure that the United States remains at the forefront of science and technology, and I'm glad to be able to tell you that even within the current fiscal constraints, the FY 2012 budget request keeps science as a key priority.

NEW AWARDS VERSUS MORTGAGES

Subcommittee. Mr. Koonin, let's get into the way Science does business and ensures that its funds are being used to best effect. Basic Energy Sciences is a good case study, for which you requested nearly $2 billion. According to your Department, those funds break down in some interesting ways. I'll spare you the details, but one conclusion is that only $130 million of that $2 billion would be for new research at non-DOE facilities. That's about 6.5%. In total, the $2 billion you're requesting would only fund $191 million in new awards. You are defending your programs as critical for U.S. innovation.

Secretary Koonin. The BES program supports basic research that underpins a broad range of energy technologies. The BES programs, coordinated with the DOE applied technology programs, are critical to innovation by underpinning advances, for example, in non-carbon emitting energy sources, carbon capture and sequestration, transportation and fuel switching, transmission and energy storage, efficiency, and advanced materials for energy applications. The BES program is not a static mortgage but a very dynamic program with respect to terminating support for research projects past their fruition and starting new work within their core program. Even successful research projects have the ability to discontinue research paths that are not fruitful and start new research within their scope of work.

The very nature of scientific peer review is to identify the highest quality scientific research to support and to terminate research that is no longer productive. This turnover of research projects and areas is accelerated by the tremendous proposal pressure of new ideas that are received continuously. The funding requested for new research will be much more productive when it will build on a solid core research program.

SCIENCE RESEARCH AND INTELLECTUAL PROPERTY

Subcommittee. Secretary Koonin, the Administration has positioned the increases to energy programs at the Department of Energy as driven by improving the nation's competitiveness. To a certain extent, I can see that argument for applied research and development. But for basic science? Most of this work will, frankly, never lead to patents. And anything that does make it to the marketplace will take not months, not years, but decades. So how would your increases help American competitiveness?

Unfortunately, the Department of Energy is somewhat notorious for coming up with great ideas that go nowhere...or are picked up by other countries. What is the Department doing to identify promising discoveries and ensure they're picked up by American industry?

Secretary Koonin. Scientific knowledge is at the core of a high tech economy. Scientific research increases our knowledge of nature and integrates that knowledge in ways that are directly useable for practical engineering applications. And in the course of their work, as researchers develop new tools and techniques that allow us to discover and measure previously inaccessible physical phenomena, those tools form the basis of new technologies or solutions for overcoming long-standing technical barriers. While it can be an indicator of productivity, a count of the number of patents is a poor measure of the public benefit of scientific research—whether basic or applied. Scientific understanding is at its most practical when it solves problems that arise in the design, manufacture or operations of complex technologies—solutions that are not always patentable. Finally, research laboratories provide a prime training ground—though not the only one—for a technically talented workforce that can drive future innovation.

The DOE National Laboratories are encouraged to and are working with scientists to help them identify innovations generated from their research that can lead to commercialization. Some laboratory programs are accomplishing this by engaging with the technology transfer staff at earlier stages than done traditionally. Facilitating industry interactions also assists in providing scientists with a perspective than can assist in identifying promising commercial innovations from the basic science. Best practices are being shared among the DOE National Laboratories and with other university and federal technology transfer operations for capturing and making available for licensing the intellectual property (IP) that is being developed through DOE funded research, including providing web access to useful industry-focused information on Lab technologies available for licensing thereby making it easier for business and entrepreneurs to browse our available technologies. The Department has increased its outreach to reach a wider audience of potential licensees to commercialize technologies from the National Laboratories, including a recently-announced program to facilitate start-up companies in identifying and obtaining a low-cost option to license DOE Laboratory technologies. These options facilitate a start up in its first-year activities to raise capital and establish itself before facing the deferred costs of a license to commercialize the technology. The Department is enabling our laboratories

to better collaborate with U.S. industry. DOE has undertaken an aggressive effort to identify barriers to working with industry and is mitigating and/or eliminating them where feasible, while balancing such efforts with U.S. competitiveness and other policy concerns. All DOE exclusive licensing agreements have either a strict U.S. manufacturing requirement or other negotiated net benefit back to the U.S. economy.

SHUTDOWNS AND BUDGETARY SAVINGS

Subcommittee. Dr. Koonin, in Secretary Chu's outline of the 2012 budget request, he highlighted several terminations, stating that, "fiscal responsibility demands shared sacrifice." Within the Office of Science, the Secretary referred to the shutdown of the Tevatron, and termination of the Holifield Radioactive Ion Beam Facility. Because the Tevatron had already been slated to shut down during 2011 and the Holifield ion beam will only save $10.3 million, I'm interested to hear about other, more substantial savings the budget request makes in the Office of Science through a careful review of its programs.

What programs or activities did you eliminate or reduce due to low performance?

Secretary Koonin. The Office of Science routinely evaluates and assesses the progress and performance of the research programs it funds to ensure that taxpayer dollars are spent efficiently and effectively. The following are two examples of our decisions to reallocate funding in the FY 2012 budget. These decisions were made following a careful review of program requirements and recent research results, and, although program performance was acceptable, it was determined that these resources could be used more effectively to meet higher priority requirements. The Atomic and Molecular Physics program at ORNL is being phased out in FY 2012. This program, which had a long and very distinguished history at ORNL, was supported by two offices within the Office of Science (Basic Energy Sciences and Fusion Energy Sciences). Both offices made the decision to phase out support for the program. The Fusion Simulation Program (FSP) will be paused for assessment in FY 2012 in order to accommodate competing priorities. This program is not being terminated; rather the FES program will us the final report of the planning study, expected in the summer of 2011, to determine the future course of the activity.

Subcommittee. What decisions did you make to reduce programs after judging that they are a lower priority to the Department's mission?

Secretary Koonin. Program Managers in the Office of Science conduct regular peer reviews for each funded activity in the Office of Science. For very large activities or projects, these reviews and assessments may include participation from federal Advisory Committees chartered by the Office of Science. This rigorous review process provides SC management with an assessment of scientific and technical progress and includes recommendations for future funding; such reviews are part of the basis for funding decisions, including reductions.

INTEGRATION WITH NNSA

Subcommittee. The Office of Science's activities overlap considerably with the NNSA in several areas, ranging from the development of advanced computer systems to the production of nuclear isotopes. However, these two branches of the Department have not historically integrated their activities together—as one might imagine, there are significant missed opportunities to get more out of the Department's limited budget.

Under Secretary Koonin, how is your office working with the NNSA to better integrate programs that overlap heavily, such as the effort to develop next-generation supercomputing platforms?

Secretary Koonin. Both offices have coordinated and continue to coordinate activities at the technical and programmatic level. Both programs have built upon investments the other was making, including the ASCI White and Seaborg machines, Red Storm and Jaguar, and the Blue Gene machines at Lawrence Livermore National Laboratory (LLNL) and Argonne National Laboratory (ANL). This close coordination is continuing. In April, Under Secretary D'Agostino and I signed a Memorandum of Understanding (MOU) between our organizations specifically to coordinate efforts in the development of the next generation supercomputing platforms for scientific discovery and economic competitiveness. This MOU builds on the existing cooperation and collaboration between the computing organizations in the Office of Science and NNSA—the Advanced Scientific Computing Research (ASCR) and the Advanced Simulation and Computing (ASC), respectively. At the program level, the leadership meets at least quarterly to explore topics of mutual interest. Those meetings have been biweekly for the past 6 months as the programs jointly direct activities defining potential paths forward in the development of exascale computing. ASCR continues co-funding SciDAC activities under the program run by ASCR. The programs also co-funded follow-on R&D for the Blue Gene family of supercomputers, which will result in Blue Gene/Q machines expected to be delivered at Lawrence Livermore National Laboratory and Argonne National Laboratory in FY 2012. Most recently, the Office of Science and NNSA are closely collaborating on the development of the software roadmap for the next generation of supercomputers. This includes joint development sharing strategic planning documents and gap analyses, and providing programmatic and technical representatives for each other's planning meetings and workshops.

PERFORMANCE MEASUREMENT

Subcommittee. Unlike in previous years, this year's budget request does not include performance targets and metrics for each program in the submitted congressional justification documents.

How does the Department propose to measure the performance of Science programs, especially in light of the large increases proposed?

Secretary Koonin. The six Science (SC) research programs support fundamental, innovative, merit based peer-reviewed research to create new knowledge, and support the design, construction, and operation of a wide array of scientific user facilities essential for advancing the frontiers of research in relevant areas of science and technology and providing the Nation scientific tools to remain at the forefront of innovation and competitiveness. All research projects and facilities undergo regular peer review and merit evaluation based on procedures set down in 10 CFR 605 for the extramural grant program and under a similar process for the laboratory programs and scientific user facilities. All new projects are selected through peer review and merit evaluation. While 10 CFR 605 governs financial assistance, SC applies the same principles to national laboratory research reviews as well.

Additionally, SC has established for each of its six research programs a Federal Advisory Committee (FAC), governed by the Federal Advisory Committee Act (FACA) of 1972 (Public Law 92-463). The Office of Science charges the relevant FAC to assemble subcommittees (called Committees of Visitors (COV)) to assess a program's activities on a regular basis. Every SC program element must be reviewed by a COV at least once every three years. Each COV panel is composed of a group of recognized scientists and research program managers with broad expertise in the designated program areas. The portfolio under review by a COV generally includes all actions—both awards and declinations—for universities, national laboratories, and industry administered by the program for a set period of time, usually three years. The COV prepares a report of its findings, which is presented to the full FACA Committee at a public meeting. Following acceptance by the FACA Committee, the report is transmitted to SC-1 and released publicly. The appropriate SC Program Associate Director provides a response to the COV Report.

Subcommittee. If the Department is not setting targets for all of its programs in the budget request this year, how will it hold programs accountable to performance targets during fiscal year 2012?

Secretary Koonin. The Department is preparing a supplement to the FY 2012 Budget Request which will include the Department's entire inventory of FY 2012 annual performance measures.

HIGH ENERGY PHYSICS

TEVATRON SHUTDOWN

Subcommittee. The Tevatron at the Fermi National Accelerator Laboratory was the world's highest energy particle collider for decades until Europe's Large Hadron Collider began operating in 2009. While it had long been the Department's intention to shut down the Tevatron once the more advanced Large Hadron Collider came online, there were discussions last year about extending the Tevatron's operations several more years.

Can you explain why the Department considered extending the operating life of the Tevatron?

Secretary Koonin. A proposal to continue running the Tevatron was put forth by the users of the Tevatron to Fermilab. Fermilab had the proposal reviewed by its Program Advisory Committee, which found the proposal had significant scientific merit. Fermilab then forwarded this proposal to HEP for consideration in the FY 2012 budget.

Subcommittee. What changed that led the Department to reconsider the timing of the shutdown?

Secretary Koonin. The initial physics data rate produced by the LHC in 2010 was very low (as is common for new accelerator facilities), although it improved dramatically through the year, while the Tevatron performance continued to be excellent, surpassing established performance goals. This meant that the Tevatron would still be competitive with LHC for some important physics results, such as discovery of the Higgs Boson, longer than originally expected.

Subcommittee. How much would it cost per year to continue operating the Tevatron?

Secretary Koonin. The minimum amount to continue to run the Tevatron is $25 million per year. However, HEP and Fermilab were planning to redirect part of the workforce on the Tevatron to supporting the new projects, Muon to Electron Conversion Experiment and the Long Baseline Neutrino Experiment. It would require an additional $10 million to make new hires to maintain the planned schedules for those experiments, so the total cost would be $35 million per year.

Subcommittee. What factors led to the Department's ultimate decision to shut down the Tevatron, as originally planned, during 2011?

Secretary Koonin. HEP charged its FACA committee, High Energy Physics Advisory Panel, to provide advice on this question. In a report dated October 26, 2010, HEPAP found that extending the Tevatron run was scientifically well-justified but it was not more important to the

U.S. program than the planned new initiatives and therefore the panel recommended that the run should only be extended if additional funds could be provided. Among the factors in HEPAP's deliberations were the negative impact on the NOVA Project currently under construction and that the LHC would eventually make the truly definitive measurements of the Higgs Boson.

Subcommittee. As of now, when exactly is the Tevatron's planned shutdown?

Secretary Koonin. The Tevatron will shutdown at the end of FY 2011.

INTENSITY FRONTIER

Subcommittee. The High Energy Physics program breaks its program down into three areas: The "Energy Frontier", the "Intensity Frontier", and the "Cosmic Frontier". The two construction projects proposed to start in fiscal year 2012 focus on the so-called "Intensity Frontier", reflecting the Department's apparent plan to cede the Energy Frontier to Europe while going for the lead in the Intensity Frontier.

How well do you think leading the world on the Intensity Frontier will attract leading physicists and science engineers to the United States, and attract our nation's leading minds to science and engineering?

Secretary Koonin. The Intensity Frontier addresses many of the key questions about how the universe works that are at the core of the HEP mission, such as "why are there so many kinds of particles?" and "what happened to all the antimatter?" The scientific excitement of addressing these compelling questions, along with the technical challenges of implementing state-of-the-art high power accelerator beams and ultra-sensitive particle detectors, will continue to attract and inspire some of the best scientists and engineers to work in the U.S.

ENERGY FRONTIER AFTER THE TEVATRON

Subcommittee. While the Tevatron, the high-energy particle collider, will shut down in 2011, the fiscal year 2012 budget request requests substantial funding for work relating to the Energy Frontier.

How much of the High Energy Physics budget request focuses on work relating to the Energy Frontier?

Secretary Koonin. About $200,000,000. This includes support for LHC research and operations as well as analysis of the final Tevatron data.

Subcommittee. How do you justify this investment if we have ceded leadership in the Energy Frontier to Europe?

Secretary Koonin. Although the LHC is located in Europe, U.S. scientists are playing leading roles in the scientific collaborations that are searching for new physics there and getting credit for their important contributions. The U.S. groups designed and built major detector systems that are part of the large LHC detectors, as well as components of the accelerator, for a total investment of $531,000,000 (including NSF). We need to continue to support our top scientists, meet our commitments to operating the parts of the detectors and data analysis systems that we provided, and exploit the scientific returns on our significant investments in the LHC.

Subcommittee. Would it be better to focus all of our funding on the area in which we can lead—the Intensity Frontier—rather than diluting our efforts into the other areas?

Secretary Koonin. It is important to maintain a balance between the three major experimental thrusts of HEP because they have interlocking physics goals that provide different approaches to addressing the same fundamental questions. With appropriate balance, these thrusts reinforce and complement each other rather than diluting the overall effort. This is the approach recommended by HEPAP.

HIGH ENERGY PHYSICS SQUEEZE ON RESEARCH FUNDING

Subcommittee. The budget request for High Energy Physics includes the start of two new construction projects totaling $41 million, as well as an overall decrease to the program of $13 million. This combination puts a squeeze on research funding.

Would funding at the budget request level lead to layoffs in research staff at the High Energy Physics laboratories?

Secretary Koonin. We project no layoffs in research staff in HEP laboratories at the FY2012 President's Request level, although we note that Fermilab will need to reorient its personnel skills mix as Tevatron operations come to a close and construction projects begin to ramp up.

Subcommittee. Admittedly, striking the right balance is challenging. Research funding supports scientists today, but construction projects create the experiments for researchers down the road. How did you strike this balance between construction projects and funding for people and research in High Energy Physics?

Secretary Koonin. Cutting edge research requires continuous investment in new tools and facilities that deliver new capabilities for the researchers, so it is vitally important to make these investments in these construction projects. We tried to the extent possible to maintain the current level of research effort in the FY2012 Request since the Tevatron program will still be very active and the LHC program will be reaping the benefit of rapidly increasing data sets. In order to maintain the support for the top research groups working in priority areas, smaller efforts on older experiments and groups that do not perform well in peer review are being phased out.

ATTRACTING AND DEVELOPING LEADING SCIENTISTS AFTER THE TEVATRON

Subcommittee. With Tevatron shutting down and the Large Hadron Collider operational, the "next big thing" in high energy physics is clearly in Europe. Students and scientists flock to where the action is, and in this case it seems the action will be in Europe for high energy physics. At a time when we must keep America competitive by attracting the best scientists and engineers, this development is clearly a concern.

How do you believe the shutdown of the Tevatron impacts the ability of the United States to develop and attract the world's leading scientists?

Secretary Koonin. We note that current and planned future Intensity Frontier program at Fermilab is a world-leading program, which will continue to attract top scientific talent if we can implement it in a timely fashion.

Subcommittee. What is the Department doing to attract the best scientists in this area?

Secretary Koonin. The Office of Science is trying constantly seeking to provide researchers with the best tools possible for carrying out their research. On the Intensity Frontier, the NOvA experiment is under construction and will be premier detector for neutrinos oscillations in this decade. Liquid Argon detector technology has the promise to revolutionize neutrino physics, and the MircoBooNE project is being built to demonstrate this potential. The Mu2e experiment is planned to improve the search for charged lepton number violation by four orders of magnitude.

Subcommittee. If the Department is conceding high energy physics to Europe, then in what Science areas is the Department working to keep American leadership?

Secretary Koonin. We did not "concede" high energy physics to Europe. They now have the world-leading facility at the Energy Frontier that U.S. researchers are maximally utilizing based on our past investments in the LHC and the related detectors. In addition, we now have, or are pursuing, world-leading opportunities at the Intensity and Cosmic Frontiers.

Subcommittee. How does the 2012 budget request reflect these efforts?

Secretary Koonin. The construction funding requested for the Long Baseline Neutrino Experiment and the Mu2e experiment enables the first stage of a multi-stage program that maintains our leadership at the Intensity Frontier. Recent and ongoing investments at the Cosmic Frontier are keeping the U.S. at the forefront of research into Dark Matter and Dark Energy.

IMPACT OF NSF WITHDRAWAL FROM DUSEL CONSTRUCTION

Subcommittee. The Long Baseline Neutrino Experiment, whose construction the 2012 budget request proposes to start, is dependent on its detector being in a deep underground facility. The Deep Underground Science and Engineering Laboratory, (DUSEL), is a planned National Science Foundation (NSF) facility in which the Department of Energy planned to house the neutrino experiment detector. However, when the National Science Board announced late last year that it plans to discontinue NSF financial support for DUSEL, it put the future of DUSEL—and of the Long Baseline Neutrino Experiment—into question.

What is the impact of the NSF's decision regarding DUSEL on the Long Baseline Neutrino Experiment?

Secretary Koonin. The planning for the Long Baseline Neutrino Experiment (LBNE) assumed that NSF was providing significant infrastructure in the Homestake Mine in South Dakota and a contribution toward detector fabrication, so the NSF's decision will most likely raise the cost of the project. The Office of Science has conducted a review to evaluate different options to do a long baseline neutrino experiment at Homestake, as well as options for dark matter and neutrinoless double beta decay at either Homestake or SNOlab in Sudbury, Canada. The review report is available on the Office of Science website[1].

Subcommittee. Will it unavoidably affect the planned timeline for the neutrino experiment?

Secretary Koonin. Yes, the LBNE project team is reconsidering its options and that will delay progress on the conceptual design. The FY 2012 request for LBNE is smaller than had been planned earlier in the process, since the planning for engineering and design has been delayed by the need for more alternatives analysis and additional reviews.

Subcommittee. Since neutrino and related experiments so often rely on deep underground detector facilities, will the NSF's decision limit the United States' ability to lead on the Intensity Frontier?

Secretary Koonin. The Intensity Frontier is not limited to underground sites, and the HEP program will have world-class Intensity frontier experiments on the surface. The Office of Science review will assess various sites and possibly alternative technologies, such as liquid argon detectors, that are underground but do not require sites in deep mines.

[1] http://science.energy.gov/~/media/hep/hepap/pdf/june-2011/Review_of_Underground_Science_Report_Final.pdf

Subcommittee. What options is the Department considering for the Long Baseline Neutrino Experiment?

Secretary Koonin. Liquid Argon detectors have been one of the technology options for LBNE from the beginning. Such detectors might be effectively implemented at depths of several hundred feet rather than several thousand feet due to their superior background rejection capabilities.

Subcommittee. Is the Department likely to propose funding DUSEL itself, or to look for alternative existing locations to house the neutrino experiment detector?

Secretary Koonin. The Department is considering using the Homestake site along with other options for the experiments that it was planning to conduct at DUSEL. These are a dark matter search, a neutrinoless double decay search, and a long baseline neutrino experiment. The NSF vision for DUSEL was broader and included nuclear astrophysics, biology, and geology. Once the Office of Science review makes its recommendations on where best to place the dark matter, neutrinoless double decay, and long baseline neutrino experiments the Office of Science will consider its options and a request for funding may be made.

Subcommittee. Is the NSF open to funding other portions of the DUSEL project while the Department of Energy funds construction and maintenance, or has the NSF completely withdrawn any possibility of financial support for DUSEL?

Secretary Koonin. DOE is considering site options, including the Homestake site, for a dark matter search, a neutrinoless double decay search, and a long baseline neutrino experiment.

NSF has stated in their FY 2012 budget request that they will continue to solicit grant proposals for future particle physics research, including small-scale underground experiments that might be conducted at Homestake (should DOE decide to support the core infrastructure there) or at other existing sites in the U.S. and around the world.

Subcommittee. If the Department of Energy were to propose funding the construction of DUSEL, what would the total cost commitment be, and would the Department truly wish to add yet another facility to its roster?

Secretary Koonin. No decisions have been made yet to request funding for research at Homestake. We are waiting to hear the results of our review of the possible costs and science impact before making any decision.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

PERFORMANCE OF THE BIOENERGY RESEARCH CENTERS

Subcommittee. We've heard good things about the Bioenergy Research Centers, in particular about the Joint Bioscience Energy Institute, a lab you discussed frequently when proposing the energy innovation hubs for fiscal year 2010. But even if we hear anecdotal evidence about JBEI's successes, we're particularly interested in how well its working compared to other activities at the Department and other ways the same funding could be used—including reducing the deficit.

What systems and benchmarks have you put in place to measure the JBEI's performance?

Secretary Koonin. JBEI's progress—and that of all three Bioenergy Research Centers—is rigorously reviewed annually by an external team of science and management experts. Performance on both science and management is judged against specific scientific and technical milestones, to identify achievements and successes, to review plans for the upcoming year, and to pinpoint any areas where corrective action or additional guidance from DOE may be needed. The review evaluates progress in the three major scientific areas of feedstocks, deconstruction, and fuel synthesis, as well as for center effectiveness in developing enabling research technologies, facilitating technology transfer and commercialization, and effective center management and business systems.

Subcommittee. How is JBEI measuring up to those benchmarks?

Secretary Koonin. JBEI has performed very well in meeting its scientific and technical milestones, with significant high-impact publications and a strong record of intellectual property generation. JBEI has also demonstrated success in effective center management and scientific integration.

Subcommittee. Why has JBEI been so successful?

Secretary Koonin. JBEI's success derives from the synergy and integration of considerable scientific talent and energy pursuing a single goal. Research results from one part of the center are able to inform and accelerate progress in a different part of the center.

Subcommittee. Well, there are two other Bioenergy Research Centers. Just last week we saw a press release publicizing a research result at one of those labs. But anecdotal instances aside, how do these other two bioenergy centers measure up to the same benchmarks we've discussed for JBEI? Surely they're not all performing equally well.

Secretary Koonin. All of the Bioenergy Research Centers—JBEI, the Great Lakes Bioenergy Research Center, and the BioEnergy Science Center—are held to the same rigorous standards of performance measures and accountability. All of the centers are making substantial and significant progress toward their respective goals of fundamental research underlying a range of high-risk, high-return biological solutions for bioenergy applications. The latter two centers have also successfully met their milestones and were evaluated positively for scientific and technical progress by the external review team. Notwithstanding these positive evaluations, DOE issued further recommendations for improvements, and each center was given specific guidance appropriate for its individual focus.

EXTENSION BEYOND FIVE YEARS OF THE BIOENERGY RESEARCH CENTERS

Subcommittee. Fiscal year 2012 marks the sixth year of funding for the Bioenergy Research Centers. Secretary Chu asserted yesterday that the Energy Innovation hubs are concept based on these centers, and so I presume the Bioenergy Research Centers would follow the same review process. In particular, the Hubs and these research centers are not intended to be permanent fixtures, but rather focused, temporary initiatives aiming to solve a specific problem in a limited amount of time.

In that vein, the end of year five marks a major occasion, just as in the case of the Hubs, for the Department to carefully evaluate the performance of each center and determine whether it should be extended or concluded.

Have you begun this evaluation of each Bioenergy Research Center?

Secretary Koonin. The Bioenergy Research Centers started in the last month of FY 2007, and completed their third full year of operations in FY 2010; they will complete their fifth year of full operations in fiscal year 2012. Each center is evaluated rigorously on an annual basis against scientific and technical milestones, with the most recent review of year three conducted in September 2010. With the successful outcome from the critical third year review, there is sufficient scientific merit and strategic purpose for team-based fundamental research on biofuels to consider a noncompetitive renewal funding period of five years. The guidance for the renewal process has been issued to the centers; we expect to conduct the external reviews in early fiscal year 2012.

Subcommittee. I must say that I'm surprised to hear that a five-year review is being overlooked. I certainly hope that the Department is not creating permanent research institutions requiring ongoing federal funding commitments, without contemplation and regardless of the merits. Shouldn't each center only be continued after five years if it is exceeding expectations?

Secretary Koonin. Each center is evaluated rigorously on an annual basis against scientific and technical milestones, with the most recent review of year three conducted in September 2010. With the successful outcome from the critical third year review, there is sufficient scientific merit and strategic purpose for team-based fundamental research on biofuels to consider a noncompetitive renewal funding period of five years. The guidance for the renewal process has been issued to the centers; we expect to conduct the external reviews in early fiscal year 2012.

Subcommittee. I would think the highest level of accountability and good government requires that, by default, we end each center and Hub after five years, except in cases where their

performance justifies an extension. Why should this be different than the vision for Energy Innovation Hubs laid out by the Department in the last two years?

Secretary Koonin. The Department's management oversight of the Bioenergy Research Centers (BRCs) and the Energy Innovation Hubs is quite similar, in keeping with the fact that the establishment of the Hubs was modeled after the BRCs. In both cases, the initial five-year award term is intended to liberate researchers from short term funding cycles and provide them the flexibility to embark on more daring R&D approaches. The Department has stated that to receive funding after the initial five-year period, each Hub will need to deliver outstanding scientific results and will be expected to demonstrate the potential for exceptional future progress. In this vein, the Bioenergy Research Centers (BRCs) have a mandate to conduct fundamental research that can accelerate commercialization, while the Hubs are mandated to coordinate and execute their plan from basic research to the point of technology hand-off and commercialization. The BRCs have developed internal strategic vision plans articulating their research goals for a potential renewal five-year funding period. These plans emphasize progress and evolution of fundamental research on advanced biofuels; although developed individually, together they reflect a complementary approach that retains the unique strengths and focus of each BRC while also highlighting opportunities for high-impact interactions between the centers. With the successful outcome from the critical third year review, there is sufficient scientific merit and strategic purpose for team-based fundamental research on biofuels to consider a noncompetitive renewal funding period of five years, to capitalize on the opportunity for continued scientific progress and synergies between centers.

Subcommittee. Who is conducting the reviews?

Secretary Koonin. The review is being organized by the DOE program manager with responsibility for the bioenergy research centers.

Subcommittee. Is an outside panel conducting a full, independent peer review of the centers?

Secretary Koonin. The renewal review for each bioenergy research center will include a full external peer review team of scientific and management experts.

Subcommittee. When will you be prepared to release the results of these evaluations?

Secretary Koonin. The review findings and recommendations will be issued within 90 days following the review and no later than April 2012.

Subcommittee. I assume that the review panels should be measuring the centers' performance, first, against specific goals determined when the centers were established; and

second, against the performance of other research avenues covering similar topic areas. How are you "setting the bar" for extending or concluding each center?

Secretary Koonin. The bar is set for center continuation based on rigorous external peer review on an annual basis against scientific and technical milestones. The review criteria include consideration of scientific impact within the context of activities external to the centers. Based on the outcome from the critical third year review, there is sufficient scientific merit and strategic purpose for team-based fundamental research on biofuels to consider a noncompetitive renewal funding period of five years.

Subcommittee. I would think such a significant milestone should have been conducted with much more transparency and notice. It seems natural to conclude that these reviews were perfunctory, and that the Department never seriously considered concluding these centers after five years. I find this troubling, and worry about the implications for the Energy Innovation Hubs. How can you assure the subcommittee that these reviews were serious, rigorous, and independent evaluations holding the centers up to an extremely high standard?

Secretary Koonin. The renewal review has not yet been completed.

Subcommittee. Who conducted the reviews?

Secretary Koonin. The renewal review has not yet been completed. The DOE program manager will lead an external review panel to evaluate each center.

Subcommittee. Is an outside panel conducting a full, independent peer review of each center?

Secretary Koonin. The renewal review has not yet been completed. The DOE program manager will lead an external review panel to evaluate each center.

ELIMINATION OF MEDICAL RESEARCH

Subcommittee. I and this subcommittee have long supported keeping the Department's focus on its core energy and security missions, and the budget request seems to go in that direction by eliminating some activities that focus on research with medical applications in the Biological and Environmental Research program. We should note, however, that some of these activities are worthwhile even if they do not belong in the Department of Energy.

Have you worked to transition these activities to the appropriate federal agencies, like the National Institutes of Health, or to other non-federal agencies?

Secretary Koonin. The Department coordinates with the National Institutes of Health (NIH) to identify potential research and scientific workforce training areas for mutual cooperation and to minimize overlap between the two agencies. DOE has provided funds in fiscal year 2011 to facilitate an orderly transition of medical applications through pre-clinical testing and to complete additional technology research required to bring the visual prosthesis device to readiness for clinical trials.

Subcommittee. Does the budget request continue to fund any activities specifically focusing on medicine or medical applications?

Secretary Koonin. No, the fiscal year 2012 budget request does not include any request for funding to continue activities specifically focusing on medicine or medical applications.

BASIC ENERGY SCIENCES

BATTERIES AND ENERGY STORAGE ENERGY INNOVATION HUB

Subcommittee. The budget request proposes $34 million to establish an Energy Innovation Hub in Batteries and Energy Storage. This proposal represents a multi-year commitment of more than $130 million and deserves close examination.

I understand that the initial three Hubs first funded in fiscal year 2010 are not yet operational and have not moved into their office spaces. Given the lack of data and results from these first hubs, on what basis do you propose more energy innovation hubs, if the first group of hubs first funded with first year 2010 funding is not yet operational?

Secretary Koonin. Three Hubs were funded in FY 2010: the Modeling & Simulation for Nuclear Reactors Hub is the Consortium for Advanced Simulation of Light Water Reactors (CASL) led by Oak Ridge National Laboratory; The Fuels from Sunlight Energy Innovation Hub is the Joint Center for Artificial Photosynthesis (JCAP) led by the California Institute of Technology; and the Energy Efficient Building Systems Hub is the Greater Philadelphia Innovation Cluster (GPIC) for Energy-Efficient Buildings led by the Pennsylvania State University. All three Hubs have moved rapidly following the award into operations. As dictated by the three funding opportunity announcements, no new construction is allowed under a Hub award and each Hub is utilizing existing laboratory and office space at its host and partner institutions. In cases where the permanent Hub facility is undergoing renovation, the Hub institutions are providing temporary lab and office space that has allowed each Hub to "hit the ground running," as required by the Department. The level of commitment from the host and partner institutions in each Hub has been remarkable—all are dedicated to the success of the Hub.

The outstanding community response to the Hub concept (as indicated by significant number of excellent proposals submitted in response to the funding opportunity announcements), the excellent rate of progress of the initial Hubs, and the establishment of robust Hub management framework within DOE provide a firm foundation for moving forward with additional Energy Innovation Hubs.

Subcommittee. Are you "jumping the gun" by already proposing more hubs?

Secretary Koonin. No, the current Hubs are fulfilling the vision for these research programs—they are building a community around some of the most pressing energy challenges facing the Nation. The new Hubs will maintain this momentum and apply this model to three areas with similar challenges: Batteries and Energy Storage, Critical Materials, and Smart Grid Technologies and Systems.

Subcommittee. How did you choose a hub in batteries and energy storage, instead of focusing on any number of other research areas?

Secretary Koonin. This Hub responds to the critical need for accelerating the pace of transformational technologies for energy storage for both transportation and for the stability and introduction of renewable energy to the grid. A Hub was chosen for this area because it differs from the Department's other R&D programs in its larger scale, its higher degree of integration of scientific research with engineering development, and its focus on driving a particular energy technology to its fundamental solutions. Today's electrical energy storage approaches suffer from limited energy and power capacities, lower-than-desired rates of charge and discharge, calendar and cycle life limitations, low abuse tolerance, high cost, and poor performance at high or low temperatures. Many of these fundamental performance limitations are rooted in the constituent materials making up the storage system and in the fundamental physics and chemistry that govern the transport and storage of energy in the material. The research challenges are inherently multi-disciplinary and of a complexity that require the approach fostered by the Energy Innovation Hub to successfully tackle the challenges and provide solutions for the Nation.

The Batteries and Energy Storage Hub will target science knowledge gaps that are preventing breakthroughs in technology platforms for both mobile and grid applications. These research areas were identified in the Basic Energy Science workshop report *Basic Research Needs for Electrical Energy Storage.* The Hub will expand our scientific base for synthesis of novel nanoscale materials with architectures tailored for specific electrochemical performance, develop new methodologies to characterize materials and dynamic chemical processes at the atomic and molecular level, and expand our competencies in simulation and prediction of structural and functional relationships using leading computational tools. The Hub's ultimate technological goals are development of radically new concepts for producing storage devices from materials that are abundant and have low manufacturing cost, high energy densities, long cycle lifetimes, and high safety and abuse tolerance for a broad range of energy storage applications.

Subcommittee. The Office of Science funds energy storage activities within its Basic Energy Sciences programs, including the Energy Frontier Research Centers and other research activities. Further, the budget request proposes substantial increases for battery technology activities in the Office of Energy Efficiency and Renewable Energy; in the Office of Electricity Delivery and Energy Reliability; and in the Advanced Research Projects Agency—Energy. How would the proposed Batteries and Energy Storage Energy Innovation Hub cooperate with these other activities that would focus on overlapping areas?

Secretary Koonin. In FY 2012, DOE has proposed a balanced battery and energy storage portfolio that spans the range from basic research to applied technology development. DOE's central mechanism for coordination of battery and energy storage-related R&D efforts is the

DOE-wide Energy Storage Working Group. Representatives from each program supporting batteries or other energy storage research participate in the group, including SC, EERE, OE, and ARPA-E. Its primary functions are coordination of current research, strategic planning, and linking existing researchers to facilitate the information sharing and coordination across the basic science–technology deployment continuum.

The Batteries and Energy Storage Hub will provide a nucleus of activity for the entire fundamental energy storage research community. Establishing a focused energy storage research effort with the size, scope, and duration of an Energy Innovation Hub will garner long-term commitment from the most innovative researchers in this field. This leadership will ensure that the Hub will be an interaction, information, and communication hub: people and information will flow into it and from it to ensure that the problems and issues being faced in today's technologies are understood and that the impact of the research done by the Hub will help spur innovation and problem solving broadly. The engagement of the DOE Energy Storage Working Group will further facilitate the flow of data and information from the technology programs to the Hub. To ensure integration within the broader DOE-supported community, the Hub will be a full participant in principal investigator meetings focused on Energy Storage and related scientific topics. In addition, within BES, the Hub will be managed by the same team that manages the EFRCs focused on Energy Storage, enhancing technical interactions with the EFRCs.

Subcommittee. What are the specific goals and milestones for the proposed batteries hub? What will it aim to accomplish by the end of, for example, years 3 and 5, and when could we hope to see private sector benefits from the hub's research?

Secretary Koonin. In general terms, given the concentration of expertise and scientific leadership inherent in the Hub model, it is expected that the Batteries and Energy Storage Hub will have a significant impact within the first five years of funding, providing insights and new technologies that will spur innovation and contribute to the solutions of today's problems. It is likely that scientific developments from the Hub will provide improvement to current technologies and thus have a commercial impact in the 3–5 year timeframe. However, the Hub's ultimate technological goals include the development of radically new concepts for producing storage devices from materials that are abundant and have low manufacturing cost, high energy densities, long cycle lifetimes, and high safety and abuse tolerance for a broad range of energy storage applications. Attaining all of these goals will require the sustained research of the Hub environment, and will result in innovative solutions and economic leadership in this competitive field for the future of the Nation.

The detailed, specific goals and milestones for the Hub will be established by the proposal team in their response to the Funding Opportunity Announcement for the Hub. To ensure scientific and technological impact, these deliverables and the plans for community coordination and private sector engagement will be among the important criteria that are assessed in the selection of the successful Hub application.

Subcommittee. What are the points at which you'll review and consider cutting off funding from the Hub?

Secretary Koonin. The Hub will be assessed against the goals and outcomes that were outlined in their application and the subsequent project management schedule that will be provided during the first months of the award. The annual peer reviews of the management and technical progress will provide the "yardstick" for performance. In addition, the Hub's leadership in energy storage research and development, as well as the rate at which advances of their research are transferred to or impact industry, will be evaluated as a measure of the success of the Hub. DOE will be proactive in managing the Hub for success to ensure that early operational problems are identified and remediated. The review plan discussed above will ensure that the Hub stays on track to meet its challenging overall objective and self-identified benchmarks during the first five-year award period. Corrective action plans will be put in place to address any issues identified by the peer reviews and other periodic assessments. If, at the end of the 5-year period, significant progress has not been realized, as judged by independent merit review, renewal funding for the Hub will not be provided. As with other grants, egregious non-performance can result in termination of the grant following any of these reviews.

Subcommittee. Isn't five years too long to wait?

Secretary Koonin. The ultimate payoff expected from the Hub is development of radically new concepts for producing energy storage devices from abundant materials with low manufacturing cost, high energy densities, long cycle lifetimes, and high safety and abuse tolerance for a broad range of energy storage applications. Attaining all of these will require sustained research in the Hub environment. However, DOE expects that the Hub will make significant scientific and technical contributions well before the 5-year mark. The Hub will be subject to regular and rigorous peer review of their scientific program and their management structure, policies, and practices. Within DOE, each Hub is managed by a program office that is responsible for holding the Hub accountable and conducting periodic site-visit reviews to track and correct the progress of the Hub.

Subcommittee. What if the hub is performing poorly after two years?

Secretary Koonin. The Department will be proactive in managing the Hub to prevent this outcome. An early management review will take place in the first year of operation to ensure that the Hub is organized and managed as expected based on the proposal and DOE's expectations. If annual peer-review demonstrates that the Hub is not meeting management or technical goals defined by their project schedule, corrective action plans will be put in place to address the identified shortcomings. As with other grants, egregious non-performance can result in termination of the grant following any of these reviews. Given the motivated, scientific

leadership on the team that is expected to be awarded the Hub following an in-depth peer review of their proposal and a reverse site review of the team, termination of the grant is highly unlikely.

Subcommittee. Wouldn't it be prudent to pull the funding and put it to better use?

Secretary Koonin. Given the motivated, scientific leadership on the team that is expected to be awarded the Hub, termination of the grant for lack of technical progress is highly unlikely. The multidisciplinary research team, with a high level of R&D integration and synergy, will be a rich environment for innovation that will impact the problems we face with today's technologies. It will be prudent to, as planned and described above, manage the Hub well to ensure its success.

ENERGY FRONTIER RESEARCH CENTERS

Subcommittee. The Energy Frontier Research Centers (EFRCs) are one several relatively new research models within the Department of Energy's research and development programs. I understand there are some 46 centers established in late 2009, primarily led by universities and national laboratories.

Last year in its 2011 budget, the Department requested $40 million to establish more of these centers. This year's budget request for Science is substantially greater than the 2011 request, and yet the 2012 request contains no funding for new energy frontier research centers. What has changed?

Secretary Koonin. The EFRC model—substantial research collaborations to accelerate the fundamental research underlying our critical energy challenges—is proving to be effective and productive. Nonetheless, it is only one of many approaches and funding modalities that we use to advance energy-related science. Given the need for targeting resources under fiscal constraints, we see other ways of pursuing the research that are more appropriate at this time for the topical areas that are priorities for additional FY 2012 investments. We are working to match the research model and funding management to the problems that we are trying to tackle.

Subcommittee. Are the energy frontier research centers underperforming?

Secretary Koonin. Fundamental research can be difficult to evaluate on a short time scale, and the EFRCs were just started in August 2009. We are closely monitoring and actively managing these Centers to ensure that they are productive. In 2010, external peer-review panels evaluated the management and initial operations of each of the 46 EFRCs during a series of half day reviews. They concluded that the centers were in general performing very well, making suggestions for minor changes in cases where they saw additional opportunities.

Subcommittee. Or are there other reasons for the change?

Secretary Koonin. We are working to match the research model and funding management to the problems that we are trying to tackle. Our intent is to best match the funding approach and available resources to the issues at hand.

Subcommittee. How do you measure performance of each of the energy frontier research centers?

Secretary Koonin. We expect all of the EFRCs to be world-leading programs that encourage high-risk, high-reward research. Their focus is on fundamental science. This includes consideration of fundamental roadblocks to progress, and of the opportunities for truly

transformational new understanding. Evaluation of the EFRCs involves formal reviews in which independent expert peer reviewers assess scientific productivity, impact, and the extent to which synergies and interactions across the participants in each EFRC have led to outcomes above and beyond the individual, independent contributions of the researchers involved.

Subcommittee. What benchmarks and milestones have you put in place to systematically measure the centers' progress and maintain accountability?

Secretary Koonin. Basic science does not lend itself well to the kinds of specific performance benchmarks and milestones that are appropriate for technology development and deployment; however, a timeline of activities for the EFRCs has been developed. The EFRCs are actively managed and monitored in accordance with this timeline and the associated expectations. Two sets of formal reviews were planned: the first to assess management and initial operations has already occurred; another in FY 2012 will have a greater emphasis on scientific progress and overall impact. In addition, annual progress reports provide a synopsis of accomplishments and data on publications, collaborations, inventions and new technologies, databases produced, software created, and instrumentation developed. Periodic meetings are held with all EFRC Directors and the cognizant DOE program managers. The Directors and key EFRC staff also participate in monthly teleconferences (in smaller groups) with DOE program managers in which they provide updates on their activities and discuss upcoming events and any current issues. Some specific research highlights representing exciting early results from the EFRCs are posted at http://www.science.energy.gov/bes/EFRC/HIGHLIGHTS/highlights.html. A major public meeting, *Science for Our Nation's Energy Future: EFRC Summit & Forum*, to be held on May 25–27, 2011 at the Renaissance Penn Quarter Hotel in Washington, DC, will bring together representatives from all 46 centers to highlight early successes of the Office of Science Energy Frontier Research Centers and promote collaboration across the national energy enterprise. Beyond the formal reviews and regular meetings and discussions, DOE program staff have individual conversations with EFRCs as needed and make occasional informal site visits when feasible; a majority of the EFRCs have already had at least one such site visit.

Subcommittee. Have you found that any centers are underperforming?

Secretary Koonin. Based on the independent expert peer reviews conducted in 2010, the annual reports, and interactions between BES staff and the EFRCs during monthly phone calls, periodic Directors Meetings, and informal visits, centers are generally performing at or above expectations. We continue to follow up on comments and suggestions from the initial management and operations reviews as needed to ensure that good practices are shared and expectations are being met.

Subcommittee. If so, are you considering revoking their funding, and if not, why not?

Secretary Koonin. There is no current expectation that we would remove funding from any existing EFRC, but of course we will continue to track performance and reserve the right to adjust resources if circumstances warrant.

METHANE HYDRATES

Subcommittee. Secretary Koonin, once again the budget request moves the methane hydrates program out of fossil energy research and development to basic science. That would seem to me to be a sign that this energy source is not close to maturity, since science shouldn't be funding applied research and development. However, DOE's literature shows that the program is already well on its way to solving the last technical constraints to production. Why move this to basic science?

Secretary Koonin. The increase in Basic Energy Sciences (BES) represents a significant new effort in basic research associated with methane hydrates, not the transfer of the hydrates technology program from the Office of Fossil Energy. The emphasis of this activity will be on expanding the research base to characterize the formation mechanisms of gas hydrates and to understand and ultimately predict the environmental stability of hydrates at the systems level. BES funding will support basic experimental research and advanced simulation on how hydrates are formed, including the subtle intermolecular forces that govern the structure and properties of hydrates; the multi-phase behavior of hydrate-sediment systems; and the stability of hydrates in the natural environment.

OBLIGATION POLICY

Subcommittee. Mr. Koonin, the Department of Energy has a practice of calling funds "obligated" upon transfer to the national labs. From an oversight perspective, that makes it seem as if funds are being used, even though they can spend years being obligated but unspent. For instance, at the end of fiscal year 2010, your office had only $26 million in unobligated funds. However, it had over $2.3 BILLION in obligated, unspent funds. Depending on one's perspective, it might seem as if the Office of Science was taking a long time to spend out appropriated funds. What's the rationale for obligating funds upon transfer to the labs?

Secretary Koonin. When funding is provided to the laboratories, it is accompanied by a statement of work, and the contract with the laboratory is modified to reflect the funding provided. Per generally accepted accounting practices, DOE is required to record an obligation at that point.

The management and operating contracts under which Office of Science laboratories operate certainly are not typical contracts. As is implicit in the name, the contractors are given significant responsibility for managing work at the laboratory. Generally, very shortly after appropriations levels are settled for the year, the Office of Science distributes the substantial majority, about 80 to 90 percent, of the year's funding to the laboratories. Most funding is distributed as early in the year as possible in order to help the contractor to effectively manage work at the laboratory.

Some of this funding distributed relatively early in the year is for work that will not begin until late in the year. So mid-year, a significant portion of the obligated but uncosted balances can reflect work that DOE has contracted to be done, but which has not yet started. By year end, however, most of this work will have been started, and the uncosted balance instead primarily reflects the fact that work is not instantly complete once it is started, but instead takes time to do. Excluding Recovery Act funding, across all the DOE M&O contractors, $3.54 billion of SC funding was obligated during FY 2010, and $1.59 billion remained uncosted at year end. So of the SC work funded at the laboratories in FY 2010, about 45% was still underway at year end. As of the end of February, $780 million of this balance had been costed and $809 million remained uncosted—in other words, about half of the 77% has now been completed and about 23% is ongoing.

Subcommittee. An "obligation" is a binding agreement on behalf of the U.S. government to pay funds. How is a transfer to the labs a "binding agreement" of U.S. taxpayer dollars?

Secretary Koonin. The obligation is made when the Department provides funding and a statement of work, the contractor accepts the statement of work and reporting requirements, and the contract is modified. This is indeed a binding agreement with the contractor. If necessary, the Department can subsequently work with the contractor to amend the statement of work and funding levels, and the contract would be amended accordingly, usually to provide additional

work and funding, and if the agreement is modified, obligations are made or withdrawn accordingly.

COMPUTATIONAL MATERIALS AND CHEMISTRY BY DESIGN

Subcommittee. Secretary Koonin, your budget request includes $40 million for a new multi-agency effort in Basic Energy Sciences, called "Computational Materials and Chemistry by Design." It's an exciting topic, but your request does not explain what other agencies will be involved, or what their contributions will be. What is the composition and budget of this collaboration?

Secretary Koonin. This multi-agency collaboration is being coordinated by the Office of Science and Technology Policy and includes the Department of Energy, the National Science Foundation, the National Institute of Standards and Technology, and several Department of Defense agencies. The complete scope of the effort and the contributions from each agency are still under discussion, but as currently envisioned, the collaboration is designed to build the necessary software and data management infrastructure to greatly accelerate innovation in advanced material and chemical systems through science-based simulation. The heart of the initiative is support for the development of the new tool sets for scientific and engineering software, data analysis, and experimental validation that will integrate seamlessly into a new innovation infrastructure. A set of foundational engineering problems is under consideration to guide this infrastructure development through appropriate identification of underlying scientific and technical challenges. DOE's Basic Energy Sciences (BES) program will lead in the development of new software tools, built on expanded theoretical development and validated with supporting experimental data that catalyze a fully integrated approach from material discovery to applications, with a particular emphasis on ultimately impacting energy technology.

The Office of Science workshop report, *Computational Materials and Chemistry for Innovation*, described the recent development and deployment of the world's most powerful collection of tools for the synthesis, processing, characterization, simulation, and modeling of materials and chemical systems. The Nation is poised to take advantage of truly predictive computational simulations to dramatically accelerate the materials innovation process. As its part of the multi-agency collaboration, BES envisions the assembly of integrated teams focused on key scientific knowledge gaps to develop new theoretical models, including their realization in reusable and broadly disseminated software. Special attention will be paid to powerful new methods to distill physical laws bridging multiple length and time scales. The ultimate objective will be to develop a science-based software tool set to rationally predict and design materials and chemical processes for next-generation energy technologies.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

TARGET FOR NEXT-GENERATION EXASCALE COMPUTING CAPABILITIES

Subcommittee. A substantial portion of the increase requested for the Advanced Scientific Computing Research program is to expand exascale research or supporting activities. If we are to increase our commitment to developing exascale supercomputers, it seems that we should have a plan to know where we are, how much we plan to invest, and what we plan to get out of it.

China has previously announced a target date of 2018 for an operational exascale computing system. Do you believe this date is credible?

Secretary Koonin. I do find the 2018 target to be credible.

Subcommittee. If so, what is China doing to meet the 2018 target?

Secretary Koonin. The Chinese are developing systems and have a persistent, long term plan for deploying high performance computing systems for science and engineering. Their current roadmap includes installation of a 100 petaflop class computer for science in the 2014 timeframe. In addition, they have identified three paths to reach an exascale machine by 2018, although all of these paths would deliver systems which require over 200MW to operate:

- A system could be built by buying components from the United States, such as Intel multiprocessors, NVIDIA graphical processing units and an Infiniband interconnect, and integrating these components into a system. This is what was done to achieve the number 3 system today. That system, called Nebula, was constructed by the Chinese integrator Dawning and consumes 2.6 MW of power.

- They could integrate U.S. components with Chinese manufactured parts. This is what was done to develop Tianhe-1A, the top machine on the TOP500 list.

- There is also evidence that they could build an exascale machine using their own processors and interconnect system. For example, this summer the Chinese are expected to have a new 8-core Godson-3B processor, which will be used to power a Dawning-built supercomputer. This chip will have a peak of 128 gigaflops. The next-generation Godson-3C design is a 16-core processor that is expected to deliver 512 gigaflops. From this roadmap, it can be extrapolated that in 2018 they would have processors that can be put together to reach an exaflop system.

The Chinese government announced their plans to deploy an exaflop class system by 2018 at a public meeting in October 2010. The Chinese have been less forthcoming with regard to their

research efforts to develop applications, tools, and software for this scale of computing. It is clear from public statements that they do understand the significant challenges involved and are committed to training a large number of people. As noted above, the power requirements of these Chinese systems will fall in the 200–500MW range, a factor of 10–20 higher than the target of the proposed DOE program; however, the Chinese government has shown a willingness to divert power from its civilian population to meet government requirements.

Subcommittee. What is our target date for developing a Department of Energy exascale computing system, and what is your plan for getting there?

Secretary Koonin. Ideally, we would like to begin deploying an exascale computing system in 2018 and make it operational by 2021 to keep pace with international leadership computing systems. The power consumption target for these systems is a factor of 10–20 below the best projections of commercial technology in the absence of this effort, nominally 20MW. However, the success we have in realizing this target date is dependent on funding and starting the program as soon as possible.

The Department is working to develop an integrated approach to guide the development an exascale computing system. Research and Development (R&D) partnerships with the high performance computing, semiconductor, storage and other critical technology manufacturers, DOE laboratories and universities would be led by a DOE laboratory. A portion of the research is also of interest to other agencies such as the Department of Defense (DOD) and the Defense Advanced Research Program Agency (DARPA). These critical technologies include system power consumption, memory architectures, non-volatile storage, data movement on and off the chip, and chip reliability and resiliency. The Department will coordinate its support for critical technology research with these other agencies.

Research in advanced software and environments will be required to enable DOE applications to take advantage of the radically different hardware that will be available in this timeframe.

Research in advanced scientific applications and integrated application-hardware-software co-design will enable the applications to make the transition to the future systems and enable the applications to inform and influence the design of hardware and software. Co-Design activities will address critical Department missions in energy, the environment, and security, with the NNSA Advanced Simulation and Computing program funding both classified and unclassified national security applications and the Office of Science funding unclassified science and engineering applications. The two programs will coordinate co-design activities and will co-fund unclassified applications of joint interest.

The planning activities also envision the deployment of 100–200 petaflop prototype systems in the middle of the timeline. However, the Department is still in the process of developing the final

integrated plan. As we complete this process the Department plans to initiate some critical long-lead time research efforts which would be required in any of the scenarios under consideration.

Subcommittee. The Office of Science has repeatedly maintained that we have no target date set for developing an exascale computing platform. However, recent news reports point to a very specific plan aiming for an exascale prototype in 2015 and a fully-functioning system in 2018. According to these reports, two teams each consisting of three DOE national labs would compete with each other towards these targets. Are these reports correct?

Secretary Koonin. We have discussed such lab partnerships during our planning exercises.

Subcommittee. And if so, why has the Department not publicly stated an exascale target date and outlined its plan?

Secretary Koonin. The target date is dependent on the funding levels in both programs and when the funding begins to be available. The longer we wait to start, the less chance we have to impact U.S. vendors' stated roadmaps for 2015 testbed systems that are on the path to exascale. Given the current budget constraints, we believe it is a realistic goal to begin deploying an exascale computing system in 2018 and make it operational by 2021, but we need to start soon.

Subcommittee. What are the major obstacles to developing exascale computing platforms, and how is the budget request addressing these obstacles?

Secretary Koonin. The first major obstacle is energy efficiency; we need to significantly reduce power consumption. If you took today's technology and tried to create an exascale computer, you would need a nuclear power station to run it. Studies have shown that data communication and storage within the system will dominate the power budget. Substantial research programs are needed to investigate new system designs with significantly lower power requirements. Our goal is to enable systems that are 10–20 times more power efficient than the best projections of commercial technology in the 2018 time frame, which is equivalent to a 1,000 fold improvement in efficiency over today's systems. The result of these efforts will be applicable across the information technology sector but exascale is simply not feasible without it.

The second major obstacle is ease of use; a high productivity application development environment will have to be developed. Programmers will be required to develop application codes for systems that have potentially a billion cores. We need new methods for developing applications tailored to such complexity.

Within our budget request we have identified funds for co-design centers that will deliver the next generation scientific applications by coupling application development with formulation of hardware architectures and system software. The co-design centers will support research efforts in applied mathematics and computer science to develop libraries, tools, and software for these new technologies. They will also provide some support for research investments at U.S. industry to address critical technology barriers.

Subcommittee. History: have the fastest computers been developed by the private sector, or have they always been supported with public funding?

Secretary Koonin. To the best of our knowledge, the fastest general purpose computers have always been supported with public funding.

Subcommittee. In addition to serving as user facilities that can tackle all kinds of scientific and weapons problems, would you expect any benefits to the private sector from the development of exascale computing?

Secretary Koonin. The next generation of computing technology, with many cores on each chip and integrated accelerators, will represent a so-called disruptive change from what we know today and will impact the entire information technology sector. Most computer users will benefit from the development of exascale computing in several ways. Lowering the power costs of next generation computer processors and memory could lead to petascale clusters and terascale laptops. This will also reduce the projected power requirements to operate our digital infrastructure by over a factor of 10, with impacts that ripple through the electric power generation sector, slowing the growth in demand for fossil fuels. With improved, energy efficient computing resources, industry will be able to perform more realistic simulations on their in-house computing clusters. In addition, the experience gained from co-design centers and re-formulating applications and algorithms to reduce memory movement will also inform the re-tooling of industry codes for the new technology. System software and tools developed within the Office of Science's Advanced Scientific Computing Research core computer science and applied mathematics program will continue to be published open source and made broadly available.

The Department's Leadership facilities, where our exascale computers will be deployed, are open to all researchers including those in the private sector. In addition, our facilities will continue to provide the know-how and tools to deliver scientific results from day one. There are several private sector research and development accomplishments from allocations on our Leadership facilities at Argonne and Oak Ridge that I would like to bring to your attention:

- The Boeing Company used the computing resources at Oak Ridge to validate the applicability and predictive accuracy of their computational fluid dynamics tools and

existing experimental data to prove the accuracy of computational simulation and demonstrate its value as a substitute for costly and time consuming wind tunnel testing. This kind of testing and validation can only be done on large-scale computers that permit more detailed simulations of components and more detailed physics that is incorporated into more simulation runs to build a large result data base. However, Boeing and other companies have expressed their desire for the considerably more computing power necessary for full system simulations and end-to-end engineering optimization.

- General Motors used the Cray supercomputer at Oak Ridge to accelerate research by at least a year on new thermoelectric materials that will help increase the fuel efficiency of cars. But considerably more computing capability is needed for engineering automobiles with really novel fuel sources.

- Smart Truck Brands, an engineering services firm in South Carolina, used the leadership computing resources at Oak Ridge to develop add-on parts that will substantially reduce the fuel consumption of Class 8 long-haul trucks. Access to the Cray supercomputer enabled Smart Truck Brands in 18 months (half the usual product development cycle) to develop and use the most detailed and most accurate numerical model ever created of a Class 8 truck and trailer. Depending on the suite of parts chosen, long haul trucks that are retrofitted can achieve a 10 to 17 percent increase in miles per gallon. This reduces fuel consumption by up to 3,700 gallons per truck per year, and reduces CO_2 by up to 41 tons per truck per year. Exascale research that dramatically improves energy efficiency could put such petascale computing resources within reach of every engineering design firm in the United States.

- Pratt and Whitney's combustor project conducted on the IBM machine at Argonne was a key enabler of many improvements realized in the Pure Power® engine family. The new-generation engine improves fuel burn by 12–15% compared to today's best engines. It also cuts carbon emissions by 3,000 tons per aircraft per year (equivalent to planting over 700,000 trees) while releasing 50% fewer polluting emissions. Finally, the design is 75% quieter and has the potential to save $1.5 million per airplane per year in total operating costs. However, these achievements are dependent on running three separate sets of loosely coupled codes; Pratt and Whitney believes computing capability that enabled them to develop and use a single codes to simulate the entire engine would significantly improve optimization and allow more dramatic innovations.

Procter & Gamble (P&G), whose soaps and other household brands serve about 4.2 billion of the 6.5 billion people on the planet today, used Argonne's IBM Blue Gene/P supercomputer to conduct research to enhance existing products and develop new ones that meet environmental and sustainability goals. P&G and Penn State researchers used the Blue Gene to observe the early stages of bubble formation in full atomistic detail, allowing them to directly observe the

lowering of surface tension over time. This behavior can have a profound impact on a product's properties, and ultimately, its acceptance by consumers. This virtual prototyping gives researchers the ability to ask "what if," and then test the concept or product in any number of ways to determine next steps moving forward. Proctor and Gamble have provided real leadership to the Administration's efforts to expend HPC use in manufacturing by working with Los Alamos National Laboratory to make robust software more freely available. Our Exascale efforts would further advance these goals by making high performance systems more affordable and easier to use.

Subcommittee. Will the American computing sector be significantly advanced through this effort in, for example, personal computing?

Secretary Koonin. Yes. Achieving the power efficiency, reliability, and programmability goals for exascale will have dramatic impacts on computing at all scales, from PCs to mid-range computing and beyond.

RACE FOR FASTEST COMPUTER

Subcommittee. The United States, and in particular the Department of Energy, has developed and hosted the fastest supercomputers in the world until October of 2010, when China announced that it has developed the now-fastest system.

Is this a first? Does this mark the first occasion in which the United States has lost the lead, and the first time China has taken it?

Secretary Koonin. It is not the first time the U.S. has lost the lead; he Japanese have had the fastest computer system a number of times in the past, most recently in 2002 with the Earth Simulator. It is, however, the first that that China has taken the lead.

Subcommittee. When will the United States retake the lead?

Secretary Koonin. The United States could retake the lead with the deployment of planned 20 petaflop systems in 2012. However, leadership in terms of the fastest computer at this point is less critical than developing the revolutionary, power efficient computing technologies and applications that support U.S. scientific and national security leadership over the long term.

Subcommittee. Will Department of Energy computing systems retake the lead, and is the development of those computing systems included in the budget request?

Secretary Koonin. The Department of Energy could retake the lead with the deployment of the NNSA's 20 petaflop IBM Blue Gene/Q in 2012. This machine will primarily be used for classified research. The budget request also contains funding for a 10 petaflop IBM Blue Gene/Q at the Argonne Leadership Computing Facility, which will be available to the open scientific community. There is also funding in the budget to begin site preparations at the Oak Ridge Leadership computing facility for a 10–20 petaflop upgrade in 2013.

A computer's capability, however, is determined not only by speed and other technical parameters, but also by its reliability and accessibility to the researchers who use it. The FY 2012 Budget Request supports close collaborations and partnerships among applied mathematicians and computer scientists, applications researchers, and vendors to ensure that hardware is not developed in isolation from the user community and to enable early impact of new technologies.

Subcommittee. I understand that the Chinese computer announced in October uses American chips. How far are we from the time when Chinese supercomputers use Chinese chips, not American chips?

Secretary Koonin. This will probably happen later this year or early next year. This summer the Chinese are expected to have a new 8-core Godson-3B processor, which will be used

to power a Dawning-built supercomputer. This chip will have a peak of 128 gigaflops. The next-generation Godson-3C design is a 16-core processor that is expected to deliver 512 gigaflops.

Subcommittee. What is the Department doing to not only make sure that the fastest supercomputers are in America, but also that the American computing industry continues to make the world's fastest chips?

Secretary Koonin. Within the Department's planned exascale initiative we identified funding to support partnerships between our national laboratories and United States vendors to design the next generation computer architectures. In addition, there is funding to support technologies critical to those architectures such as investments with U.S. memory manufacturers to develop energy efficient memory.

NEXT-GENERATION COMPUTING

Subcommittee. Mr. Koonin, Advanced Scientific Computing Research is a bit of an odd fit for a Basic Science program, which should be focused on future advances, not near term. On one hand, basic science research depends on advanced computing, so there must be close cooperation between the development of advanced computing and users. On the other hand, however, only a small fraction of the program...about 8 percent...of this budget goes to developing next generation computing. While there are technological challenges to developing this level of technology, the computing community is unanimous that those problems are solvable.

You've often characterized your work as "high-risk, high-reward". Yet, your work on advanced computing seems to be more gradual than really ground-breaking.

Are you putting any investment into truly "high-risk, high-reward" computing technology, such as quantum computing?

Secretary Koonin. The Research and Evaluation Prototypes activity within the Advanced Scientific Computing Research (ASCR) program in the Office of Science is focused on technologies that will be available within the next 10 years. The computing facilities supported by this program are similar to the scientific user facilities across the Office of Science and provide forefront research capabilities. The ASCR core research efforts in Applied Mathematics, Computer Science, and Next Generation Networking for Science are similar to the basic research efforts across the Office of Science and innovations often take a decade of sustained effort to turn into the workhorse tools and techniques that make the facilities deliver forefront science. The strength of the ASCR program is delivering world leading computational and networking capabilities and, as importantly, the research to extend the frontiers of science and technology.

The goal of delivering exaflop class computers with a power efficiency of 10–20 times greater than the current commercial roadmaps is an example of an ASCR investment into extremely high reward research with significant but manageable risks. Our time scales are aligned with the missions of the Department of Energy to deliver tools for scientific leadership and has enormous potential rewards.

Subcommittee. If not, why not?

Secretary Koonin. ASCR does not invest in one computing technology that is considered to be high risk, quantum computing, because the types of algorithms that quantum computing has been shown to be useful for are all related to cryptanalysis, which is not a DOE mission. In the case of other advanced technologies, such as advanced materials for semiconductors, we closely monitor the "high-risk, high-reward" technology research of our partners both within DOE, and

other agencies, including ARPA-E and DARPA, which have a mission to support such investments.

FUSION ENERGY SCIENCES

FUSION ENERGY SCIENCES WITH GROWING ITER COMMITMENTS

Subcommittee. The budget request reduces funding for fusion energy sciences primarily due to a decrease in the United States' contribution to ITER, the international fusion energy experiment. However, our ITER commitments are expected to increase substantially in the coming years, and this is the last budget that the program can continue with a flat budget without significantly cutting into fusion research activities here at home.

How will the Department afford to meet ITER funding commitments while still maintaining our own base of fusion scientists?

Secretary Koonin. The coming year provides appropriate funding for both ITER and the base program. The Department is working hard to develop a budgetary approach for magnetic fusion that both enables us to succeed in ITER project construction and keeps the U.S. domestic research effort at the leading edge during project construction and during ITER's research life.

Subcommittee. If we pay for ITER but fail to support our own fusion scientists, won't we end up in 2018 with a beautiful new machine in southern France and no American scientists to use it?

Secretary Koonin. I entirely agree that in order to obtain the maximum benefit from ITER, we require a strong domestic program prior to and parallel with ITER's research operations. We have a number of existing facilities in the U.S. and emerging opportunities overseas that should keep our scientists fully engaged. In this decade we plan to use both to develop the best approaches for doing research internationally with our national labs and universities, enabling us to maximize U.S. researchers' impact and scientific return when ITER begins operating.

Subcommittee. How will we do this in today's budget environment, where the Department simply cannot assume an overall increase in funding in future years?

Secretary Koonin. The Office of Science understands the importance of building and maintaining state-of-the-art facilities through capital investment while at the same time supporting research operations and funding research scientists. As such, we try to stage capital projects in a way that allows for infrastructure updates while maintaining sufficient funding to advance our research mission.

For roughly 9% of the construction cost, the U.S. will have access to 100% of the research data derived from the machine while providing U.S. industry with valuable experience in working in

a number of cutting edge, fusion-related areas: making U.S. participation in ITER potentially very cost effective.

ITER INTERNATIONAL FUSION EXPERIMENT

Subcommittee. ITER, the international collaboration to develop a large-scale fusion energy test reactor, has had significant funding and management challenges. The Department indicates that new ITER management as well as some formalization of funding commitments from the European Union, indicate that the project is back on track.

Are you confident that ITER is through its most difficult times and back on track? What challenges remain in getting the project off the ground?

Secretary Koonin. Yes. The new management team is in place and operating based on an agreed project baseline and funding cap. We are very confident in the ability of the new management to execute according to the baseline. Projects of this complexity and duration can be extraordinarily difficult to manage. As such, ITER will require strong, continued oversight from the U.S. and the other ITER Members.

Subcommittee. The United States is slated to provide, among other things, the "central solenoid"—essentially an extremely large superconducting magnet. We hear very positive indications of the United States' progress, but also concern from other groups about U.S. industry's experience in manufacturing in this area. How would you assess our ability to deliver, and what is the Department doing to ensure we are successful, on-time, and on-budget?

Secretary Koonin. The U.S. will work with our Japanese partners to meet our Central Solenoid (CS) magnet commitments. The Japanese are providing the superconducting conductor, while U.S. industry will provide the winding forms and fabricate the final CS magnet using the Japanese conductor. This is a very strong technical and scientific partnership that should be able to overcome any difficulties that occur. The recent earthquake in Japan has affected the ability of our Japanese partners to complete their commitments in a timely way. The U.S. is working bilaterally with the Japanese and multilaterally with the ITER Organization and the other ITER Members to minimize delays from the earthquake and to reoptimize the delivery schedule.

Subcommittee. Secretary Koonin, when thinking about taking the project through to its planned completion in 2018, what are the biggest risks in getting to that point?

Secretary Koonin. Many of the technical risks are being or have been mitigated. The schedule requires timely funding in order to meet our commitments and strong management and oversight of the industrial contractors that will be fabricating U.S. components for ITER. Also, management challenges can arise with seven parties working together to deliver components of such a complex, integrated system. As such, maintaining the most effective relationships possible with the central ITER Organization and the other members' domestic agencies is critical. To this end, the new leadership of ITER represents a tremendous advance.

Subcommittee. What is being done to mitigate those risks?

Secretary Koonin. The U.S. ITER Project Office (USIPO) has a strong scientific, technical and project management team in place to help ensure the timely and cost-effective completion of U.S. commitments. The Department will work with the Congress and within the Administration to secure necessary funds and work with the USIPO, the ITER Organization, and the other ITER Members to maintain strong project management discipline to maintain project cost and schedule. The U.S. is also actively engaged with ITER leadership and representatives from the domestic agencies. It was this sort of engagement that enabled the positive developments in the overall project management.

NUCLEAR PHYSICS

PU-238 PLUTONIUM PRODUCTION

Subcommittee. The budget request includes funding in the Office of Science to support the restart of plutonium-238 production. While both the NNSA and NASA use this isotope, NASA is expected to use the vast majority of the material.

Why, then, does the budget request propose for NASA and DOE to both pay 50 percent of the total cost of this project?

Secretary Koonin. Within the Department, the Office of Nuclear Energy has responsibility for the restart of plutonium-238 production and the FY 2012 Nuclear Energy budget request includes funding for this effort. No funding is requested for plutonium-238 production within the Office of Science. The proposed DOE-NASA funding allocation properly acknowledges the Department's mission to maintain a national capability for a range of Federal users and its responsibility to manage efforts related to the safe and secure production of special nuclear material. Considering DOE's role in this project, the fact that the production capability will be entirely DOE-owned, and other factors, the Administration believes the proposed cost sharing arrangement between DOE and NASA is the most appropriate scenario.

Subcommittee. Shouldn't NASA shoulder the majority of this budgetary burden?

Secretary Koonin. The proposed cost-sharing arrangement addresses the costs for reestablishing a production capability. Once that capability is established, NASA would reimburse DOE for the material unit cost required to support NASA missions.

MOLYBDENUM-99 ISOTOPE PRODUCTION

Subcommittee. We have had some challenges in the last several years due to our dependence on a very small number of foreign suppliers of molybdenum-99, an important isotope both for national security and medical diagnostic applications.

What is the current status of molybdenum-99 production and supply?

Secretary Koonin. The National Nuclear Security Administration (NNSA) within the Department has responsibility for addressing the needs of the U.S. for the medical isotope molybdenum-99 (Mo-99). The global supply of Mo-99 has experienced substantial shortfalls in recent years due to expected and unexpected closure of some of the world's few research reactors and isotope production facilities that produce this important medical isotope. The current Mo-99 production infrastructure is aging and uses proliferation-sensitive highly enriched uranium (HEU) to produce Mo-99, which is against nuclear nonproliferation objectives to reduce and eliminate the use of HEU in civilian applications.

The global supply of Mo-99 experienced a substantial shortfall in 2009 and 2010 due to the maintenance shutdowns of two research reactors that produce Mo-99: the National Research Universal (NRU) research reactor in Canada and the High Flux Reactor (HFR) in the Netherlands. Since both reactors resumed operations in 2010 there has not been a supply shortage; however the decreased reliability of these aging production facilities has highlighted the need to invest in increased, replacement Mo-99 production capacity using technologies that do not use HEU.

Subcommittee. Have we reached a long-term solution for molybdenum-99 production, or have we only solved short-term problems?

Secretary Koonin. The National Nuclear Security Administration (NNSA) has a long-standing mission to convert isotope production facilities from HEU to low enriched uranium (LEU) targets. Because of this expertise, NNSA is also working with U.S. commercial entities and the U.S. national laboratories to accelerate existing commercial projects to produce Mo-99 in the United States using production methods that do not use HEU. The goal is to reach a long-term solution for Mo-99 production in the United States.

NNSA's strategy is to accelerate the commercial establishment of a diverse and reliable domestic supply to avoid any single point of failure. NNSA is supporting three separate non-HEU-based technology pathways to produce Mo-99: solution reactor, neutron capture, and accelerator. The goal of the program is to support the establishment of domestic commercial production as rapidly as possible where economic forces will dictate the future market for medical isotopes.

Solution reactor technology has been demonstrated and there is experience in operating homogeneous solution reactors. Production rates for this technology are expected to be among the highest of the different technologies being considered, although additional R&D on fuel solution chemistry during operation and the recovery of Mo-99 from the irradiated fuel solution is required. This production process generates radioactive waste, although total amounts are less than those generated by the standard fission-target technology.

Neutron Capture Technology is based on neutron capture in targets of Mo-98. This is a well known technology and is historically how Mo-99 was supplied to the medical community when the industry was first being developed. It is based on utilizing Mo-98 targets and a source of neutrons, which are captured in the target resulting in the production of Mo-99. This technology results in minimal amounts of radioactive waste, compared to the standard fission-target technology, although it has a lower activity than fission-based Mo-99 processes. Since current generators in the nuclear pharmacies cannot use the lower activity Mo-99 generated from this process, their design would need to be modified.

The first proposed accelerator technology is based on exposing Mo-100 targets to high energy gamma rays to induce a reaction that produces Mo-99. The major components of this option are based on proven technologies. Once the technology is demonstrated in a complete process, it offers the possibility of relatively simple operation from the standpoints of both the accelerator and target processing facility, because of the reduced radioactive environment in the absence of fission products. This non-fission based technology has the benefit of resulting in minimal radioactive waste compared to the standard fission-target technology, and comparable to Neutron Capture Technology. R&D is needed for the Mo-100 target designs and for the overall proof of concept. The lower specific activity of the Mo-99 (compared to fission-based processes) resulting from this process prevents current generators from being suitable for use, and requires development of another generator design.

The second proposed accelerator technology is based on fissioning an LEU aqueous target through the introduction of accelerator-produced neutrons. Since the technology fits into the existing supply chain, where Mo-99 is extracted from uranium fission products before it is purified, there may be a lowered cost of production. R&D is currently underway to prove the concept and scale up the concept for major production.

In June 2010, NNSA initiated a funding opportunity announcement (FOA) for the LEU target technology. However, the company that was selected for demonstration of the LEU target technology ultimately declined the FOA award. The irradiation of solid uranium targets with a neutron source to produce Mo-99 is a demonstrated technology currently used by the industry (most current production is done with HEU targets). The overall process (target preparation, irradiation, and dissolution) using LEU targets is nearly identical to that of using HEU targets and may therefore offer an easier transition for HEU-based producers. Production rates for a LEU target facility are expected to be among the highest of the different non-HEU technologies being considered. Development of the processing facilities to dissolve the targets and extract

Mo-99 needs to take place to support eventual production; however, some LEU production facilities are already in existence, such as Australia, Argentina and others, listed in the 2009 National Academies report "*Medical Isotope Production without Highly Enriched Uranium.*" In addition, fission-based technology can use existing Tc-99m generators, which will expedite the delivery of Mo-99 to the market. However, among the technologies considered, fission-based production generates the most radioactive waste.

NNSA has assisted South Africa in the conversion of its Mo-99 production process from HEU targets to LEU targets, although this was not an enhancement of domestic production of Mo-99. Additionally, over the past two years South Africa has been able to increase its production when necessary to alleviate the shortages resulting from the unexpected shutdowns of both the NRU and HFR reactors.

Subcommittee. What is the long-term solution to ensuring domestic supply of this important isotope?

Secretary Koonin. NNSA's strategy is to accelerate the commercial establishment of a diverse and reliable domestic supply to avoid any single point of failure. NNSA is supporting three separate non-HEU-based technology pathways: solution reactor, neutron capture, and accelerator. The goal of the program is to support the establishment of domestic commercial production as rapidly as possible where economic forces will dictate the future market for medical isotopes.

One cause of the critical shortfalls of the Mo-99 supply in recent years is that foreign governments have provided subsidies to Mo-99 production in their respective countries. This practice has kept the price of Mo-99 artificially low, making sufficient reinvestment in the market infeasible. Because ongoing government subsidies to Mo-99 production could have the effect of continued supply shortfalls, NNSA's strategy is to support commercial industry in accelerating existing projects to produce Mo-99 in the United States, not to provide ongoing subsidies in the long-term. The strategy to move the market away from ongoing subsidies is crucial to ensure a reliable supply in the long term.

As mandated by Section 630 of the Energy Policy Act of 2005, DOE submitted a report to Congress in August 2010 entitled *Producing Medical Isotopes without Highly Enriched Uranium* that discloses commitments of commercial producers to supply adequate domestic requirements of medical isotopes without the use of HEU by August 2014.

WORKFORCE DEVELOPMENT

INCREASE FOR GRADUATE FELLOWSHIPS

Subcommittee. The budget request proposes a 72 percent increase over the current level for workforce development activities, including an $11 million increase—or 222 percent—for the Office of Science's Graduate Fellowship program. This subcommittee has been and remains extremely concerned with redundant activities across federal agencies, especially in today's fiscally constrained environment.

When agencies like the National Science Foundation fund nearly identical programs and hold much more institutional expertise on administering these programs, why should the Department of Energy be funding—and expanding—such programs?

Secretary Koonin. The DOE Office of Science Graduate Fellowship program (DOE SCGF) designed to help address the future workforce needs of the Office of Science by developing the next generation of scientists and engineers to support the DOE missions, administer its programs, and conduct research that will advance science and technologies for the Nation's energy future. Today, DOE's federal and contractor workforce includes more than 30,000 workers with STEM backgrounds, about half of whom are employed at Office of Science laboratories. Ensuring the availability and readiness of its future workforce is a key responsibility of the DOE. A special feature of the DOE SCGF program is the introduction of Fellows to research supported by the Office of Science and the DOE national laboratory system through required attendance at an annual meeting held at a different DOE laboratory each year. As part of the annual meeting, Fellows present their research, attend science lectures and poster sessions, visit laboratory facilities, learn about career opportunities at DOE laboratories, and learn how to access the Office of Science user facilities for their graduate research and future work. Fellows are encouraged to enter into collaborations with researchers at the laboratories, even during their graduate careers.

Subcommittee. What is to be gained by agencies competing with each other for name recognition?

Secretary Koonin. The DOE SCGF is not in competition with other agencies for name recognition for DOE. Rather, its purpose is to attract and train scientists in disciplines critical to the mission of the Office of Science. Though still in its early years, the DOE SCGF program has already developed practices that other agencies have recognized and are beginning to adopt, including non-concurrent acceptance with other Federal graduate fellowships, so more students can be supported with limited funding; an annual research meeting; and an integrated online and onsite peer review process that enables a high volume review of applications in a short period of time.

Subcommittee. Wouldn't this only serve to confuse students looking for fellowships in the name of making the U.S. Department of Energy a more widely-recognized "brand"?

Secretary Koonin. The DOE SCGF program does not appear to be confusing students. Quite the contrary—applicants are attracted to the special features of the program and to the disciplines supported by the Office of Sciences, especially those disciplines underpinning advances in our understanding of new energy technologies and environmental processes.

INFRASTRUCTURE

CONSTRUCTION PROJECTS

Subcommittee. I've said in this room before that maintaining our aging infrastructure is a critical challenge for our nation. That challenge applies not only to our water infrastructure, but also to our aging science and technology infrastructure. However, in today's budget environment—in which this subcommittee is highly unlikely to receive additional funding over last year—we must be careful about making new funding commitments.

Of the proposed increase for Science, $240 million is to expand existing construction projects or to start new ones. The request includes 7 new starts for construction projects in the Office of Science, if we count major equipment construction projects.

Secretary Koonin, what is the total funding commitment for these new starts, through to completion of the projects?

Secretary Koonin. In the FY 2012 Budget request for the Office of Science, there are eight new starts for construction and major item of equipment projects. Costs estimated for these projects generally are preliminary, and for the majority of the projects, the current cost estimates are ranges. The high side of the estimated total funding commitment, presuming all projects with funding ranges for their cost estimate were at their upper limits, is $983 million. The low end is $737 million.

Subcommittee. During what fiscal years will these construction projects reach their peak need for funding, and how does the Department plan to fit these construction projects into its budget given the tight fiscal constraints that we expect?

Secretary Koonin. Of the eight new starts, three projects are proposed to be fully funded in FY 2012: the Dual-Frequency Scanning Cloud Radar Alaska and Azores sites at $3.07 million each and the Transmission Electron Aberration-Corrected Microscope II (TEAM II) at $18 million. The remaining five projects do not yet have approved performance baselines, and so an outyear funding profile has not yet been set. The High Altitude Cherenkov Detector (HAWC) is anticipated to be primarily funded in FY 2012 and FY 2013 at relatively similar levels. The NSLS-II Experimental Tools (NEXT) and the Science and User Support Building at SLAC are expected to reach their peak need for funding in FY 2013, with peak funding estimated to be about $25–35 million each. The Advanced Photon Source Upgrade (APS-U) and Linac Coherent Light Source II (LCLS II) both will likely reach their peak funding level around FY 2015, at approximately $85–100 million each.

The FY 2012 budget request, within an overall tight funding constraint that would continue to hold domestic discretionary funding flat, is prioritized to allow growth in select areas, including continued support targeted to the doubling of basic research at select Federal agencies, and this prioritization is expected to allow these project profiles to be comfortably accommodated within the Office of Science's outyears.

UTILITY UPGRADE PROJECTS

Subcommittee. The fiscal year 2011 budget request included funding for two new utility upgrade projects under Science Laboratories Infrastructure, but the fiscal year 2012 request does not request funding for these items. What has changed?

Secretary Koonin. The Utilities Upgrade project at Fermilab and the Utility Infrastructure Modernization project at the Jefferson Laboratory have been deferred to a start date in FY 2013 or later. The budget request did not propose to start these two projects in FY 2012 because of the emergence of a higher priority project at SLAC: the Science and User Support Building project.

Subcommittee. As I'm sure you know, the current continuing resolution forbids new projects or activities not funded in fiscal year 2010. How did the Department fund these new construction projects given that statutory prohibition?

Secretary Koonin. The Department did not fund the two utility projects due to the prohibitions under the continuing resolution.

INERTIAL CONFINEMENT FUSION ENERGY

NATIONAL RESEARCH COUNCIL STUDY

Subcommittee. Dr. Koonin, this subcommittee has been pushing the Department for years to take a harder look at inertial fusion energy (IFE) in addition to its traditional work with magnetic confinement fusion, and we're generally pleased that over the last year some real progress has been made. You brought David Crandall over from NNSA to a new post within Science to oversee IFE work, and the National Research Council (NRC) is currently examining this technology's potential. We all hope to see the results of that study this summer.

Would you please explain to the subcommittee what the NRC's mandate is for this study?

Secretary Koonin. As set forth on the NAS/NRC website, the committee will prepare a report that assesses the prospects for generating power using inertial confinement fusion; identify scientific and engineering challenges, cost targets, and R&D objectives associated with developing an IFE demonstration plant; and advise DOE on its development of an R&D roadmap aimed at creating a conceptual design for an inertial fusion energy demonstration plant.

In short, the questions are: Is IFE viable? What are the challenges and how might we move forward? We anticipate using this report, along with technical progress in the research, to choose whether or not to formulate a new program on Inertial Fusion Energy Technology (IFET) and how to structure such a program if we move forward. Such a new direction would build from the existing fusion ignition development in the Inertial Confinement Fusion program in NNSA and the inertial fusion sciences basis within the Fusion Energy Sciences program of the Office of Science. These programs are expected to continue. The new aspect would be a focus on moving toward an energy project and the necessary technology.

Subcommittee. How are you hoping to use its conclusions?

Secretary Koonin. The output of this study will be used to determine whether an IFE program is warranted and, if it is, to help construct a roadmap that would guide the development and execution of such a program. From this report, technical gateways through which such a program must pass will be identified. The hope is to develop various options for a viable program that can be robust to funding realities and opportunities.

NATIONAL IGNITION FACILITY

Subcommittee. To date, the largest inertial fusion facility is the National Ignition Facility at Lawrence Livermore National Laboratory. It's the flagship of the National Ignition Campaign. Originally, this device was estimated to cost $1.1 billion and be completed in 2002. When it was finally completed in 2009, it cost $3.9 billion. While it has made promising progress, it still hasn't achieved ignition.

What is the timeframe for the first attempt at ignition?

Secretary Koonin. Particular attributes of the inertial confinement fusion process of laser coupling and capsule implosion need to be achieved before a practical attempt at ignition will be appropriate. The present progress and schedule of research suggests that these attributes might be achieved by the end of FY 2012. However, the research nature of progress toward those attributes does not allow absolute prediction of the timeframe for first ignition attempt. Currently, we see the first credible ignition experiment being attempted sometime in the FY 2012–FY 2014 timeframe.

Subcommittee. I understand that serious technical challenges delayed the first "credible" ignition attempt by about a year. What major obstacles still stand in the way of achieving ignition?

Secretary Koonin. The major obstacles to achieving ignition are technically complex. The team works from extensive computational simulations and laboratory experience to change and optimize target fabrication and laser pulse shape (steps in laser energy at carefully selected times of less than billionths of a second) to make progress to the required attributes. As we currently understand the process; the velocity of the imploding spherical capsule, its final imploded shape, the shocks within the capsule (caused by time steps in laser energy during a shot), and the extent of mixing of the materials within the capsule must all be simultaneously controlled to exacting specifications during the shot. Getting these properties of the target implosion to the projected values will then provide the attributes expected to give ignition. This is an amazingly complex set of attributes to control at microscopic size scale and with timing of laser energy to below billionths of a second. It is scientifically exhilarating to observe that the laser and the diagnostics are providing the detailed control and measurements to allow the required progress. Making the targets to the exacting and changing specifications is the greatest current challenge and takes some time but that challenge also appears possible to meet with the capabilities the program has developed.

Subcommittee. How will information and data gathered from a successful ignition shot be used? Will it be most useful for weapons stewardship purposes, or for inertial fusion energy research?

Secretary Koonin. The information from ignition is critical to both nuclear weapons stewardship and energy application of inertial fusion. The ignition process is "nuclear burn" that is sudden and controlled by detailed physics that are difficult to predict. Somewhat similar, nuclear burns occur in the function of nuclear weapons and also in astrophysical explosions in the cosmos. Critical aspects of simulations of other nuclear burn events will be verified by ignition at the NIF. For nuclear weapon purposes, changes will then be made in the laser driven implosion process to see what makes ignition fail or work more strongly, testing aspects of simulations of explosive nuclear devices. For energy applications ignition is essential because only then is more energy released through fusion than is provided by the driving laser. That is the starting point for energy applications and simulations and predictions of how inertial fusion energy might be realized build from improving that ignition process and then steadily repeating it. Ignition gets that research direction started and some aspects of required results can be demonstrated in future experiments at NIF in the near term after that.

OFFICE OF SCIENCE ROLE IN INERTIAL FUSION ENERGY

Subcommittee. While the National Ignition Campaign has been an NNSA-driven process so far because of its core stockpile stewardship mandate, more scientists in the energy arena are speaking of the importance of achieving ignition for the future of fusion energy.

What is the appropriate role of the Office of Science in inertial fusion energy, and how do you expect your budget for these activities to change over the next five years?

Secretary Koonin. The Office of Science, through its Fusion Energy Sciences program extends and evaluates the science basis of all fusion energy concepts. It has had an inertial fusion energy component since 1992 but, by agreement, established through the Secretary's Fusion Policy Advisory committee in 1990, it relies on the NNSA for the fundamental element of laboratory ignition. It has nurtured some driver concepts and the high energy density physics that underpin the inertial fusion energy (IFE) ideas. If the current drive to ignition is successful, a new challenge will be what technology development is required for energy production. We will rely on the current National Academy of Sciences study on IFE to guide our planning of such an effort and it will be connected with the existing activities in NNSA and Office of Science. The roadmap to be developed should be possible to follow at varying funding levels and paces. The budget for such activities would be in the Office of Science in the foreseeable future. Many factors influence the possible budget over the next five years, and any funding numbers would be speculative at this time. Congress will see those budget plans as they are developed.

INERTIAL FUSION ENERGY – RETAINING SCIENTIFIC EXPERTISE

Subcommittee. It's well known that there is a legitimate difference of scientific opinion regarding the most promising technologies to lead to successful fusion reactors...that's one thing the NRC study is supposed to help sort out. In the meantime, this subcommittee has been concerned that the Department not let promising expertise "die on the vine".

How is the Department helping groups like the Naval Research Laboratory to keep on essential staff until a coherent inertial fusion energy plan is developed and implemented?

Secretary Koonin. The challenges in ignition and envisioning an inertial fusion energy future attract highly capable people, including the group at Naval Research Laboratory. In the past that group had both advanced materials and laser properties valuable to the NNSA and advanced inertial fusion energy with funding within the NNSA budget. The funding ended two years ago. The NNSA has provided funding to the group in order to maintain some of the planning leadership contributing to their present programs. Within submitted budgets such funding could be extended into FY 2012.

THURSDAY, MARCH 31, 2011.

DEPARTMENT OF ENERGY—LOAN GUARANTEE PROGRAM AND ARPA-E, FY 2012 BUDGET

WITNESSES

DR. ARUN MAJUMDAR, DIRECTOR, ARPA-E

JONATHAN SILVER, DIRECTOR, LOAN GUARANTEE PROGRAM

Mr. WOMACK [presiding]. I would like to call this hearing to order. Good afternoon to everyone who is here today.

Administratively, it should be noted that some time in the next half hour or so we will be called to vote on the floor and at the appropriate time we will recess the proceedings so that we can do our legislative duty and go to the floor and commit those votes and then return back for, hopefully, the questioning.

Our hearing today is on the fiscal year 2012 budget request for the Department of Energy's loan guarantee programs and the Advanced Research Programs Agency–Energy, ARPA–E. Dr. Majumdar and Mr. Silver, both welcome to the Committee.

Mr. MAJUMDAR. Thank you.

Mr. SILVER. Thank you.

Mr. WOMACK. Chairman Frelinghuysen has said in every hearing this year that it will be highly unlikely that this Subcommittee will see an increase in funding in 2012. Let me reinforce those remarks.

Our task this budget cycle, my first in this institution, is different than in recent years. We are going to have to fund the right balance in investments in our most critical needs with an eye toward those that protect our nation and that create jobs, but at a much lower funding level.

I may be new to Congress, but I was a mayor of a dynamic city in Northwest Arkansas for many years and I know the difficulty in cutting budgets. But I also know that in order to get us out of this fiscal mess, we have got to help the private sector create jobs. It is a fine line to walk because we must not—must not—compete with the private sector or crowd out investment.

Gentlemen, your accounts are some of the newest and most controversial at the Department. I cannot tell you that there is unanimous support for your programs but I can promise you a fair hearing and an opportunity to show how your activities are a worthy investment of scarce taxpayer funds. I would encourage you to take this opportunity to explain to us how you ensure that you do not compete with the private sector.

You can be assured that this Subcommittee will be paying close attention to your remarks and answers.

At this point I will end my remarks. We will have plenty of time to engage in the Q&A to follow. Please ensure that the hearing records, questions for the record, supporting documentation re-

quested by the Subcommittee, are delivered in final form to us no later than four weeks from the time you receive them. Members are reminded that if you have additional questions for the record you have until the close of business tomorrow to provide them to the Subcommittee office.

With that I will turn to the Ranking Member, Mr. Pastor, for his opening comments.

Mr. PASTOR. Thank you very much, Mr. Chairman. Good afternoon, Mr. Chairman. Good afternoon, Panel Members. Dr. Majumdar, it is good to see you again, and Mr. Silver, thank you for joining us this afternoon.

Dr. Majumdar, I would be interested to hear what progress has been made at ARPA–E. As you know, there have been great concerns regarding ARPA–E's program's overlap with the science program, in particular, competition for scarce funding.

While the Subcommittee was a reluctant supporter of the program, now that we have started down the road, I believe that given the positive reviews, we should pursue the model long enough to determine if we can get greater return on our investment.

This support in no way relieves the Department of its responsibility to ensure that redundancy is eliminated and successes are translated to other programs.

Mr. Silver, with the recent events in Japan, I am looking forward to an update on the outlook for the nuclear loans. Also, I would like to understand the status of the Recovery Act funding for renewables and how, if necessary, we transition these projects that have spent tens and hundreds of thousands of dollars pursuing these applications, what happens to them.

And thank you, Mr. Chairman, I yield back my time.

Mr. WOMACK. Thank you, Mr. Pastor. And with that, we will begin the testimony. Dr. Majumdar, you may lead off.

Mr. MAJUMDAR. First of all, I would like to extend my thanks to the Chairman, the Ranking Member, and the esteemed Members of this Subcommittee for inviting me here today to present the Department of Energy's fiscal year 2012 budget request for the Advanced Research Projects Agency for Energy, ARPA–E.

As I have said before to many of you, I consider you all to be my board of directors and I am now here to report to you, my board, what we have done in the past and what we plan to do in the future.

I want to start today on a historical note. ARPA–E is modeled after DARPA, which was created in 1958 in response to the launch of Sputnik when it was felt that the United States was losing its technological lead to the Soviets and we needed some quantum leaps in technology. In the next 30 years DARPA helped catalyze innovations, such as the Internet, GPS, stealth-type technology, and many others. This has strengthened not only our national security, but also economic prosperity. We should all thank the 87th Congress, which in 1962 gave DARPA its first appropriated budget of $246 million and became part of the long history of American innovation.

We are now in another Sputnik-like moment. We import more than 50 percent of the oil we use while sending about $1 billion a

day overseas. Our gasoline prices rise because of instabilities around the world. This, in the long-term, is not sustainable.

We are also falling behind in the global race of clean and sustainable energy solutions. Our children's and grandchildren's secure future is at stake and that secure future is like a stool with three legs: national security, economic security, and environmental security. At the foundation of all three securities are innovations in energy technologies.

ARPA–E's goal is very simple: catalyze energy innovations for a secure American future. Today, on behalf of all Americans, let me now thank you for all your hard work in keeping ARPA–E within the continuing resolution for its first appropriated budget. I hope 20 to 30 years from now our children and grandchildren will remember you as part of the history of American energy innovations.

In our short existence of less than two years, what have we done so far? We have stood up an organization with a philosophy of excellence in everything we do. I would now like to share with you some five core values and some early successes.

Number one, people. Recruit the best talent possible. Thanks to statutory provisions we have very quickly recruited, without regard to civil service laws, the best and the brightest program directors into ARPA–E. Our program directors stay for a maximum of three years and then they have to leave. This is not a permanent job. Their future career depends on how they perform at ARPA–E and they have a three-year clock ticking. This has led to an incredible focus on outcomes.

Number two, speed and efficiency. To be globally competitive, speed is of the essence. We have developed a streamlined process where we can execute with a fierce sense of urgency and unprecedented speed and efficiency. We have reduced the contracting time to two months and introduced many other efficiency measures to get things done quickly. We are the urgency agency.

Number three, breakthrough technologies through competition. Let me give you an example. We created a program to innovate future batteries that would give electric cars longer range and make them cheaper than gasoline-based cars so that electric cars could sell without subsidies. This battery does not exist today and there is high risk in its development. Under this program we announced ambitious targets for cost and performance but we are agnostic on the technology. There are now 15 different teams translating science into 15 different competitive technologies. We create the competition and we will let the market pick the winners.

ARPA–E's focused on identifying opportunities for new energy technologies that are too risky for the private sector. It then provides really ambitious technology agnostic performance and cost targets to create competition amongst innovators and pioneers for breakthrough energy technologies.

Number four, stewardship and integrity. Be the best possible stewards of taxpayer dollars. All projects in ARPA–E are selected purely based on merit and input from a panel of experts. Once selected, our program directors are personally invested in each and every project they manage, that is they are essentially part of the team trying to help them when they get stuck. But if a technology is not working, we put the project on red alert and give them a fi-

nite time to recovery and if we find the technology does not work, we will terminate the project. I would rather put that money back in the Treasury than continue down an unsuccessful path.

Number five, create a value for secure future, ensure that ARPA–E technologies matter and they create value. We just announced a partnership with the Department of Defense to co-develop energy storage systems so that forward operating bases can reduce their fuel consumption by more than 30 percent. This is currently a national security issue. We plan to do this in FY '12, but these technologies also need to succeed in the commercial market. Back in 2009 and early 2010, 6 of our 120 technologies that we funded, received about $24 million in ARPA–E funding, which allowed these teams to do the research and reach the milestones ahead of schedule. Based on this de-risking of technologies, they then attracted more than $100 million in private sector investment this year, which is 4 times the leveraging of taxpayer dollars, federal dollars. It is important that ARPA–E creates the value for society and makes impact on a national economic security.

Early this month we organized a very successful second ARPA–E Energy Innovation Summit, which was attended by more than 2,000 innovators, entrepreneurs, investors, federal, state agencies, Members, and staffers of Congress and the White House. We showcased 100 of the ARPA–E-funded technologies and 100 more technologies that ARPA–E could not fund. We need them to succeed as well because at the end of the day we want the United States to be globally competitive and win the future, not just ARPA–E technologies.

ARPA–E has certainly caught the imagination of the entrepreneurial innovation community and there is now a strong belief that the U.S. can significantly reduce their oil imports and win the global race in clean energy. I hope you get a chance to visit some of the pioneers and innovators in your own districts.

Where will ARPA–E go in the future? ARPA–E will continue to proactively seek out white spaces where it can fill a vital gap in early stage R&D with coordination with the Department's basic science and applied technology programs. For example, we, in the United States, have found the largest reserves of natural gas in the world. Can we use that in our transportation sector and reduce our oil use? Can we produce high-efficiency and low-cost engines and fuel cells to maximize the use of natural gas?

Our electric power generation is produced largely with domestic resources of energy. Can we convert that clean electricity and generate from nuclear plants into liquid fuels for transportation? This cannot be done today. Can we create lightweight materials for high energy density batter packs for electric vehicles? We are dependent on materials other than oil within our aging energy infrastructure. Can we innovate those magnets and lighting technologies that will eliminate the need for rare earths? And can we develop those technologies that increase the security of the grid and make it more reliable? These are some of the opportunities we plan to address in FY '12 budget.

Thank you for the opportunity to testify before you today and I look forward to answering any questions.

Statement of Arun Majumdar
Director, ARPAE
U.S. Department of Energy
FY 2012 Appropriations Hearing

ARPA-E
Catalyzing Energy Breakthroughs to Secure America's Future

Chairman Frelinghuysen, Representative Pastor, distinguished members of the subcommittee, thank you for the opportunity to testify today on behalf of the Advanced Research Projects Agency-Energy (ARPA-E) for the Fiscal Year 2012 Budget request of $650 million.

I want to start on a historical note. On February 12, 1958, President Eisenhower signed Public Law 85-325, authorizing the creation of the Defense Advanced Research Projects Agency (DARPA). This was in response to the launch of Sputnik and to a realization that the U.S. had lost its technological lead and its future security was at stake. DARPA has since been responsible for the development of many transformational technologies, such as the precursors to the internet, stealth and GPS. In 1962, DARPA appeared in its first appropriation bill, and the 87th Congress that voted for it became a part of our history of innovation. As the President has said, today the U.S. faces a new Sputnik-like moment. Our future depends on three securities: national security, economic security and environmental security. At the foundation of all these securities are innovations in energy technologies that would reduce our dependence on foreign oil, provide clean and inexpensive electricity, and create a secure, efficient and sustainable infrastructure. As the first Director of ARPA-E, I am grateful for the opportunity to play some role in the creation of a secure American future.

ARPA-E can play a role in protecting America's national security. As a country, we import more than 50 percent of oil and export about $400 billion per year (about $1 billion per day), a sizeable portion of our trade deficit. The recent oil price spikes due to turmoil in the Middle East highlights just how vulnerable we are to even short-term instabilities around the world. This is not sustainable in the long-term. We must create a diverse portfolio of sustainable options for transportation and mobility based on domestic resources to decrease the burden of oil imports. That requires innovations in energy technologies. We also need to reduce the cost of electricity from clean and sustainable sources (clean coal, nuclear, natural gas, solar, wind, geothermal etc) so that energy is affordable to Americans and our businesses are enabled to power the economy.

ARPA-E can also help ensure America's economic security. Income levels are rising in the world and the world needs more energy. Every nation in the world wants to use sustainable and clean energy. Unfortunately, the technologies that are needed in the future do not exist today. If we are to win the future, we need to use our American ingenuity and technological leadership to invent affordable clean energy technologies, make them locally, and sell them globally, just as we did in information technology and biotechnology. This offers an important global business opportunity for the USA. We have a window of opportunity and we need to grab it; speed is of the essence.

ARPA-E focuses exclusively on breakthrough technologies promising genuine transformation in the ways we generate, store, distribute and utilize energy. If just a fraction of the projects funded by ARPA-E are successful, the U.S. will benefit greatly by creating new industries and jobs, making energy technologies substantially more cost-saving, profitable, and cleaner in a sustainable way.

EARLY SUCCESSES

Early Successes in Technology Innovations

How does ARPA-E measure success? ARPA-E enables the nation's pioneers and entrepreneurs to innovate breakthrough technologies that do not exist yet today – but if they did, they would make today's technologies obsolete and create large commercial markets. For example, ARPA-E has invested in a portfolio of ideas on rechargeable batteries that would make electric cars have longer range and lower lifecycle cost than gasoline-based cars so that electric vehicles can scale without subsidies and significantly reduce our dependence on imported petroleum. Today's lithium ion battery is inadequate and no one else in the world has this future battery. The global race is on. ARPA-E is focused on identifying the opportunity and creating a competition among innovators. The portfolio of ideas that ARPA-E funds are too risky for the private sector to invest in at this time. However, if one of the ARPA-E ideas is shown to be practical, it could indeed change the world. But transformations do not happen overnight – it will take at least 10-15 years to scale these technologies in cost and volume, and indeed change the world. In the process, many of these ideas will fail and ARPA-E will let the market pick the winners.

In the next 3-5 years, we can only look for indicators of success: (1) Are we attracting the best minds to energy R&D? Are we getting the best ideas? (2) How many small businesses have been created? (3) Do we have the world's best performance? (4) How many patents have been filed and licensed? (5) If ARPA-E's funding has created value, how much follow-on funding has the private sector made?

We are seeing some initial early signs of success. I am happy to report that six projects funded by ARPA-E received $24M in 2010. These small investments allowed these innovators to do the research and overcome some serious technical barriers, ahead of schedule. Only when this happened, the private sector realized the value of these innovations and invested more than $100M in only one year. In addition, we have seen 17 patents filed. While we are still in the early stages, these are good signs for future success.

ARPA-E Operational Success – Institutionalizing a Sense of Fierce Urgency

In order to win the future in a globally competitive world, speed is of essence. Since ARPA-E demands speed from the innovator community, I strongly feel that the community and you should demand speed and urgency of ARPA-E. ARPA-E is administered in ways that enable the agency to be lean, effective, and agile. ARPA-E strives to be a model of excellence for a small agency. In its short existence of less than two years, ARPA-E has implemented several key business process innovations that have earned it recognition as an organization to emulate.

We have streamlined the operations within ARPA-E to introduce unprecedented levels of speed and efficiency. ARPA-E has created a 5-Es process for program creation and management:
(1) ***Envision*** a new opportunity for a program and do background in-house research;
(2) ***Engage*** the experts from the technical community for stakeholder input, an internal debate about reasons for creating a new program, and the announce a new program and receive proposals;
(3) ***Evaluate*** the proposals based on merit-based technical peer review;
(4) ***Establish*** the program by selecting and contracting multiple awards;
(5) ***Execute*** the program by active hands-on project management by ARPA-E program directors for proper stewardship of taxpayer dollars (see later).

This process has not only increased the speed and efficiency but has also improved the quality of the reviews and project management. The total process from conception of a new program to contracting awards (first 4 Es) takes 6-8 months, with contracting down to just 2-3 months. ARPA-E achieves this by utilizing a program development process that includes extensive up-front technical research and technical workshops co-hosted with other DOE program offices, and technical community members. ARPA-E also employs a thorough merit-based peer review process. Further, ARPA-E has embedded dedicated procurement and legal teams, allowing ARPA-E to achieve exceptional speed and efficiency for processing awards from announcement to signing contracts. This speed, efficiency and transparency are critical for our government, and that is exactly what ARPA-E is doing. You could call ARPA-E the "urgency agency."-

As noted in a report from the President's Council of Advisers in Science and Technology (2010), "Although the ultimate success of the research funded by ARPA-E is unknown... they have been successful in their peer review of proposals, quick negotiation of contracts, and rapid hiring of high-caliber personnel."

The success of these technologies depends not only on the scientists, engineers and entrepreneurs that we fund, but also on the program directors we have hired. Most anticipate that they will stay at ARPA-E only for a maximum term of 3-4 years. But while they are here, our program directors are involved in active project management and are literally part of the teams they are funding to help them speed up the process of innovation. They have a fierce sense of urgency, and they are demanding speed from our teams.

Technical flexibility, speed, agility and empowerment of Program Directors are the key aspects of ARPA-E's programs. For example, the emerging importance of rare earth metals in the energy sector has been highlighted by the mismatch between the rapidly growing demand relative to the limited global supply. ARPA-E was able to rapidly respond to this pressing problem and arranged a workshop in December 2010 to bring together thought-leaders from across scientific and engineering disciplines to identify transformational, early-stage applied research and development approaches to address the technical challenges related to the potentially limited availability of rare earth metals and critical materials in the energy sector.

ARPA-E and National Security – Partnership with Department of Defense

Building on an already strong cooperation between the U.S. Department of Energy and the U.S. Department of Defense on national security issues, the U.S. Secretary of the Navy, Ray Mabus, recently announced at the ARPA-E Energy Innovation Summit a new partnership between ARPA-E and the Department of Defense to jointly develop energy technologies that will be use to make our nation and our armed forces secure. This partnership will be initiated during the 2012 fiscal year. The Department of Defense's Office of the Assistant Secretary of Defense for Research & Engineering (ASDR&E) aims to take advantage of early technology breakthroughs funded through ARPA-E. In particular, using ARPA-E's technical expertise in grid scale energy storage, batteries for electric vehicles, and power electronics, ASDR&E plans to develop hybrid energy storage systems that will provide future defense systems with long duration storage suitable for a variety of applications, including military bases and mobile units.

Cost effective energy storage is also of interest to DOD's Installations and Environment office, which will work with ARPA-E to assess the technology requirements for storage across military installations. Vulnerability to energy supply disruption is a significant challenge for facilities dependent on the commercial power grid, and backup power is both limited and

expensive. Onsite renewable electricity generation combined with grid scale storage would allow installations to maintain critical functions in the event of grid disruption and enhance installations' efforts to develop micro-grids for energy security.

ARPA-E is continuing its discussion with the DoD to build upon these partnerships and create other ones where innovations in clean energy technologies would make our nation secure.

ARPA-E Energy Innovation Summit

ARPA-E recently hosted its second annual Energy Innovation Summit. We were able to attract our nation's best energy innovators from industry, academia and government; the Summit had over 2,000 registered participants spanning all stakeholder communities, including scientists and engineers, entrepreneurs, small and large business CEOs and CTOs, technology investors from the venture community and investment banks, policy researchers and NGOs. A key feature of the Summit is the technology showcase, where ARPA-E showcases not only the technologies that it invested in, but also showcases other promising technologies. The goal is to ensure that America wins the future, not just the ARPA-E technologies.

The Summit also brought together as speakers and panelists an incredible lineup of energy thought leaders from around the country, including Arnold Schwarzenegger, former governor of California, Chad Holliday, former Chairman & CEO, DuPont; Chairman, *Bank of America,* Ray Mabus, Secretary of the Navy, Senators Lisa Murkowski, Lamar Alexander and Mark Udall, Congressman Steve Israel, as well as Secretary Chu and senior leadership from DOE and the White House. We intend to host another Summit in 2012 and we hope you will join us next year.

Last year at the hearing, your committee made a recommendation that since last year's Summit was so successful that ARPA-E should consider organizing mini-Summits around the country to bring the local innovation ecosystem together. I am pleased to report that we have indeed followed up and organized a mini-Summit in Arizona that was very successful. We hope to do a few more in the future and I look forward to working with you in this regard.

UNIQUENESS OF ARPA-E PROGRAMS AND PROJECTS

ARPA-E enables the nation's pioneers and entrepreneurs to innovate technologies that do not exist yet today – but if they did, they would make today's technologies obsolete and create large commercial markets. ARPA-E does not focus on exploratory science, but instead on translating the science into breakthrough technologies that are too risky and early-stage for private sector investment. The goal is identify opportunities and develop those energy technologies that establish entirely new learning curves to make our nation secure and clean energy affordable and sustainable.

ARPA-E programs generally fall into two categories:

- *Translating New Areas of Science into Technology*—for example, ARPA-E's current Electrofuels program. In contrast to today's biofuels (based on algae, sugarcane, corn or cellulose) that use photosynthesis, the goal of the Electrofuels program is to create a biological, non-photosynthetic process to produce liquid fuels. This is an entirely new way of creating biofuels that is potentially more than 10 times more efficient than today's biofuels, which could potentially mitigate the problems of land and water use. This approach is not being done anywhere else.

- *Creating a Quantum Leap in Technology* —for example, ARPA-E's current program called Batteries for Electrical Energy Storage in Transportation, or BEEST. While DOE and most outside R&D is focused on lithium-ion batteries, ARPA-E is looking for other battery chemistries, such as Zinc and Magnesium, that, if successful, would yield batteries that are less expensive and provide longer range vehicles than today's approaches based on lithium-ion batteries.

Please note that ARPA-E identifies the opportunity and creates a competition. In its solicitations, ARPA-E provides cost and performance metrics for projects to meet or beat, and does not prescribe the method up front, i.e. it is technology agnostic. ARPA-E funds a portfolio of competitive approaches and then seeks to let the scientific competition play out and leave it to the private sector to pick which technologies will be commercialized.

ARPA-E proactively seeks out "white spaces" where it can fill a vital gap in early stage research and development; coordination between the Department's basic research and applied technology programs is a high priority for the Secretary of Energy. For example, ARPA-E has created a Panel of Senior Technical Advisors (PASTA), a group of technical leaders within DOE spanning the Office of Science, the Office of Fossil Energy, the Office of Nuclear Energy, the Office of Energy Efficiency and Renewable Energy, the Office of Electricity Delivery and Energy Reliability, and others from senior DOE leadership positions. The intent of the PASTA meetings is to share information, avoid duplication, and engender coordination, cooperation, and collaboration among all of the DOE research programs. In addition, other DOE programs are involved from beginning to end in ARPA-E's program development process—providing technical consultation, co-hosting technical workshops, and serving as reviewers for ARPA-E concept papers and full applications.

ARPA-E's programs and projects to date have included:

- **Electrofuels:** ARPA-E seeks to use microorganisms to harness energy and convert carbon dioxide into liquid fuels. Theoretically, this could be ten times more efficient than current approaches.
- **Batteries for Electrical Energy Storage in Transportation (BEEST):** The goal of the BEEST program is simple: Create a new generation of rechargeable battery technologies that will allow a longer range and lower life-cycle cost than gasoline-based cars, so that electric cars can scale without subsidies.
- **Building Energy Efficiency Through Innovative Thermodevices (BEETIT):** The BEETIT program seeks to develop cost-competitive energy-efficient building cooling technologies that will reduce energy consumption from: (1) overall cooling and (2) refrigerants used in vapor compression systems.
- **Agile Delivery of Electrical Power Technology (ADEPT):** The ADEPT program seeks to create microelectronic circuits that incorporate transistors able to handle high voltages and advanced magnetic materials for much smaller power transformers and inductors. The improved electrical power efficiency from ADEPT could result in smaller personal computers and computer servers, produce lightweight chargers for electric vehicles and allow for the controlled movement of electricity by routing through transmission lines to avoid congestion and overloading.

- **Innovative Materials and Processes for Carbon Capture Technologies (IMPACCT):** IMPACCT is pushing the boundaries of carbon capture research through technologies such as new liquid chemistries that dissolve carbon dioxide and a capture system inspired by jet engines that transforms carbon dioxide from a gas into pellets of dry ice. If successful, the IMPACCT program will allow the continued use of America's coal-based power infrastructure without further increases in carbon dioxide emissions.
- **Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS):** The GRIDS program seeks to develop new technologies that enable widespread use of cost-effective grid-scale energy storage.

2012 Programs –Potential Topics

The five broad thematic strategic direction areas are areas of technical interest that ARPA-E will explore.

Transportation Systems

Broadly speaking, reduction in imported petroleum is critical for our national and economic security. ARPA-E will continue to invest in the transportation sector, in both alternative domestic sources of sustainable fuels and electrification of vehicles.

Some broad goals follow:

- Development of those batteries and systems that would make electric vehicles have a range of 300-500 miles and be less expensive than cars based on internal combustion engines. This would enable electric vehicles to be market competitive without government subsidies.
- Development of sustainable and market-competitive transportation fuels using domestic resources such as natural gas or a combination of carbon dioxide and hydrogen, that have 5-10 times less land and water use than that of biomass or algae based biofuels. This would be especially attractive for long-haul trucks and air transport where electrification is unlikely to make an impact.
- Novel uses of information technology to reduce fuel consumption, avoid traffic congestion, and optimize use of existing transportation resources.
- Novel cost-effective power generation or propulsion systems that have significantly higher efficiency than today's internal combustion engines, and thereby maximize the use of transportation fuels.

Stationary Power

ARPA-E's goal is to create a diverse portfolio of technological options for low-cost clean electricity from traditional and renewable sources. This will make the U.S. the world leader in these technologies and thereby lead to economic prosperity and American jobs. The broad goals include:

- Electricity generation from solar, wind, natural gas, nuclear, clean coal and other sources to meet base load and peak power at levelized cost of electricity of 5-6 cents/kWh.
- Integrated energy supply systems for distributed supply of heating, cooling, and power in optimal ways.

Given the increasing reliance on an overwhelming percentage of the nation's electricity that comes from stationary power sources, ARPA-E is developing specific future focus areas for programs that employ novel approaches, materials, devices, and processes to make revolutionary

advances in the way we capture and utilize energy from a portfolio of diverse renewable and other power sources.

Electrical Infrastructure

The U.S. electric grid is undergoing a technical renaissance through the deployment of initial smart-grid technologies. This technical renaissance is motivated by the need to modernize the grid for the 21st century: the U.S. grid is many decades old and often running at maximum capacity, making it vulnerable to outages and security threats.

ARPA-E's goal is to develop next generation technologies that will make today's approaches obsolete, and would truly revolutionize the grid for secure, stable, and reliable transmission and distribution of electrical power and maximize the capacity of today's infrastructure. These technologies could be sold globally, thus leading to American jobs and economic prosperity. Some broad goals are as follows:

- Low-cost electrical storage to increase utilization of renewable resources such as wind and solar.
- Advanced, low-cost and smart components for high-efficiency power transmission, conversion and management at ultrahigh voltages for transmission and medium-to-low voltages for distribution networks.
- Technologies for system-level stability, security, high capacity and reliability for the whole U.S. transmission-distribution system.

End Use Efficiency

Energy efficient technologies for buildings, both commercial and residential, offer a tremendous opportunity to reduce energy demand. Buildings consume 40 percent of energy in the U.S., while the industrial sector consumes 30 percent. 72 percent of the nation's electricity and 55 percent of natural gas is used in buildings. The cooling and heating of buildings consumes 40 percent of the total energy used in buildings. This translates into 12 percent primary energy use in the U.S. To date, activities in ARPA-E in energy efficiency have focused mainly on buildings.

ARPA-E will continue to invest in the buildings sector to develop high-efficiency energy technologies, including an expansion of the current BEETIT program and new technologies for energy measurement systems and integrated building operations, as well as a novel way to light a room. This will be coordinated closely with the new Buildings Energy Innovation Hub as well as all the activities in the Office of Energy Efficiency and Renewable Energy.

ARPA-E's goal is to develop those technologies that do not exist today, but if they did they would lead to substantial life-cycle monetary savings by increasing the efficiency of how energy is used in buildings and industry. Some of the program's broad goals include:

- Reduction of energy consumption by 50% with a pay-back period of less than 5 years by highly efficient and smart use of heating, cooling and electrical power in homes and commercial buildings.
- Advanced and alternative technologies to provide industrial goods and services with substantial reduction in energy consumption and a pay-back period of less than 5 years.

Embedded Efficiency

On the demand side of our energy economy, energy is consumed primarily in three sectors—buildings, transportation and industry. Buildings consume approximately 40 percent of

our primary energy, transportation about 28 percent, and industry about 32 percent. Reduction of energy consumption in the industrial sector is essential to ARPA-E's mission and will be achieved through "embedded efficiency" programs.

ARPA-E's goal is to focus on the industrial sector with the aim to develop cost-competitive technologies and industrial processes to significantly reduce energy consumption and emissions. Some of the program's broad goals include:

- Advanced and alternative technologies to provide industrial goods and services with substantial reduction in energy consumption and a pay-back period of less than 5 years.
- Utilization of waste heat from industry and other uses in intelligent ways to reduce primary energy consumption.

Wireless Innovation Fund

The President's Wireless Innovation and Infrastructure Initiative proposes to reallocate a total of 500 megahertz of Federal agency and commercial spectrum bands over the next 10 years in order to increase Americans' access to wireless broadband. Repurposing spectrum will greatly facilitate access for smart phones, portable computers, and innovative technologies that are on the horizon. This effort will also enhance Americas public safety, infrastructure, and competitiveness by investing some of the expected auction receipts in the creation of a broadband network for public safety, expanding access to wireless broadband in rural America, and a Wireless Innovation (WIN) Fund to help develop cutting edge wireless technologies. As part of this initiative, ARPA-E will participate in the WIN Fund by supporting clean energy activities.

An additional $100 million in mandatory funding is proposed from the Wireless Innovation Fund for ARPA-E to develop cutting-edge wireless technologies. In FY 2012, ARPA-E plans to utilize funds available from the Wireless Innovation Fund on projects related to wireless information technology, as outlined in the detailed justification of the projects section, particularly in Electrical Infrastructure, End Use Efficiency, and Transportation Systems.

Seedlings/Broad Funding Announcement

The focus of the Seedlings/Broad Funding Announcement line is to provide funding for innovative projects that happen to fall outside the boundaries of a specific topic area FOAs. ARPA-E believes it is important to capture any truly innovative projects that may be out there and to foster an inclusive community that demonstrates ARPA-E is open to funding projects that are outside of the specific focus topic areas FOAs. In FY 2012, ARPA-E plans to have at least one Broad Funding Announcement.

CONCLUSION

ARPA-E's goal is to help catalyze energy breakthroughs with speed and efficiency to secure America's future by attracting the best minds to focus on the major technical challenges in this field and by stimulating technical and the entrepreneurial community to innovate on energy technologies.

Mr. WOMACK. Thank you, sir. Mr. Silver.

Mr. SILVER. Thank you, Mr. Chairman. Mr. Chairman, Ranking Member Pastor, and Members of the Committee, my name is Jonathan Silver and I am the Executive Director of the Department of Energy's Loan Programs Office. I would like to thank you for the opportunity to testify today and for the important role you play in ensuring that our nation supports and benefits from a broad-based, comprehensive, and forward-looking energy sector.

It is increasingly clear that the nation that can harness the power of clean, renewable, cost-effective energy will lead the 21st century, and the United States is engaged in a global race to achieve that goal. Yet to date, as a nation, we have not demonstrated the kind of sustained commitment to clean energy that is needed to remain competitive and we are at risk of failing to benefit fully from the most important markets of the new century.

Just this week the Pew Charitable Trust released a report that gives new cause for concern. Although clean energy investment in the United States increased 51 percent in 2010, driven largely, I would point out, by the historic and important contribution of the American Recovery and Reinvestment Act, we fell to third among major industrial nations in total investment in the clean energy sector. As recently as 2008, we were first. And though we have the world's largest economy, we rank ninth in the world in clean energy investment as a percentage of GDP.

The Pew report calls China the world's clean energy superpower and notes that it is now the leading producer of both wind turbines and solar modules.

I cite this data not to stoke fear, but to reiterate the great promise of clean energy for our nation. This is, as the President and Secretary Chu have noted, our Sputnik moment and clean energy investment is key to winning the future. Sustained investment in clean energy has the potential to ensure our global competitiveness, enhance our national security, protect our environment, and create new and good jobs today.

Before entering government I was a venture capitalist and spent years investing in the technology sector, the last industrial revolution. I believe the opportunity in clean energy is even bigger, but this opportunity, while exciting, is finite. If we miss it now, we may miss it forever. That's because there are important differences between high tech and energy. Investors in technology could get in cheaply and exit easily. By contrast, clean energy investments are generally capital-intensive, highly illiquid, and often generate fixed or at least knowable rates of return.

Traditional lenders have limited capacity or appetite to underwrite the high completion risks associated with large-scale, first of a kind, energy projects. This is where federal financing plays an important and much needed role. The loan programs provide long-term, low-cost financing, making possible commercial scale projects that would not otherwise get built. These projects create jobs, increase the supply of clean energy, and help build out our domestic supply chains. This in turn drives down unit costs making future projects and products more competitive.

Federal support brings private capital off the sidelines and by demonstrating the efficacy of innovative technologies makes it

more likely that similar projects will attract private financing without government support in the future.

The success of our efforts is already clear. In the 2 years since this Administration took office we have committed to provide over $26 billion worth of guarantees to 25 projects with total project costs of over $42 billion. These projects are spread across 20 states and represent a wide variety of clean energy and automotive technologies. They include the world's largest wind farm, two of the world's largest concentrated solar power facilities, numerous geothermal sites, the first nuclear power plant, Congressmen, in the last three decades, a biodiesel refinery that will triple the amount of biodiesel in the United States, innovative electric vehicles, and more.

The sponsors of these projects estimate that they will create or save almost 60,000 direct jobs. There are, of course, thousands more indirect jobs that will be generated as well. Cumulatively these projects will generate enough energy to power 2 million households and avoid the annual carbon dioxide emissions of almost 4 million cars. To put that in some perspective, that is double the number of vehicles in Arkansas and over two times the number of housing units in Little Rock.

The loan programs also represent great value to the government and to the taxpayer. It is important to keep in mind that this is not a grant program. We expect every loan and loan guarantee we issue to be repaid in full. We review applications on a competitive basis, which means we do not fund every eligible project. Those we do fund are put through a rigorous and comprehensive financial and technical review similar to, and, frankly, given the wide range of government policies, in some ways more comprehensive than the review a private sector lender would conduct before a single dollar of taxpayer money is put to work. Those reviews are paid for by fees charged to the applicants. The costs of running our program are not borne by the taxpayer.

When loans are repaid, the nation benefits from the increased investment at virtually no cost to taxpayers. We also represent an effective leveraging of government resources since a relatively small amount of funding supports a much larger amount of investment. Every dollar of appropriate credit subsidy obligated to date under the 1705 program has supported $17 worth of clean energy projects.

We are proud of our accomplishments and believe that the President's 2012 budget proposal will allow us to build on this. As you know, the budget includes $36 billion in additional authority for nuclear power loan guarantees, which will promote the deployment of new, advanced, and safe nuclear power projects. This authority, combined with our existing authority, should be sufficient to support 6 to 8 nuclear power projects, including the Vogtle Project, which has already received a commitment, $200 million in credit subsidy for renewable energy systems and efficient end-use technologies, which would enable us to support an estimated 1- to $2 billion in loan guarantees under the 1703 program. This would be the first no-year credit subsidy funding made available and would permit us to focus on truly innovative technologies.

Based on our average credit subsidy usage to date, we expect the $200 million in subsidy will support approximately 2 to 5 new projects during the next year; $100 million in credit subsidy to support up to $2 billion in loan guarantees to universities, schools, and hospitals to spur investment in energy efficient retrofits. This pilot program is one component of the President's Better Buildings Initiative and would help these entities save on energy usage and associated costs. And finally $6 million to support ongoing loan monitoring efforts under the ATVM program.

These projects are important and I believe worth supporting.

Again, thank you for inviting me here today. I look forward to answering any questions you may have.

Written Statement for the Record of Jonathan Silver
Executive Director of the Loan Programs Office, U.S. Department of Energy
United States House Committee on Appropriations
Subcommittee on Energy and Water Development
March 31, 2011

Introduction

Chairman Frelinghuysen, Ranking Member Visclosky, and members of the Committee, thank you for the opportunity to testify today. My name is Jonathan Silver, and I am the Executive Director of the Department of Energy's (DOE) Loan Programs Office (LPO). DOE's loan programs are a critical part of our nation's commitment to clean energy and the jobs and financial opportunities it presents. I welcome the opportunity to discuss with you the Department's 2012 budget requests for the programs, and our significant accomplishments to date.

Global and Domestic Context in which the Loan Programs Operate

Clean Energy Opportunities

There is no doubt that clean energy has an important role to play in America's future. We all believe that the extent to which we can deploy new, innovative clean energy technologies will have critical implications for our future global competitiveness, national energy security, economic recovery, and the environment.

As Secretary Chu often notes, America's future prosperity may well depend on our ability to lead in the global transition to a clean energy future. The nation that harnesses the power of clean, renewable energy will be the nation that leads the 21st century. Yet, to date, our nation has not demonstrated the type of sustained commitment to clean energy investment that is needed to remain competitive. For example, the Pew Charitable Trusts recently estimated that, while the U.S. has the world's highest GDP, we ranked ninth in clean energy investment as a percentage of GDP in 2010.[1]

Global competitiveness is not the only issue at stake here. The U.S. imports a significant portion of the petroleum it consumes from foreign sources, and this dependence on oil threatens our national security. Investments in clean energy sources can help us regain control of our energy future and achieve energy independence.

Clean energy not only has long-term, strategic benefits, it is also an important part of our ongoing national economic recovery. Investments in clean energy projects, including power generating plants, manufacturing facilities, and retrofitting activities, create new and good jobs – and they create them now.

Deployment: Importance, Obstacles, and Role for Government

[1] The Pew Charitable Trusts "Who's Winning the Clean Energy Race?," March 2011, at 12.

Much of the public discussion around clean energy focuses on research and development, which is crucial to reaching our long-term national energy goals. But near-term deployment of innovative, commercially-ready technologies is critical, as well. Deploying such technologies at scale drives down unit costs – as it creates new supplier companies – and actually incentivizes future research and development efforts. Commercialization also drives innovation; it is a virtuous circle.

Unfortunately, the pace at which innovative technologies are deployed in the United States has been slowed by both cyclical and structural impediments. The recent economic crisis slowed the pace of investment in clean energy projects. Traditional lenders pared back their appetite for risk, resulting in reduced liquidity in the market. The tax equity market – one of the principal sources of equity for renewables projects – shrank, as well.

There is also a systemic shortage of debt financing for clean energy projects, which stems from the relatively high completion risks associated with such projects - principally technology risk and execution risk. Private sector lenders have limited capacity or appetite to underwrite such risks on their own, particularly because commercial-scale clean energy projects are capital-intensive and often require loans with unusually long tenors. Thus, there is a "valley-of-death" in the clean energy technology development cycle, between the pilot-facility stage and commercial maturity, where companies find it difficult to obtain the financing needed to deploy their technologies at commercial scale – the very point at which they begin to have a meaningful impact on jobs and the environment.

The Department of Energy's loan programs were designed to address these impediments and fill this financing gap. Loan guarantees lower the cost of capital for projects utilizing innovative technologies, making them more competitive with conventional technologies, and thus more attractive to lenders and equity investors. Moreover, the programs leverage the Department's expertise in technical due diligence, which private sector lenders are often unwilling or unable to conduct themselves.

Achieving our nation's clean energy goals – including global competitiveness and domestic energy security – will require the deployment of innovative technologies at a massive scale, and the DOE loan programs are an important element of federal policy to facilitate that deployment.

Background on the Loan Programs

As you know, the Loan Programs Office actually administers three separate programs: the Title XVII Section 1703 and Section 1705 loan guarantee programs, and the Advanced Technology Vehicle Manufacturing (ATVM) loan program.

The 1703 program was created as part of the Energy Policy Act of 2005 in order to support the deployment of innovative technologies that avoid, reduce, or sequester

greenhouse gas emissions. Currently, the program has $18.5B in loan guarantee authority for nuclear power projects, $18.5B in authority for energy efficiency and renewable energy projects, $8 billion for advanced fossil projects, $4 billion for front-end nuclear projects, and $2 billion in mixed authority, following the reprogramming of $2 billion from mixed to front end nuclear authority.

The Section 1703 program was designed to be cost-neutral to the government. To that end, the legislation directs DOE to charge fees sufficient to cover the program's administrative costs. 1703 also is a "self pay" credit subsidy program, meaning that applicants themselves pay the credit subsidy cost associated with any loan guarantees they receive from DOE.

The Section 1705 program was created as part of the American Recovery and Reinvestment Act of 2009 (Recovery Act), to jump-start the country's clean energy sector by supporting projects that had difficulty securing financing in a tight credit market. The 1705 program has different objectives than 1703, and different programmatic features. Most notably, applicants under 1705 are not required to pay the credit subsidy costs associated with the loan guarantees they receive. Those costs are paid through funds appropriated, by Congress (though applicants still must pay application and other administrative fees). Additionally, to qualify for 1705 funding, projects must begin construction no later than September 30, 2011. DOE's authority to enter into loan guarantee agreements under 1705 expires on that date, as well.

Under the Section 1703 program, DOE has offered conditional commitments for four projects so far, including nuclear power, front end nuclear, and two energy efficiency projects, which amount to just over $10.6 billion in total government supported financing, including capitalized interest. Under 1705, we have so far issued conditional commitments, representing just under $7.3 billion in financing, including capitalized interest, to 16 projects. In addition, approximately 25 other projects are sufficiently far along in the due diligence process that we have issued a working draft term sheet and are in active negotiations with the applicants. LPO estimates that these projects, if they ultimately reach financial close, will utilize all of our remaining credit subsidy appropriations.

While there has been significant interest in the 1705 program, there has been little demand for renewables loan guarantees under the 1703 program. This may, in part, reflect the ability of certain renewable projects to qualify under 1705. But it may also reflect the fact that innovative clean energy companies – which tend to be smaller and have less capital – often consider the potential self-pay credit subsidy cost to be prohibitive.

The ATVM program issues loans in support of the development of advanced vehicle technologies to help achieve higher CAFE standards and reduce the nation's dependence on oil. Congress funded this program with $7.5 billion in credit subsidy appropriations to support a maximum of $25 billion in loans. To date, DOE has committed and closed five ATVM loans, totaling over $8.3 billion, which will support advanced vehicle projects in

eight states. We anticipate making a number of significant additional ATVM loan commitments in the coming months.

Recent Progress

The Loan Programs Office has made great strides since this Administration took office two years ago. At that time, DOE had not yet issued a single loan or loan guarantee. Since March 2009, the Department has issued conditional commitments for loans or loan guarantees to 25 projects, 15 of which have reached financial close – with more to follow soon. Of these 25 projects, four have been supported under the 1703 program, 16 under the 1705 program, and five under the ATVM program.

DOE has provided (or conditionally committed to provide) over $26 billion in financing to these 25 projects, which have total project costs of over $42 billion. The projects are spread across twenty states, and they reflect an array of clean energy and automotive technologies, such as wind, solar, advanced biofuels, geothermal, transmission, battery storage, and nuclear. The projects include the world's largest wind-farm; two of the world's largest concentrated solar power facilities; the first nuclear power plant in the last three decades; the world's first flywheel energy storage plant; and a biodiesel refinery that will triple the amount of biodiesel in the United States.

Project sponsors estimate these 25 projects will create or save almost 60,000 jobs, including construction and operating jobs.[2] Cumulatively, they will generate nearly 23 million MWh of clean energy each year – enough to power two million households, or approximately the same number of households in the state of Louisiana.[3] And they will avoid over 18 million tons of CO2 annually – more than is produced by all of the approximately three million registered cars in Indiana.[4]

Value of DOE Loan Programs

It is important to remember that the loan programs are not grant programs; LPO expects that the loans it provides or guarantees will be repaid. We review projects on a competitive basis, and we do not fund every eligible project. We ensure that the loans we support meet our statutory requirement of having a "reasonable prospect of repayment." Every project that receives financing first goes through a rigorous financial, legal and technical review process – similar to, and in some ways more comprehensive than, what a

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[2] Breakdown by program is as follows (based on Sponsor estimates): **1703:** 5,210 construction, 1,340 permanent; **1705**: 10,550 construction, 3,390 permanent; **ATVM**: 5,700 created, 33,000 saved.

[3] Sources: EIA 2005 Residential Energy Consumption Survey, Table US8; U.S. Census Bureau, American FactFinder, 2010.

[4] Sources: U.S. Environmental Protection Agency, Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle; U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2008, Table MV-1 (December 2009).

private sector lender would conduct – before a single dollar of taxpayer money is put to work.

Not surprisingly, this type of sophisticated review requires thousands of man-hours, which is costly. However, administrative costs associated with the Title XII programs, including personnel expenses, are required by Title XVII to be covered by fees paid by applicants. The programs are designed to be self-supporting and DOE strives to meet this requirement.

Moreover, the programs can efficiently and effectively leverage government resources to spur private-sector investment. The financing provided by the loan programs is "additive." It is intended to finance projects that – because they would have difficulty accessing conventional debt markets – might otherwise not get built. A relatively small amount of appropriated credit subsidy can support a large amount of new private sector investment. Moreover, when a loan is fully repaid, the nation will have benefited from the incentivized private sector investment at relatively little cost to taxpayers.

The potential benefits are great. The projects supported by the loan programs promote economic growth and job creation. Clean energy and automotive technology projects can create large numbers of construction and permanent operating jobs. In addition, these projects help lower the delivered cost of renewable energy and contribute to the build-out of the domestic supply chain and manufacturing base that we will need to "win" the clean energy future.

2012 DOE Loan Programs Budget Highlights

The President's 2012 budget recognizes the value of the DOE loan programs, and builds upon their success to date. Specifically, the budget requests (1) up to $36 billion in additional authority for nuclear power loan guarantees under the 1703 program; (2) $200 million in appropriated credit subsidy for renewable energy systems and efficient end-use energy technologies under the 1703 program; (3) $6 million in appropriations for loan monitoring administration under the ATVM program; and (4) $100 million for a proposed Better Buildings Pilot Loan Guarantee Initiative for Universities, Schools, and Hospitals.

Title XVII: 1703 Innovative Loan Guarantee Program

Nuclear Power: The Department requests up to $36 billion in loan guarantee authority to help deploy a new generation of American nuclear reactors. The additional loan guarantee authority for nuclear power projects, which would bring the 1703 program's cumulative authority for nuclear power projects to $54.5 billion, will promote deployment of new plants and support an increasing role for private sector financing. The new authority, combined with our existing authority, is expected to be sufficient to support six to eight nuclear power projects, including the Vogtle project, which has already received a conditional commitment.

Renewable Energy Systems and Efficient End-Use Energy Technologies: The Department requests $200 million in appropriated credit subsidy, under the 1703 Program, to support an estimated $1 to $2 billion in loan guarantees for renewable energy system and efficient end-use energy technology projects.

Administrative Costs: The FY 2012 budget also requests $38 million to evaluate applications received under the eight solicitations released to date, monitor outstanding loan guarantees, and ensure efficient and effective management of the loan guarantee program. This request is expected to be offset by collections from borrowers authorized under Title XVII of the Energy Policy Act of 2005 (P.L. 109-8).

ATVM Program

The Department requests $6 million to support ongoing loan monitoring activities associated with the program mission of making loans to automobile and automobile part manufacturers for the cost of re-equipping, expanding, or establishing manufacturing facilities in the United States to produce advanced technology vehicles or qualified components, and for associated engineering integration costs.

Better Buildings Loan Guarantee Initiative for Universities, Schools, and Hospitals

To spur investment in energy efficiency retrofits for buildings which serve as assets to our communities, the Department requests $100 million for loan guarantee subsidy costs to support up to $2 billion in loan guarantees for universities, schools, and hospitals. This pilot program is one component of the President's Better Buildings Initiative and would fund cost-effective technologies and measures to assist universities, schools, and hospitals save on energy usage and associated energy costs. The Department also requests $5 million for administrative expenses to carry out the program. I look forward to working with Congress to develop the authorizing statute for the program.

Conclusion

The DOE Loan Programs have made an important and lasting contribution to our national clean energy landscape. We look forward to working with Congress to ensure that they are funded at an appropriate level while we continue to administer them in the most effective and efficient way possible – while appropriately protecting taxpayer funds.

Mr. WOMACK. Thank you, Mr. Silver. My first question will be directed to Mr. Silver. It will be a long time, generations, before we know the full human and economic impact of the events in Japan. Your program has $18.5 billion available for nuclear loan guarantees and before the tsunami one conditional commitment had been offered and about $11 billion, according to my numbers, was still available, not quite enough for the two next expected applicants, one in Texas and one in Maryland.

So, the basic question is, has there been any change in the program since this series of events for assistance?

Mr. SILVER. Well, Congressman, first of all, let me say that our hearts go out to the people of Japan and, as you know, I'm sure, the Department of Energy has been actively involved in working to assist the Japanese government and the Japanese people with a variety of different kinds of support. We have sent experts and other personnel into the site. We have airlifted over both material and instrumentation, which would allow them to benefit from its use.

We take the safety of nuclear power very seriously. I do need to say that the loan guarantee program is a financing program and we looked—our focus is on the viability of the financing structures around various clean and renewable energy technologies. We work closely with related agencies, the Nuclear Energy Agency at the Department of Energy and of course the Nuclear Regulatory Commission, and as I am sure you know, the process for any applicant, but including the nuclear applicants, to receive a loan first stops at a conditional commitment. A conditional commitment is an expression of an intent to make a loan, but is dependent on the applicant completing whatever other conditions precedent the CPs are required before we can close such a loan.

Among the many CPs in a nuclear power project, of course, is a permit to build the structure from the Nuclear Regulatory Commission and we rely on their work and their expertise to ensure the safety and security of those structures.

Mr. WOMACK. Has anybody pulled out?

Mr. SILVER. As I am sure you know, we were—we have been in discussions with a number of projects. Late last year we were close to the resolution of a project in which two parties to a particular project, members of a consortium, decided they had diverse interests and decided to disband that particular partnership. That project continues to move forward through a restructuring of the partnership itself, which has nothing to do with the loan guarantee program, and all other things being equal, we would expect to be able to move that project and others forward provided the relevant financing metrics, which are important to us, are able to be met.

Mr. WOMACK. Back to the events in Japan, how has it impacted your request for $36 billion additional in guarantees? In other words, do you now need less?

Mr. SILVER. No, sir. I do not believe we do. The original request was not driven by—obviously occurred before and was not driven by the events in Japan, but was instead intended to support a different rationale, which is it is our belief that it is important to be able to provide funding for at least two examples of four different kinds of nuclear technologies, and that is what—that is how you

arrive at the $36 billion. The total aggregate cost for that would be the $18.5 billion plus the $36 billion.

Obviously, we take the safety and security of these issues incredibly seriously and will not move forward to a final close until we have be assured that all the safety requirements are in place, but the number itself is driven by our goal to establish a variety of technologies and then let the private sector decide which are the most relevant and obviously then take the lead in making those investments.

Mr. WOMACK. Has it affected your timelines? In other words, how quickly would this additional authority actually be used?

Mr. SILVER. From a financing—from an investment perspective, that is a due diligence perspective, it has not affected our timeline. Obviously, it is too early to tell, I think, given the unfolding events in Japan, what the actual implications on the timeline will be, but I have every expectation that we would be able to put that capital to work in a meaningful timeframe.

Mr. WOMACK. What would be the chances, then, of reaching conditional commitments for more plants that would require additional authority in fiscal year '12?

Mr. SILVER. What would be the chances?

Mr. WOMACK. Yes.

Mr. SILVER. I believe we are on track with the most robust projects and expect to move both of them or all three or four of them, depending on how many we can get done, forward in that kind of timeframe.

Mr. WOMACK. Okay. Thank you. Okay. Mr. Pastor.

Mr. PASTOR. I believe that there is about $2 billion, approximately $2 billion remaining from the technology neutral loan authority provided in 2007, and if current estimates are correct, would the Department consider using the remaining unallocated authority for nuclear?

Mr. SILVER. Well, Congressman, as you know, we—that is, know your money, as you point out, and mixed use funds, and so we will look to deploy it in the most effective manner possible. We have, as you might assume, over subscription in virtually every category and so we will work to make sure that we deploy it against the most robust and safest projects, which at the same time can reach maturity without providing a crowding out effect in the market to which the monies are intended.

Mr. PASTOR. Given that even with that additional loan guarantee the Department would be slightly short of the requirement for the next two applicants, would you issue a conditional commitment with the majority of the guarantee firm and the remaining contingent upon appropriation?

Mr. SILVER. We are eminently flexible in the way we structure transactions because we need to be. Every transaction is unique and it will not surprise any of the members of this Committee to know that by definition, therefore, our work is bespoke. Having said that, I believe that it is hard to pull together the other financing required for projects of this size and scale without full commitments behind a loan guarantee.

Mr. PASTOR. Do you foresee any legal constraints?

Mr. SILVER. I am not aware of any at the present but I would like to come back to you on that answer, sir.

Mr. PASTOR. Okay. Have you discussed this possibility with any of the applicants?

Mr. SILVER. We have looked at a variety of different financing scenarios as we do with every application. Until we have agreed on a specific set of terms and conditions, the transactions are relatively fluid, so at this point I think we are still trying to understand what kind of resources we will have to be able to apply against the projects.

Mr. PASTOR. Thank you, Mr. Silver. I will yield back.

Mr. WOMACK. Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman. Mr. Silver, welcome. Dr. Majumdar, Namaste. You are a reflection of one of my pet, not peeves, but rather policies around here. We have had much discussion in the Congress over the last several years about what we should or should not do by way of immigration policy. Generally speaking, we have had a long-established policy whereby families and people have come to our country, and people go through the academic process, undergraduate work, master's and doctorate work, and then we insist they go back home. It is my view that that is the dumbest thing we could possibly do. I believe we ought to be taking the cream of the crop, keeping them here, insisting that their families remain, if possible, because that is the heart of the way America was built. So, that is by way of welcome, sir.

Mr. MAJUMDAR. Thank you.

Mr. LEWIS. We are going to be having votes, and I have a number of questions relative to 1703, 1705, and I would appreciate responding initially, but of the record, further, if you would, I am specifically interested in knowing how many loan applications you are currently processing under 1705 and how many do you anticipate can be completed before the program's sunset? And with that, within your current authority, do you foresee any problems in transactions or applications in 1705 or 1703 moving forward? Are there difficulties in that timeline?

Mr. SILVER. Congressman, thank you for that set of questions.

As I am sure you know, one of the applicants to this process is actually in your district, Bright Source, which we have enjoyed a long and, I think, effective working relationship with——

Mr. LEWIS. I am surprised that you knew that.

Mr. SILVER. We have, as you know, $2.4 billion of appropriated funds available for credit subsidy. We have closed and conditional commitments on about 40 percent of that funding and we have a group of transactions that are in what we call the interagency review process, which brings that number to about 60 percent.

In addition, we have another 25 or so projects with term sheets in hand, which means that they are not only eligible, but that significant due diligence has already gone on and we are in the iterative process of negotiating a set of terms and conditions with them.

If we are able to bring the majority of those transactions to closure, we will have used all of the $2.4 billion of credit subsidy. I said it that way because we actually have issued term sheets for greater than the $2.4 billion because inevitably in the negotiation

process transactions sometimes fall off or fall apart, so we have provided ourselves with a small cushion to ensure that we will make use, full use of the funding.

Mr. LEWIS. Mr. Chairman, within my own district, a huge territory where solar energy will be on the horizon, a variety mix of wind energy projects as well, indeed I think it is a really important part of our energy independence future, but in the meantime I have great concern about whether you are sensitive to just how much pressure there is to reduce patterns of growth and spending rather than to respond directly to wish lists. So, tell me what happens to your budgets if we indeed find some major reductions in the fiscal year '12 appropriations process.

Mr. MAJUMDAR. Well, I think, as you have seen, the President has requested the budget, I think he has looked at the success, early success, of this agency, ARPA–E, in terms of recruiting people. We stood up an agency in less than two years and we have got some unprecedented speed and efficiency in deploying capital. This is about the innovation that we foster in the United States, and we have always out-innovated the rest of the world in information technology and bio technology, and we can do that in clean energy as well.

And given the successes in terms of leveraging of federal dollars for private capital after they do their research, as well as the people that we have recruited given the statutory provisions that we have, I think this is one of the highest priorities for the President and the Secretary of Energy, and so that is why he has put his money where the action is, and where the success is, and I think that's where they're putting their efforts.

Mr. LEWIS. Thank you.

Mr. SILVER. Obviously, Congressman, we are sensitive to the need to ensure that our funding is spent well, efficiently, effectively. I do need to say that the impact of a reduction along the lines envisioned in an H.R. 1 would be devastating.

In 1703, which as I know you all know a set of authorizations rather than appropriations. It would effectively eliminate all of the remaining available authorizations. This means that we would lose any ability to do any work in innovative renewables technologies. We would be forced, given—there would be some availability to move some choices around a little bit, but essentially this would remove our ability to do any work in advanced fossil fuels, and so on the authorization side, it is very, very significant.

On 1705, it would, of course, essentially end the program. This has two effects, not only would we not be able to see our way clear to supporting the 25+ projects that are already in term sheet status, we would actually lose the ability to close those projects with conditional commitments.

As you know, funds in this program are not obligated until financial close. A conditional commitment is not a financial close. Unfortunately, we do not control, to any real extent, the timeframe between conditional commitment and financial close because that is a set of actions the applicant has to take.

And I guess I would make one other observation in general, which is that a large number, all of our applicants, but all of the applicants that we are working on currently, of course, have spent

enormous amounts of time and money getting to this point with us and so there would be implications for them directly as well.

Mr. WOMACK. Let me recess the meeting now, if it pleases my colleagues, so that we can go to the floor and vote, and we will try to return here in about 15 minutes. We will be in recess.

[Recess.]

Mr. WOMACK. To those guests who are gathered and to our witnesses. Obviously, our voting is a major part of what we do, so thank you for your patience and understanding as we take care of that action. Mr. Fattah.

Mr. FATTAH. Let me thank the Chairman. And why do we not begin with the 1703 and 1705 loan guarantee efforts? So on the nuclear side, the administration is pursuing, after a 30-year dearth of activity building new nuclear facilities, you now have one deal that is in process and you have a number of decision packages that are being assembled.

The Ranking Member, Mr. Pastor, was asking you earlier about whether or not we had an instance where you had an applicant who was prepared to proceed with a loan guarantee in part, contingent on future appropriations. In that instance you would be amenable, all other things being in place, and there were no legal constraints present. Under that set of scenarios, and all other things being equal, would you be afraid to go forward with that deal?

Mr. SILVER. Thank you for the question, Congressman. Obviously, we will work with the resources that Congress makes available to us. Perhaps a bit of history would be in order.

The nuclear solicitation in 2006/2007 generated 12 applications; 2 of those then withdrew of their own accord. There were 10 and those were ranked in a sense by their readiness to proceed. They were then tranched so that we could move them forward in groups, focusing particularly, as I said earlier, around the notion of trying to identify alternative technologies that the private sector could then review and participate in.

Those projects vary in size, they vary in technology, they vary in geography. You know, as you are well aware, Pennsylvania actually ranks second in the nation in nuclear power generation. So these are big and important across the country.

We tailor our work and our transactional—our negotiations with applicants around the unique features of those applications, so.

Mr. FATTAH. I guess the real point is that you have the capacity to do deals.

Mr. SILVER. Uh-huh.

Mr. FATTAH. And you have a number of applicants who are trying to be in a position to do their deal, right? So if you had a package that was ready to go, and an applicant who was prepared to go, and you did not have the full wherewithal, because we have not finalized our process yet for FY '12, but they were prepared to go contingent upon appropriations, is that a deal that you would be prepared to proceed on?

Mr. SILVER. Well, it is certainly a deal we would be prepared to discuss with them. I am not aware of any applicants who are currently in a position, as I understand it, to proceed with what would be a contingent conditional commitment.

Mr. FATTAH. But if there was such, you would be sitting down?

Mr. SILVER. If there was such, we would certainly be willing to, you know, discuss it.

Mr. FATTAH. I just needed to conclude that for my colleague. And now let me move to my point. And you come to this with a great deal of experience and capacity as an honest grad, I want to put this on the record, from Harvard——

Mr. SILVER. Thank you.

Mr. FATTAH. [continuing]. And your studies in Paris, and as a Fulbright scholar, you are, you know, bringing an extraordinary amount of capacity to this effort. I want to walk through the 1703 and 1705 loan guarantee program in some detail.

Now, we are proceeding in this administration with more traditional types of nuclear plants. The Secretary has also said over the last few days that small nuclear reactors and a mismodular approach are going to be at the forefront of some of the efforts. I assume they would be eligible perhaps.

Mr. SILVER. That is an interesting question. The answer is, unfortunately, it depends. Again—and the reason I say that is because we are a project finance group, and as such, at its most basic, what we are trying to do when we analyze these transactions is to ensure that there is a stream of free cash flows available to meet the repayment schedules that we have established with these projects.

We are looking for that—to walk the line between innovative technologies that at the same time can reach commercial maturity during the time in which they are being financed. I personally believe, and I know the Secretary does, that there is a bright future for small modular reactors. The question would be whether or not a project presented to us was sufficiently commercializable at that stage for us to be able to negotiate.

Mr. FATTAH. Right, but if the business plan was sound and if it was commercializable, it would be you dealing a yes out of that deal.

Mr. SILVER. Yes, I will defer to both my colleague here and to others at the Department as to the stage of technical readiness for commercial deployment of SMRs. But should such an occurrence exist, we could certainly look at funding something.

Mr. FATTAH. And we have a relatively unknown gentleman in the country by the name of Bill Gates who has been investing tens of millions of dollars in this TerraPower approach, which would have the added advantage of having no spent fuel for us to have to deal with.

Mr. SILVER. Yes, sir, that is one of the advantages.

Mr. FATTAH. Would this also be conceptually something, assuming it got to the point down the road that they show up at your door?

Mr. SILVER. If there was an open solicitation, which is the only way we are permitted to review applications, such that a commercializeable small modular reactor project could apply, then certainly—and we had the resources to work with it, then, yes, it would.

Mr. FATTAH. Okay. Now, I have been a leading proponent of the loan guarantee program on the nuclear side, but also on the renewable side. So you have $18 billion, and you have a fairly significant

deal flow there that runs a range of activities. The size of the deal, the minimum size is what?

Mr. SILVER. There is no minimum size, but by virtue of the kind of work that we do, you end up gravitating towards projects which are large enough to be robust enough to generate the cash flows which will repay the loans.

We have worked on projects as large as, obviously, as nuclear projects, but we have worked on renewables projects, you know, multiple-billion-dollar projects, but we have also done deals and have conditional commitments and closed commitments for projects that are 15-, 20-, 30-, 40-, $50 million in size.

Mr. FATTAH. Right. Now, I am trying to get well below that, people who are involved in very significant innovative activities. Would there be a possibility of pooling dollars for smaller loans to entrepreneurs who are working on activities that could meet the other criteria, but that may be looking for much smaller dollars?

Mr. SILVER. 1703 is, as you know, Congressman, the program which focuses principally on innovative technologies. The challenge in using the $18½ billion worth of authority for renewables projects there is, not surprisingly, that innovative energy technology companies tend to be smaller, less well capitalized, more modest revenue streams and the like.

Because 1703 is a self-pay program, that is, the credit subsidy is paid by the applicant, it becomes very challenging for a small, thinly capitalized company to come up with and put forward the capital. We would be thrilled to work on projects in the 1703 program, innovative energy projects, small innovative energy projects. We probably do need to discuss how we finance those and what rule, if any, credit subsidy would play. One of the reasons——

Mr. FATTAH. I am glad you posed that because my idea here is that we have states like Pennsylvania and others who have technology and energy related activities which they are trying to generate in their states and help entrepreneurs. If you could marry perhaps state economic development efforts in this regard, they may be able to serve as a partner and a deal that could allow us to light many more candles, if you would.

Mr. SILVER. I would be eager to work with you on that.

Mr. FATTAH. I would like to talk to you about that. Doctor, let me ask you a question. When we started with the American Recovery Act, what percentage of the battery market did we have in the world?

Mr. MAJUMDAR. Well, in 2009, we had less than 1 percent lithium-ion battery manufacturing, and actually we invented the lithium-ion battery in early——

Mr. FATTAH. We invented it, but it went elsewhere.

Mr. MAJUMDAR. It went elsewhere, yes.

Mr. FATTAH. Now, what percentage after this very significant effort by the stimulus program, what percentage of the market do we now have?

Mr. MAJUMDAR. I think——

Mr. FATTAH. Or are we approaching?

Mr. MAJUMDAR [continuing]. Yeah, by the next year or 2 years, we will probably have the capacity to build about 14 to 20 percent

of the battery manufacturing, lithium-ion battery manufacturing in this nation.

Mr. FATTAH. Now, part of what you are doing is, you are trying to not just look about where we are now, but where the future is, and one of the challenges in this electric car area is the development of a battery that could really allow me to drive from Philadelphia to Boston, or to take very long distances, right?

Mr. MAJUMDAR. Right.

Mr. FATTAH. And so you capitalized a number of activities in this regard. Some are very, very, you know, promising, and I think that what you are suggesting now is that we want to look at natural gas in addition to this battery effort, that part of what you want to do in FY '12 is to look at the fact that we have such a significant and abundant amount of natural gas, you would like to see how we can move that into the transportation side, right? The challenge there, as you see, is to do essentially what we have done in the battery size?

Mr. MAJUMDAR. Well, it is similar. I think in the transportation sector, frankly, we do not have enough options like we have in the electrical sector. And I think it is really for our own national security and economic security that we create options. And, you know, we are paying a billion dollars a day and sending it out——

Mr. FATTAH. Four hundred billion dollars a year buying oil from other people, yeah.

Mr. MAJUMDAR. So I think we should—we need options, and I think electrification is one option. And, as you pointed out, we are looking for those batteries that will make electric cars have a longer range and have a low life cycle cost and gasoline, so you do not need any subsidies for them to be sold. In the natural gas sector, we are looking at, you know, several options, how do you convert natural gas to gasoline, and the way it is done today, what is called—something called a Fischer-Tropsch process, is just too expensive in gasification, making some gas and then making gasoline is just too expensive, and it is not going to work for the natural gas that we get in the United States and the shale gas.

We put all that together, it is not really complete unless the cost of—the price of oil goes high. So we are looking for other approaches, innovative approaches that no one in the world has today, and that we want to, you know, we want to pursue, and the way we do it is, we bring a workshop together with all the experts around the country and say, hey, here is a challenge, can you do it cost effectively. At the end of the day, cost is what matters in energy, and can you do it at scale. And so out of that comes out various, you know, stretch goals, and we then, you know, if this is something that is interesting, we look around and see what other parts of DOE are doing it, if they are doing it, then we will not duplicate that, but if no one is doing this, that is the white space that we talk about, and that is the kind of thing that we will proceed in.

Mr. FATTAH. Now, what has been the correlation between the amount of public investment and the amount of venture capital or private equity that has occurred—after your additional investment?

Mr. MAJUMDAR. Yeah, so we are, you know, we are sort of PVC, this is highly risky, translating science into the first prototype, and

showing, you know, people think it is impossible, they say here is a—actually possible, that is where we are too risky for the private sector.

But one of the things that we have done is that we have funded over 120 projects in the first three rounds, and six of those projects received $24 million about a year and a half ago, and that allowed them to do the R&D, meet the milestones.

We have yearly milestones, meet those milestones ahead of schedule, and that attracted the private sector, and they have now invested more than $100 million in those technologies, which is leveraging 4–to–1 in a year and a half or so, and this is continuing to happen more and more.

And these are only six of the technologies. Some of the technologies will fail because, you know, people will not be able to make the prototype, the technology may not work, but there are a few success stories that are showing up right now.

Mr. FATTAH. I went out and visited some of our national labs with our Chairman. Now, one of the projects that you invested in is a lithium oxygen deal?

Mr. MAJUMDAR. Yeah, lithium air battery, which is the holy grail, the highest energy density battery, and people thought it was impossible, because, as you know, lithium is explosive in water. And they made this battery out of some new materials that they have found, and they created composites to protect the lithium so that they actually—this battery works in water. You dip it in water and it starts working and it does not explode.

And this is, as I said, the holy grail. People think that this is—if this happens, then lithium-ion batteries could be obsolete, if this thing really works in scales and manufacturing. So the Japanese, we learned that the Japanese have put now a team—Toyota has put about a team of 100 engineers or so saying that, okay, if they can do it, maybe we can. So there is a global race going on. And so we want to, you know, support——

Mr. FATTAH. It is a race we were running in for—until the last two years, so—but I am glad you are at least out in front of it, and we thank the Chairman.

Mr. WOMACK. Thank you, Mr. Fattah. Dr. Majumdar, this budget request is for $550 million alongside the mandatory piece that you have. Now, since they have not received any program funds since fiscal year '09, when they got 400 million from ARRA, I would count this request in that same general massive increase category that the Department has asked for energy efficiency and renewable energy. So you obviously consider this a successful program. Why?

Mr. MAJUMDAR. Well, there are multiple successes that I would say that—and this is not just me saying there are other people outside, credit with people who are saying that, as well. Number one, we stood up this agency in less than two years, and we have shown the speed and efficiency which is unprecedented. You know, getting contracting time down to two months, getting a team together, some of the best minds in the technical community, they are now in ARPA–E and they are putting together—and they have only a three-year clock, so they are really aggressively trying to push the technical communities to innovate with an urgency that will make U.S. competitive.

We are also looking at technologies which are quantum leaps, which is the equivalent of the Internet or the GPS, which 10, 20 years from now, people will look back and say that this made U.S., you know, economically prosperous and gave us national security. So that is the kind of innovation that is going on.

And, you know, we are disciplined in how we do it. We have deployed capital very efficiently, and, you know, those are the early successes. And as I said, the private sector has noticed after the risk has been produced. So those are the early successes, and I think the President and, as I said, the Secretary, this is one of their highest priorities, because this is where, you know, things are moving, and things are working, and we have the whole innovation ecosystem alive right now to make the U.S. competitive.

Mr. WOMACK. You talked a moment ago in response to Mr. Fattah's question, you gave an illustration of I think a couple of programs, it may have been more than that, that you had invested 24 million in, got a 4–to–1 return on investment, as we talk about our successes, can we talk about our failures? Is it appropriate to mention those that we have not enjoyed the same type of success, and how much has been invested?

Mr. MAJUMDAR. Well, we are, as I said, we are only about a year and a half into the whole agency, and there are some projects that are on red alert right now, and we have given them warning, saying that you are not meeting your milestones or things are not working. And, you know, instead of just cutting it right away, we want to give them a little chance and help them. But at the end of the day, if it does not work in the next few months, we will terminate them, and as I said, I would rather put that money back in the Treasury.

Mr. WOMACK. Have you terminated some?

Mr. MAJUMDAR. Not yet.

Mr. WOMACK. Not yet.

Mr. MAJUMDAR. So we have given them two warnings, some of them, and they are on the last three strikes, and they will be out, and then I will put the money back in Treasury.

Mr. WOMACK. What kind of assurance can you give our Committee that an increase like this could actually be put to use, implemented in a year?

Mr. MAJUMDAR. Well, we have shown that, from scratch, we put this agency and deployed $360 million in a year, year and a half, and that is the efficiency that we have created. And I think this is where we have—since we have demonstrated that, and since, you know, people outside have noticed, and I will just give you a few examples.

The President's Council of Advisors in Science and Technology, these are the top leaders within this nation. They are the national treasure; they reviewed us and the Department of Energy, and there is a whole report that has gone to the President, and there is a whole section building on the success of ARPA–E, because they feel that there are some things that have gone right out here that the rest of the Department should notice and see if those can be implemented elsewhere.

So this is—there are other people saying that. There is a report from American Energy Innovation Council, which is Bill Gates, Jeff

Immelt, John Doerr, Norm Augustine, these are the Who's Who in the tech business world, and they have said the same thing. There is another report from the American Enterprise Institute, Brookings Institute and Breakthrough Institute which have said exactly the same thing. So these are other people saying that this is where the success is, this is where we can out innovate, take the quantum leap and be ahead of the rest of the world, and we should be number one in solar technology, batteries and fuel, et cetera, and we should lead, and this is where the leadership can come from in the technology side.

Mr. WOMACK. You and I talked recently about my visit back in my own district to a company, Arkansas Power Electronics, and their work, and I am assuming that is a recipient of some type of support through this program. And the work that they are doing to shrink the size and create, and I will show my ignorance here of the concept, which is okay, to shrink the size for the electrification of the batteries that are going into passenger cars and to create some real efficiency into how you cool those components. Is that an example of the type of work that we are talking about, and is that a good news story, I am assuming it is, or the future of that technology?

Mr. MAJUMDAR. It is not only a good news story, it is a great news story, I will tell you why. This is what is called a field of power electronics, we invented it. We have not invested in it for decades. And we have lost the art and the science of power electronics. Why do we need power electronics? Even the power supply of your computer, or if you want to charge electric car, the technology to do that, to convert high voltage to low voltage, AC to DC, DC to AC, you need it in solar technology, you need it in transformers and substations, distribution substations, et cetera, we buy most of them from abroad, from overseas, and we pay a lot of money for that.

We have lost the art of doing that. And these are dumb devices. The power supply is quite dumb today, from the computer power supply. So this program that we created called ADEPT, Agile Delivery of Electric Power Technology, this is to take that quantum leap in power technology so that we never have to buy those transformers from abroad, but instead, sell a smarter, better, cheaper, lighter, you know, power electronics to the rest of the world. And this is made of semi-conductors, silicon carbide, gallium nitride, I will not go into more details, and we are the best in the world in those. Knowing that they are better, why go along down a different path? So that is—in fact, this is an example, the one that we have in your district is an example for technology to enable charging and efficient power electronics in electric car. So right now, today's electric cars power electronics, it needs to be cooled because it is based on silicon, and silicon cannot work more than 100 degrees Celsius.

While we are switching to silicon carbide, you not only make it more efficient, you eliminate the cooling system for the power electronics, which is a really sort of quantum leap in technology. So it is a great example.

Mr. SIMPSON. One of the concerns I think we all have, particularly—it should be this way anyway, but more so when you have declining resources—is, in the military what we call mission creep.

And that is the one operation with a certain set of goals and objectives, kind of moving over into someone's other lane. And that is one of the concerns I have as a new member.

ARPA–E proposes some large increases in areas that overlap significantly with proposed increases in other DOE programs. When one project's mission grows so much that it starts overlapping with others, what controls do we have to ensure that we are not creating unnecessary duplication? And I say unnecessary because I realize that programs need to talk to one another, and perhaps have issues or projects ongoing that are complimentary in some respects. So when I say unnecessary duplication, duplication that is simply not cost-effective.

Mr. MAJUMDAR. Right. So, we take a lot of care in making sure that what ARPA–E does no one else in the Department of Energy—not just the Department of Energy, in the Federal Government does, which is, how we define as white space, that there is an opportunity out there no one else is funding. And this is the quantum leap in technology. So we take a very team approach within the Department of Energy.

For example, if I take the occasion of—this example of the battery. Now in energy efficiency, renewable energy there is an Office of Vehicles Technology, which is investing in lithium ion battery and making it cheaper and better, so that we gain dominance in the lithium ion batter. Our goal is to make the lithium ion batteries obsolete. So we will not invest in lithium ion battery. But we want to do that in a coordinated way to make the lithium air battery so that, you know, so that the people in the EERE office are aware of it. But we are not overlapping in that sense. And we look to science to provide the understanding of how these batteries work. So, if they fail, we can go back to the, you know, to the drawing board to understand what is going on.

So we take a lot of care. We have what is called a panel of senior technical advisors that ARPA–E has created. These are all the top technical leaders from all the offices in the DOE to make them aware, to get a feedback loop so that, again, we are coordinated and we do not duplicate.

Mr. SIMPSON. I would like to come back to another line of questioning as it concerns natural gas. But at this time I am going to yield to the gentleman from Mississippi, Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman.

We have had the opportunity to visit. I think we share a goal that I have modified from a challenge I had as a child. I was inspired by President Kennedy that our nation landed a man on the moon and successfully returned him back to Earth before the end of the decade.

One of my missions serving in Congress is to ensure that by the end of this decade, our nation become energy secure. We have talked about it a lot throughout much of my lifetime, but I do not think we have accomplished much.

My first question is, I have identified what we need to do to reach that goal. I have identified three broad categories. Let me outline those categories and see if you can think of anything that I have left out, if maybe there is a fourth one I have not thought of.

The first one, and it is one where you are going to be most involved, is technological innovation: doing things tomorrow that we may not even have terms for today, things that do not exist today. The second is using our existing energy resources in a more efficient manner. And the third is developing more of our existing energy resources.

So, I guess my first question is, in a broad context, are there any other categories that you see we need to have to accomplish that objective?

Mr. MAJUMDAR. You know, frankly, Congressman, this is a great point. And I should say, by the way, I was inspired by what you said in our meeting in your office. That you are a product of the Sputnik age and you wanted to be an astronaut. Even though you did not go to the moon and walk on the moon, you benefited from it. And I think this is exactly what we need to do. We need to do a few things. And as you pointed out, technology innovation is absolutely critical. Because we have to lead and I, frankly, I do not want to be number two to any other nation. I want to be number one because that is what the United States has always done in technology innovation.

If I were to add one more, I think it is not only important to innovate out here, we also need to manufacture out here. And it is that out-innovate and out-building. And I would, if I may just add one more to that?

Mr. NUNNELEE. It is why I asked.

Mr. MAJUMDAR. Because I think that will lead to, I believe, the economic prosperity of our nation to jobs. And I think in this—everyone is looking at, you know, energy security, not just our nation. Other nations are also importing oil. If he can figure out how to do it, and that is the leadership, this is the biggest business opportunity for the United States, not just a national security.

So that is the only thing I would add to it. But I totally agree with this.

Mr. NUNNELEE. All right. And let me ask you, and this becomes even more difficult, I am trying to evaluate where we need to go. How would you assess the percentage for each of those four categories that you think would apply to our ultimately reaching that goal? So, by the end of this decade we would become energy secure. Is it 50 percent technology where you are most comfortable? Is it 50 percent exploring existing energy resources? How would you allocate the total chance of success among those four categories?

Mr. MAJUMDAR. I think it is hard for me to sort of give you a number right now. I can get back to you on that. But as you heard, the President gave a speech on energy yesterday. And he talked about reducing our oil imports by one-third by the end of this decade, and I think we should have options to doing that.

One is, of course, as he pointed out we can use our domestic resources of oil and natural gas. We do not have ways to use natural gas in transportation, and that is one of the things I want to pursue in FY '12 budget: how to use natural gas and convert that into liquid fuels. And this is hard. People have tried this in the past, but there are opportunities that we think that have not been tried.

At the same time, there is electrification of transportation, at least for light-duty vehicles and some of the, you know, fleets of de-

livery trucks, et cetera. FedEx is converting all of their small delivery trucks to electrified trucks. So, here is an opportunity out there.

So while I would, you know, I would love to give you a number, but I think there should be a competition between all of these to see, you know, what can reduce our oil imports and reach the President's goal?

Mr. NUNNELEE. And I would appreciate you giving some thought to that, and following up for a conversation. My experience from business is that: I identified my desired outcome. Then the percentage that I anticipate from that desired outcome is the percentage of resources I ought to be dedicating to reach that outcome. I have to determine in my own mind, okay, if we think achieving energy security by 50 percent is through developing existing resources, then I ought to be spending 50 percent of my time and 50 percent of our nation's budget doing that.

But I would like to explore this. So, Mr. Chairman, with that I will save some more questions for follow-up.

Mr. SIMPSON. Thank you. Mr. Fattah, back to you.

Mr. FATTAH. Mr. Silver, let us work through this. Because I think that just as it is true in the whole battery area that a couple years ago we were in a deficit position as a country in terms of our participation in a share of world market, when we look at these other areas, I mean, we know that for instance in nuclear we did literally nothing for 30 years. I was a young state legislator on the Energy and Mines Committee in Pennsylvania when we were last dealing with nuclear in Pennsylvania. So now the administration has moved forward in that area.

I mean, we hear that, you know, Spain, Germany, where are we at in terms of the wind industry in the world relative to our economic competitors?

Mr. SILVER. We are increasing the rate in which we are installing wind energy. Wind is probably the most mature of the renewable technologies working in the United States today. However, as I am sure you know from the——

Mr. FATTAH. Are we the leading country in the world in wind energy?

Mr. SILVER. Well, it depends on how you define that. We have only a few companies that actually make the turbines. The cells, which are essentially the motors which manage the turbines, require parts and materials which are in short supply here, particularly rare earth materials, which we need to be cognizant——

Mr. FATTAH. Well, China has control of about 95 percent of the rare earth materials in the world, right?

Mr. SILVER. That is correct. So, the amount of wind energy in this country is growing. It is growing significantly, but it is not growing as fast as it is in some other countries.

And in renewable capacity, from a national perspective, no other countries have more renewables on a per capita basis and on a——

Mr. FATTAH. So if we invested less, would we improve our position in the world? Or would our opposition——

Mr. SILVER. You know, Congressman——

Mr. FATTAH [continuing]. Probably continue to be——

Mr. SILVER. I think if we invested less, I think we would most likely fall further behind.

Mr. FATTAH. Okay. So, geothermal, we went to Toronto. You can see them taking water out of the river and you run it through downtown office buildings for energy purposes and back into the river. You cannot find that anywhere, at least in Philadelphia or New York.

Mr. SILVER. You are right. In fact, I actually——

Mr. FATTAH. On a city where——

Mr. SILVER [continuing]. Think there is a relationship between your question and Congressman Nunnelee's, and it gets to this question of innovation and manufacturing. And I do not believe that these are linear. It is, in fact, a virtuous circle of innovation. That is, innovation drives commercialization. Commercialization, in turn, drives innovation. And it is why these programs and these efforts fit so importantly together. But while we focus on innovation we must absolutely focus on execution and implementation at the same time.

Mr. FATTAH. So, I mean, in Israel, for decades if you were going to build a home you had to have a geothermal unit, right?

Mr. SILVER. Right.

Mr. FATTAH. We have just seemed to have not been in this business for decades, this whole question of energy or energy policy. So I am trying to figure out whether if we lessen our investment—and we have now had a robust effort over the last two years, right? We have seen remarkable success in a variety of these areas. Obviously, we still have a long way to go. And I am trying to understand because you talked a little bit about where the deal flow is now.

I mean, obviously what we want to do—because we want to rely on the private sector, we want to use government dollars in the same way we did with NASA to create technologies. I mean, it is over 17,000 products that have been commercialized through getting us to the moon and, you know, the whole effort of NASA. So, I mean, there is a benefit here on the job side, on the energy side, and also on the national security side.

So, I mean, I think if America is going to be number one, I mean, we have to make this investment. And arguably we should be even doing more than we are doing. I think one could make an argument because if you look at what China is doing, I mean, they have invested a great deal of money in an effort to, you know—just look at the rare earth materials side. They have 35 percent, but they have also locked down now 95 percent in the rest of the world.

So we are going to create a circumstance where for our children and our grandchildren that creates a kind of a self-fulfilling cycle in which not only are we behind, but that we will be forever behind unless we make the investments that we need to make. And, you know, the economies of the moment, you know, the budget challenges of the moment notwithstanding, we are not shadow boxing here. I mean, we are actually playing against other—we are in an economic competition against other powers in the world.

And we have to think through, particularly in this energy area, because I am very focused on manufacturing. And manufacturing, we are the number one manufacturers in the world even though we

only have 300 million people. And we are beating people with 2 billion, you know, in China or 1 billion in India. But we cannot power our manufacturing sector unless we have power sources that are efficient, that are renewable, and that do not do the kind of damage to our environment that we would not want our children to inherit.

So, I want to thank you for your testimony and I will yield back.

Mr. SILVER. Congressman, you said it better than I ever could have. The only thing I would add to that is that the reason to build out at scale is actually because we have underinvested in the energy space for so long. We lack a supply chain and building out at scale drives the creation of those supply chains, which in turn creates the manufacturing base to which you are referring. I could not agree with you more.

Mr. FATTAH. Thank you.

Mr. SIMPSON. Mr. Nunnelee is more ambitious than I am, trying to become energy independent within the next ten years. I just want to live long enough to actually see us finish a budget by October 1st of the fiscal year. And that is something that I am, like, 80 percent sure when October 1st comes. It comes sometime right after September 30th, and we cannot seem to get that done.

But, that aside, you talked about how innovation drives commercialization drives innovation and stuff. The one other factor that is in there that probably drives more of it than anything is cost and price. We can do a lot of neat things. If it is not cost- or price-effective or competitive with other things, it is not going to find a place in the marketplace. So, that is one of the things that we have to look at, and I suspect that one of the things that your program does is how can any of these technologies that are some neat things—how can we make them cost-effective for commercialization?

Mr. MUJUMDAR. That is right.

Mr. SIMPSON. You mentioned that you invested in technologies or potential technologies that are too risky for the private sector to take on, and I look at one of the programs that you are proposing—the request for a hundred million dollar pot of money of mandatory funding for something called the Wireless Innovation Fund. This funding would be a one-time allocation made available from a spectrum auction. ARPA–E would receive a hundred million dollars to develop cutting-edge wireless technologies. Your budget explanation is pretty thin on why we are doing that. What is the plan for this funding in more detail? Would you use similar rounds of applications as you have with appropriated dollars for this in-house research at DoE labs?

And basically I look at this and go wireless technologies, if there is anything that is developed over the years by the private sector, it has been wireless technologies. Why would we be involved in that? Why would the government need to be involved in that?

Mr. MUJUMDAR. This is really the use of wireless technology and energy technology. Just to give you an example, today our grid is—it is old; it is overloaded; it is unreliable; and it is not very secure at all. And I think there is a—you know, there is a need to make the smart grid, and today what is going on at smart grid is really sort of measuring, if it is smart meter or something called phasor measurement units to look at, you know, in AC transmission what

is going on, and it is just a measurement. The communication of that data to make sure that a grid is resilient to cyber attacks, as well as to control it and to stabilize it, to increase the capacity of existing infrastructure has not been yet. And that needs high-speed communication, which is——

Mr. SIMPSON. Is some of that work not being done at some of the National Labs?

Mr. MUJUMDAR. Not really. This is—right now, the use of those measurements—to be able to route electricity in the right way—in fact, we had a workshop right on that—to be able to route electricity, to be able to stabilize needs network control, feedback control at the network level, and that has not been done. And so that is the kind of thing, innovation, that I think is very important.

You know, we have done a lot of information technology, and I agree with you. But the connection of IT with ET has not happened, and I think this needs—this is a place where—again, this is a one-time in a mandatory spending which can be spent over several years, not just one year, and we hope to use this opportunity to make IT and ET sort of come together. And I think there are a lot of security issues I think that are important out here.

Mr. SIMPSON. Well, I appreciate the work that you do, and, you know, we have always said in this Committee over the years that all the science and research that is done, while it is important, at some point in time has to show itself in something that the American people can see a value at.

Mr. MUJUMDAR. Right.

Mr. SIMPSON. Deployment is what we like to use, and I think both your agencies are ones that help get those technologies and those things out the door and on the ground so that people can see what their investment is for.

Mr. Silver, I have heard a great deal of praise from the nuclear industry for the administration support of the Nuclear Loan Guarantee Program. I have also heard, as you can well imagine, some industry sources that describe the Federal Loan Guarantee Program as being, for lack of a better term, constipated. In this discussion, it is important to note that the Loan Guarantee Program for nuclear energy does not pay the credit subsidy fee. Instead, the Nuclear Loan Guarantees are unique in that the industry pays for these fees. Although we account for these loan guarantees as a cost in the budget, they are likely to be money makers in the long run. How do we streamline this program so that it can provide the required booster our electrical generation needs and still do the due diligence from the government perspective that I think everybody wants us to do and that we need to do?

Mr. SILVER. Yes, thank you for the question, Congressman. As you know, and as you and I have spoken about before and lived through, obviously, you got a chance to see our work up close and personal on the ARIVA project and the kind of due diligence that goes into work like that. I think perhaps it might make sense to offer a bit of context for the program.

Between 2005 and 2009, early 2009, actually no loans, either 1703 or 1705 loans, were issued by the Department of Energy.

Mr. SIMPSON. Right.

Mr. SILVER. And, in fact, as recently as January of 2009, there were 14 or 15 people on staff. I arrived there, just as a point of reference, in November of 2009. We had about 35. We now have about 170. That includes federal employees as well as professional consultants and contractors. And as a result, we have been able to ramp up the production of those loans to the extent that we have now done 25 or 26 loans, put $26 billion worth of credit subsidy, of loan guarantees, into the market, which in turn have generated about 43 or $44 billion worth of project costs.

But let me address the question you asked by describing some of the challenges that this program faces.

This is, at base, a project finance group. And as a result, projects need to conform to the requirements of project financing. As I described a little bit earlier, that is to say we need to be able to identify after our due diligence, after our negotiation of the term sheet, where the cash flows from these projects are going to emanate in order to be able to be repaid. Not all technologies are—maybe I will say it this way. Project finance is not always the most appropriate financing vehicle for all stages of the development cycle. And in the private sector, financing groups, even project financing groups, make use of a much broader array of financing instruments than we have available to us.

Second point I might make as a general challenge is that innovative projects, particularly innovative projects we are driving to scale, take a long time to develop. But the schedule at which that happens is largely out of our control. While we are committed to the notion of putting this money to work in a meaningful time frame, the projects can only proceed at the pace at which the applicant itself can proceed. And we all need to remember that this is not a unilateral discussion; it is a bilateral discussion. So there are things we have to do. As in any business negotiation, there are two parties at the table. As lenders, we simply cannot make the projects go faster than that.

Third, I would note simply the inherent tension between innovation and commercialization. Driving one to the other is the essence of our responsibility but also part of the framework within which we have to work. What we have built is a project finance group that is certainly larger than any other in the country and arguably as good as or better than any other because of some of the other issues I alluded to that we need to take into consideration when we do our due diligence.

It is absolutely true that applications—some applications have been in our shop for a very long period of time. But that is driven principally by the fact that the program itself was not funded until late 2008. Now that we are fully operational and have had the chance to do the things that ideally a startup organization would have done to begin with—for example, we built—we were an entirely paper-based operation—we built a front-end electronic submission, an electronic portal for submission of applications, which I might point out brought the intake process down from about three to four months to about eight to ten days as part of the logical thing any business actually would have done to improve its performance.

As a side bar, I would note that that front-end piece of software that we built was awarded the best piece of business process management software built by a government agency anywhere in the United States in 2010.

But the moral of that story is we are trying to run ourselves as efficiently as we can and as efficiently as the private sector does, in general, for applications that have come in once we achieve critical mass, and we are able to take an application through in roughly the same period of time even though we have more obstacles in roughly the same period of time it would take in the private sector. It is a function of having built ourselves to scale that permits us to do that, and keeping that scale is essential to being able to continue to produce at that level.

Mr. SIMPSON. Well, I appreciate that and thank you for pointing out the fact that, you are right, there are a number of years that there were no loan guarantees approved and this Committee used to complain about that substantially, and you have taken this agency and really stood it up. And we appreciate that, and I know you are working on things. We want to work with you to make sure that we make it as streamlined as possible while we still do the due diligence that we are required to do.

The Calvert Cliffs Nuclear Plant withdrew its request for a loan guarantee citing the credit subsidy cost. How is the credit subsidy cost calculated? Are the credit fees guidelines a reasonable balance based on the risk and the desire to move projects forward?

And I understand that you are updating the formula credit subsidy cost. Can you tell me how this process is going and whether or not you will explain the new formula to the public and the industry?

Mr. SILVER. Credit subsidy is both a complicated and a simple concept. At its most basic, it represents what the estimates driven by the inputs to our model identify as the potential loss on a net present value basis at a point of default, and each part of that is important, because it is important to understand that these are not binary investments. That is to say once you make an investment, if something were to wobble or go wrong you do not necessarily put your money at risk. If you had borrowed—provided a loan guarantee for a hundred dollars and there were ten payments of $10 each and the first nine payments had been made and there was a default that occurred here, the credit subsidy is the calculation of the relative amount of the loss that you would recover through the recovery process.

It is made up of two basic inputs, although there are enormous data points that roll up to that. One is the estimated risk of the project, and the second—at its most basic—and the second is the likelihood of recovery; and those two blended together produce a credit subsidy score.

The credit subsidy scoring process is—the credit subsidy score is the derivative of a model that was built by a large inter-agency process some years ago and predates me but involves those inputs and that assessment. We do look at it regularly.

There has been some discussion reported in the popular press around recovery rates, anchor rates, and the recovery rate around nuclear projects; and we continue to try to evaluate that to make

sure that we are using the best available inputs in order to make the projects as viable as possible.

Mr. WOMACK. Doctor, could you tell me about the relationship between ARPA–E and the Office of Science?

Mr. MUJUMDAR. Sure. We are independent of Office of Science. In a statutory provision, I report directly to the Secretary, not just the organizational part.

We, in ARPA–E, do not do science. We translate science into breakthrough technologies, so we are complementary to what science does.

I should say that before I came here I was a scientist, an engineer funded by the Office of Science, so I know how that works and what they do.

And I make it a point to make sure that we are not duplicating what they are doing but in fact leveraging them in the best possible way to translate the science into breakthrough technologies that would make you as competitive in the future.

Mr. WOMACK. For those members that may not have been here before, when they stood ARPA–E up, they organized it based on a highly successful program in the Defense Department, DARPA.

Mr. MUJUMDAR. DARPA, that is right.

Mr. WOMACK. And we found that to be, really, a successful program over in the Department of Defense, and this was organized pretty much in the same way, learned the lessons from DARPA and hopefully improved on it even, and I think you guys do wonderful work and I look forward to working with you, and as I said this is what gets stuff out that people see.

Mr. MUJUMDAR. Right.

Mr. WOMACK. Can see the value of the investment we are making. I know, Mr. Silver, the Loan Guarantee Program is important in getting the new technologies out in the nuclear industry to improve the safety of our nuclear fleet where the new reactors that we are going to be building are safer than the older reactors with the passive provisions, safety provisions, and those types of things. So it is important that we continue to improve the safety and the newness and the most updated technology in a lot of these areas, and your program plays a very important part in that.

Mr. SILVER. Thank you.

Mr. WOMACK. Thank you.

Mr. MUJUMDAR. Thank you.

Mr. SIMPSON. And a pretty small staff, small footprint in your department, too. Am I——

Mr. MUJUMDAR. That is right. We are only 25 people.

Mr. SIMPSON. Yeah, tucked away in an area over by L'enfant?

Mr. MUJUMDAR. Sure.

Mr. SILVER. That is right, yeah.

Mr. MUJUMDAR. We have a happy hour. You are welcome to join happy hour Friday evenings.

Mr. SIMPSON [continuing]. State's got more football players——

Mr. WOMACK. Speaking of that, we are getting close to that time frame.

I do have one more question for the doctor here, and that is—I said I would come back to natural gas and you had mentioned in response to Mr. Fattah's question earlier about converting nat-

ural gas, I guess, into gasoline, and my question was more about how future natural gas technology is going to play in the transportation market. So, where are we headed in that direction? I ask that from the perspective of, you know, a representative from a state that has got a natural gas plays going on.

Mr. MUJUMDAR. Well, I think there is a—actually, yesterday in the President's speech, the President mentioned natural gas and that these are—we should, you know, produce them in a safe and responsible way, but also the use of natural gas both for our domestic electricity supply, which today a natural gas combined cycle is the cheapest way to produce electricity. But if you could use that in the transportation sector, there are many ways of doing it, whether we have, you know, LNG and LPG, you know, sort of in the long distance transportation. Frankly, that technology exists today.

In terms of actually using natural gas to liquid fuels, conversion of that, that is where I think we should be focused. At least in ARPA–E that is where we would like to focus on, because there are so many stranded reserves of natural gas. I know there is natural gas that has been founded here. There is lot of natural gas that is stranded in Alaska. And we cannot put that in the pipeline, because that pipeline is for liquid fuels. So, if you could somehow convert that to liquid fuels, then maybe we could use that. But also making more efficient engines. Today, if you can increase the efficiency of the use of natural gas in the engines, I think that would be best user for natural resources out here.

So, I think there are many opportunities out here, both in the production and the use and infrastructure for natural gas.

Mr. WOMACK. I have no further question, Mr. Fattah, Mr. Simpson, Mr. Nunnelee.

Gentlemen, I want to thank you for the time today and your testimony and the work you do on behalf of the greatest country on the face of the earth, this United States of America. Thank you for your service to our country. And a reminder that the questions for the record, supporting documentation, let us meet the timelines and the dates established in my opening remarks, and with that, this hearing is adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

ARPA-E AND LOAN GUARANTEE PROGRAM
FISCAL YEAR 2012 BUDGET HEARING

MARCH 31, 2011

NUCLEAR LOAN GUARANTEES POST FUKUSHIMA

Subcommittee. Mr. Silver, it will be generations before the people of Japan are able to fully heal from the March 11 earthquake and subsequent events. In addition to the human tragedy, the economic effects of the Fukushima nuclear disaster will continue to be felt for some time.

Your program has $18.5 billion available for nuclear loan guarantees. Before the tsunami, one conditional commitment had been offered, and approximately $11 billion was still available—not quite enough for the two next expected applicants, one in Texas and one in Maryland.

Mr. Silver, Has there been any change in the programs applying for assistance?

Mr. Silver. We have not been informed of any material design changes currently contemplated by any of the nuclear power projects in our pipeline. DOE remains committed to supporting safe nuclear power projects and we will continue to monitor discussions about those projects with the Nuclear Regulatory Commission and other relevant agencies.

Subcommittee. How will the events in Japan affect the Administration's request for an addition $36 billion of loan authority, if there is a reduction in demand or a slowing of the licensing process? Do you now need less?

Mr. Silver. Nuclear power will continue to be an important component of our nation's clean energy portfolio and supporting safe and innovative nuclear power projects is part of the Title XVII loan guarantee program's mandate. While it is too early to determine what, if any, effect the recent events in Japan will have on the cost of, demand for, or regulatory process associated with, nuclear power projects, the Department remains committed to supporting safe nuclear power projects through loan guarantees, and we expect to move forward with the Vogtle project and other nuclear power projects in our pipeline.

Subcommittee. How many nuclear generation projects, and for how much, are likely to receive term sheets by the end of fiscal year 2011?

Mr. Silver. To date, the Department has issued three conditional commitments to support one nuclear power project and has approximately $11.1billion remaining in nuclear power loan guarantee authority. DOE is working with several additional applicants. However, the timing of conditional commitments depends on many different factors, many of which are outside of DOE's control, and we cannot say with certainty when any particular deal will be ready to move forward.

Subcommittee. How quickly would this additional loan authority actually be used? What are the chances of reaching conditional commitments for more plants that would require additional authority in fiscal year 2012?

Mr. Silver. Depending appropriations, we expect to be in a position to offer up to two conditional commitments in fiscal year 2012.

ARPA-E FUNDING INCREASE

Subcommittee. Dr. Majumdar, this request includes $550 million for ARPA-E. Since they haven't received any program funds since fiscal year 2009, when they got $400 million in the ARRA, I'd count this request in the same "massive increase" category as the Department's ask for energy efficiency and renewable energy.

You obviously consider this a successful program, but why? What, precisely, has ARPA-E been able to do with the first $400 million that it received from taxpayers?

Dr. Majumdar. With the first $400 million, ARPA-E has issued three Funding Opportunity Announcements (FOAs) and received an overwhelming response from the technical community. ARPA-E has reviewed approximately 3,700 concept papers and nearly 700 full proposals, from which 121 projects were selected for funding for six programs. These six programs are Batteries for Electrical Energy Storage in Transportation (BEEST), Innovative Materials & Processes for Advanced Carbon Capture Technologies (IMPACCT), Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS), Agile Delivery of Electrical Power Technology (ADEPT), Electrofuels, Building Energy Efficiency Through Innovative Thermodevices (BEETIT).

Initially funded in FY 2009, ARPA-E is at the forefront of the Department of Energy's efforts to accelerate the pace of innovation. ARPA-E fulfills a critical need for transformational energy technologies. But transformations do not happen overnight – it will take at least 10-15 years to scale these technologies in cost and volume, and indeed change the world.

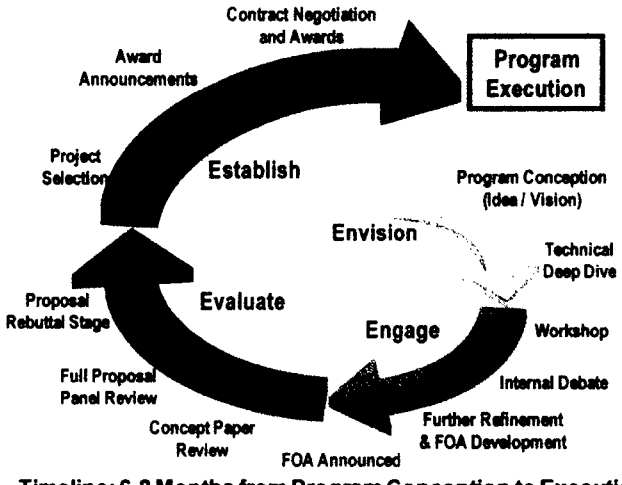
In the next 3-5 years, ARPA-E will look for signs of success: (1) Are we attracting world-class minds to energy R&D? Are we getting world-class ideas? (2) Do we have the world's best performance? (3) How many patents have been obtained? (4) If ARPA-E's funding has created value, how much follow-on funding has the private sector made?

ARPA-E is seeing some early signs of success. Because ARPA-E's initial funding allowed them to lower risk and demonstrate results, six projects funded by ARPA-E for a total of $24 million in 2010 have received over $100 million in private sector follow-on funding. ARPA-E's initial funding

allowed these innovators to do the research and overcome significant technical barriers ahead of schedule. In these cases, the private sector investors have communicated that the follow-on funding would not have arrived without ARPA-E's initial investment. Overall, ARPA-E projects have garnered over $260 million in such follow-on funding. In addition, 17 patents have been filed as a result of ARPA-E funding. While ARPA-E is still in the early stages, these are good signs for future success.

In addition, ARPA-E and the Assistant Secretary of Defense for Research and Engineering are presently establishing the framework of a program that will lead to the development of a hybrid energy storage module.

ARPA-E implemented a novel process for the development and creation of programs that features extensive technical community engagement, topical workshops, a three-stage peer review process that allows for rebuttals to reviewer comments, and rapid contract negotiation, as shown in the figure below. This process has earned ARPA-E accolades, most notably from the President's Council of Advisors on Science and Technology



Timeline: 6-8 Months from Program Conception to Execution

Despite its depth of engagement and multi-stage evaluation, this model affords a timeline from conception to execution that is greatly accelerated—

typically only six to eight months. This allows ARPA-E to respond rapidly to newly emerging technological discoveries and geopolitical events in its creation of new programs.

ARPA-E prides itself on constant innovation, both in the technologies it seeks and its own business practices. ARPA-E's embedded dedicated legal and procurement teams allows it to achieve an unprecedented pace of transferring awards from announcement to the signing of cooperative agreements—usually about two to three months—a pace that is uncommon in the public sector. This speed and efficiency of process has been instrumental to ARPA-E's success and reputation.

Subcommittee. What assurance can you give us that the program could implement such a massive increase in one year?

Dr. Majumdar. ARPA-E is well-equipped to handle an increase in funding. ARPA-E successfully responded to the challenge of awarding Recovery Act funds in just 17 months – with only a fraction of current staffing levels – through the creation of novel processes for evaluation and contracting, careful resource allocation, and the efforts of a bright, determined team. The current, expanded ARPA-E team, with its crucial previous experience of creating and managing the seven existing programs, awarding and obligating the Recovery Act funds, and establishing policies and practices, has the resources and expertise to obligate and award the entire FY2012 appropriated amount on schedule.

ARPA-E DUPLICATION WITH OTHER DEPARTMENT OF ENERGY PROGRAMS

Subcommittee. Dr. Majumdar, the ARPA-E budget proposes some large increases in areas that overlap significantly with proposed increases in other Department of Energy programs. In my time before coming here, we talked about mission creep—when one project's mission grows so much that it starts overlapping with others, and soon enough you've got two projects doing the same thing. I'd like to make sure that's not what we've got here.

I'll give a few examples: the budget request for both ARPA-E and the Office of Energy Efficiency and Renewable Energy propose funding for research on solar energy, smart grid technologies, building efficiency, and electric vehicles. The Office of Science also does work in several of these areas.

How do you justify $550 million for ARPA-E when so much of the proposal is in areas that overlap with these other programs? Can you explain how this is not duplication of effort?

Dr. Majumdar. ARPA-E has a fundamentally different mission and function than other Department of Energy programs. ARPA-E funds the development of transformational energy technologies that have high technical and market risks, but where a short-term R&D effort could deliver game-changing results. The role of ARPA-E is to translate science into breakthrough technologies. This leverages, but does not duplicate, the activity in the Office of Science, which focuses on science and not technology. Furthermore, ARPA-E focuses on developing breakthrough technologies that do not exist today in the energy market and are disruptive. The Applied Energy Programs focus on significantly improving today's technologies thereby making them more compatible with the market.

ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. Moreover, all work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities to facilitate the transition

of successful ARPA-E projects to other DOE programs. Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

To improve coordination within DOE, ARPA-E has formed a Panel of Senior Technical Advisors (PASTA). PASTA consists of Assistant Secretaries (or their Technical Appointees) of all the relevant applied energy offices as well as the heads of all the relevant offices in the Office of Science. The purpose of PASTA is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the DOE. In addition, the Director of ARPA-E actively coordinates with the Director of the Office of Science as well as the Under Secretaries for Energy and Science.

Subcommittee. Let's take a specific example. One of your proposed focus areas for ARPA-E would develop advanced manufacturing processes and the discovery of metal alloys resistant to extreme temperatures. At the same time, the Office of Energy Efficiency and Renewable Energy proposes a new $100 million program called "Next Generation Materials." And according to the budget request, that EERE program will focus on next-generation manufacturing processes and high-performance materials that can operate in extreme environments. Can you explain how these two programs are not duplication of effort?

Dr. Majumdar. In the area of "Next Generation Materials" specifically, ARPA-E is not duplicative of EERE's efforts because the research has different focuses, different risk profiles, different levels of technology maturity or Technology Readiness Level (TRL), and different application spaces.

First, ARPA-E "Next General Materials" program has a different focus than EERE's program. ARPA-E will focus narrowly on devices and components. By contrast, EERE will spend $20 million of the requested $100 million for Next Generation Materials towards an Energy Innovation Hub for Critical Materials that will focus on systems-approach to integration and broader issues. The remaining requested funds are targeted towards EERE R&D

investment in a very broad range of materials, including: ceramics, polymers, metals, and composites.

Second, ARPA-E projects have a different risk profile than EERE. ARPA-E is focused on transformational and disruptive programs that have a higher risk profile than projects funded by other DOE elements. This means that some of the ARPA-E projects will fail, but the ones that succeed will truly be transformational in nature. EERE aims to reduce the cost of existing technologies, but ARPA-E's goal is to replace existing technology with entirely new, transformative technologies.

Third, ARPA-E projects occupy a unique position in the technology development space vis-a-vis projects sponsored by other DOE programs. With respect to Next Generation Materials, ARPA-E will focus on the manufacture and integration of high-temperature materials (e.g. those that can withstand temperatures of nearly 2400 degrees Fahrenheit) for low-cost power generation through high-efficiency engines. For example, the high temperature materials for manufacturable small compressors and recuperators are at a higher TRL than is typically pursued by the Office of Science. ARPA-E uses technology workshops as a tool to coordinate with other parts of DOE and prevent duplication of effort.

Fourth, ARPA-E projects occupy a different application space than EERE projects. In the area of high efficiency engines mentioned above, one potential application is microturbines on the order of 5 to 10 kilowatts for distributed generation. This is a technology-application pair that is not under consideration at EERE. Another new application space is the integration of nuclear facilities with high temperature thermal storage, which is a possibility that ARPA-E explored through a workshop that was held in January 2011.

ARPA-E agrees that mission creep and program overlap within DOE are unacceptable. As discussed above, ARPA-E programs do not overlap with other agencies within DOE and instead provide distinct additional value through high-risk, high-reward programs that span the gaps between existing DOE programs and accelerate promising ideas toward commercialization.

RELATIONSHIP WITH THE PRIVATE SECTOR

Subcommittee. Gentlemen, it's basic common sense that private sector investment drives private sector jobs. Your programs are specifically designed to overlap in some way with private sector investments and activities. Our goal, we must remember, is to help the private sector, not hinder it.

What is the appropriate role of government in your areas?

Dr. Majumdar. ARPA-E fulfills a critical need for transformational energy technologies. Given the recent surge in energy investments overseas and unparalleled growth in the global demand for energy resources, the next few decades must be the most innovative period of U.S. history in order to remain competitive in the energy economy of the future. ARPA-E will play a key role in fostering that innovation. The magnitude of this challenge is enormous, as is the opportunity.

ARPA-E identifies and promotes early-stage transformational research and development projects in areas that industry by itself is not likely to support because of technical and financial uncertainty. At ARPA-E, we seek to make investments in transformational energy technologies that private sector investors are not likely to fund at their present development stage. ARPA-E investments have both high technical risk and high market risk. Private capital generally undertakes projects with minimal technical risk. It is extremely rare for private capital to finance projects that have high technical risk and high market risk. ARPA-E does not fund technical ideas that have previously received private sector funding.

ARPA-E creates the competition where industry by itself is unlikely to fund. ARPA-E does not pick winners and losers. Instead, ARPA-E creates balanced portfolios of competing technologies. Many of the projects will eventually fail; the market must dictate which projects will succeed. ARPA-E simply sets the cost and technological targets, and the private sector will dictate which approach of the many projects ARPA-E funds is best.

Projects funded by ARPA-E transition technologies across the "valley of death" in order to reduce investor risk and motivate commercial investment. Successful ARPA-E projects are then "handed off" o private sector for late stage development and scaling.

Mr. Silver. The Loan Programs play a critical role in promoting our clean energy future by leveraging private investment to deploy clean energy technologies at commercial scale and filling a financing gap left unfilled by the private sector. Federal credit programs provide financial assistance to borrowers who cannot obtain private sector credit under reasonable terms and conditions. The use of private credit markets should be encouraged, and any impairment of such markets or misallocation of the nation's resources through the operation of Federal credit programs should be minimized. Ultimately, as the private sector proves able and willing to finance such projects without government incentives, the need for the Loan Programs will diminish.

Subcommittee. How have you analyzed where Department funding would complement private sector activities, and when it would displace or hinder them?

Dr. Majumdar. As discussed earlier, ARPA-E seeks early-stage, transformational energy technologies that have both high technical risk and high market risk. Private capital is generally invested in projects with minimal technical risk. It is extremely rare for private capital to finance projects that have high technical risk and high market risk. ARPA-E has put in place practices to ensure that agency funding is only disbursed to ideas not already being pursued by the private sector. These practices include recruiting program directors with knowledge of the private sector landscape implementing a rigorous program development process, and requiring mandatory disclosure from applicants.

ARPA-E hires Program Directors with a background in science and industry in order to make more precise determinations of the types of high risk projects that are appropriate for ARPA-E to fund. ARPA-E is very careful not fund any technical idea that had previously received money from industry. The agency also has a rigorous program development process. Before announcing a program, ARPA-E undertakes a comprehensive process to ensure that it is locating a "white space" that is not being addressed by the private sector. ARPA-E technical staff review existing literature to identify potential program areas. From here, ARPA-E technical staff conduct "deep dive" research into specific potential program areas to determine the current state of the art, the main players in this space, the major technology challenges, and, most critically, whether there is significant technology white space for a high-impact ARPA-E program.

From there, ARPA-E will hold a workshop, bringing in the relevant players from industry, academia, and government to further refine concepts for potential programs. Program Directors connect with the business world and lead a competitive, thorough review process to fund promising projects that are not being funded by the private sector.

In addition, each applicant for ARPA-E funding must fully disclose all sources of funding (past, current, or pending) for all potentially related or identical projects. Once the award is issued, recipients are required to fully disclose any additional funding that it receives from any public or private source. This ensures transparency and enables ARPA-E to make appropriate funding determinations.

ARPA-E does not crowd out private investment or negatively skew the marketplace. Private capital is unlikely to finance projects with high technical risk and high market risk. Public investment allows for appropriate maturation of the technologies, effectively de-risking them, which stimulates private investment for technology scale-up and manufacturing. Because ARPA-E's initial funding allowed them to lower the risk and demonstrate results, six projects funded by ARPA-E for a total of $24 million in 2010 have received over $100 million in private sector follow on funding. ARPA-E's initial funding allowed these innovators to do the research and overcome significant technical barriers ahead of schedule. The follow on funding would not have arrived without ARPA-E's initial investment. Moreover, the private sector looks favorably upon ARPA-E funded projects because it is aware of ARPA-E's rigorous selection process. ARPA-E projects are viewed as having passed muster, increasing the likelihood that the private sector will invest follow-on funding. Overall, ARPA-E projects have garnered over $260 million in such follow-on funding.

Mr. Silver. Clean energy projects with relatively high technology or completion risk, that require extremely long-term financing, and/or that have particularly high upfront capital costs can sometimes find it difficult to obtain conventional financing in the private markets. By focusing our efforts on projects that exhibit these characteristics, the Loan Programs complement, and avoid competing with, private sector lenders.

Subcommittee. How do you determine when it is time for your programs to step back in a particular area, or not enter into an activity at all, because the private sector doesn't need any more of a "push"?

Dr. Majumdar. As discussed in the previous question, ARPA-E has thorough criteria in place to ensure that agency funding is only disbursed to projects not already being pursued by the private sector. ARPA-E does not proceed forward in a potential area of research if it does not pass ARPA-E's criteria.

ARPA-E continually assesses private sector investment in specific fields and technology areas by meeting and communicating regularly with venture capitalists and other private investors to get a sense of their appetite for risk and the types of projects they are funding and not funding. In addition, ARPA-E hires Program Directors with backgrounds in science and business in order to make more precise determinations of the types of high risk projects that are appropriate for ARPA-E to fund, where the private sector has not already invested.

ARPA-E programs fund projects for a two to three year period. Before deciding to extend or renew a program, ARPA-E steps back and evaluates how the program has impacted the market, whether the private sector does not need any more of a "push", or whether renewed investment is essential.

Mr. Silver. As you know, the loan programs are solicitation-based, meaning that we accept applications only in response to targeted solicitations. The solicitations we issue are targeted to those technologies/sectors where credit assistance may help meet policy goals. The Loan Programs Office closely monitors an array of data, including publicly available data, private research, and propriety data shared by the companies with which we interact on a regular basis, which provide a broad and up-to-date view into the private sector finance markets. As the private sector proves more able and willing to finance clean energy projects on its own, the need for government financing will be reduced.

Subcommittee. Do you have any formal or informal private sector advisory groups set up to help you understand where the private sector is headed?

Dr. Majumdar. ARPA-E does not have any formal or informal private sector advisory groups. As noted previously, ARPA-E meets and communicates regularly with venture capitalists and other private investors to get a sense of their appetite for risk and the types of projects they are funding and not funding. In addition, ARPA-E hires Program Directors with

backgrounds in science and business in order to make more precise determinations of the types of high risk projects that are appropriate for ARPA-E to fund.

Mr. Silver. While the Loan Programs do not have formal advisory groups of this type, staff members and senior leadership meet regularly with members of the private sector, including private and tax equity investors, venture capitalists, trade organizations, project developers, utilities, and lenders, to discuss the topic.

NEW "BETTER BUILDING" PILOT LOAN GUARANTEE PROGRAM

Subcommittee. Mr. Silver, the fiscal year 2012 budget request proposes yet another new loan guarantee program, this one to support energy efficiency retrofits for universities, hospitals, and schools. You're asking for $100 million to guarantee up to $2 billion in loans, and your proposal would permit the entire amount of that to be guaranteed by this program. This program seems to duplicate the goals of state and local programs to also improve efficiency.

Why should the federal government take over this responsibility from the states?

Mr. Silver. The Department does not view the proposed pilot program as taking over responsibility from states and local programs. There is a significant, unmet demand for this type of financing among universities, schools, and hospitals, which serve as assets to our communities. We believe that the federal government, by effectively leveraging the expertise of the Department, can work with our partners to meet this demand effectively and efficiently. We consider this pilot program to be a complement to the many important energy efficiency programs that are currently operating at the state and local levels—leveraging non-Federal resources, and sharing risk with private partners.

Subcommittee. Your current loan programs have been plagued by delays and IG reports critical of your Department's management practices. Why should Congress provide funds for yet another loan program until we're sure these problems are solved?

Mr. Silver. The Loan Programs Office has made great strides since this Administration took office two years ago. At that time, DOE had not yet issued a single loan or loan guarantee. Since the spring of 2009, the Loan Programs have offered $35.9 billion in total government supported financing, including capitalized interest to 38 clean energy projects with total project costs of almost $57.6 billion. Cumulatively, these projects will produce nearly 35 million megawatt hours yearly – enough to power nearly three million households – and create or save over 64,000 jobs across 35 states.

We are always looking to improve our programs, and we take the IG's recommendations seriously. We believe that recent program improvements have addressed their concerns, and that the Department is well-positioned to build on our success moving forward.

DOE anticipates that the $100 million in credit subsidy for a new "Better Buildings Pilot Loan Guarantee Initiative for Universities, Schools, and Hospitals" could support up to $2 billion in loan guarantees to support energy efficient retrofits. The Department looks forward to working with Congress to develop the structure of a successful program.

Subcommittee. I hope that this proposal is in response to a problem that was brought to your attention. Since your budget justification doesn't lay out the problem...just the bare bones of the proposal...please explain to the Committee what you're trying to solve.

Mr. Silver. The Buildings Pilot Loan Guarantee Initiative is part of the President's Better Buildings Initiative and would fund cost-effective technologies and measures to assist universities, schools, and hospitals with the implementation of energy-efficiency retrofits. These assets, which are critical to our communities, like many organizations in this challenging economic environment, are looking for ways to cut costs and ensure that they are able to continue to devote their limited resources to their core missions. There is a demonstrated and unmet demand, among these types of entities, for financing to implement energy efficiency technologies that will enable them to save money on energy usage and associated energy costs. The requested $100 million in budget authority would enable the Department to support up to $2 billion in loan guarantees to support such financing.

Subcommittee. Why did you not include all non-profit organizations, including religious facilities, in this program?

Mr. Silver. The FY 2012 budget reflects a number of difficult choices, regarding the allocation of limited resources. Moreover, "pilot" programs are, by their nature, limited in scope. The Department believes that the demand for, and potential benefits to be realized by, energy efficiency retrofits is particularly strong in the context of universities, schools, and hospitals.

ADVANCED RESEARCH PROJECTS AGENCY – ENERGY (ARPA-E)

ARPA-E INVESTMENT AREAS

Subcommittee. So far, ARPA-E has had three funding rounds, which include rather involved titles such as "Building Energy Efficiency through Innovative Thermodevices." How do you select your potential investment areas?

Dr. Majumdar. Solutions to current energy challenges cannot be achieved by following the status quo. As such, ARPA-E Program Directors create innovative, high-impact energy programs, which drive project selection. Multiple projects, representing a diverse range of technology solutions across a broad range of scientific fields, are selected for their potential to significantly benefit the energy market, economically and socially.

ARPA-E selects potential investment areas by considering the science and technology landscape, the market landscape, and the regulatory landscape. Only in instances where circumstances in each of these areas are aligned to enable transformative, breakthrough discoveries that have the potential to then be brought to market scale will ARPA-E invest in technology development. Programs are created through a detailed process that begins with a thorough vetting of a technology concept to identify potential topics for program development. ARPA-E Program Directors will coordinate with other DOE offices and federal agencies, as well as groups outside of government, to identify untapped opportunities.

ARPA-E has a rigorous program development process. Before announcing a program, ARPA-E undertakes a comprehensive process to ensure that it is locating a 'white space' that is not being addressed by the private sector. ARPA-E technical staff review existing literature to identify potential program areas. From here, ARPA-E technical staff conduct "deep dive" research into specific potential program areas to determine the current state of the art, the main players in this space, the major technology challenges, and, most critically, whether there is significant technology white space for a high-impact ARPA-E program. From there, ARPA-E will hold a workshop, bringing in the relevant players from industry, academia, and government to further refine concepts for potential programs. Program Directors connect

with the business world and lead a competitive, thorough review process to fund promising projects that are not being funded by the private sector.

Subcommittee. Several of them, such as "Batteries for Electrical Energy Storage in Transportation," are areas that other parts of the Department have been, or still are, researching. Why is ARPA-E looking at the same thing, and why should we fund similar research in different parts of DOE?

Dr. Majumdar. ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. Moreover, all work in collaboration to identify gaps in their research portfolios ("white space") as well as through co-hosting topical workshops in the development of programs. This coordination also serves to inform all parties of each other's ongoing research activities to facilitate the transition of successful ARPA-E projects to other DOE programs.

With respect to the question of battery storage, ARPA-E's Batteries for Electrical Energy Storage in Transportation (BEEST) program fills a "white space" that was not being researched by DOE or the private market. The Office of Science focuses on basic science, like understanding the electrochemistry of metal-oxygen reactions as well as lithium reactions and transport in a variety of intercalation compounds. EERE, as an applied program, focuses on making the current lithium-ion battery safer, more cost-competitive, and more efficient.

ARPA-E focuses on making the current lithium-ion battery obsolete, potentially replacing it with new metal-air (Li-Air; Zn-Air; Al-Air, etc) battery devices that are ten times better in cost-performance metrics than today's Li-ion systems. This new generation of ultra-high energy density, low-cost battery technologies for long-range (300 to 500 miles) plug in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) pushes the boundaries of batteries as we know them. For instance, ARPA-E projects are researching using lithium air systems that can hold as much energy as a tank of gasoline in the same volume, or new ways to safely store energy that will provide cars with energy for up to a 500 mile range and be able to fully

charge in minutes. These projects have a higher degree of risk and have the potential to be more transformative than other DOE research.

Subcommittee. Your budget request lays out six areas that you're considering investing in during fiscal year 2012, if you get funding. Please explain those areas for the subcommittee, and why you chose them.

Dr. Majumdar. ARPA-E's FY12 budget request is designed to respond with maximum speed and flexibility to our nation's energy challenges. Technical flexibility and empowerment of Program Directors is a key aspect of ARPA-E. Rather, ARPA-E plans to do in-depth research, market studies, have discussions with experts from the technical community, and hold a technical workshop before starting a program to determine if an area of interest is ready for an ARPA-E program.

Stationary Power: Given the increasing reliance on an overwhelming percentage of the nation's electricity that comes from stationary power sources, ARPA-E plans to continue to make strategic investments in this sector. ARPA-E is developing specific future focus areas for programs that employ novel approaches, materials, devices, and processes to make revolutionary advances in the way we capture and utilize energy from a portfolio of diverse renewable and other power sources.

Electrical Infrastructure: While the first generation of smart-grid technology is being deployed as a high speed information network in parallel with the energy network, ARPA-E plans to developing technologies that can realize the full vision of a smart grid. Leveraging the smart-grid information network provides a platform for new energy technologies: from widespread deployment of breakthrough approaches to energy storage; to highly distributed, efficient, and modular approaches to energy generation; to more efficient and secure approaches to controlling the cyber-physical transmission grid system.

End Use Efficiency: ARPA-E plans to continue investing in the buildings sector to develop high-efficiency energy technologies, including an expansion of the current BEETIT program and new technologies for energy measurement systems and integrated building operations; as well as a novel way to light a room.

Embedded Efficiency: Reduction of energy consumption in the industrial sector is essential to ARPA-E's mission and could be achieved through "embedded efficiency". ARPA-E plans to focus on the industrial sector with the aim to develop cost-competitive technologies and industrial processes to significantly reduce energy consumption and emissions. Another example of embedded efficiency is the use of water in agriculture, power generation, natural gas production, etc. Unchecked use of water in industrial processes can lead to shortages of drinkable water, which then necessitates consumption of significant energy to produce clean water. Hence, sustainable and low-energy pathways of reusing water and producing drinkable water are within the realm of ARPA-E's emphasis on embedded efficiency.

Transportation Systems: ARPA-E is currently focusing to create a diverse portfolio of technological options that would reduce our reliance on imported oil, and instead rely on efficient use of domestic sources of energy for transportation.

Wireless Innovation (WIN) Fund: An additional $100 million in mandatory funding is proposed from the Wireless Innovation Fund for ARPA-E to develop cutting-edge wireless technologies. In FY 2012, ARPA-E plans to utilize funds available from the Wireless Innovation Fund on projects related to wireless information technology, as outlined in the detailed justification of the Projects section in the Congressional Justification, particularly in Electrical Infrastructure, End Use Efficiency, and Transportation Systems.

Subcommittee. How are they coordinated with similar work in the rest of the Department?

Dr. Majumdar. The purpose of ARPA-E is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the rest of DOE. Each ARPA-E program area is created to coordinate with and leverage the rest of DOE's work.

Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE

offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

To improve coordination within DOE, ARPA-E has formed a Panel of Senior Technical Advisors (PASTA). PASTA consists of Assistant Secretaries (or their Technical Appointees) of all the relevant applied energy offices as well as the heads of all the relevant offices in the Office of Science. The purpose of PASTA is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the DOE. In addition, the Director of ARPA-E actively coordinates with the Director of the Office of Science as well as the Under Secretaries for Energy and Science.

ARPA-E coordinates within DOE to identify areas where ARPA-E could add significant value. Through this process, ARPA-E identifies these areas of focus as having "white space" where ARPA-E funding could play a critical role in accelerating the development of transformational energy technologies.

Subcommittee. Please provide the Committee with an Agency-wide strategy for investment in these areas.

Dr. Majumdar. ARPA-E has a clear and vital purpose: to catalyze energy innovations for a secure American future and to ensure U.S. technological leadership in developing and deploying advanced energy technologies. ARPA-E recognizes the need to move beyond incremental changes to existing energy technology and to identify those transformational technologies that will disrupt markets thereby making current technologies obsolete. ARPA-E Projects will identify and promote early-stage research and development projects with the promise to make revolutionary advances in breakthrough sciences, translate scientific discoveries and cutting-edge inventions into technological innovations, and accelerate transformational technological advances in areas that industry by itself cannot and will not support because of technical and financial risk and uncertainty.

In formulating the FY 2012 request, ARPA-E undertook a thorough analysis to determine what levels of funding were appropriate. ARPA-E works in close coordination with DOE's basic science and applied research programs

to avoid duplicative research and ensure a balanced research portfolio across the DOE. ARPA-E conducted a thorough preliminary technical review to find the "white space" that is ripe for ARPA-E investment. These gaps and opportunities are translated into program concepts that undergo rigorous internal debate and external review. Before starting a program, ARPA-E does in-depth research, market studies, has discussions with experts from the technical community, and holds a technical workshop to determine if an area of interest is ready for an ARPA-E program.

The respective dollar values for each program reflect the Agency's strategic decision about the size of the "white space" opportunity and the potential for transformative change. Investments in the FY 2012 request reflect a clear and deliberate strategy to support the areas with the most direct impact on the energy, security and environmental missions of the Department.

ARPA-E will focus on five areas:

First, given the increasing reliance on an overwhelming percentage of the nation's electricity that comes from stationary power sources, ARPA-E plans to continue to make strategic investments in this sector. ARPA-E's goal is to create a diverse portfolio of technological options for low-cost power generation from traditional and renewable sources.

Second, while the first generation of smart-grid technology is being deployed as a high-speed information network in parallel with the energy network, ARPA-E plans to develop technologies that can realize the full vision of a smart grid. ARPA-E's goal is to develop those next generation technologies that will make today's approaches obsolete, and would truly revolutionize the grid for secure, stable, and reliable transmission and distribution of electrical power and maximize the capacity of today's infrastructure.

Third, ARPA-E plan to continue investing in the buildings sector to develop high-efficiency energy technologies, including an expansion of the current BEETIT program and new technologies for energy measurement systems

and integrated building operations, as well as a novel way to light a room. ARPA-E's goal is to develop those technologies that do not exist today, but if they did they would lead to substantial life-cycle monetary savings by increasing the efficiency of how energy is used in buildings and industry.

Fourth, reduction of energy consumption in the industrial sector is essential to ARPA-E's mission and will be achieved through "embedded efficiency" programs. ARPA-E's goal is to focus on the industrial sector with the aim to develop cost-competitive technologies and industrial processes to significantly reduce energy consumption and emissions.

Fifth, ARPA-E plans to continue investing in the transportation sector, in both fuels and vehicles. ARPA-E goal is to create a diverse portfolio of technological options that would reduce our dependence on oil, and instead rely on the efficient use of domestic sources of energy for transportation,

DISRUPTIVE V. INCREMENTAL ADVANCES

Subcommittee. Dr. Majumdar, the Department seems to have a bias toward nearly perfect or disruptive technology and in the process sacrifices steady, incremental change that could be transferred to the market place quickly. ARPA-E seems the perfect example of this rule. Especially given your new role as the acting Under Secretary for Energy, what is your opinion on the relative weight that should be given to incremental improvements and how is that reflected in this budget request?

Dr. Majumdar. ARPA-E is following its statutory mandate by focusing on high-risk disruptive technologies that do not exist today, but if they did they would make today's technologies obsolete. These are by their very nature too risky for the private sector. The Applied Energy programs are focused on significant improvements on current technologies (e.g. lithium-ion batteries) to make them cheaper and better, and thereby enable scaling in the market. That is, they are trying to accelerate technology progress down a known learning curve, whereas ARPA-E is trying to create new, transformative technologies. The roles of ARPA-E and the Applied Energy Programs are therefore complementary. It is important to note that both are needed to make the US secure and globally competitive. However, there ought to be a balance between them. The President's budget request reflects that balance.

CRITICISMS THAT ARPA-E TAKES AWAY FROM SCIENCE

Subcommittee. Doctor, one of the criticisms of ARPA-E is that it necessarily takes away from Science funding at the Department. I'm sure you are aware that one of the hesitancies this Committee has had in the past was that we were building new bureaucracy to address shortcomings in the Science program without addressing the fundamentals of the problems there.

This problem hasn't gone away. In a February 2 New York Times article about ARPA-E, the authors note that none of the ARPA-E projects are expected to produce commercial products for years to come, and you are quoted as saying "success is probably 10 to 20 years away". This happens to be roughly the same time line as some Office of Science projects.

Are you investing in projects that the Office of Science should be working on instead? If so, why are we funding your program and the Office of Science to do similar work?

Dr. Majumdar. Programs within the Department of Energy take great care to ensure that they work in concert because that is how everyone will succeed. The Office of Science and ARPA-E are pursuing complementary aims – the Office of Science funds basic science research and does not fund technology development. On the other hand, ARPA-E focuses on translating science into breakthrough energy technologies.

ARPA-E has a fundamentally different mission and function than other Department of Energy programs. ARPA-E fulfills a critical need for transformational energy technologies – technologies that hold the potential to radically shift the nation's energy reality. ARPA-E occupies a unique position in the technology development space not occupied by other DOE programs. Whereas the Office of Science focuses on fundamental science research, ARPA-E funds early-stage energy technologies when they are considered too high-risk (both technical risk and market risk) to attract investment from other government agencies and private investors. The applied programs focus on taking technologies down the economic learning curve, but ARPA-E focuses on creating transformative and disruptive new technologies. ARPA-E focuses on transferring science to breakthrough technologies.

For example, with regard to batteries, the Office of Science would focus on understanding the electrochemistry of metal-oxygen reactions as well as lithium reactions and transport in variety of intercalation compounds. The Applied Energy Offices might focus on lithium-ion batteries via different configurations and materials for cathodes, anodes, separators, electrolytes for automobile market. By contrast, ARPA-E projects are researching new metal-air (lithium-air, zinc-air, etc) battery devices and systems for the automobile market that are ten times better in cost-performance metrics than the lithium-ion batteries of today's vehicles.

ARPA-E takes great care to ensure that its projects do not overlap with other DOE programs, but instead complement them in multiple ways. The program works in close coordination with program offices on its "borders" – DOE's basic science and applied research programs – to avoid duplicative research and ensure a balanced research portfolio across the DOE. In the development of a FOA, ARPA-E will co-host topical workshops and collaborate with other DOE program offices to identify gaps in DOE's research portfolio ("white space"). This coordination also serves to inform all parties of each other's ongoing research activities to facilitate the transition of successful ARPA-E projects to other DOE programs.

Before issuing a funding opportunity announcement on a particular technology area, ARPA-E studies the technology area in depth. ARPA-E consults closely with other DOE offices and programs to avoid any duplication or redundancy. ARPA-E engages members of other DOE offices in ARPA-E workshops, defining the funding opportunity announcements, and proposal review process.

To improve coordination within DOE, ARPA-E has formed a Panel of Senior Technical Advisors (PASTA). PASTA consists of Assistant Secretaries (or their Technical Appointees) of all the relevant applied energy offices as well as the heads of all the relevant offices in the Office of Science. The purpose of PASTA is to coordinate and leverage each of its programs and also to ensure that ARPA-E provides unique value within the DOE. In addition, the Director of ARPA-E actively coordinates with the Director of the Office of Science as well as the Under Secretaries for Energy and Science.

ARPA-E's goal is to invest in translating ideas and concepts developed from the Office of Science's basic science research into disruptive technologies, and make them market ready.

TERMINATING PROJECTS

Subcommittee. Doctor, you should be reaching the point where you can evaluate some projects against progress milestones. One of the reasons your program has gotten support is that it promised to terminate programs which were not reaching their goals.

Do you have any which are in that situation?

Dr. Majumdar. Decisions to discontinue funding are made on a case-by-case basis. The oldest of ARPA-E's projects are just a little over a year into their work, so it is still early. We do have some projects that have been given warning, and we have offered them assistance to make progress. If we ultimately decide not to continue funding a project funded with Recovery Act funds, the money will return to the Treasury.

Subcommittee. How are you proposing to manage termination of these projects?

Dr. Majumdar. Upon selection of a recipient for award, we work with the recipient to establish a set of technical milestones and deliverables for each quarter and year. ARPA-E focuses on high-risk, high-reward energy technology development, so our technical milestones and deliverables are very aggressive. We incorporate these technical milestones and deliverables into our funding agreements with the recipients. We closely monitor the recipients' progress throughout the year. The Program Director will conduct at least two site visits for each of the projects in his/her program, where he/she will visit the laboratory to monitor the recipients' progress and assess whether they have met their technical milestones and deliverables, and if not, why they have not met these milestones and deliverables. These milestones and deliverables are an objective yardstick for measuring the recipients' technical progress each quarter. If, after a quarterly review, ARPA-E determines that the recipient has failed to meet milestones, schedule, or cost commitments, ARPA-E may at its discretion 1) renegotiate these terms/conditions and continue funding, 2) discontinue funding under this agreement, or 3) notify the recipient the recipient that they are at risk of termination and give them an opportunity to meet the milestones. In addition to the site visits, the Program Director will conduct a comprehensive program review once a year, where each project in the program will be reviewed in depth. The technical milestones and

deliverables are used during these meetings to determine whether the project is meeting its stated objectives, and whether we should maintain funding for the project.

Subcommittee. Have you actually terminated any projects to date?

Dr. Majumdar. To date, we have not terminated any projects for failure to reach milestones.

Subcommittee. Is there something this Committee can do to assist?

Dr. Majumdar. We appreciate this Committee's continued support.

ARPA-E FLEXIBILITY AT RISK

Subcommittee. Dr. Majumdar, one of the explanations you've given for your program's successes to date is that you have the flexibility to identify highly promising, yet underfunded, investment areas. You have little bureaucratic "stovepipes" to restrict creativity or responsiveness. In fact, your budget request states "ARPA-E is organized and administered in ways that enable the program to be lean, effective and agile."
That makes sense to me. I'm therefore wondering about your budget request, where you specify technological areas in which you want to invest in fiscal year 2012: Stationary power, electrical infrastructure, embedded efficiency, etc. Why did you choose to be so specific, instead of keeping the potential investment areas notional?

Dr. Majumdar. Because its role and risk-taking approach are unusual in government and circumstances and opportunities will change rapidly, ARPA-E must be highly adaptable, relying heavily on the professional judgment and integrity of its team. ARPA-E has adopted several operational innovations that are uncommon in the federal government. These innovations expedite the program development and project selection process without compromising quality or integrity. ARPA-E's project teams, lead by Program Directors, are adaptable and empowered to change tactics to suit changing technology or business landscapes. In ARPA-E's organizational structure and processes, there are no stovepipes; instead, ARPA-E is designed to support quick reactions to changes in the energy landscape: both to find solutions to new challenges and to seize opportunities.

In the Fiscal Year 2012 budget request, ARPA-E tried to maintain an open and transparent relationship with Congress and also maintain the flexibility and agility that makes ARPA-E unique. ARPA-E continues to improve its internal strategic vision for the future direction of the agency. The Fiscal Year 2012 budget request reflects a decision by ARPA-E to reorganize and simplify the agency for this reason. The previous budget request organized ARPA-E actions into 18 technological areas; we have simplified this down to six.

Subcommittee. Do you have any concerns that this approach would impede the flexibility, and perhaps the effectiveness of your program?

Dr. Majumdar. No, ARPA-E does not have concerns that this approach would impede the flexibility or effectiveness of ARPA-E. These groups should not be considered control points; there are no set dollar values committed to each area. These technological areas should in no way be viewed as bureaucratic 'stovepipes'; this represents ARPA-E's efforts to be notional. Taken as a composite, they represent almost the entire scientific world ARPA-E engages in; similarly, each topic is broad enough to allow for creativity and responsiveness.

ARPA-E is open to considering any "out of the box" proposals that do not fit within the parameters of specific funding opportunities. For this reason, ARPA-E has published on its website instructions for the submission of unsolicited proposals (http://arpa-e.energy.gov/About/FAQs.aspx, under "Unsolicited Proposals"). Additionally, ARPA-E plans to hold an open funding opportunity in FY 2012. Like ARPA-E's first funding opportunity, this funding opportunity would be open to any transformational energy technology.

MANDATORY FUNDING FOR THE "WIRELESS INNOVATION FUND"

Subcommittee. Doctor, your request includes a new $100 million pot of mandatory funding for something called a "Wireless Innovation Fund". This funding would be a one-time allocation, made available from a spectrum auction. ARPA-E would receive $100 million to "develop cutting-edge wireless technologies". Your budget request has less than a page of explanation for this...rather thin for a new program.

What is the plan for this funding, in more detail?

Dr. Majumdar. The President's Wireless Innovation and Infrastructure Initiative proposes to reallocate a total of 500 megahertz of Federal agency and commercial spectrum bands over the next 10 years in order to increase Americans' access to wireless broadband. Repurposing spectrum will greatly facilitate access for smart phones, portable computers, and innovative technologies that are on the horizon. This effort will also enhance America's public safety, infrastructure, and competitiveness by investing some of the expected auction receipts in the creation of a broadband network for public safety, expanding access to wireless broadband in rural America, and a Wireless Innovation (WIN) Fund to help develop cutting edge wireless technologies. As part of this initiative, ARPA-E will participate in the WIN Fund by supporting clean energy activities.

The country's aging electrical grid is a patchwork of out-dated, overloaded, and unreliable infrastructure. It's not just a system that delivers energy inefficiently – the country's electric grid is increasingly vulnerable to failure and attack. To ensure American energy independence and efficiency, broadband and other advanced communications technologies could be used to modernize the grid. Paired with high-tech tools, like dynamic management software and remote sensors, broadband could help advance innovations in renewable power, grid storage, and vehicle electrification.

A one-time allocation of $100 million in mandatory funding is proposed from the Wireless Innovation Fund for ARPA-E to develop cutting-edge wireless information and energy technologies. These technologies communicate data to ensure that the grid is resilient to cyber attacks, as well as to control and stabilize it, and to increase the capacity of existing

infrastructure. ARPA-E projects would further seek to be able to route electricity and create network and feedback control at the network level.

The $100 million allocation is envisioned to be spent over several years. In FY 2012, ARPA-E plans to utilize funds available from the WIN Fund on projects related to wireless information technology, as outlined in ARPA-E's budget justification, particularly in Electrical Infrastructure, End Use Efficiency, and Transportation Systems.

ARPA-E plans to explore technologies that complement existing smart grid technologies (such as residential "smart meters") and enable more efficient routing of electricity, more efficient operation of transformers and substations, and more effective diagnosis of and rapid response to system faults, including the use of wireless technology. Additionally, ARPA-E plans to investigate ways to dramatically improve building efficiency through innovative technologies that identify energy losses without the need for expensive system retrofitting, including wireless technology.

ARPA-E will also support development of novel information technology systems for the transportation sector, including wireless technology. Future programs may include development of advanced systems that allow vehicles to communicate with both roadways and other vehicles, and new network monitoring and optimization tools that dynamically reroute traffic and alter traffic signals.

Subcommittee. Would you use similar rounds of applications as you have with appropriated dollars, or is this for "in-house" research at DOE labs?

Dr. Majumdar. The WIN funding will be awarded in a similar manner to past ARPA-E solicitations.

Subcommittee. Hasn't the private sector been doing a fairly good job at developing wireless technologies? Why should the government get into such a thriving private sector market?

Dr. Majumdar. The private sector is doing a great job with wireless information technology but has not focused on connecting wireless information technology with energy technology. This is the type of "white

space" ARPA-E was designed to address, because resulting technologies could dramatically improve the efficiency of the electrical grid.

SIGNS OF SUCCESS

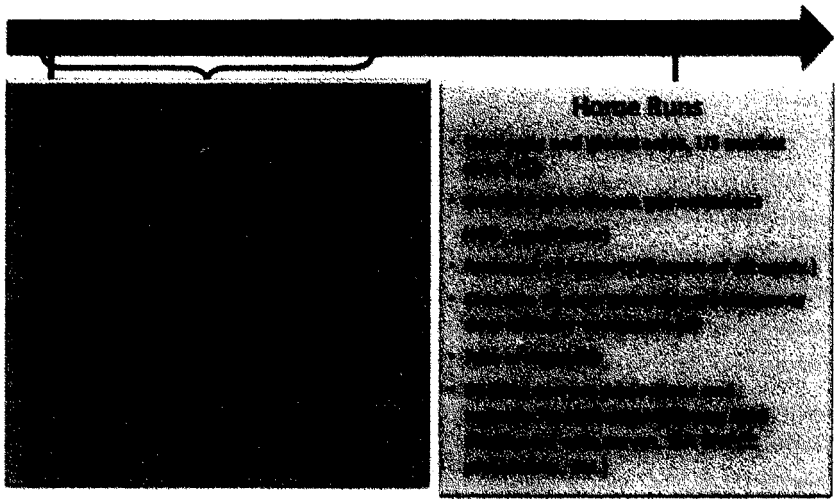
Subcommittee. Dr. Majumdar, this subcommittee is constantly struggling with figuring out which programs are succeeding for the taxpayer, and which need to be reformed or eliminated. Recently, the New York Times ran a story about early projects your program funded – 37 of them, for $151 million. Of these, six have received $108 million in additional private venture capital. Do you have any updates to these numbers?

Dr. Majumdar. These six projects have not, to date, received any additional follow-on funding. However, as an update, ARPA-E projects have received a total of $260 million dollars in follow-on private sector investment. ARPA-E takes this as a strong indication of success at provoking the private sector to invest in energy. These are projects that would likely not be receiving any private sector investment unless ARPA-E had stepped up and provided the initial seed money to de-risk some of these projects. ARPA-E provided the initial funding that allowed these companies to start their research and lower the risk level of their project in order to improve its attractiveness to private sector investors.

Subcommittee. What do you think a reasonable percentage would be for ARPA-E project failure...that is, projects which never receive any private sector funding?

Dr. Majumdar. ARPA-E will be a success if it enhances the economic and energy security of the United States and ensures that the United States maintains a technological lead in developing and deploying advanced energy technologies. ARPA-E focuses on high-risk, high-reward energy technology development, with an expectation that a substantial percentage of our projects will fail.

There are different metrics of success for different time scales. For example, if the supported technologies are techno-business "home runs", it could take more than 10 years beyond a successful ARPA-E project to scale the technology in cost and volume. Secretary Chu has repeatedly said that, due to the high-risk nature of the projects, ARPA-E would be pleased if 10-15% of the projects become such "home runs". In the next 3-5 years, we can only look for indicators of this future success.



ARPA-E will not hesitate to cancel projects and terminate funding where appropriate. It is important to understand that we will learn not only from projects that succeed, but also from projects that "fail." Historically, important scientific and technological knowledge has often been generated by projects that did not achieve their original objectives. Successful projects can incorporate and even rely on knowledge obtained through previous, unsuccessful projects. Thus, ARPA-E expects the United States will benefit from all the ARPA-E projects, whether they are "successful" or not.

ARPA-E does not pick winners; rather, ARPA-E funds multiple competitive and parallel approaches to reach the same performance and cost target of technology with very aggressive technical milestones and deliverables. After the technology is de-risked, ARPA-E then lets the private sector pick the ones that are best for business. A successful project is one that meets the technical milestones and deliverables over the course of the award period. ARPA-E sets the bar high and builds into funding agreements milestones and deliverables that, if met, would not only overcome a specific technical barrier but also allow a technology to attract future private investment and make progress toward the market. The results are technology options for the nation and some element of internal competition within the nation, both of which are very important for innovation and U.S. technological lead in the world. This is a different model than the venture capital investment.

ARPA-E does not judge success simply based upon private sector follow-on-funding. For example, ARPA-E is exploring partnerships with the Department of Defense to establish joint programs to leverage common interest in energy technology development that would have long-term benefit to both commercial and defense markets.

ATTRACTING AND RETAINING TOP TALENT AT ARPA-E

Subcommittee. Dr. Majumdar, ARPA-E has been widely regarded for attracting some of the top industry and university talent to head up its programs. It seems that two things differentiate ARPA-E: the attention and "buzz" surrounding it while it's a new program, and the approach to bring in program directors for a limited number of years.

How would you rate your current ability to keep and attract new talent at ARPA-E?

Dr. Majumdar. We feel that ARPA-E has been extremely successful in attracting talent from the technical community to become Program Directors. Many of these people are active scientists, engineers and researchers from technical community, who are now serving the nation. In all cases, they are as technically savvy as the people that we fund. This parity has helped the ARPA-E program directors take active interest in each of the projects they manage, and thereby help the teams make progress, especially when they are stuck.

By law, the terms of Program Directors are limited to three years, although the term may be renewed. Because the terms of program directors are limited, ARPA-E intends to solicit applications for program director positions on a rolling basis. To date, ARPA-E has hired eight Program Directors. Six of the Program Directors administer the 121 projects that were selected through ARPA-E's first three funding opportunities. The two remaining Program Directors oversee the FY 2011 funding opportunities.

We feel ARPA-E remains an attractive place for the nation's top scientists and engineers, filling the unique role of early-stage, high-risk, high-reward research. ARPA-E is pleased to have been praised by the President's Council of Advisors on Science and Technology as an exciting, pioneering and critically important place to work.

Subcommittee. The current program directors are only slated to stay at ARPA-E for three years, I believe. Do you foresee any challenges in attracting the next round of program directors?

Dr. Majumdar. No, we do not foresee any challenges attracting the next round of Program Directors. The attention ARPA-E has received for its

dynamic work environment and transformative research indicates that ARPA-E will remain an attractive opportunity for future program directors.

Subcommittee. How would you see extending ARPA-E's success in attracting top talent to the other applied research offices in the Department of Energy?

Dr. Majumdar. ARPA-E has used its special hiring authority to quickly hire scientific, engineering, and professional personnel pursuant to its statute. ARPA-E has used this authority to hire eleven people, including top scientists and engineers to serve limited terms as Program Directors and Fellows. This special hiring authority is a valuable mechanism for quickly hiring the best applicants.

Another practice that ARPA-E employs is term limits. ARPA-E staff members choose to serve their country for a select amount of time. This ensures a highly motivated workforce ready to meet the urgent challenges facing our country. Of course, every program has a different mission and goals and will have to determine what hiring practices best suit its needs.

UP-FRONT FUNDING FOR AWARDS

Subcommittee. Dr. Majumdar, ARPA-E Recovery Act grants were fully funded up front: that is, Recovery Act funding covered the entire cost of each 2-3 year grant awarded by ARPA-E. In regular fiscal years, other Department offices sometimes fund awards across several years using money appropriated across several fiscal years. ARPA-E has decided to fund projects in fiscal year 2012 in the same fashion as it did in the Recovery Act—by fully funding most awards with fiscal year 2012 appropriations alone. In other words, awards granted with 2012 funding will not create "mortgages"—or commitments—to be paid with future years of appropriations.

There are obviously advantages to both approaches. This seems like a logical approach for ARPA-E. Dr. Majumdar, can you describe how you chose this approach?

Dr. Majumdar. ARPA-E managed the Recovery Act funding in this way for several reasons. First, the budget authority to obligate Recovery Act funding expired at the end of FY 2010; so we needed to ensure that all of the Recovery Act funds appropriated to ARPA-E were obligated before that expiration. We had to choose whether to obligate funds to cover all three years of a smaller number of projects, or just the first phase of a larger number of projects. The former made more sense for a new agency that was just starting up.

Now that the Recovery Act has concluded, ARPA-E may choose to fund some projects with outyear mortgages rather than fully funding each cooperative agreement. With our team, structure, and processes now in place, we will determine the manner we think is best for the program on a program-by-program, and in some cases, project-by-project basis, in order to enable the greatest flexibility in the use of appropriated funds.

In addition to the reasons already provided that support the full funding approach, the no-mortgage approach makes sense for ARPA-E because it does not place restrictions on funds that future Program Directors will inherit. Moreover, it lowers financial uncertainty for the performer, who can then focus on the technology rather than securing future funding.

However, there are cases where it may make sense to obligate funding on cooperative agreements in amounts that would cover some period of time less than the full duration of the agreement. For example, if a project offers great promise but is particularly risky, perhaps we would fund an amount that would reach the first technical milestone go/no-go decision point. Not going through the deobligation process will allow us to move funding more rapidly to other projects.

In sum, having a flexible approach to funding projects in place will allow us to better achieve our legislative mandate.

Subcommittee. Do you believe that other Department offices should fully-fund grant awards as well? Are there any compelling reasons to do otherwise?

Dr. Majumdar. Just as ARPA-E reserves the option to use either approach determined on a case-by-case basis, other Department program offices should utilize the approach that best suits their needs.

LOAN GUARANTEE PROGRAMS

1703 RENEWABLE LOAN GUARANTEE AUTHORITY

Subcommittee. Mr. Silver, your office provided information to the Committee indicating that over $18 billion of the $18.5 billion in authority for renewable energy projects cannot be used because there is no appropriated credit subsidy. Why is this so, especially recognizing that there seems to be plenty of demand for nuclear and fossil energy guarantees, for which applicants also have to pay their subsidy costs, which may be in the hundreds of millions of dollars?

If applicants for these projects cannot pay even a small percentage of their overall project costs, should we be backing them with taxpayer dollars?

Mr. Silver. The difficulty we face in using this authority is not that renewable projects "cannot pay even a small percentage of their overall project costs." All of our loan recipients – including renewables projects under 1703 – are required to repay any credit assistance, and therefore ultimately are expected to pay a significant portion of the project costs themselves. Additionally, guarantees are limited, by statute, to no more than 80% of project costs to ensure the borrower has significant equity in the loan. DOE frequently provides loan guarantees supporting a considerably lower percentage of total project costs. However, some innovative projects with a higher risk profile, while still credit-worthy, may have difficulty paying an upfront credit subsidy cost equal to the Government's expected subsidy cost of the credit assistance. This is particularly true of innovative renewable energy companies which are often more thinly capitalized than nuclear companies.

In the recently-passed FY11 Continuing Resolution, Congress provided $170 million of appropriated credit subsidy to support energy efficiency and renewable energy projects. We believe that this will enable us to support some projects, which we may not have been able to participate in the program otherwise.

Subcommittee. This $18 billion in unused authority could be easily used by other technologies. Why shouldn't we free this funding up for other technologies that we know will use the support?

Mr. Silver. We are not familiar with the origin of the $18 billion figure you cite. Congress has demonstrated its intent for DOE to use this authority to support energy efficiency and renewable energy technologies. In the recently passed FY11 Continuing Resolution, Congress provided $170 million of appropriated credit subsidy to support energy efficiency and renewable energy projects. We believe that this enable us to support some projects, which may not have been able to participate in the program otherwise.

ADVANCED TECHNOLOGY VEHICLE MANUFACTURING PROGRAM

Subcommittee. Mr. Silver, in 2008 the Advanced Technology Vehicle Manufacturing Program was provided with $7.5 billion for credit subsidy costs to support up to $25 billion in direct loans to manufacturers of advanced technology vehicles and related automotive components. Today, more than two years after this program was first authorized, more than $4.2 billion still remains. Chrysler has famously pulled out of the program, saying it didn't need the support. It seems to me as if the program has essentially stalled.

According to information provided by your Department, you have loaned $8.4 billion from this program to four projects. The largest of these projects was for Ford, at nearly $6 billion. Another $2 billion in projects has been identified, although nothing has been finalized. That makes $10.4 billion in likely commitments that you have shared with the Committee. Are there any other potential projects in the pipeline that we should know about?

Mr. Silver. The Department would like to clarify two issues raised by your question: (1) it was General Motors, not Chrysler, that publicly announced it would no longer be seeking an ATVM loan guarantee; and (2) we are not familiar with the origin of the $10.4 billion figure that you cite.

The ATVM Loan Program has, as you note, closed five loans totaling over $8.3 billion. It is our policy not to discuss the status of specific applications. However, the program has a significant number of applications under review.

Subcommittee. How much of the appropriated subsidy would you need if all of these projects were actually offered loans?

Mr. Silver. While it is difficult to provide specific estimates because credit subsidy calculations are not finalized until loans are finalized, we expect that the projects currently in active review would, if they reached financial close, use the majority of our remaining funds.

Subcommittee. The Department has provided other information which says that $17.5 billion, not $10.4 billion, of authority would be used

by the end of fiscal year 2011. How do you explain the difference between $17.5 and $10.4 billion?

Mr. Silver. The Department is not familiar with the origin of the $10.4 billion figure cited in the question, and cannot comment on it. DOE has issued approximately $8.3 billion in loans to date and the department has a significant number of applications under review.

Subcommittee. Given that this program was signed into law under "emergency" authority and how slowly it is now progressing, at what point would you consider it appropriate to return the unused funds to the Treasury?

Mr. Silver. The ATVM Loan Program has closed five loans totaling over $8.3 billion. We expect that the loans currently in active review would use the majority of our remaining appropriated credit subsidy.

ARRA SUBSIDY-PAID LOAN GUARANTEE AUTHORITY

Subcommittee. Mr. Silver, the stimulus Act provided $6 billion to directly subsidize loan guarantees for renewable energy and energy efficiency. Today, even after the previous majority used more than $3 billion for other priorities, more than $2 billion in subsidies remain...subsidies that will expire at the end of this fiscal year if they're not used.

While some of us may have concerns about whether taxpayer dollars are well used in this program, I don't want to see businesses cut off at the knees at the end of the fiscal year, especially if the delays have been even partially caused by the Department or OMB.

Mr. Silver, information your office has provided shows just over $14 billion in 1705 projects with term sheets out. How many of these are likely to drop out?

Mr. Silver. Under the 1705 program, which expired on September 30th, 2011, DOE issued $16.1 billion in loan guarantees to support 28 projects. DOE worked diligently to ensure that all projects were fully vetted before a guarantee was issued. Not all eligible projects that were under active review ultimately received a loan guarantee. Some projects that were under review but did not close by September 30th may be eligible to receive loan guarantees under the 1703 program, either on a self-pay basis, or by using the credit subsidy appropriated by the FY 2011 Continuing Resolution.

Subcommittee. What is your projection for the amount of subsidy that would be needed to cover the remaining, viable, projects? I don't need specifics...just a ball-park estimate.

Mr. Silver. Following the expiration of the Section 1705 program, the Department has $170 million in credit subsidy and $1.5 in self pay authority provided in the 2011 Continuing Resolution to support innovative renewable energy and efficient end-use energy projects under the Section 1703 program. In addition, the 2012 Budget requests $200 million in appropriated credit subsidy.

Subcommittee. Are there other 1705 projects without term sheets that are at risk of being cut off at the end of the fiscal year?

Mr. Silver. As you know, in May 2011, we notified over 40 projects, eligible for 1705 funding, that their applications were being put on hold because the projects were not in a position to reach financial close by the 1705 program's September 30th, 2011 expiration date. Some of those projects may be eligible for loan guarantees under the 1703 program.

Subcommittee. Your budget request includes $200 million to support what looks to be the same sort of program – a taxpayer-subsidized guarantee program. Would the projects that might be cut off at the end of September be eligible for this funding without additional authorizing legislation?

Mr. Silver. Under the recently-passed FY 2011 Continuing resolution, most 1705-eligible projects that applied for a loan guarantee prior to February 24, 2011, will be eligible under the 1703 loan guarantee program for the self pay authority and appropriated credit subsidy provided under that resolution. The 2012 Budget requests $200 million in appropriated credit subsidy to support innovative renewable energy and efficient end use technologies. Projects that utilize innovative technologies would be eligible for such funding without additional authorizing legislation.

Subcommittee. What are the roadblocks holding back these projects?

Mr. Silver. It is impossible to generalize across the broad array of projects that have applied for a loan guarantee to date. Many projects are delayed by factors outside of DOE's or the applicant's control, including litigation and/or regulatory/permitting issues. Others require significant restructuring to ensure that they represent a good investment of taxpayer resources. For example, some projects need to do things like raise additional equity, adequately demonstrate the efficacy of their technology, and/or finalize critical project agreements or plans. Where these roadblocks exist, DOE works closely with applicants to resolve these issues as expeditiously as possible. Where there are no roadblocks, we are committed to processing these transactions as quickly and efficiently as possible, while ensuring that taxpayer funds are properly safeguarded.

Subcommittee. What are you doing to fix this?

Mr. Silver. With respect to external roadblocks that these projects face, there is little that the Loan Programs Office (LPO) can do, other than work closely with the applicants to help them identify and expeditiously resolve these issues – which we do. With respect to the LPO internal process, we have worked diligently over the last eighteen months to streamline our review and improve our communications with applicants. For example, we hired a significant number of qualified personnel, released a new website and portal to allow for the electronic submission of applications, streamlined the NEPA process, and reduced average intake time to less than two weeks. This has allowed us to process well-structured, creditworthy projects much more quickly, while ensuring that taxpayer funds are properly safeguarded. We are committed to continually improving our process and incorporating lessons learned to ensure that we operating as efficiently, transparently, and effectively as possible.

RECENT IG REPORT ON LOAN GUARANTEE RECORD KEEPING

Subcommittee. Mr. Silver, the DOE Inspector General just issued another report criticizing the loan guarantee program. In this report, he found that the program's record keeping was not an "effective source of critically important Program information." This is bad enough, but similar charges were brought against the program in 2009. The Department said at that time that all the issues had been dealt with. That's obviously not the case.

The loan guarantee program has faced charges of political manipulation, inconsistent decision-making, and general inefficiency. Now we learn that there seems to be a systemic inability to keep the records to show that these charges aren't true.

What is the depth of the problem, and what can you assure us is being done about it?

Mr. Silver. It is important to note first that the Inspector General did not assert that the Loan Program Office's decision-making on loan guarantees was flawed. The IG report also did not suggest that the Loan Programs Office has not maintained all of the relevant underwriting and transaction documents. The report did point out that they were not always stored in one central document management system.

The underwriting of the loan guarantees is so comprehensive and thorough that it results in a vast amount of documentation and analysis for each project. While the Loan Programs Office did, and does, maintain, for every transaction, a vast archive of documents, it agreed with the conclusion that the programs needed an improved document management system. Although it was not mentioned in the report, we had been developing, and have since implemented, a new, state-of-the-art, centralized data system.

The IG report also did not comment on protocols, which are relevant. We have revised our records management protocol to better integrate document and records management into our daily business practices to ensure that our records management practices continue to meet or exceed all applicable standards, regulations, and best practices.

GAO REVIEW OF THE LOAN PROGRAM

Subcommittee. This Committee has tasked GAO to review the Loan Program annually. The GAO 2010 report under this mandate found, among other things, that DOE had implemented the program in a way that treats applicants inconsistently.

Has the program implemented procedures to ensure consistency?

Mr. Silver. We disagree with GAO's assessment that we treated applicants inconsistently. The Loan Programs are solicitation-based – meaning that we accept applications only in response to specific solicitations that we issue, each of which is tailored to a specific category or categories of technologies or project types.
Each solicitation clearly lays out the criteria that will be used to analyze applications submitted in response to that solicitation – and DOE is vigilant in applying them on a consistent basis within each solicitation.

The GAO report's criticisms were based on comparing different types of projects across different solicitations. We believe that technology differences may appropriately be subject to different review criteria, so long as the criteria are made clear to, and applied consistently across, all similarly situated applicants.

CREDIT MODEL

Subcommittee. Mr. Silver, the structure of the credit model has been an ongoing topic of concern. To date the credit model has not been made public, nor have many of the criteria. The stated reason for this has been that if it were made public, companies could "game" the system. Yet, several project finance representatives have disputed this claim and have maintained that transparency is in everyone's interest. They argue that, yes, some proposals would be structured differently as a result of understanding the credit model, but in the end this would be beneficial, not detrimental to the program.

Would you take some time to explain your position and why the financial folks on the other side of this argument are wrong?

Mr. Silver. The credit subsidy cost reflects DOE's analysis of the risks associated with each project, including its analysis of the borrower, the project and the financial prospects of both. The credit subsidy cost assessment relies on highly sensitive business confidential information, and itself is sensitive information that would likely influence the borrower's ability to raise capital for the project. Further, release of this business confidential information could have other adverse effects for applicants, and/or for other applications for similar technologies. For example, if the public views a high fee/risk for one project as indicative of the sector as a whole, then stronger projects using similar technology may not be able to access private investment.

Subcommittee. What factors does the model take into account? Please provide for the record the risk areas and their relative percentage weight.

Mr. Silver. In developing a credit subsidy estimate, the Loan Programs Office staff reviews and scores every aspect of the transaction, including, but not limited to: pledged collateral, market risk, technology risk, regulatory risk, contractual foundation, operational risk, and recovery profile. The result is a credit subsidy range that incorporates all available information regarding the project and financing at the time. The approach to determining the credit subsidy is based on transaction risk analysis which is similar to that conducted by private sector lenders.

RECOVERY RATE

Subcommittee. Mr. Silver, I understand that the model assumes a 55% percent recovery rate. A uniform recovery rate seems a rather simplistic approach; do you have mechanisms to address project specific variables?

If so, how much of a difference can these issues make in the recovery rate of an individual project?

Mr. Silver. The model specifically incorporates adjustments to reflect project-specific factors so that the assigned recovery rates reflect all relevant and available information for the underlying project.

Subcommittee. What are the factors you consider?

Mr. Silver. The model incorporates a broad range of factors that affect the recovery estimate, including: market, technology, regulatory, contract and operations risks, as well as collateral and other project-specific factors.

Subcommittee. Have you used a recovery rate other than 55% in any closed or conditional loan?

Mr. Silver. Yes, the credit subsidy scores for loan guarantees have incorporated a broad range of recovery estimates.

Subcommittee. Please provide for the record any final or conditional commitment that used a recovery rate other than 55%, the rate used and the factors that lead to the adjustment from the default rate of 55%

Mr. Silver. Each project is evaluated, and all relevant information is incorporated into assumptions for the credit subsidy cost, including the recovery rate assumption. Factors include market, technology, borrower, and other project-specific characteristics that could affect the recoveries in the event of default.

TRADE SECRETS ACT

Subcommittee. The Congress has had a difficult time evaluating this program due to lack of information. The predominate excuse for not providing detailed information is the Trade Secrets Act. Generally speaking, Mr. Silver, the Congress' authority and power to obtain information, including but not limited to proprietary or confidential information, is extremely broad. Upon occasion, Congress has found it necessary and appropriate to limit its access to information it would normally be able to obtain by exercise of its constitutional oversight prerogatives. But where a statutory confidentiality or nondisclosure provision is not made explicitly applicable to the Congress, the courts have consistently held that agencies and private parties may not deny Congress access to such information on the basis of such provisions. Ambiguities in such statutes as the Trade Secrets Act and the Privacy Act have been resolved in a committee's favor. The courts have also held that the release of information to a congressional requester is not considered to be disclosure to the general public.

What does the Committee have to do to get the information necessary to receive detailed information on this program?

Mr. Silver. The Department is willing to provide information requested by the Committee to the extent that it can do so consistent with its obligations under the Trade Secrets Act and other relevant regulations. We would be happy to discuss this issue further with the Committee in the context of specific requests for information.

REVIEW OF ELIGIBILITY

Subcommittee. Mr. Silver, it has come to the attention of the Committee that the Program has not always had consistent reviews of eligibility of proposals for the program. In one case, a company spent 17 months and hundreds of thousands of dollars pursuing a loan guarantee, only to be told after 17 months that it "was not eligible as a matter of law"

First, how did it happen that a company could spend 17 months only to have the Department reverse its opinion?

Mr. Silver. Applications, and the technologies they seek to develop, occasionally change. This forces the Loan Programs Office to re-start application reviews consisting of highly sophisticated technical and financial analyses conducted by our experienced professional staff. In those cases, DOE has to reevaluate the proposal based on the new information provided which may ultimately result in a different outcome.

Subcommittee. Have you addressed the review problems associated with this oversight? Can we expect that your reviews at the start of an application will be more accurate?

Mr. Silver. The Department is committed to ensuring that the Loan Programs have the resources needed to process and review applications as efficiently and effectively as possible. To that end, the Loan Programs made a number of improvements in 2010, including a significant increase in qualified personnel and more robust and regular communications with applicants. We are well-positioned to process transactions at a rate, and with a level of transparency, that meets the business needs of our applicants, while ensuring that taxpayer monies are properly safeguarded and statutory requirements are met.

ADDITIONAL $2 BILLION IN TECHNOLOGY NEUTRAL GUARANTEES FOR NUCLEAR

Subcommittee. Approximately $2 billion remains from the technology neutral loan authority provided in 2007, if current estimates are correct. Would the department consider using the remaining unallocated authority for nuclear? If no, why not?

Mr. Silver. The Department has not made a decision as to how to utilize the authority in question.

Subcommittee. Given that even with that additional loan authority the Department would be slightly short of the requirement for the next two applicants, would you issue a conditional commitment with the majority of the guarantee firm and the remainder contingent upon appropriation?

If no, it would not help the applicant.

Mr. Silver. No. The Department cannot issue conditional commitments in excess of available authority. Issuing conditional commitments contingent upon future appropriations could ultimately preclude funding the best projects, impede competitive funding, and spur a race to apply vs. focusing efforts on bringing the strongest projects to financial close.

Subcommittee. Are there legal constraints?

Mr. Silver. The Department cannot issue conditional commitments in excess of available authority.

Subcommittee. Have you discussed this possibility with any applicants?

Well, at least one of the two next applicants has told folks up here that they could live with a partial commitment and move forward. Of course it's not the ideal situation, but if the alternative is nothing, it's at least a very strong signal if the vast majority of the funds are secure. The applicant might feel the need to make contingency plans; however they would otherwise just be waiting.

Mr. Silver. The Department cannot issue conditional commitments in excess of available authority.

FOSSIL ENERGY LOAN GUARANTEES

Subcommittee. Mr. Silver, you have issued no loan guarantees for fossil fuel plants, even though you have over $8 billion in authority available to you. What's holding up this program?

Mr. Silver. The Department recognizes the importance of advanced fossil projects, and currently has six such projects in due diligence. In fact, the Department recently issued a draft term sheet to its first advanced fossil application. Two other projects are sufficiently far along in the process that DOE anticipates issuing each a draft term sheet in the near to medium term. Each of these projects has a number of open items that need to be resolved before DOE can determine, as is required by statute, that there exists "a reasonable prospect of repayment of the principal and interest on the obligation by the borrower." Some of these issues involve local and state legislatures or other governing bodies, on which the Loan Programs cannot force a timetable.

Subcommittee. According to your Department's information, you have $3.2 billion in projects that may be finalized this fiscal year. What is the status of this funding?

Mr. Silver. The Department is not familiar with the origin of the $3.2 billion figure cited in the question, and cannot comment on it. The Department currently has six fossil projects in due diligence. In fact, the Department recently issued a draft term sheet to its first advanced fossil application. Two other projects are sufficiently far along in the process that DOE anticipates issuing each a draft term sheet in the near to medium term. Each of these projects has a number of open items that will need to be resolved before DOE can determine, as is required by statute, that there exists "a reasonable prospect of repayment of the principal and interest on the obligation by the borrower."

Subcommittee. You apparently have enough projects identified to use up the rest of the $8 billion, although they're not far enough along in development to finish them by the end of this fiscal year. What is the timeline for these to be completed?

Mr. Silver. It is impossible to predict, with any certainty, the timeline for the remaining projects, as each faces a unique set of challenges and milestones.

ROLE OF OMB

Subcommittee. Mr. Silver, this subcommittee has been very concerned by the lack of transparency coming out of OMB regarding this program. After all, OMB has the power to set the subsidy rates for each project within your portfolio, yet they don't seem to be accountable to anyone about their decisions.

When I apply for a mortgage, and I'm unhappy about the rate I'm getting, there are things I can do...for instance, improve my credit score, or negotiate with the lender. Is there any way for a company who is applying for your program and hoping for a better subsidy rate to negotiate with OMB? If not, why not?

Mr. Silver. The Department has extensive interactions with applicants during the underwriting process and engages in active negotiation over deal terms. Those terms have an impact on the ultimate credit subsidy cost. But the credit subsidy cost itself is not negotiated or calculated with applicants. Consistent with statutory requirements and good stewardship of taxpayer resources, the cost is calculated by the Department, and reviewed and ultimately approved by OMB, using an agreed-upon methodology and model that is consistent with the Federal Credit Reform Act and implementing guidance. The Department is responsible for selecting projects and negotiating deal terms. OMB is responsible for reviewing and approving the credit subsidy cost, and, OMB personnel do not have direct negotiations with applicants.

USEC NUCLEAR "FRONT-END" LOAN GUARANTEES

Subcommittee. Mr. Silver, we all recognize that the USEC situation has been a hot political issue for your office.

What's the status of USEC's loan guarantee application? Is it still active?

Mr. Silver. The Department cannot provide information on individual applications.

Subcommittee. What issues are they trying to resolve in order to improve their chances of receiving a loan guarantee?

Mr. Silver. The Department cannot provide information on individual applications. That said, the Loan Programs clearly lays out the criteria that will be used to analyze applications submitted in response to each solicitation – and DOE applies those criteria on a consistent basis.

Subcommittee. Although this particular application seems to have gotten special treatment, the way you are treating this application should be the same way you'd treat any application in the same set of circumstances. Your office has been criticized for lack of consistency in how you evaluate and manage loan applications.

Would you please explain to the subcommittee what best practices your office has learned through the USEC situation, and how you will apply them to further loan applications?

Mr. Silver. The Department cannot provide information on individual applications.

QUESTION FROM RANKING MEMBER VISCLOSKY OF INDIANA

Mr. Visclosky. Mr. Silver, the Loan Guarantee Office is in the midst of conducting due diligence on a number of projects under the 1703 program, including the Indiana Gasification project, an advanced fossil energy project in my home state of Indiana. The Indiana Gasification project will provide substitute natural gas to the Indiana Finance Authority for sale to Indiana consumers. Although this project was selected by DOE for due diligence and negotiations of terms and conditions necessary for a conditional commitment for a loan guarantee in July of 2009, I understand the Loan Guarantee office still has not yet issued Indiana Gasification a draft term sheet.

Can you tell me when you will propose a draft term sheet to begin negotiations over the terms of a conditional commitment with the Indiana Gasification Sponsor?

Mr. Silver. The Department cannot provide information on individual applications.

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