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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2013

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

SECOND SESSION

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

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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.

ROB BLAIR, JOSEPH LEVIN, ANGIE GIANCARLO,
LORAINE HECKENBERG, and PERRY YATES,
Staff Assistants

PART 6

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PART 6—ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2013

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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2013

WEDNESDAY, MARCH 21, 2012.

DEPARTMENT OF ENERGY—ENVIRONMENTAL MANAGEMENT & HEALTH, SAFETY, AND SECURITY FY 2013 BUDGET

WITNESSES

DAVE HUIZENGA, SENIOR ADVISOR FOR ENVIRONMENTAL MANAGEMENT (ACTING), OFFICE OF ENVIRONMENTAL MANAGEMENT, DEPARTMENT OF ENERGY

GLENN PODONSKY, CHIEF HEALTH, SAFETY, AND SECURITY OFFICER, OFFICE OF HEALTH, SAFETY, AND SECURITY, DEPARTMENT OF ENERGY

Mr. FRELINGHUYSEN. The hearing will come to order. Good morning, everybody. Thank you for being here. We have before us this morning David Huizenga, senior advisor for Environmental Management to the Secretary of Energy. We also have Glenn Podonsky, the department's Chief Health Safety and Security officer. We welcome you both to the subcommittee and we look forward to your testimony.

Before we begin I would like to note that a colleague of yours, Brad Peterson, died last week in New Mexico due to injuries from a car accident. He was most recently with the Office of Secure Transportation. And I think I speak for everybody on the panel here on the subcommittee on extending our condolences to his family, his colleagues at the office, and to the department.

Mr. HUIZENGA. Thank you, Mr. Chairman. He was a great guy.

Mr. FRELINGHUYSEN. We are pleased to note his work and we regret his passing.

The Environmental Management budget request for Fiscal Year 2013 is 5.009 billion for defense cleanup activities, a $14 million reduction from last year's inactive level. While it is clear that many tough decisions have been made in putting together this request, you have even tougher decisions ahead. Many of your current cleanup agreements relied upon continued large increases in funding, increases that are unrealistic even with the strong support we have for these activities within the committee. It is the responsibility of the department to explain where those timelines are in jeopardy and to work constructively with its stakeholders to establish affordable milestones which would meet our legal commitments and our financial restraints.

Mr. Podonsky, your budget request is $246 million, a reduction of 2 percent from last year's level. At the same time, you are under-

taking a review of the department's safety and security model. I hope you will be able to show us this morning that this budget request will fully support that important work.

Gentlemen, you are appearing together before the committee for the first time in order to better explain some of the challenges and, yes, some of the opportunities the EM Program and other nuclear operations that the department are facing. This subcommittee is taking a note of some very serious issues facing the department. Reports of poor project management leading to out-of-control cost growth and an apparent weakness in nuclear safety culture to name two of the most worrisome.

The EM Program is at the middle of these concerns and the Health Safety and Security Office is mandated to evaluate and help resolve them. Over the past few years, the Department has taken some positive steps to address these issues such as updating its project review procedures. More recently, EM has been re-evaluating its bureaucracy to see if it should be realigned. We will be watching closely to make sure that safety in project management is adequately resolved and that management reforms are actually effective.

Gentlemen, reports have identified major problems at the waste treatment and immobilization plant in Hanford. It appears that the Department of Energy has not yet been able to resolve significant design problems and changes may be on the horizon which will undoubtedly impact that project's cost and schedule, and could put the milestones of the Tri-Party Agreement in jeopardy. There are reports that as these troubles have festered, the safety culture of the site has deteriorated to such an extent that some find them to be a major risk to the project itself. The reforms you put in place must address these issues both at Hanford and anywhere else they threaten to come up.

Mr. Podonsky, your group has done some good work looking into the sources of the safety culture problems, and we are looking forward to hearing your findings. Ensuring that these facilities will operate safely is one of our greatest responsibilities, and the subcommittee cannot support any plan that would place the safety of your employees and the public in any jeopardy. Please 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 us no later than four weeks from the time you receive them. And I also ask that if members have additional questions they would like to submit to the committee for the record, they please do so by 5:00 p.m. tomorrow.

With these opening comments, I would like to yield to our ranking member, Mr. Visclosky, for any opening comments he may care to make.

[The information follows:]

OPENING STATEMENT
The Honorable Rodney Frelinghuysen
Chairman, Energy and Water Development Subcommittee
House Committee on Appropriations

Hearing on the Fiscal Year 2013 Budget Request for the
Department of Energy's Offices of Environmental Management and Health, Safety and Security
March 21, 2012

Good afternoon, everyone. We have before us today David Huizenga, Senior Advisor for Environmental Management to the Secretary of Energy. We also have Glenn Podonsky, the Department's Chief Health, Safety, and Security Officer. We welcome you both to the subcommittee, and look forward to your testimonies.

Before we begin, I'd like to note that a colleague of yours, Brad Peterson, died last week in New Mexico due to injuries from a car accident. He was most recently with the Office of Secure Transportation, and I think I speak for everyone here on the subcommittee in extending our condolences.

The EM budget request for fiscal year 2013 is $5.009 billion for defense cleanup activities, a $14 million reduction from last year's enacted level. While it is clear many tough decisions have been made in putting together this request, you have even more tough decisions on the way. Many of your current cleanup agreements relied upon continued large increases in funding – increases that are unrealistic even with the strong support we have for these activities. It is the responsibility of the

Department to explain where those timelines are in jeopardy and to work constructively with its stakeholders to establish affordable milestones which will meet our commitments.

Mr. Podonsky, your budget request is $246 million, a reduction of two percent from last year's level, at the same time you are undertaking a review of the Department's safety and security regulatory model I hope you'll be able to show us today that this budget request will fully support your important work.

Gentlemen, you are appearing together before the subcommittee for the first time in order to better explain some of the challenges, and opportunities, the EM program and other nuclear operations at the Department are facing. This subcommittee has taken note of a number of very serious issues facing the Department – poor project management leading to out of control cost growth, and an apparent weakness in nuclear safety culture, to name two of the most worrisome. The EM program is at the middle of these concerns, and HSS is mandated to evaluate and help solve them.

Over the last few years, the Department has taken some positive steps to address these issues, such as updating its project review procedures. More recently, EM has been reevaluating its bureaucracy to see if it should be realigned to get rid of red tape. We will be watching closely to make sure that safety and project management are adequately resolved and that the management reforms are actually effective.

Gentlemen, there are major problems at the Waste Treatment and Immobilization Plant at Hanford. DOE has as yet been unable to resolve significant design problems, and changes may be on the horizon which will undoubtedly impact the project's cost and schedule, and could put the milestones of the Tri-Party Agreement in jeopardy. And as these failures have festered, the safety culture at the site has deteriorated to such an extent that some find it to be a major risk to the project itself. The reforms you put in place must address these issues, both at Hanford and anywhere else they threaten to come up.

Mr. Podonsky, your group has done some good work in looking into the sources of the safety culture problems, and we're looking forward to hearing your findings. Ensuring these new facilities will operate safely is one of our greatest responsibilities, and this subcommittee cannot support any plan that would place the safety of your employees and the public in jeopardy.

Please 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 us no later than four weeks from time you receive them. I also ask that if Members have additional questions they would like to submit to the Subcommittee for the record, that they please do so by 5:00 PM tomorrow.

With those opening comments, I would like to yield to our ranking member, Mr. Visclosky, for any opening comments that he would like to make.

Mr. VISCLOSKY. Thank you very much. Mr. Huizenga and Mr. Podonsky, thank you very much for being with us today.

Mr. Huizenga, this will be your first time before the subcommittee as the leader of the Office of Environmental Management and I do have faith that you are up to the challenge ahead of you. The appearance of both of you will give the subcommittee a perspective on the individual programs and, also, the opportunity to understand how they interact and work together to ensure DOE projects are meeting the mission while also maintaining a safe work environment.

The Manhattan Project and resulting nuclear weapons complex was an unparalleled scientific achievement. Today, we must obviously address the environmental impacts of this monumental undertaking, ensuring the health and safety of those communities affected. The Federal Government's obligation to remediate these sites is without question. However, given the constrained physical environment it will be paramount that all resources are used to their fullest potential. I understand that the department is undergoing a review of the implications of flat funding to the cleanup effort, and I would be interested today in hearing if you have any initial feedback for the subcommittee.

Mr. Huizenga, I will make a point to you that I made to both Secretary Chu and NNSA Administrator D'Agostino. Issues of project management, corporate governance, and workplace safety are not the most electrifying issues to tackle, but I attach special importance to them and I do believe they are vital to the success of the department's mission. A strong leadership and fundamental management reform are not forthcoming at the Department of Energy after all of these many years. It will significantly inhibit the execution of your mission as well as the department's credibility. I hope that you will take some time today to update us on your specific actions in this regard, in particular any progress that you have made in getting EM off the GAO's high-risk list.

Mr. Podonsky, in my opinion, worker health and safety is one of the most important elements in meeting the department's mission. In particular, given the materials and facilities under EM's charge, the potential human and financial losses that have come from having an unsafe worksite are mindboggling. I appreciate that you have taken seriously your charge to ensure the safety of the department's projects and look forward to discussing in detail your office's progress on this front.

Mr. Chairman, thank you very much for the time.

[The information follows:]

Visclosky Opening Statement at Hearing on FY13 Budget for Environmental Management

March 21st, 2012

Subcommittee Ranking Member Rep. Peter Visclosky

Good morning, Mr. Huizenga and Mr. Pondonsky. Thank you for taking the time to discuss the Environmental Management (EM) and Health, Safety and Security (HSS) offices with us today. Mr. Huizenga, this will be your first time before the Subcommittee as the leader of the Office of Environmental Management. I have faith that you will be up for the challenge ahead.

The appearance of both the EM and HSS today will give the Subcommittee a perspective on the individual programs, and also the opportunity to understand how they interact and work together to ensure DOE projects are meeting the mission while also maintaining a safe work environment.

The Manhattan Project, and the resulting Nuclear Weapons Complex, was an unparalleled scientific achievement that was made possible by the development of an unprecedented infrastructure and industry, in both its size and legacy. Today we must address the environmental impacts of this monumental undertaking, ensuring the health and safety of those communities affected. The Federal government's obligation to remediate these sites is without question; however, given the constrained fiscal environment, it will be paramount that all resources are used to their fullest potential. I understand that the Department is undergoing a review of the implications of flat funding to the clean-up effort, I would be interested today in hearing if you have any initial feedback for the Subcommittee.

Mr. Huizenga, I will make a point to you that I made to both Secretary Chu and the NNSA Administrator D'Agostino. Issues of project management, corporate governance, and workplace safety are not the most electrifying issues to tackle, but they are vital to the success of the Department's mission. If strong leadership and fundamental management reform are not forthcoming at the Department of Energy, it will significantly inhibit the execution of your mission as well as the Department's credibility. I hope that you will take some time today to update us on your specific actions in this regard, in particular, any progress you may have made in getting EM off the GAO's high risk list.

Mr. Pondonsky, in my opinion, worker health and safety is one of the most important elements in meeting the Department's mission. In particular, given the materials and facilities under EM's charge, the potential human and financial losses that can come from having an unsafe worksite are mindboggling. I appreciate that you take seriously your charge to ensure the safety of the Department's projects and look forward to discussing in detail your office's progress on this front.

Thank you, Mr. Chairman for the time.

Mr. FRELINGHUYSEN. Thank you, Mr. Visclosky. Mr. Huizenga, can you speak to what the Environmental—excuse me, I apologize. Your statements.

Mr. HUIZENGA. Thank you, Mr. Chairman. Good morning, Chairman Frelinghuysen, Representative Visclosky, and Representative Simpson. I am honored to be here today to discuss the positive things that we are doing for the Nation through our ongoing efforts in the Environmental Management Program and, of course, to address your questions regarding our fiscal 2013 budget request.

Our request of 5.65 billion enables the Office of Environmental Management to continue the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research. Our cleanup priorities are based on risk and our continuing efforts to meet our regulatory compliance commitments. Completing cleanup promotes the economic vitality of the communities surrounding our sites and enables other crucial DOE missions to continue. By reducing the cleanup footprint, we are lowering the cost of security and other overhead activities that would otherwise continue for years to come.

In August 2011, the Office of Environmental Management was aligned under the Office of the Under-Secretary for Nuclear Security. This realignment promotes the natural synergies that exist between EM and NNSA. For example, at Oak Ridge Laboratory, we are working closely with NNSA now to accelerate the transfer of certain components of the Uranium–233 inventory.

This inventory is valuable for National Security applications and supports NNSA missions. Removing this material and transferring it to NNSA for their use will result in cost savings for our program and enable us to move forward with cleanup at the Oak Ridge National Laboratory.

Over the years, the Office of Environmental Management has made significant progress in accelerating environmental cleanup across the complex. For example, last December, at the Defense Waste Processing Facility at our Savannah River Site in South Carolina, we solidified a record 37 canisters of highly radioactive waste. These are more canisters than we have filled in one month in the facility's 15-year history. Out west at our Moab site in Utah, we celebrated the removal of five million tons of uranium tailings from the site to a safe location away from the Colorado River. Through 2011, we safely conducted over 10,000 shipments of transuranic waste to the Waste Isolation Pilot Plant in New Mexico, the world's largest operating deep geologic repository. As you can see from some of these accomplishments the EM has made great progress and will continue to do so with your help.

We could not have achieved such notable accomplishments without an outstanding Federal and contractor workforce. The safety of our workers is a core value and is incorporated into every aspect of our program. I am sure we are going to be talking about that and I welcome the opportunity to talk more about it with Mr. Podonsky and you today. We maintain a strong safety record and continually strive for accident and incident-free workplaces. We seek to continue improvements in the area of safety by instituting corrective actions and aggressively promoting lessons learned

across our sites. In collaboration with Mr. Podonsky's office and our field sites, we are working to achieve a stronger safety culture within our Program and ultimately improve safe construction and operation of our facilities.

We will continue to identify opportunities to reduce the life-cycle costs of our program, including the development of new technologies and other strategic investments. For example, in fiscal year 2013, we will continue our efforts to develop technologies that allow for the segregation and stabilization of mercury-contaminated debris and improve groundwater monitoring.

Finally, we continue to work with the Government Accountability Office as we institutionalize the improvements in contracting and project management which I know are important to you. We have established project sponsor positions at Headquarters for all of our capital asset projects and conduct regular peer reviews of our most complex projects. We are including the U.S. Army Corps of Engineers personnel in some of these teams because of their project and contract management expertise. We are committed to becoming a best-in-class performer in the area of project management.

Chairman Frelinghuysen, Representative Visclosky, and Representative Simpson, we continue to apply innovative cleanup technologies so that we can complete our quality work safely, on schedule, and within costs thereby demonstrating value to the American taxpayers. Thank you and I would be pleased to answer your questions.

[The information follows:]

Written Statement of David Huizenga
Senior Advisor 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 21, 2012

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) 2013 budget request for the Department of Energy's (DOE) Office of Environmental Management (EM). The EM FY 2013 budget request of $5.65 billion enables EM to continue the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research.

Environmental Management Program Strategies: A National Responsibility

The DOE Strategic Plan highlights EM's objective to complete the environmental remediation of our legacy and active sites by disposing of radioactive wastes, remediating contaminated soil and groundwater, and deactivating and decommissioning (D&D) radioactively contaminated facilities. EM is committed to sound technology development and deployment. EM develops and implements first-of-a-kind technologies to further enhance its ability and efficiency in cleaning up radioactive waste. Through these innovations, EM and the companies that perform its cleanup work have remained world leaders in this arena. Our work in EM enables other crucial DOE missions to continue across the United States. By reducing our cleanup footprint, EM is lowering the cost of security, surveillance, infrastructure, and overhead costs that would otherwise continue for years to come.

Overview of Program Priorities

To best address our cleanup objectives, EM's cleanup prioritization is based on achieving the greatest risk reduction benefit per radioactive content (wastes that contain the highest concentrations of radionuclides) while continuing to meet regulatory compliance commitments and promote best business practices. EM's priorities to support this approach include:

- Radioactive tank waste stabilization, treatment, and disposal;
- Spent (used) nuclear fuel storage, receipt, and disposition;
- Special nuclear materials consolidation, processing, and disposition;
- Transuranic waste and mixed low-level/low-level waste disposition;
- Soil and groundwater remediation; and
- Excess facilities D&D.

Creating Synergies that Last

In an effort to maximize the accomplishments of mission-critical projects and organize needs more closely with DOE's resources, EM was aligned under the Office of the Under Secretary for Nuclear Security in August 2011. This alignment allows DOE to capitalize on the expertise that exists among the National Nuclear Security Administration (NNSA), EM, the Office of Legacy Management, and the DOE Chief Nuclear Safety Officer on areas related to project management, nuclear materials and waste handling, and nuclear safety and security.

There are natural synergies between EM and NNSA. At Savannah River Site, EM and NNSA are working closely together to utilize the H-Canyon facility and support multiple missions including: converting about 3.7 metric tons of plutonium into suitable feed for NNSA's Mixed Oxide Fuel (MOX) Fabrication Facility; removing contaminants in the plutonium to make it amenable for use as MOX feed; and reducing the amount of plutonium that EM needs to package and send to the Waste Isolation Pilot Plant for disposal. These activities will occur in addition to EM's utilization of H-Canyon for activities such as the commencement of the process for the disposition of spent (used) nuclear fuel that is not suitable for extended storage in L-Basin.

At Oak Ridge National Laboratory, EM and NNSA are working together to accelerate the transfer of certain components of the Uranium-233 inventory that are valuable for national security applications. This cooperative effort will support NNSA's missions related to safety, nuclear emergency response, and special nuclear material measurement and detection. This initiative will result in cost savings for the EM program and enable EM to move forward on cleanup of nuclear facilities which will allow other DOE missions to continue. In addition, EM has established a partnership with NNSA to build upon the success of the Supply Chain Management Center, leveraging buying power across the combined EM and NNSA complexes for commonly used goods and services with the objective of realizing cost savings for the EM program similar to those NNSA has achieved.

Safety Culture

The safety of EM workers is a core value that is incorporated into every aspect of the EM program. To best protect our workers, EM has a goal of zero accidents or incidents in the work place and to date, has maintained a strong safety record. EM continues to utilize the Integrated Safety Management System to ensure that all work activities are appropriately scoped, analyzed for hazards, comprehensively planned to eliminate or mitigate those hazards, and effectively performed by trained employees. In addition, EM follows DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy* which instills the philosophy that line management is responsible for ensuring the safety when work is being performed. EM seeks to continue improvements in the area of safety by instituting corrective actions, promoting lessons learned, and developing new or improved processes.

EM strives to promote and maintain a healthy safety culture at all of its sites. DOE defines safety culture as "an organization's values and behaviors modeled by its leaders and internalized by its members, which serve to make safe performance of work the overriding priority to protect the workers, public, and the environment." As part of this effort, EM is working with DOE's Office of Health Safety and Security (HSS) and utilizing DOE's Implementation Plan for the Defense Nuclear Facilities Safety Board Recommendations 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant* to guide its actions and decision-making. As part of this effort, HSS has provided guidance and recommendations including how to better promote the raising of safety concerns on projects such as the Waste Treatment and Immobilization Plant. HSS will also conduct independent "extent of condition reviews" of major EM capital projects this year including the Sodium Bearing Waste Treatment Facility at Idaho and the Salt Waste Processing Facility at the Savannah River Site. In accordance with the *Consolidated Appropriations Act Conference Report, FY 2012*, DOE, including EM and HSS, will conduct reviews of nuclear facility construction projects with a total project cost greater than $1 billion, to determine if those projects are being managed in a way that could pressure contractors or Department managers to lessen nuclear safety in order to demonstrate acceptable project performance.

To further instill a healthy safety culture in EM, within the next year, EM will conduct 'town hall' style meetings at its sites with defense nuclear facilities. At these meetings, EM senior leadership will emphasize the importance of maintaining a strong safety culture and soliciting employee input regarding safety. EM will continue to keep its employees, the public, and the states where cleanup sites are located, safe from radioactive and hazardous materials contamination. EM will also further instill core values and principles that will allow for improved communication and team building in order to accomplish its mission goals.

Compliance

Over the last 22 years, EM has maintained a working relationship with regulators and developed agreements and compliance milestones that provide the framework and schedule for cleaning up the Cold War legacy at DOE sites. There are approximately 40 such agreements. In FY 2011, EM met 97 percent of its enforceable agreement milestones. In light of the potential need to renegotiate some of the compliance milestones, EM's goal in FY 2013 is to meet 100 percent of its compliance agreement milestones.

The FY 2013 EM budget request funds the closure of high level waste tanks 18 and 19 in the Savannah River Site F-Tank Farm. At Los Alamos National Laboratory, FY 2013 funds expedite the disposal of much of the above-ground transuranic waste that is currently stored on the mesa at the Laboratory. In addition, all remedial actions related to soil cleanup will be completed in the northwest section of Oak Ridge National Laboratory.

Reducing Lifecycle Cost

EM will continue to identify opportunities to make strategic investments that reduce the overall cost of the cleanup program while shortening project and program schedules. The current life-cycle cost estimate for EM is $274 to $309 billion. This includes $100 billion in actual costs from 1997 through 2011, and an additional estimate of $174 to $209 billion to complete EM's remaining mission in the timeframe of 2050 to 2062. EM will continue to identify opportunities, including technology development, to reduce the life-cycle cost of its program. In FY 2013, EM will continue efforts to develop technologies that allow for the segregation and stabilization of mercury contaminated debris; develop attenuation-based remedies for groundwater; and utilize technologies that enable the safe extended storage of spent (used) nuclear fuel at DOE sites. To enhance its technology program, EM has established the position of Chief Scientist to provide recommendations to the Senior Advisor for Environmental Management on complex technical and design issues.

Contract and Project Management

To ensure that EM delivers the best value for the American taxpayers, the FY 2013 budget request reflects its continued improvement in acquisition, contract, and project management. EM will require more rigorous front-end planning ensuring contract statements of work and deliverables are based on clear project requirements and assessment of risks; nuclear safety requirements are addressed early; and changes to the contract and the project baseline are managed through strict and timely change control processes. EM will further improve acquisition processes by obtaining early involvement and approvals on various acquisition approaches from DOE senior management, including the Office of Engineering and Construction Management, the Office of Procurement and Assistance Management, the Office of the General Counsel, and the Office of Small and Disadvantaged Business Utilization.

In terms of project management, since August 2009, EM has been utilizing the Office of Science model for construction project review/project peer review process that relies on the expert knowledge and experience of certified engineers, scientists, DOE contractors, engineering laboratories, and the academic community. These reviews determine whether the scope of projects and the underlying assumptions regarding technology, management, cost, scope, and schedule baselines are valid and within budget. These reviews are scheduled to occur approximately every six months and assist EM with actively addressing problems and monitoring the effectiveness of the resulting corrective actions.

Over the last two years, EM has established separate operations activities and capital asset projects within its Project Baseline Summaries. Capital asset projects are managed in accordance with DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. EM is currently finalizing the operations activities policy and the protocol to manage operations activities, which are not governed by DOE Order 413.3B.

EM's continued progress in contract and project management has resulted in EM meeting three of the five criteria needed in order to be removed from the Government Accountability Office's (GAO) High Risk List. 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 remaining concerns is that EM must provide the capacity (people and resources) to address problems. To address GAO's first concern, EM's reorganization establishes project sponsor positions at Headquarters for all capital asset projects. EM is also continuing to enhance its partnership with the U.S. Army Corps of Engineers by supplementing selected project peer review teams with U.S. Army Corps of Engineers personnel who have demonstrated expertise in project and contract management.

GAO's second remaining 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 this concern, EM's Annual Performance Plans have been established as a vehicle for measuring, tracking, and validating progress. In addition, EM has developed an annual Continuous Improvement Plan for Contract and Project Management to guide and monitor improvements. EM will continue to share improvements in project and contract management with GAO and other stakeholders. EM is committed to continued improvements in contract and project management and is focused on being removed from GAO's High Risk List.

Highlights of the FY 2013 Budget Request

The FY 2013 budget request for EM is $5.65 billion, after offsets of $485.1 million. The offsets reflect the proposed reauthorization of the D&D Fund deposit ($463 million), the use of prior year uncosted ($12.1 million) and unobligated ($10 million) balances to offset ongoing mission work in the EM program. The FY 2013 budget request for EM is made up of $5.49 billion for defense environmental cleanup activities, $198.5 million for non-defense environmental cleanup activities, and $442.5 million for Uranium Enrichment Decontamination and Decommissioning Fund. Examples of planned activities and milestones for FY 2013 by site-specific categories are:

Idaho National Laboratory, Idaho

(Dollars in Thousands)

FY 2012 Current Appropriation	FY 2013 Request
$389,800	**$405,397**

- *Complete operations of the Sodium Bearing Waste Treatment Facility.*

The Sodium Bearing Waste Treatment Facility supports the cleanup mission at Idaho National Laboratory by treating the remaining 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 to 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. Testing and readiness verification on the Sodium Bearing Waste Treatment Facility will be completed in preparation for startup in the third quarter of FY 2012.

- *Ship contact-handled transuranic waste to the Waste Isolation Pilot Plant, as well as retrieve buried waste.*

  During FY 2013, approximately 4,500 cubic meters or more of contact-handled transuranic waste will be shipped to the Waste Isolation Pilot Plant for disposal. In addition, small quantities of buried waste will be retrieved and shipped to the Waste Isolation Pilot Plant for disposal.

Los Alamos National Laboratory, New Mexico

(Dollars in Thousands)

FY 2012 Current Appropriation	FY 2013 Request
$188,561	**$239,143**

- *Disposition of transuranic waste and low-level/mixed low-level waste.*

  The Solid Waste Stabilization and Disposition Project is comprised of the treatment, storage, and disposal of legacy transuranic waste and low-level/mixed low-level waste 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 2013, to support the requirements in the 2005 Compliance Order on Consent, Los Alamos National Laboratory will disposition 1,603 cubic meters of transuranic waste and continue low-level/mixed low-level waste disposal activities.

- *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 after evaluation and assessment of human health and ecological risks. In

FY 2013, activities include: investigation and characterization of two Technical Areas under the Canon de Valle Capital Asset Project and completion of the investigation and corrective measures evaluation of Material Disposal Area T to obtain final regulatory remedy selection.

Oak Ridge Site, Tennessee

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$419,758	**$421,250**

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

  The East Tennessee Technology Park was originally built as a uranium enrichment facility for defense programs. The D&D of K-25, the former gaseous diffusion process building within the East Tennessee Technology Park, is the top priority because of worker safety concerns stemming from the continual deterioration of the building. In FY 2013, activities at the East Tennessee Technology Park include: continue characterization and removal of high-risk equipment in the East Wing of K-25; continue removal of gaseous diffusion equipment from the North End of K-25; and continue demolition of the K-25 building and dispose of associated wastes.

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

  The continued operation of the Transuranic Waste Processing Center enables EM to meet various regulatory milestones. By the end of FY 2013, Oak Ridge will process a cumulative total of 236 cubic meters of contact-handled transuranic waste and a cumulative total of 70 cubic meters of remote-handled transuranic waste at the Transuranic Waste Processing Center in preparation for eventual disposition. FY 2013 activities include the: continued transfers of transuranic waste bound for the Transuranic Waste Processing Facility; and the continued processing and disposition of contact-handled transuranic and remote-handled transuranic waste.

- *Mitigate mercury contamination at the Y-12 National Security Complex.*

  Mercury cleanup activities within the Y-12 National Security Complex are necessary to reduce the potential contamination of the Upper East Fork Poplar Creek that flows through the City of Oak Ridge. In FY 2013, with the utilization of American Recovery and Reinvestment Act funds, EM will complete

characterization activities at the Y-12 National Security Complex land area formerly housing the Building 81-10 Mercury Recovery Facility.

Paducah Site, Kentucky

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$143,082	**$142,479**

- *Operation of the Depleted Uranium Hexafluoride Conversion Facility.*

  The Depleted Uranium Hexafluoride 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 2013, activities include: operate the Depleted Uranium Hexafluoride Conversion Facility and package 18,000 metric tons of depleted uranium for disposition.

- *Conduct groundwater treatment operations and D&D activities.*

  Past nuclear energy and national security missions resulted in soil and groundwater contamination within and around the Paducah site. In FY 2013, activities include: complete construction and initiate operations of the Southwest Plume Trichloroethylene Source Area Remedial Treatment System; complete Northeast Plume Pump and Treat System optimization construction and testing; and complete demolition of former uranium production facilities, C-340 and C-410 complexes.

Portsmouth Site, Ohio

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$254,527	**$186,672**

- *Operation of the Depleted Uranium Hexafluoride Conversion Facility and dispose of uranium oxide and hydrofluoric acid.*

The Depleted Uranium Hexafluoride 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 2013, activities include: operate the Depleted Uranium Hexafluoride Conversion Facility and package 13,500 metric tons of depleted uranium for disposal.

- *Conduct 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 2013, activities include: conduct X-326 deactivation work that consists of hazardous material removal, isolations, and equipment removal; and conduct characterization, treatment, and disposition of waste associated with D&D of other ancillary facilities.

- *Continue utilization of our excess material assets to conduct our cleanup mission.*

  The transfer of uranium supports environmental remediation and decontamination and decommissioning activities at the Gaseous Diffusion Facilities. Consistent with applicable laws, including the USEC Privatization Act, DOE plans to transfer up to 1,750 metric tons of uranium in FY 2013. The actual value of the material is subject to the final amounts transferred quarterly and the market value at the time of the transfer.

Richland Site, Washington
(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$1,021,824	**$1,037,773**

- *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 along the Columbia River Corridor as part of EM's continued pursuit of the Hanford 2015 Vision. In an effort to reduce Hanford's cleanup footprint, FY 2013 activities include: operating the Environmental Restoration Disposal Facility in support of Hanford Site demolition and remediation activities; completing the interim response actions for the 100 N Area; completing the interim remedial actions for the 300-FF-2 Waste Sites; completing the selected removal and/or remedial actions for 13 high risk facilities

in the 300 Area; and continuing the remediation of the 618-10 and 618-11 burial grounds.

- *Conduct 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 2013, EM will: continue site-wide groundwater and vadose zone cleanup activities; groundwater contamination monitoring, operations, and necessary modifications of existing remediation systems; and deploy chemical and biological treatment to select areas in support of final remedies.

Office of River Protection, Washington

(Dollars in Thousands)

FY 2012 Current Appropriation	FY 2013 Request
$1,181,800	**$1,172,113**

- *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, over 50 million gallons of radioactive waste must be removed and processed to a form suitable for disposal, and the 177 underground storage tanks to be stabilized. In FY 2013, activities include: complete bulk retrieval of one C Farm single shell tank; completing hard heel removal of two C Farm single shell tanks; operating the 222-S laboratory and 242-A evaporator; and continuing activities for tank waste mixing.

- *Continue construction of the Waste Treatment and Immobilization Plant complex.*

The Waste Treatment and Immobilization Plant is pivotal to EM's tank waste cleanup mission at Hanford. The Waste Treatment and Immobilization Plant provides the primary treatment capability to immobilize (vitrify) the radioactive tank waste at the Hanford Site. The Waste Treatment and Immobilization Plant complex includes five major facilities: Pretreatment Facility, High-Level Waste Facility, Low-Activity Waste Facility, Analytical Laboratory, and the Balance of Facilities. As of December 2011, the Waste Treatment and Immobilization Plant construction is approximately 59 percent complete and design is 84 percent complete. In FY 2013, activities include the following:

  - At the Pretreatment Facility, continue engineering, design and large scale integrated testing to confirm the design of critical Pretreatment process vessels.

- At the High-Level Waste Facility, continue forming, rebar, and placement of concrete for High-Level Waste Facility walls and slabs on the third to fourth stories.
- At the Low-Activity Waste Facility, continue planning activities for construction startup and turnover of multiple Low-Activity Waste Facility systems to operations.
- At the Analytical Laboratory, complete mechanical systems procurement and complete electrical terminations.
- At the Balance of Facilities, complete Balance of Facilities Plant design engineering and complete construction of nine facilities that make up the Balance of Facilities including the Chiller Compressor Plant and Steam Plant.

Savannah River Site, South Carolina

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$1,316,922	**$1,303,493**

- *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 2013, activities include: continue construction of Salt Waste Processing Facility; continued operation of F and H Tank Farms; continued to operation the Defense Waste Processing Facility and the production of 312 canisters of high-level waste packaged for final disposition; continued operation of the Actinide Removal Process and Modular Caustic Side Solvent Extraction at planned rates; continued operation of the Saltstone Facility at planned rates; and continue construction of Saltstone Disposal Units 3-5.

- *Consolidation of special nuclear materials.*

  In FY 2013, activities include: initiation of the processing of non-pit plutonium to produce plutonium oxide suitable for use in the MOX Fabrication Facility; packaging the non-MOX plutonium for disposition to the Waste Isolation Pilot Plant; reducing the residual plutonium-238 contamination in the F Area Materials Storage Facility; and initiating the disposition of any vulnerable spent (used) nuclear fuel in H Canyon that is not suitable for extended storage in L-Basin.

Waste Isolation Pilot Plant, New Mexico

(Dollars in Thousands)

(Includes Safeguards & Security Funding)

FY 2012 Current Appropriation	FY 2013 Request
$218,179	**$202,987**

- *Operate the Waste Isolation Pilot Plant in a safe and compliant manner and dispose of contact-handled and remote-handled transuranic waste from DOE sites.*

  The Waste Isolation Pilot Plant in Carlsbad, New Mexico, is the nation's only mined geologic repository for the permanent disposal of defense-generated transuranic waste. In FY 2013, the EM budget request supports maintaining an average shipping capability of 21 contact-handled transuranic waste and 5 remote handled transuranic waste shipments per week from major shipping sites such as Idaho, Savannah River Site, and Los Alamos National Laboratory.

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 achieving our mission and will continue to apply innovative environmental cleanup strategies to complete 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. FRELINGHUYSEN. Thank you for your testimony. Mr. Podonsky, good morning.

Mr. PODONSKY. Thank you, Mr. Chairman and ranking member Visclosky and members of the Subcommittee for inviting me here today to testify on the 2013 budget of the Health Safety and Security Office. With your permission, I would like to submit my written testimony for the record.

Mr. FRELINGHUYSEN. Consider it done. Thank you.

Mr. PODONSKY. I would like to take a moment just to describe the role that the HSS plays within the DOE. And also address an issue that has received a lot of attention lately, and that is the safety culture within DOE and its role in ensuring the DOE's ability to accomplish its mission. First and foremost, I want to tell the committee, subcommittee that the secretary and the deputy secretary are extremely committed to maintaining a safe and secure work environment for employees and to ensure that its operations are not adversely affecting the health, safety, or security of the surrounding communities or of the Nation.

My organization, HSS, is charged with helping DOE fulfill that commitment. We are very proactive advocates for the protection of DOE's workers as well as the protection of the DOE's assets. We are passionate about our mission. We have pursued every day with a sense of urgency and with a personal commitment. We strive to use and influence this commitment throughout the rest of the DOE.

Our program consists of a wide variety of activities that are described in details in our budget's proposal but the essential elements are responsible for internal policies that govern health, safety, and security of the department, providing technical assistance to help align, implement those policies, and, maybe most importantly of all, to provide independent oversight of the DOE's performance as well as providing an enforcement of health safety and security requirements when necessary. The execution of our mission is accomplished through a variety of outreach efforts that include current and former workers, national labor union leadership, the Defense Nuclear Facility Safety Board, contractors, community leaders, and the Congress.

We support the secretary and deputy secretary's commitment to a strong safety culture where all employees are encouraged to bring up safety concerns without fear of reprisal. The goal of safety in executing this mission is not just show or a bumper sticker. It has to be believed by the leaders and carried out through their actions.

A robust safety culture is needed, especially for a large costly construction project, from designing and planning through construction operation to decommissioning, in order to reduce potential of escalating costs and to ensure DOE meets its commitments. HSS has been assessing the safety culture up at the Hanford Waste Treatment Immobilization Plant, which, as you know, is the DOE's largest ongoing project with an estimated cost of over $12 billion and over 3,000 Federal and contract workers.

We found in our recent inspection that most people working on the project believe that safety was a high priority, but, alarmingly, there was a significant number that expressed reluctance to raise

safety issues or concerns. We have provided recommendations to the department and to the Federal and contracted management at the site. And the recommendations have been accepted by the department, by the secretary, by the deputy secretary, by the under secretary for NNSA, and by my colleague Dave Huizenga. And we will be working with them to make sure that full implementation of those recommendations take place.

As a result of this review, the secretary and the deputy secretary directed HSS to then do a center review condition of safety culture at all large projects within the department. We have started that. I would be happy to talk to you more about that.

These are the projects that are over $1 billion in costs. The review will determine if those projects are being managed in the way that could pressure contractors or DOE managers to disregard nuclear safety in order to demonstrate acceptable project performance. We look forward to actually coming back and brief you, the subcommittee, the results which will be complete that end of the project in the fall.

I would like to thank this committee and the staff for the interest you continue to show in HSS and our role in providing independent, unbiased, unfiltered information to the DOE of management, the leadership of the department, the secretary, and the deputy secretary on how well or how poorly the department is performing. Thank you.

[The information follows:]

Written Testimony of Glenn S. Podonsky
Chief Health, Safety and Security Officer
U.S. Department of Energy
FY 2013 Appropriation Hearing
Before the
Subcommittee on Energy and Water Development
Appropriations Committee
U.S. House of Representatives

March 21, 2012

INTRODUCTION

Chairman Frelinghuysen, Ranking Member Visclosky, and members of the subcommittee, thank you for inviting me to testify today on the Fiscal Year (FY) 2013 Budget Request for the Office of Health, Safety and Security (HSS). As the central organization within the Department of Energy (Department or DOE) responsible for health, safety, and security, providing corporate-level leadership and strategic vision to coordinate and integrate these programs, HSS provides the Department with effective and consistent policy development, technical assistance, safety analysis, corporate safety and security programs, safety and security training, DOE-wide independent oversight, and regulatory enforcement. HSS also provides effective cross-organizational coordination to resolve Defense Nuclear Facilities Safety Board-(DNFSB) related technical and management issues to ensure worker and public health and safety. As the Chief Health, Safety and Security Officer, I advise the Secretary and Deputy Secretary on all matters related to health, safety, and security across the complex.

DOE has made a commitment to maintain safe and secure work environments for all Federal and contractor employees and to ensure that its operations do not adversely affect the health, safety, or security of the surrounding communities or the nation. It is HSS' job to help the Department fulfill that commitment, and we do so through programs and activities aimed at assisting the Department accomplish its critical scientific, energy, and national security missions in ways that ensure the health, safety, and security of DOE workers and vital assets.

The written testimony is provided in two parts. The first provides highlights regarding various activities administered by HSS, and the second is a summary of the FY 2013 budget request identifying all HSS activities.

PRINCIPLE HSS ACTIVITIES

HSS is responsible for a wide range of activities crucial to the Department's efforts to safely and securely pursue its mission objectives and to ensure that the Department fulfills its national and international obligations related to the health, safety and security of its activities. Principle activities related to HSS responsibilities are summarized in the following paragraphs.

HSS FY 2013 HEWD Written Testimony

In January 2012, HSS published an Independent Oversight assessment of nuclear safety culture and management of nuclear safety concerns at the Hanford Site Waste Treatment and Immobilization Plant (WTP), a follow-up to the October 2010 HSS review of the WTP nuclear safety culture. The WTP is DOE's largest ongoing design and construction project, with an estimated cost of over $12 billion and a current workforce of about 3000, and plans to transition to an operating nuclear facility in 2019. HSS accelerated its schedule for the follow-up assessment in response to an August 2011 request from the Senior Advisor for Environmental Management that cited the serious concerns that had been raised about the safety culture at WTP. This follow-up assessment also satisfied a Secretarial commitment to DNFSB Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*. The assessment focused on the DOE organizations with site-level line management responsibility for WTP – the Office of River Protection and the DOE WTP Project Office – and the site contractor – Bechtel National, Incorporated, including its subcontractors. Results of the assessment indicated that most WTP personnel believed that safety was a high priority. However, a significant number of both Federal and contractor staff expressed reluctance to raise safety or quality concerns, leading to the conclusion that significant management attention at both Federal and contractor organizations is needed to improve the safety culture at WTP. In addition, the assessment identified significant concerns regarding the processes for developing nuclear design and safety basis and for managing safety issues. The development and implementation of corrective actions to address the specific issues identified are ongoing. As part of a broader extent-of-condition assessment, and based on the results of this assessment, HSS will more fully evaluate DOE Headquarters organizations to gather additional information about the role of Headquarters line management organizations in the safety culture and management of safety issues at WTP. The results of these assessments will provide recommended next steps for continuous improvements.

HSS supports the Department's commitment to a safety culture that encourages all employees to pursue safe performance of work, promotes a questioning attitude, and ensures that executing mission goals safely is not just a slogan but a value shared by all. Towards that end, and as specified in the explanatory statement accompanying the Consolidated Appropriations Act Conference Report, 2012, HSS, in coordination with the National Nuclear Security Administration (NNSA), the Office of Environmental Management, the Office of Engineering and Construction Management, and the Office of Procurement and Assistance Management, is conducting a review of all DOE nuclear facility construction projects with a total project cost greater than $1 billion to determine if those projects are being managed in a way that could pressure contractors or Department managers to lessen nuclear safety in order to demonstrate acceptable project performance.

HSS continues to conduct rigorous independent oversight appraisals of DOE performance in the areas of safeguards and security, cyber security, nuclear safety, emergency management, and environment, safety and health. Information gained from these appraisals provides Departmental senior management, line management, HSS, and other policy organizations the information they need to effect improvements in these programs. In FY 2011, HSS conducted more than 50 independent appraisals of DOE, NNSA, and Power Marketing Administration operations, with a particular focus on new nuclear facility construction and safety basis upgrades for existing nuclear facilities, the physical protection of Category I special nuclear material, and DOE

capabilities for managing and mitigating the effects of the most highly advanced cyber security threats.

HSS continues implementation of the recommendations of the Government Accountability Office (GAO) report GAO-09-61, *Department of Energy Needs to Strengthen its Independent Oversight of Nuclear Facilities and Operations*, as requested in the explanatory statement accompanying the Omnibus Appropriations Act, 2009. Activities include performing increased reviews of high hazard nuclear operations to evaluate programs and processes for developing, maintaining, and implementing nuclear facility safety bases and implementing safety basis technical safety requirements; performing cross-cutting reviews of selected nuclear safety topical areas based on information derived from metrics, data analysis, performance trends, and changes in requirements; and more closely monitoring corrective action implementation to ensure effective resolution of remaining issues. In FY 2012, HSS completed the establishment of the HSS nuclear safety site lead program to facilitate improved targeting of safety-related oversight activities based on operational risk and facility conditions. HSS site leads are experienced nuclear safety professionals assigned to monitor operations at sites with nuclear facilities and activities. The knowledge obtained through site lead operational awareness is utilized to make informed decisions in selecting and prioritizing independent oversight reviews that are tailored to the site's conditions. HSS also continues to provide unrestricted access to nuclear safety appraisal reports while ensuring continued compliance with information security requirements.

HSS coordinated the Department's internal focus on responding to the Fukushima Daiichi nuclear disaster by developing Safety Bulletin 2011-1, *Events Beyond Design Safety Basis Analysis*, issued by the Secretary in March 2011, which outlined DOE's initial actions in assessing DOE facilities' safety characteristics under beyond-design-basis conditions, such as those occurring at Fukushima Daiichi. HSS conducted a nuclear safety workshop in June 2011, bringing together experts from DOE as well as commercial nuclear organizations to explore key concepts and elements for ensuring nuclear safety at Department facilities and discussing the actions that both the Department and the commercial nuclear industry have taken in response to Fukushima. Following the workshop, HSS coordinated the development of recommendations issued by the Secretary in a report titled *Review of Requirements and Capabilities for Analyzing and Responding to Beyond Design Basis Events*. HSS is now working with DOE program offices to complete all resulting recommended actions by the end of 2012.

HSS promotes continuous improvement in the Department's safety and security programs through management and implementation of the DOE enforcement programs that are required under 10 C.F.R. Part 820, *Procedural Rules for DOE Nuclear Activities*; Part 824, *Procedural Rules for the Assessment of Civil Penalties for Classified Information Security Violations*; and Part 851, *Worker Health and Safety Program*. These rules provide the Department with multiple enforcement mechanisms through which it can effectively impact contractor safety and security performance in conjunction with the contract mechanisms available to the DOE line organizations. HSS and NNSA carefully evaluate the circumstances of each particular case and the performance of the contractor(s) involved to select the appropriate enforcement vehicle when such action is warranted. In FY 2011, HSS completed 13 enforcement investigations (four for worker safety, seven for nuclear safety, and two for classified information security) that resulted in the issuance of a notice of violation, consent order, settlement agreement, or special report

order. HSS also issued several enforcement letters for events and non-compliant conditions that had been discovered and promptly and aggressively addressed by the contractors in accordance with the Department's expectations.

HSS continues to interface with other Federal departments and agencies, such as the Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), Department of Labor (DOL), Department of Health and Human Services (HHS), Department of Homeland Security (DHS), and Department of Defense (DoD), to share information and coordinate efforts in strengthening the Department's and the Nation's overall safety and security posture. Additionally, HSS outreach efforts go beyond other Federal departments and agencies to include national and local labor unions, non-governmental organizations, and other stakeholders. These efforts have resulted in improved understanding of the health, safety, and security issues facing the Department's workers and the development of solutions for these issues.

HSS coordinates the Department's efforts with DOL and HHS's National Institute for Occupational Safety and Health (NIOSH) to better facilitate the implementation of the Energy Employees Occupational Illness Compensation Program Act (EEOICPA). HSS will continue to increase the level of coordination and improve the interface between the DOL EEOICPA and the DOE Former Worker Medical Screening Program (FWP) to increase the efficiency and timeliness of providing benefits to eligible personnel who have contracted a covered illness as a result of working at a DOE facility. In FY 2011, HSS, in cooperation with the grantee service providers, implemented program efficiencies in the FWP to ensure some 8,000 medical screenings continue to be performed each year for those former workers who want them. HSS continues to conduct additional outreach efforts to inform former workers of the program's benefits.

HSS continues to meet the United States' international commitments with the Governments of Russia, Japan, and the Marshall Islands in the area of the health effects of ionizing radiation. In cooperation with the Department of State, HSS assisted in renewing, through 2014, the Radiation Effects Research agreement between the United States and Russia to conduct research of worker and population radiation exposure near Russian nuclear production operations. This research contributes to improving and revising U.S. and international radiation protection standards and practices by estimating cancer risks from exposure to radiation. HSS has strengthened the Department's relationship with the Government of Japan by assisting the completion of a high-level review of the Radiation Effects Research Foundation's future activities concerning the health status of the survivors of Hiroshima and Nagasaki. HSS continues to oversee a combined medical care and logistics cooperative agreement to provide efficient and effective annual comprehensive medical examinations and treatments to the people of the Marshall Islands exposed to radiation during the 1946-1958 U.S. nuclear testing program in the Pacific, and continued environmental monitoring through the Lawrence Livermore National Laboratory.

HSS is responsible for maintaining the Department's safety and security directives that are designed to ensure a safe environment for Departmental workers and the public; provide effective security for National assets entrusted to the Department; and meet commitments to the Department's stakeholders, Congress and the DNFSB. These directives establish clear expectations in such areas as: nanotechnology, worker safety, protection program operations,

graded security protection, quality assurance, high performance sustainable building, environmental protection, radiation protection, nuclear safety, nuclear materials packaging, information security, nuclear material control and accountability, and Federal technical capabilities. In FY 2008, HSS began amending the 107 safety and security directives to eliminate unnecessary requirements and shift toward performance-based requirements to provide meaningful, clear, concise directives that are not overly prescriptive or duplicative. In FY 2010, at the direction of the Deputy Secretary of Energy, HSS implemented additional safety and security reforms designed to reduce the administrative burden on Departmental operations while maintaining the highest standards of safe and secure operations. HSS achieved its project milestone of completing all directive revisions, or submitting them for concurrence, by September 30, 2011. As of December 31, 2011, 102 of the 107 HSS directives (95 percent) were completed (revised, re-certified, or cancelled). The other five are in concurrence review and are projected to be finalized in FY 2012.

HSS, in collaboration with DOE program and site offices, assists with developing strategies for embedding sustainability principles in site operations. HSS has successfully assisted DOE organizations in establishing formal Environmental Management Systems that integrate mission achievement with energy and environmental objectives. As a result of implementing these systems, DOE in FY 2011 achieved an 86 percent waste diversion rate equating to the diversion of nearly one million metric tons of end-of-life materials from disposal. Also, 15 DOE sites were recognized by the EPA Federal Electronics Challenge program; DOE received over 40 percent of all such awards given across the Federal government. In addition, HSS works with the DOE Sustainability Performance Office to support outstanding environmental performance through the DOE Sustainability Awards program. This year, the Deputy Secretary presented 31 awards to teams and individuals from across the DOE complex. In collaboration with the DOE Office of Procurement and Assistance Management, HSS initiated new tracking and recognition programs for sustainable acquisition that assists the Department in identifying successes and challenges in acquiring products and services with sustainable attributes (e.g., recycled content), thereby contributing to the reduction of the Department's energy and environmental footprint and the amount of waste requiring disposal.

The National Training Center (NTC) continues to provide training and professional development services to DOE and DOE contractor employees. In FY 2011 over 5,000 students attended 252 courses or completed eLearning/self-study courses; and the NTC developed, updated, and conducted training in such areas as physical security, vulnerability assessments, protective force operations and tactics, personnel security management and adjudication, and nuclear safety. Emphasis placed on improving safety training courses resulted in updating or revising 40 courses and the deployment of three new safety training courses, *Unreviewed Safety Question*, *Review and Approval of Nuclear Safety Basis Documents*, and *Safety Instrumented Systems*. To improve the efficiency and effectiveness of DOE standardized training, the NTC Training Approval Program certifies DOE sites to provide NTC courses and to develop and deliver safeguards and security training at their locations. In addition, the NTC has enhanced its eLearning capabilities in order to offer more of its training through interactive computer-based courses. The NTC continues to partner with DOE site management, the National Institute of Environmental Health Sciences, and worker union representatives to assess and identify opportunities for improvements in the Department's safety training processes and courses. The latest outcome of these efforts is

the deployment of common safety training programs for new site employees at the Oak Ridge Reservation, minimizing delays in productivity.

HSS continues to assist the DOE/NNSA complex in the implementation of the Graded Security Protection (GSP) policy which establishes requirements that a site's multiple security layers and protection elements are fully evaluated and that each site assesses a range of threats and scenarios. HSS activities in support of GSP implementation consist of performance testing, independent oversight evaluations, and onsite technical field assistance. Teams of experts with skills in information security, personnel security, physical security systems, hazardous materials, performance testing, and vulnerability assessment and risk management interact with DOE/NNSA headquarters program offices and field sites to evaluate cost-efficient, highly effective safeguards and security programs. NNSA utilizes Zero-Based Security Reviews (ZBSR) and security-based deep dives designed to identify and eliminate programmatic fragmentation, reduce costs, promote security improvements and standardize the implementation of select security requirements across NNSA in order to provide clear and consistent performance expectations for security disciplines. At NNSA's request, HSS provided resources to conduct ZBSRs at three locations and deep dives at four locations. As a result of these efforts, the GSP policy has been fully implemented at nine sites; and the Y-12 National Security Complex provided an approved project management plan for full implementation by the end of FY 2012. While the Department has made considerable progress in implementing its long-term security planning policy, the dynamic nature of the threat, the critical mission of the Department, and the grave consequences associated with the theft and/or misuse of a nuclear weapon or special nuclear material require that DOE continue to improve and implement robust security processes, to include: periodic assessments by subject matter experts; formal collaborations on security processes with DoD and other government agencies; a rigorous training and performance testing program; coordination with the U.S. Intelligence Community; application of the principles of risk management; and independent oversight evaluations and technical field assistance by HSS.

HSS continues to manage the classification, declassification, and controlled information activity to ensure that the Department meets its statutory responsibility under the Atomic Energy Act to implement the U.S. Government-wide program to classify and declassify nuclear weapons-related information (i.e., Restricted Data and Formerly Restricted Data) in order to prevent proliferation of nuclear weapons and technology. HSS implements the Department's policy of protecting classified and other sensitive information and releasing information that can be released without harming national security. HSS is completing a fundamental review of its National Security Information guidance as required under Executive Order (E.O.) 13526, *Classified National Security Information*, to refine and reaffirm what information must be protected. HSS continues to assist DOE, other U.S. agencies and other governments in managing classified information through training programs, identifying classified information, and developing consistent rules for handling nuclear weapon information. Over the past three years HSS has achieved, and works to maintain, a reduced backlog of Freedom of Information Act requests by ensuring that classification reviews that once took months or years to complete now take only days. Additionally, HSS continues to support the National Archives effort to review over 400 million pages of historical records by December 31, 2013, as directed by E.O. 13526. The law requires that these records be reviewed for nuclear weapon information by their

originating agency and assigns DOE the role of verifying that these reviews are of sufficient quality to prevent the inadvertent release of classified nuclear weapon design information. In response to the President's mandate, HSS has significantly increased its resources at the National Archives and, working with the National Declassification Center, streamlined its quality control sampling methods to better handle the huge volume of records. As of December 31, 2011, over 100 million of the 400 million pages had been reviewed. It has recently come to the attention of the National Archives that agencies now have over 700 million additional pages of records in special media form that must be screened for nuclear weapon information.

HSS manages a number of viable safety indicators applicable to most DOE contractor operations that provide Departmental leadership, line management, and stakeholders with timely information to gauge the success of Departmental safety program implementation. These safety performance indicators and trends are developed and analyzed by HSS utilizing DOE operational and occurrence data collected through various reporting mechanisms and provided through Internet-based tools and databases. In addition, HSS periodically conducts in-depth assessments on safety issues that challenge the Department. Results are used to focus the Department's efforts to prevent adverse events such as serious injuries or loss of life; overexposures to radiation, hazardous materials, or other hazardous conditions; inadvertent offsite releases of nuclear and non-nuclear materials; nuclear criticality events; and localized fires and explosions that would negatively impact the Department's ability to accomplish its mission. HSS is also taking action to increase the transparency of the Department's safety performance to the public through the use of the Internet and other outreach activities.

FY 2013 BUDGET REQUEST OVERVIEW

The HSS FY 2013 budget request of $245,500,000 includes $139,325,000 for the Health, Safety and Security Program and $106,175,000 for Program Direction. A summary of the activities to be conducted in FY 2013 with the requested funding is as follows.

The HSS FY 2013 request reflects reduced reliance on contractor services and elimination of activities that will least impact the most important priorities central to the Department's commitment to maintaining safety and security excellence, especially those related to high-risk, high-consequence activities. The FY 2013 request reflects the elimination of some domestic health research; a reduction of 26 Federal full-time equivalent positions and associated salaries and benefits; decreased reliance on contractor support for health, safety, environment, and security policy, assistance, and training activities via implementation of operational efficiencies and increased reliance on the Federal workforce; and efficiencies in DOE Headquarters security operations. Some of these savings are applied to increase funding for nuclear safety and cyber security oversight; nuclear safety policy, assistance, and enforcement; and former worker medical screening activities.

Worker Safety ($4,846,000) Worker safety and health policies promote safe work practices to support Departmental objectives regarding best-in-class safety performance exceeding that achieved by similar industrial operations. Funding supports increased assurance that mission-related work is conducted with a full understanding of the potential worker health- and safety-

related risks, application of controls necessary to mitigate those risks, and avoidance of future liabilities associated with worker compensation programs. Funding provides for research, efforts to update and maintain existing standards, and the development of new safety and health requirements based on new or evolving working conditions, when warranted; technical assistance to DOE programs, laboratories, and sites in the implementation of health and safety requirements and programs; and implementation of corporate health- and safety-related programs and information technology systems. Funding also provides for collecting, analyzing, and trending operational safety data to identify strengths and weaknesses of safety programs at Departmental facilities and programs that support continuous improvement through shared operating experience.

Nuclear Safety ($9,696,000) Nuclear Safety activities include establishing and maintaining nuclear safety policies and requirements to ensure adequate protection of workers, the public, and the environment from hazards associated with nuclear facilities and operations. These activities also establish general facility safety requirements in the areas of fire protection, natural phenomena hazards, maintenance and quality assurance to ensure that products and services meet or exceed the Department's objectives in each of these areas, as well as providing assistance to field elements with respect to the implementation of requirements and in resolving nuclear safety, facility safety, and quality assurance issues.

Environment ($2,407,000) Environmental activities support the Secretary's strategic sustainability performance objectives by fostering efficient use of resources and energy throughout DOE operations, assisting in the responsible management of natural and cultural resources on and around DOE facilities, reducing the carbon footprint of DOE activities, and avoiding future liabilities in these areas. Funding provides technical support for the development of policies, requirements, and guidance related to environmental compliance; the encouragement of green purchasing; sustainable environmental stewardship, pollution prevention, and greenhouse gas reduction; and implementation of environmental performance tracking and reporting across the DOE complex. Environmental activities also provide technical support for maintaining DOE's radiation protection framework (including research and development of computer-based tools), thereby implementing its Atomic Energy Act responsibilities to provide protection to the public and the environment consistent with national and international radiation protection standards and Departmental risk management strategies.

Health Programs ($51,790,000) Health Programs support domestic and international health studies to investigate and identify work-related injuries and illnesses in DOE workers and the public surrounding DOE sites and other radiation exposure-related activities. The benefits of these projects and programs include discovering and documenting health effect outcomes that provide the scientific basis for the national and international worker protection policy and standards that DOE uses to provide the levels of protection appropriate for the risks posed to workers by hazards present at DOE sites. Domestic health research activities provide support to National assets used to respond to radiological events throughout the country and to the conduct of health studies on communities surrounding DOE sites. Former worker medical screening activities provide for the conduct of medical screenings for former DOE and DOE-related beryllium vendor employees to identify adverse health conditions that may have resulted from work conducted at DOE facilities or at beryllium vendors on behalf of DOE. Workers who are

found to have illnesses related to work on behalf of DOE are referred to DOL for potential compensation through EEOICPA. DOE supports DOL's implementation of EEOICPA by providing information regarding employment status, exposures to radiation and toxic substances, and operational history of DOE facilities in support of claims filed by current and former DOE Federal and contractor employees. International health activities include the:

- Russian health studies program – a collaborative research program between the United States and Russia to determine the risks associated with working at or living near Russian former nuclear weapons production sites;
- Japanese health studies – a bi-national undertaking by the United States and Japan to conduct epidemiologic studies and medical surveillance of the survivors of the atomic bombings of Hiroshima and Nagasaki; and
- Marshall Islands program – radiological medical surveillance and cancer care and treatment of the Marshallese and environmental monitoring in support of safe resettlement of four atolls.

Enforcement ($1,947,000) DOE's worker safety and health, nuclear safety, and classified information security enforcement activities implement congressionally mandated programs specified in 10 C.F.R. 851, Worker Safety and Health Program; 10 C.F.R. 820, Procedural Rules for DOE Nuclear Activities; and 10 C.F.R. 824, Procedural Rules for the Assessment of Civil Penalties for Classified Information Security Violations. The goals of these enforcement activities are to ensure that DOE contractors adhere to worker safety and health, nuclear safety, and classified information security regulations, and to promote proactive improvement of worker and nuclear safety and security performance through timely self-identification, reporting, and correction of non-compliant conditions, to enable contractors to achieve excellence in mission accomplishment without the need for enforcement actions.

Safety and Security Training ($15,000,000) This activity develops and maintains the proficiency and competency and builds the management excellence of DOE safety and security personnel, in direct support of Secretarial objectives, through standardized training for the protection of the environment, the safety and health of the public and the workforce, and the security of critical Departmental and national security assets. The DOE NTC, located in Albuquerque, NM, serves as the primary resource for DOE safety and security training.

Security Operational Support ($5,762,000) Security operational support activities provide technical and field expertise to Federal staff to develop Department-wide safeguards and security requirements and guidance; provide assistance to DOE operations; and maintain and manage corporate-level safeguards and security-related programs and information technology systems. These activities support all Secretarial objectives by providing a tailored level of security requirements for a wide range of Departmental scientific, research, and national security objectives based on the security significance of their national assets. Security policies, requirements, and guidance are developed to be clear and easily implemented, with the goals of securing nuclear material and classified matter and protecting the highly specialized and trained DOE workforce.

Classification, Declassification and Controlled Information ($8,707,000) The classification, declassification, and controlled information activity ensures that the Department meets its

statutory responsibility to implement the U.S. Government-wide program to classify and declassify nuclear weapons-related information (i.e., Restricted Data and Formerly Restricted Data) in order to prevent proliferation of nuclear weapons and technology. Funding for this activity supports the implementation of E.O. 13526, Classified National Security Information, to classify other information critical to national security (i.e., National Security Information), such as security-related information concerning our nuclear sites, energy critical infrastructure information, and chemical/biological, and radiological dispersal devices. With the issuance of E.O. 13526 and, more recently, E.O. 13556, Controlled Unclassified Information, technical support will be used to develop implementation policies, requirements, and guidance documentation.

Security Investigations ($9,850,000) Security investigations provides support to Departmental personnel security programs associated with providing access authorizations (security clearances) to DOE Federal and contractor personnel who, in the performance of their official duties, require access to classified information or certain quantities of special nuclear material, as required by section 145 of the Atomic Energy Act of 1954, as amended, and E.O. 12968, *Access to Classified Information*. The conduct of investigations and granting of access authorizations is based on 10 C.F.R. 710, *Criteria and Procedures for Determining Eligibility for Access to Classified Matter or Special Nuclear Material*. Funding provides support for the development and maintenance of DOE policies, requirements, and guidance; technical assistance; programmatic oversight; and corporate-level services associated with granting and maintaining access authorizations. Funding also provides for the conduct of corporate-level access authorization adjudications (i.e., performing case reviews, conducting evaluations, and preparing decision packages), and the operation and maintenance of corporate-level information technology systems used to manage access authorization data and processing.

Security investigations provides the funding for background investigations conducted by the Federal Bureau of Investigations and Office of Personnel Management for DOE Headquarters personnel whose access authorizations are managed through DOE Headquarters, while the responsible DOE program offices fund investigations for field personnel and Headquarters personnel whose access authorizations are managed through offices other than DOE Headquarters.

Headquarters Security Operations ($29,320,000) The Headquarters security operations activity provides for the physical protection of all DOE Headquarters facilities and assets, including information, in the Washington, DC, area through the deployment of a protective force; the management and operation of countermeasures, alarms, and access control equipment; and the implementation and oversight of security-related programs. Funding for these activities provides a safe and secure work environment and assures line management, workers, and stakeholders that their activities within Headquarters facilities are effectively protected.

Program Direction ($106,175,000) Program Direction provides for Federal staffing and mission support services to provide overall direction and execution of the HSS mission of providing the Department's health, safety, and security policy, technical assistance, analysis, corporate programs, safety and security training, independent oversight, and enforcement.

Funding provides for salaries and benefits for 350 Federal full-time equivalent employees (a reduction of 26 from the FY 2012 level) with the technical expertise needed to carry out the HSS mission to provide: corporate-level leadership and strategic vision to coordinate and integrate health, safety, nuclear safety, and security policy development and technical assistance; safety- and security-related analysis; corporate safety and security programs; safety and security training; quality assurance programs; DOE complex-wide independent oversight; safety and security enforcement; executive protection; and effective cross-organizational coordination to resolve DNFSB-related technical and management issues to ensure worker and public health and safety. The Federal staff also manages the conduct of domestic and international health programs, implements physical and personnel security programs for DOE facilities in the National Capital Area, and, manages the U.S. Government-wide program to classify and declassify nuclear weapons-related technology and national security information.

Program Direction also provides for mission support activities for independent oversight and DNFSB liaison activities. HSS has analyzed its use of support services and has established specific criteria for using these services efficiently. While HSS has some unique Federal employee expertise, technical contractual support services continue to be a practical and cost-effective method for supporting the Federal staff as needed. The evolving need for world-class expertise in a multitude of disciplines can best be met through the use of contractors who can rapidly respond to the continually changing skill mix required to provide a surge pool of personnel with technical expertise in a wide range of safety and security disciplines.

Independent oversight activities are designed to ensure maximum value to the Department by identifying gaps and vulnerabilities in safety (worker, nuclear, and facility safety) and physical and cyber security programs and related performance. Independent oversight activities are tailored to the unique needs of each DOE program and site office, and consider relative risks and past performance in determining specific assessment activities. Safeguards and security and cyber security-related independent oversight activities help determine whether special nuclear materials, classified matter (parts and information), and information technology systems are adequately protected. Safety-related independent oversight activities help ensure that the workers and the public are adequately protected from the hazards associated with the Department's sites and operations, and minimize the occurrence of events that could negatively impact the Department's ability to perform its mission and achieve its goals. Independent oversight activities provide accurate and timely information and analysis regarding the effectiveness of the Department's safety and security programs and other functions of interest. Information is made available to the Secretary, Deputy Secretary, Under Secretaries, congressional committees, and other stakeholders, such as unions and local public interest groups, to provide confidence that the Department's operations are performed in a safe and secure manner.

Independent oversight activities complement but do not replace DOE line management's responsibility for security and safety, as required by Departmental policies. Independent oversight functions include those that: (1) are required by a Federal law, Executive Order, or other mandate; and (2) need to be performed by an organization with independence from mission responsibilities to ensure that DOE safety and security programs are credible to internal and external stakeholders. As required by DOE Order 227.1, Independent Oversight Program,

independent oversight activities are performed by personnel who are organizationally independent of the DOE program and site offices that implement policies and programs, and who can therefore objectively observe and report on those policies and programs as they relate to Departmental operations.

CONCLUDING REMARKS

In conclusion, as the Chief Health, Safety and Security Officer, I am aware of the vital role and significant responsibilities assigned to HSS in support of the Department's scientific, energy, and national security missions. Those responsibilities include programs and efforts to ensure the health, safety, and security of DOE workers, surrounding communities, and National assets. In FY 2013, HSS will focus on:

- Developing cost-effective solutions for achieving best-in-class safety performance built upon a foundation of integrated safety management and enhanced through concepts such as safety culture, voluntary protection programs, and environmental management systems;
- Ensuring a graded approach to performance-based oversight of Departmental operations, such as nuclear facilities, through increased programmatic assistance, independent oversight, and enforcement presence at such facilities;
- Honoring the National and Departmental commitment to current and former workers through cost-effective implementation of the former worker medical screening program and support to DOL for implementation of EEOICPA;
- Enhancing the protection of national security assets entrusted to the Department through cost-effective security solutions that are consistent with successful mission accomplishment; and
- Continuing a corporate approach of openness and collaboration with management, workers, unions, and other interested parties to address complex health, safety, and security issues.

We are confident that with the continued support of DOE management, our stakeholders, and Congress, we can expand on recent accomplishments and contribute to efforts to further strengthen the Department's health, safety, and security posture, resulting in an increased assurance that DOE workers, the public, and our national security assets remain safe and secure.

Mr. FRELINGHUYSEN. Thank you very much, Mr. Podonsky. There are good reasons that the both of you are sitting together here. And each of you have a mission and to a certain degree you somewhat have to be independent. But in reality, where I think the bipartisan concern is support for both of what you are both doing.

Mr. Huizenga, can you speak to what the Environmental Management organization is doing to evaluate the implications of the reduced budget, or the other term is constrained fiscal environment, and what it means to the department's cost and schedule projections for meeting the many constant milestones?

Mr. HUIZENGA. Yes, I can, sir. First of all, let me just point out that 2013 request will enable us to fully meet our compliance agreements and our milestones in Fiscal Year 2013. It is a request that takes into account all of these issues. That being said, I do not want to underestimate the difficulty I believe we are going to have in the out years. In prior years, we have signed up for a number of milestones at many of our sites and we did this in a sense when we thought we might have slightly higher budget projections when things were different a few years ago. And we are in the process now of working complex-wide to understand if we were stay at relatively flat budgets for the next few years what that would mean for our compliance agreements.

We started this discussion with our stakeholders in a meeting last November in New Orleans. We were being upfront with people that we are going to have to have open and transparent dialogue. If indeed we are going to need to make some adjustments, we want to give people a chance to understand our thinking and our rationale. We will be looking at the highest risk activities across the complex to make sure we are continuing to focus on them on those. Of course, this is a complex issue. It will take us another month or two to get our arms around completely the——

Mr. FRELINGHUYSEN. So, you are working on a new strategic plan having touched base as I assume you do on a regular basis with all your stakeholders, the municipalities, and localities?

Mr. HUIZENGA. Exactly.

Mr. FRELINGHUYSEN. And so, we are going to be getting a new strategic plan?

Mr. HUIZENGA. We are going to have to assess what we think we can do assuming a flat budget. Last time we did this we thought about $6 billion range. We are looking now closer to $5.5 or $5.65 billion consistent with our budget request. Obviously, if we baselined our program and signed agreements at $6 billion there is going to be things that are going to have to be moved out if we are coming in——

Mr. FRELINGHUYSEN. So, we are going to be apprised of what those might be?

Mr. HUIZENGA. We will be in consultation with our stakeholders and with you, of course, to explain what we think this ultimately——

Mr. FRELINGHUYSEN. So, you are going to lay out a pathway here?

Mr. HUIZENGA. That is our——

Mr. FRELINGHUYSEN. Based on flat budget?

Mr. HUIZENGA. In our fiscal year 14 budget build, we are trying to take this into account complex-wide.

Mr. FRELINGHUYSEN. So, this and a lot of what you are dealing with is incredibly complex? All these sites have a degree of complexity and some are involved with consent decrees. And you are taking all of that into consideration?

Mr. HUIZENGA. Correct. We are currently——

Mr. FRELINGHUYSEN. Not only do you have expectations, but states and localities and I assume the courts have some expectation that certain things are going to be done within a timetable. So, are you taking a look at that timetable?

Mr. HUIZENGA. Absolutely. We recognize our commitments to the local people in these areas that have made sacrifices over the years for the country. And we want to move ahead with the cleanup activities as expeditiously as possible. With that being said, we recognize that there are fiscal constraints that need to be addressed and we need to try to take those into account.

Mr. FRELINGHUYSEN. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Mr. Huizenga, in the fiscal year 2012 Appropriations Act there is a requirement that the secretary notify the committee not later than 30 days before any uranium transfer takes place. Twice, as recently—most recently, I should say, as Wednesday, the department has violated the provisions of this statute as far as congressional notification. What is the problem?

Mr. HUIZENGA. We had two administrative errors, and we will not have another one.

Mr. VISCLOSKY. That is the proper answer. Another question is the issue of benefits for workers who transfer from USEC to the D&D contract. And Portsmouth has been an issue recently, and on March 9th, United Steelworker President Leo Girard wrote a letter that, among other things, said that we ask that DOE and its contractors at the site restore their benefits, including pensions and retiree health care, their seniority, any vacation time they have lost, any seniority credits to which they are due, and any other wages and benefits that have been scrimped as a result of the flawed 2011 service contract transition. What, from your perspective, is the problem at Portsmouth, and what action is the department taking or not taking?

Mr. HUIZENGA. This is a complex issue and we met with the USW representatives several times. I met with him personally. I know that they have been in discussions with the Secretary's staff, as well. We fundamentally have a different view of the nature of when the employees change from USEC to working for Fluor-B&W Portsmouth LLC, the new contractor, our view is that they, the contractor, Fluor-B&W Portsmouth LLC, it is their responsibility to negotiate the benefits package. It really is not the Department of Energy's position. We set broad guidelines to make sure that they are doing this lawfully. They have to have some curbstones of which they need to stay in between. But it is up to Fluor-B&W Portsmouth LLC to work this out with the Steelworkers.

Mr. VISCLOSKY. Could I ask, assuming the worst and it is not worked out and the steelworkers file suit, there will be legal ex-

penses and court costs involved. Are those reimbursable to the contract by the Department of Energy?

Mr. HUIZENGA. In general, my understanding is that we pay the court costs for these type of issues.

Mr. VISCLOSKY. Will the steelworkers' legal expenses and court costs be reimbursed by the Department of Energy?

Mr. HUIZENGA. That I do not know. I would have to get back to you on that, sir.

[The information follows:]

Mr. HUIZENGA. The Department of Energy (DOE) does not have a contract with the Steelworkers Union. DOE's prime contractors negotiate collective bargaining agreements between themselves and individual unions. If a union sues a DOE contractor operating under a cost-type contract, the contracts generally provide that most legal costs incurred by the contractor, including settlements, are allowable. There are a number of exceptions, however, and those would have to be reviewed in the context of a particular matter. The larger question is whether a judgement against the contractor would include the legal expenses and court costs of the union; that is generally not the case in American litigation. However, to the extent a judgment against the contractor includes legal expenses incurred by the opposing party, they would likely be allowable to the same extent as other costs incurred by the contractor.

Mr. VISCLOSKY. I must express a concern that you provide—not you personally, but the Department, an unlevel playing field. If some party, whether it is in this case, the United Steelworkers, or another party, feels themselves aggrieved and they have to pay their own legal expenses and court costs and the contractor working for DOE gets reimbursed by the taxpayers, and somebody has deeper pockets than another party and they just outlast people, I think it is a very unfair proposition. So, I would ask that, while the department may not have the ultimate liability for the contract, that special attention should be paid because I think, in this case, the aggrieved party, at least that is the allegation, is in a very unfair situation legally.

Mr. HUIZENGA. Yes.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Thank you, Mr. Visclosky. Mr. Simpson.

Mr. SIMPSON. Thank you. And thank both of you for being here today. We appreciate it very much. We mentioned fiscal constraint that we are under and probably will be under even greater after the budget resolution passes today which—never mind, I will not go there.

Let me ask you. I think we have to find uses that maybe beyond what the original use was for some of the facilities. Currently INTEC at Idaho maintains a wet storage capability. The Navy is looking to refurbish their facility for wet storage for Navy fuel. Is it possible to keep the wet storage facility at INTEC at play and have a shared facility, potentially with the Navy, rather than doing the refurbishing of the Navy's wet storage facility?

Mr. HUIZENGA. To continue to use the existing one?

Mr. SIMPSON. At INTEC.

Mr. HUIZENGA. I am not—to be honest with you, the Navy is moving out in their direction and——

Mr. SIMPSON. I know. I am looking to try to save money here somewhere.

Mr. HUIZENGA. I understand that. I had not tried to interfere with that. I could talk to the NNSA folks and see if there is some synergy there.

Mr. SIMPSON. I am certain that the Navy would like to have their own facility. The question is, is that fiscally the responsible thing to do if we have a wet storage facility at INTEC that could serve the same purposes? We share the use of the Advanced Test Reactor with the Navy and so forth.

Mr. HUIZENGA. Absolutely.

Mr. SIMPSON. I would hope that you would explore the possibility, even though I would suspect that the Navy would like their own facility and not have to share. That is kind of the way the Navy is. I understand that. But it would seem to me like it might save some money in the long run.

Mr. HUIZENGA. I would certainly agree.

Mr. SIMPSON. Without having to put the other money into refurbishing their facility, which I cannot remember how much it is, but it is a substantial sum that they have requested, is it not? Yes. So, I am just suggesting——

Mr. HUIZENGA. I will look into that.

Mr. SIMPSON [continuing]. In this limited fiscal environment that we need to look at other things along the way.

Along that same line, the Advancement Mixed Waste Treatment Plan will finish its Idaho mission within the next couple years. This is a facility that has done a fantastic job, I think. It would seem to be a shame to shut it down. Are there other missions that that facility could facilitate?

Mr. HUIZENGA. I believe they are already making a contribution in that regard. Of course, they are doing a great job in Idaho with retrieval and packaging of the transuranic waste in Idaho. And as I understand it, they have also been successful in taking some waste from Hanford to Idaho, packaging it up and sending it down to WIPP so, you know, we certainly could explore——

Mr. SIMPSON. So we may see a continued operation in that facility beyond the time when they finish their actual drop?

Mr. HUIZENGA. I think that your point is well taken and at these times of fiscal constraints, we need to look at all options. And if we have got a facility that is up and running and doing a good job, then it can provide a more complex-wide benefit, I would be happy to look into that.

Mr. SIMPSON. Okay. After the publication of the recommendation of the Blue Ribbon Commission, we have heard a lot of talk about consent-based process to identify a site to store spent nuclear fuel. Under the Idaho Settlement Agreement, the State of Idaho consented to temporarily store Navy and DOE spent fuel in exchange for DOE's commitment that the Idaho National Lab shall direct the research, development, and testing of treatment, shipment, and disposal technologies for all DOE fuel. That program did this work under the National Spent Fuel Nuclear Fuel Program. It is not funded in the 2013 budget. Do you plan to fund this activity at the INL? And if not, how can you get states to consent to store spent nuclear fuel when commitments made to those already storing spent nuclear fuel were not kept or will not be kept?

Mr. HUIZENGA. I talked to the folks on the National Spent Fuel Program about this a couple times, and we do intend to continue to fund them.

Mr. SIMPSON. Okay. I have got some other questions, but I will——

Mr. FRELINGHUYSEN. Thank you, Mr. Simpson. Mr. Huizenga and the ranking member raised Portsmouth as a focus. The GAO, and you mentioned the GAO, I think, in one of your opening statements, has ruled that the Department's past use of uranium transfer to fund the cleanup work at Portsmouth is illegal, violating the Miscellaneous Receipts Statute. Is the $178 million you have requested for Portsmouth the total amount of the cleanup work that you plan on funding in the fiscal year 2013 budget or do you plan on using the TAILS transfer authority again in contravention of the law?

Mr. HUIZENGA. Well, we respectfully disagree with the GAO's view on that, Mr. Chairman. We believe that we, under the Atomic Energy Act, have the authority to barter the uranium, and we hope to continue to do so because, indeed, we want to continue to accelerate our cleanup work at Portsmouth. And we have an asset, and we believe we can continue to barter this if we send some of the natural uranium to the contractor in return for the work that they will do for us.

Mr. FRELINGHUYSEN. Why not Paducah?

Mr. HUIZENGA. That is a good question.

Mr. FRELINGHUYSEN. Well, that is why I asked you.

Mr. HUIZENGA. Sir, I will have to look into it. I know we are focused right now. I mean——

[The information follows:]

Although the Department's current Secretarial Determination on uranium transfer was approved to support the acceleration of cleanup activities at Portsmouth, it is possible that future transfers, if any, could be considered for use to fund Paducah activities. However, currently planned cleanup activities of Paducah are supported by appropriated funds. Decontamination and decommissioning of the actual Gaseous Diffusion Plant (GDP) is not within EM's current baseline scope because the United States Enrichment Corporation currently leases and operates these facilities.

Mr. FRELINGHUYSEN. I hear a lot about Paducah.

Mr. HUIZENGA. We are doing different work at Paducah, obviously, because at the moment they are still operating and we have got a solid budget request for Paducah, so we think we are okay there.

Mr. FRELINGHUYSEN. The fiscal year 2012 conference agreement directed you to, and I quote, "provide the full details of any proposed barter, transfer, or sale of uranium" in your budget request. How much additional funding do you expect to generate for cleanup activities through these transfers, and why were you not able to provide this information in your budget request as we so clearly directed?

Mr. HUIZENGA. These numbers depend, in part, on the uranium market, and I think that what we tried to do is provide a sense of our intention in this regard. And then, as we continue to want to do these on a quarterly basis, then we intend to get the signature authority correct and then we will send the letters up to you.

Mr. FRELINGHUYSEN. Please do. Mr. Visclosky.

Mr. VISCLOSKY. Mr. Podonsky, in the past, and I talk about the past, the Department has tended to not give adequate attention to the issue of safety and safety culture, and particularly at Hanford, but not necessarily limited to Hanford. I appreciate the fact that you had the Defense Nuclear Facility Safety Board study, contractor had a study, and the department has self-initiated two studies. If you could, for just a minute or two, bring the subcommittee up to speed as to what you and Mr. Huizenga are doing relative to making sure that there is transparency, there is an openness of culture, and that safety is going to be at the forefront here.

Mr. HUIZENGA. I attach a lot of importance to it.

Mr. PODONSKY. As we do, too. And I want to thank you for asking me that question. I was enjoying the hearing up to now.

First of all, if you will indulge me, we are responsible for independently assessing the performance of the department in terms of environment, safety, health, safeguard cyber. Nuclear safety culture is something that is not new to the department. The recognition of its importance is what is slowly becoming more apparent. When we look at what transpired, first with the Defense Board, Defense Nuclear Safety Board, about a year and half ago, looking into a whistleblower issue out at the Hanford site, the former assistant secretary on Ines Triay contacted my office and asked us to take a look at what was going on at the same time. And that was the genesis of the first report that we produced.

And to understand that first report, we did identify issues, but we used our nuclear safety engineers. We used our technical capabilities, but what we did not have a recognition of, and that is the need for experts in safety culture. So, we reached out to the NRC and, following their years of experience, we actually brought on an external expert in nuclear safety culture, in behavioral sciences, and so that was the basis for our next review that we have done.

And I have to do this in order to answer your question because it is complex. BNI, to their credit, as I would expect any good contractor to do a self-assessment, and that is what they did. They brought in some experts that they hired to do a self-assessment on their operation.

So, you have four reports: our two and the two you just mentioned. What they all have in common is that they all identify that there are concerns. The varying degrees are the Defense Board, I would characterize it as having a chilled atmosphere is what they refer to out at the Hanford location. BNI identified it as isolated incidents. And then our report said it was much more pervasive than that in the second go around.

What this has done, especially the most recent report that we did, and not meant to be a self-serving statement, but we used some rather rigorous focus groups, very structured interviews, as well as proven surveys of the staff out there as to what they were really feeling so we could reach into what the workers felt and could get to the folks that really had not already spoken before or maybe they did not feel safe in saying anything. And we actually penetrated that barrier through our processes using our experts.

So, that brings us to where we are now. The Department, the contractor out there, the management out there, my colleague Dave

Huizenga, the Secretary of Energy, all of us now recognize the extent of the problem which we did not understand before. None of us really understood how pervasive the issues are. Not the fear of raising issues, but as we said in our report, the concern that nobody is really interested in hearing about these issues, that the project costs and schedule were trumping safety. That was the biggest difference. And what the Department is doing now is I believe, with the embracing of the recommendations, both in our report, the Defense Board's Board Recommendation 2011–1, some of the findings that the BNI folks identified for themselves, I have every confidence that Dave Huizenga and his leadership, with the support of Tom D'Agostino and the Secretary of Energy, are going to start addressing these issues in a very systematic way. The proof will be in the pudding. The workers have to believe this. The workers have to believe that they can raise issues without concern of reprisal without fear of retaliation, and that is a tall order for this department.

Mr. FRELINGHUYSEN. Will the gentleman yield?

Mr. PODONSKY. Absolutely.

Mr. FRELINGHUYSEN. Have conditions improved?

Mr. PODONSKY. Since our first report, Chairman, yes, there have been improved conditions. Since our current report, I would tell you Mr. Huizenga in his capacity as managing the EM organization for the Secretary of Energy, whatever title you give him, he has taken more interest than any other person that I have seen at that level. He has been out to Hanford almost as many times as my team has been out there and maybe more. That hands-on personal involvement of Department leadership makes all the difference in the world because then the contractors know that we are serious. The Federal staff begin to believe us. And I believe what Mr. Huizenga—and it is not because he is sitting next to me, I am telling you I have seen the actions, that I believe that EM is going to move out in the direction that it has not previously done.

Mr. FRELINGHUYSEN. If the gentleman will continue. You know, allegations come up and they have to be considered seriously. Some of them may be old, but I assume you take a look at whether they are fresh allegations. But the general question, are conditions better than they were? Has the safety culture improved?

Mr. PODONSKY. We have seen——

Mr. FRELINGHUYSEN. Thank you for yielding.

Mr. PODONSKY. Sure. We have seen some evidence of improvement but I will tell you, just I am concerned that we must make sure that all Federal managers and contract managers understand the seriousness of safety culture. Just today in the Weapons Complex Monitor there was an article that talked about one of the whistleblowers registering a concern because during the course of our enforcement activities, that it appeared that an Environmental and Nuclear Safety manager at URS was not being allowed to be involved in interviews that we were conducting. And I will just tell you, to me, as the independent overseer of the Department, that is a clear indication that there still needs a whole lot of work to be done within the framework of both the Federal management and contract management to understand that even if you have best interests in mind for your corporation, you still cannot allow people

to feel intimidated, even if you just have an attendance in a meeting.

Mr. VISCLOSKY. Or people having the opinion that no one is listening, forgetting the issue of whistleblowers. I congratulate you because I am not an apologist, as you know, for the Department on a regular basis. I have been disappointed in the past on the issue of the safety culture. That too often, well, it is a disgruntled employee. Sometimes whistleblowers are wrong or incorrect, sometimes they are very right, but it has tended to be passed off as discrete individual circumstances. I also appreciate that the culture is very hard to change, and people do have to understand, no, we are in this for the long haul.

So again, anything we can do to be of assistance, I would ask you to do it. I also appreciate that you are taking this, if you would, approach to other projects within the department. And I congratulate you for that, but would also remind you we will be attentively following your progress on this, but wish you well on it. Thank you very much, Mr. Chairman.

Mr. FRELINGHUYSEN. We are going to Mr. Simpson. So, was this—I happened to see this article as well. Was this something that occurred last year?

Mr. PODONSKY. No, no, no, sir.

Mr. FRELINGHUYSEN. What is the timetable?

Mr. PODONSKY. This was just in the last few weeks.

Mr. FRELINGHUYSEN. Just a couple weeks. All right.

Mr. PODONSKY. If the subcommittee is interested, I can give you more articulation on this. But I do know that we expressed our concern to Mr. Huizenga and Mr. Huizenga has already taken action.

Mr. HUIZENGA. Mr. Chairman, if I may? I have been talking to Glenn about this and we are making it very clear, providing guidance to the Office of River Protection out at Hanford and the contractor that no one will interfere with the HSS reviews; that they will have unfettered access to the documents and to the people that they need to to conduct their investigation.

Mr. FRELINGHUYSEN. Thank you for your response. Mr. Simpson.

Mr. SIMPSON. Along that same line, you said that making safety a high priority and making sure that the contractors understand that it is a high priority to the Department. That is an initial step. Are there process changes that need to be made in order to more than just say it is a high priority?

Mr. PODONSKY. Mr. Huizenga I am sure will follow, but if you will allow me, there is something called a safety-conscious work environment, SCWE, which is an environment where the workers feel that they can raise issues without fear of retaliation. And I realize this is a budget hearing. And we can put all sorts of money on these projects and on these programs, but at the end, it is the leadership. It is the core values that the managers feel. And do they believe in the safety and do the workers believe in them as well? And if the workers do not believe the leaders and the managers, no matter how much money we put on these projects, they are not necessarily always encouraged to get out there and do the job because they do not always know that they are going to be able to

do it as safely or raise issues, especially if they have issues that might improve the process.

So the Department is looking at all sorts of experiences that were gained today in our other like similar hazardous work, and so there is a lot that we can do. But the most important thing that has to happen is that the leaders, like my colleague Dave Huizenga, like the Secretary of Energy, like the deputy secretary, need to continuously talk about the importance of safety and prove it through their actions. So at the end of the day, Congressman, whether it is a project of a nuclear construction or a nuclear operation, it does not matter. What is important is whether the values are expressed by actions, indeed by the managers that are out there, both Fed and contractor. And that is what has to change.

And when the whistleblowers—we talked about the whistleblowers a moment ago from the ranking member—whistleblowers, there are some that have good points and some that do not have good points at all. But they all need to be heard and need to be—felt that they are listened to and what happens to their issues that they raise. All of that comes together into a safety culture. It does not happen overnight but it has to be continuous and it has to be from one administration after another regardless of Republican or Democratic. It does not matter. Because at the end of the day, these are our workers and they have to feel they are being protected.

Mr. SIMPSON. Okay. Mr. Huizenga, tell me about DOE's efforts to respond to the recommendation of the Blue Ribbon Commission. What is EM doing in this effort and when should we expect to see a plan from the administration of whether they accept the Blue Ribbon Commission's recommendations, also, that is going to require onsite storage? And what about spent nuclear fuel apparently onsite? What is EM doing to make sure that the spent fuel is stored and safe and its facilities are adequate for a longer than expected period of time?

Mr. HUIZENGA. Thank you. Well, we have been working, of course, for years to stabilize our spent nuclear fuel. You know that in Idaho, we have moved a lot of the fuel out of the old wet storage pools into dry storage, and it can be stored safely there for many years to come.

Similarly, we have stored Hanford production reactor fuel in a dry storage building. So we are in the process—and also, of course, we are going to be starting up a facility at Idaho to stabilize the remaining liquid high-level waste. And hopefully, later in April and by the end of the year, we will have that material in a stable form.

So our goal is, given the uncertainties that we do have with the ultimate desire to find a repository for the Nation, we want to make sure that this material can be stored for several decades safely. And in that regard, we want to ultimately work to find a solution.

So we are working closely with the Office of Nuclear Energy within the department. The Secretary of Energy has set up a task force and my staff members are working with Assistant Secretary Lyons' staff members to respond to the Blue Ribbon Commission's recommendations. I think it is in a six-month timeframe and we

need to consult with the members of Congress and try to find the next step and path forward.

Mr. SIMPSON. So we should see a recommendation or a plan within the next six months?

Mr. HUIZENGA. Our intention is to come back up here within that timeframe and consult with you and put something on the table.

Mr. SIMPSON. Okay. As I understand it, your EM program is responsible for the disposition of excessive plutonium at Hanford. Pete Lyons and the Office of Nuclear Energy owns the plutonium at Idaho and the NNSA's. Nonproliferation program is handling the MOX plant and the excess plutonium at Savannah River. It seems to me that we have excess plutonium and we have got three different entities in charge of it. Does this make sense?

Mr. HUIZENGA. I think it does. It actually might be a little bit hard to explain. But in a sense, the nonproliferation mission that is being supported with the MOX plant in South Carolina, they have got a clear understanding and vision of what they are going to do. Ultimately, they will make MOX fuel out of several tons of excess plutonium, 34 tons of excess weapons pits. And our excess plutonium basically is not usable, so we are packaging up the excess plutonium and sending it to WIPP.

To be honest with you, I do not know exactly what any people—I think that they are doing some separations technology and working at the Idaho facility now to try to explore backend of the fuel cycle. So we each are working in our lane. We are working together. We know what each other is doing. And indeed at South Carolina, at the Savannah River site, we are using our H-Canyon Facility to generate feed for the MOX plant to take some of that plutonium and clean it up and send it off to MOX. And we are using the H-Canyon to package some material and send it to WIPP.

I think we each have the plutonium that is best suited for our particular mission and we are taking care of it.

Mr. SIMPSON. Okay. Has there been any unexpected challenges in moving EM to under NNSA?

Mr. HUIZENGA. Other than the fact that we might have done a little bit better job rolling it out, I think that—honestly, all kidding aside, I really think that there was a wisdom and a vision there.

The mission of the other Under Secretaries is to focus on science and focus on research and bring home other important activities within the department's mission. But, of course, the defense programs actually generated most of this waste years and years ago, so they actually know where it came from and how to deal with it.

And so the synergies that we found by coming under Mr. D'Agostino, the Under Secretary of Nuclear Security and the Administrator of NNSA, it has really made some things much easier for us bureaucratically inside the building. We can go to him and talk to him about issues. He has a complete understanding of the technical nature of the issues. He has a relationship with the Defense Nuclear Facilities Safety Board, so if we have Defense Board issues—and he is working through Defense Board issues with NNSA. We are working through some with EM. There is a common understanding of the terms and the issues. So we are looking for opportunities all the time to benefit from the fact that we are

under the Under Secretary of Nuclear Security, and indeed we found some.

Mr. SIMPSON. Thank you.

Mr. FRELINGHUYSEN. Thank you, Mr. Simpson. Mr. Huizenga, I would like to have a greater degree of comfort relative to the safety culture. Did the Department pay the contractor to do its own assessment of some of the problems at the Waste Treatment Plant?

Mr. HUIZENGA. We did pay for the——

Mr. FRELINGHUYSEN. Is that a common practice?

Mr. HUIZENGA. It is in the contract fundamentally that if there are issues that need to be addressed, we will pay for things like this Independent Review.

Mr. FRELINGHUYSEN. And last November that was done, and then they reached a conclusion which seems to be somewhat different than Mr. Podonsky's.

Mr. HUIZENGA. I think it is different. I think that Mr. Podonsky, as he pointed out, there was kind of a gradation between the Defense Nuclear Facilities Safety Board's findings, the chilled atmosphere, the independent review by the contractor who, I guess, did not find as chilled an atmosphere, but also found that there was a common issue——

Mr. FRELINGHUYSEN. I am not impugning anybody—I just wanted to hear how independent it could be if——

Mr. HUIZENGA. Well, they selected people with a reputation for knowing their business and working in the field for many, many years, and we met with them.

Mr. FRELINGHUYSEN. So would your conclusion be different than Mr. Podonsky's?

Mr. HUIZENGA. No. I think, basically, what I am trying to say is that, in the end, although each of the reports had slightly different views on things, they all pointed out that there are issues that need to be addressed, that there are safety culture issues at hand that indeed we have to acknowledge and work to try to improve, and that is indeed what we are doing.

Mr. FRELINGHUYSEN. Well, I am sure you are doing it. What is your take on this, Mr. Podonsky?

Mr. PODONSKY. Well, I do not refer to the BNI review as independent because I do not see it as independent because it was done for the contractor by the contractor, regardless of where the funds came from. And I am not here to impugn their efforts. I am well aware of all the people that served on that panel. They are very distinguished qualified people. But again, at the risk of sounding self-indulging, we used a process that was very structured.

And we learned from our first inspection to bring in external expertise in the area of safety culture so that we could actually get to understand what the workers were really feeling. Because, again, if I might, when we first went out and we conducted our interviews, there was some artificialities in those interviews that were unintentional. But when you put a lot of people in a room together, they are not always going to open up. The venue does not allow for it. But the focus groups that we did in the second group, or second inspection, we had peers talking to one another, and we did 37 of these and they were anywhere from 5 to 10 employees each. We had over 250 people we talked to.

And the point I am trying to make, in our review that we ended up with, is we ended up with understanding exactly what the workers were saying and not our interpretation of what the workers were saying. So I think, in the end now, EM and the department I think get the picture of how pervasive the problem is.

Mr. HUIZENGA. If I may, Mr. Chairman, just for a clarification point. I mean, I think the bottom line is, I went out with Glenn to Hanford when he briefed out the results of his most recent study.

Mr. FRELINGHUYSEN. And may we commend you because Mr. Podonsky said that you have been out there an extraordinary number of times.

Mr. HUIZENGA. Yeah. I am going there again later today. But the point really, and I think this is important——

Mr. FRELINGHUYSEN. If we ever let you out of here.

Mr. HUIZENGA [continuing]. The contractor who—you know, you can debate who should pay for the independent review, but the contractor, and Glenn can substantiate this, said that Glenn's report trumps all the reports. I mean, they are paying attention to the findings in Glenn's report to the extent that their report might not have been as critical as Glenn's. They have embraced, and so have we, the fact that Glenn had some findings that need to be addressed.

So they are not minimizing Glenn's report in favor of their own. We have got to move past that, frankly.

Mr. FRELINGHUYSEN. The companies that are involved in these activities are well-known and well-respected. And the issues they deal with are extremely complex, to say the least. But we are dealing with these consent reviews, which I think are important.

Savannah River has been invoked. Mr. Huizenga, the fiscal year 2013 budget proposes that the Savannah River site H-Canyon facility transition to, what is called a modified operations mode. What are some of the activities that you have planned and do these include reprocessing of spent nuclear fuel?

Mr. HUIZENGA. Yes, they do. We are going to take some fuel that we believe is at risk and reprocess it through H-Canyon. There is some fuel that is being stored at Savannah River site that cannot be stored for a long time. And we are going to process that fuel over the next year or year and a half through the H-Canyon and basically send it to the waste tanks so it will not be a vulnerability in the future. We are also partnering in one of the synergies that I mentioned with NNSA. So our base funding is on the order of about $150 million a year to keep the H-Canyon in warm standby but not actually doing much.

If you make an investment of about $20 million you can run one of the dissolvers. So the NNSA people are pitching in $20 million to run one of the two dissolvers to generate MOX feed. We are going to use the other dissolver to dissolve this fuel. We will continue to actually do some repacking of waste to go to WIPP and the HB line, which is on top of the H-Canyon. We are going to be continuing to do some R&D to try to purify plutonium that might also serve as additional feed for the MOX.

Mr. FRELINGHUYSEN. So the bottom line is that you are working with other programs, right——

Mr. HUIZENGA. Yes.

Mr. FRELINGHUYSEN [continuing]. Offices to identify how to use the facility as the committee pretty much has directed throughout the——

Mr. HUIZENGA. Yes, indeed. And we are working with the Office of Nuclear Energy as well to look at backend of the fuel cycle research and development opportunities that they might be able to use the canyon for.

Mr. FRELINGHUYSEN. We are glad to hear that. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Mr. Huizenga, I would like to discuss the issue of project management and design while under construction. The Department has said that it will no longer begin construction on projects before the design is complete as part of its efforts to get off the GAO high-risk list. Yet, this past August, a contractor was allowed to weld shut the vessel heads where the Department continued construction and despite existing unresolved design issues. Why was that decision made and what were the circumstances? Is this the exception to the new rule or have we gone back to construction while design is underway?

Mr. HUIZENGA. Well, we made a decision, for better or worse, a long time ago on the WTP project to have it be a design-build project. And of course, the desire is always to have your design running far enough ahead of your construction that you do not have such a narrow gap that you run into issues. This vessel welding is probably one of those areas where we are narrowing. And the fact of the matter is it was a management decision to keep moving, making progress. The vessels were in the shop and the next step was to weld the heads on. Time will tell whether, in the end, that was a good management decision because we will be able to place those vessels on schedule or whether we are going to have to actually take the tops off the vessels and make some adjustments to the mixing devices that are inside.

You know, we have got an aggressive testing program that will go on for the next year or more to test the performance of those vessels to mix the complicated waste that will come out of the tanks and be processed in the pretreatment facility. But at this point, it is a function of the fact that we are moving along in a design-build mode, and we try ever as we may to not have these situations where we are creeping up on a decision before we have all the testing done. But in this instance, and with the complicated issues of mixing, we are running pretty close.

Mr. VISCLOSKY. When will we know whether it was the correct decision or not? When will that determination be made?

Mr. HUIZENGA. We probably now are not realistically going to know for about a year.

Mr. VISCLOSKY. Okay.

Mr. HUIZENGA. But suffice it to say that, you know, this comes back to one of the safety culture issues. Some people are concerned that we are going to install those vessels and we will not know really whether they are actually going to function safely, and we have got a hold on that.

The vessels are in the shop and they are being stored. They will not ultimately be installed, because if we are going to have to actually make some adjustments as a result of our increased knowledge

through the testing program, we are not going to be able to do it once they are installed, and we recognize that. So we are going to hold off, complete our testing, and then be able to install them.

Mr. VISCLOSKY. I appreciate knowing that. Are there any other circumstances right now where we are close as far as continuing construction relative to where we are in design, or because of just the inertia involved whatever may be structurally, will some of these circumstances still exist despite the Department's decision to make sure they have extended design out far enough to avoid this in the future? Are there others we should be cognizant of?

Mr. HUIZENGA. There are other issues associated with piping and other vessel issues. And as a matter of fact, we, recognizing that this is an important area and we need to get it right, we have just recently issued direction to the contractor to demonstrate to us that some of these things that are questionable are actually completely consistent with our design margins. So we are actively engaged in this discussion with the contractor.

Mr. VISCLOSKY. If you could, for the record, provide a list of the major circumstances where this exists? Because again, I am concerned that, given past culture, we are going to design before we construct. But that is what we have been saying for 20 years out here, to again make sure that the contractor understands. This is a different day.

Mr. HUIZENGA. We certainly——

Mr. VISCLOSKY. I have been on this subcommittee through three administrations. And from my perspective, it has been a bipartisan failure with the Department that we continue to be on this high-risk list. And we are in the third year of the administration and I would hope people, if we are serious about it, know the culture is changing on that aspect, too.

Mr. HUIZENGA. Yes. We can provide some stuff for the record. I would just point out, one of the issues is well-known to the Defense Nuclear Facilities Safety Board. There are some questions on potential erosion and corrosion in these vessels. If the waste itself is particles that are abrasive when you are shooting them through at high velocity through the pipes and into the tanks, it can erode some of the stainless steel. So we are looking at that very aggressively.

[The information follows:]

The two largest line item projects within Environmental Management's portfolio, the Waste Treatment Plant and Salt Waste Processing Facility, are both being constructed under design build contracts. The design maturity of the Salt Waste Processing Facility has reached a state where there are no instances where the project is in construction with significant design risks still in existence.

At the Waste Treatment Plant, the project is currently moving from a design and construction focus, to construction, start-up and commissioning focus.

Mr. HUIZENGA. I guess, if you do not mind, if I can just take a second to address maybe some of the issues that Glenn was raising. I mean, I am on my way to Hanford for the fourth time since coming back to EM. I take this very seriously. I have had two all-hands meetings talking with the people out there about the importance of safety.

But back to one of the questions that was raised, you know, is this just rhetoric? And I want to try to explain what we are doing to institutionalize the fact that safety is important. And ultimately

we are not going to—you know, nobody wants to run this facility if it cannot be run safely.

So the people that have been raising the issues about erosion and corrosion for some time now, I have sat down with them the last time I was out there for two hours and went through their complex and technical list of questions. And I think what we are doing, as we are trying to do as Glenn suggested, to demonstrate that we actually are interested in understanding the problem.

And again, we might not all ultimately come to the same conclusion, but we are going to have a transparent discussion of the issues and communicate back to people, okay, this is how you feel and why you believe this is—we either agree with you—as a matter of fact, sometimes we have agreed with people and have actually gotten back to them and told them that we agreed with them. So we need to do a better job of tracking the issues and getting back to people. And that is basically I think what we are doing to institutionalize the fact that it is a different day.

Mr. VISCLOSKY. And I would encourage you to continue those efforts. And, again, just so we can have that list of legacy, if nothing else. I understand you may have some legacies where you are close, and there may be extenuating circumstances, but there ought to be a limited universe, and nobody added to it.

Mr. HUIZENGA. We do not need to keep doing that, I think is your point.

Mr. VISCLOSKY. Mr. Chairman, one other question. On the Separations Process Research Unit in Schenectady, DOE was criticized by EPA for a number of failures such as not properly evaluating whether there was a risk of releasing contamination into the environment. Do you agree with EPA's criticism or take exception to it, is the truth somewhere in the middle?

Mr. HUIZENGA. Yes. I mean, it was, again, kind of an administrative issue that needed to be worked through with EPA relative to the NESHAP's permit requirements. We have done that now, we are in agreement now and understand our path forward. It stemmed, of course, from the initial problems in the fall of 2010, when one of the tanks was pulled out inappropriately and started to be cut up, and some contamination was released on the site. So what we are doing now to address that and work closely with the EPA is we are putting in closures over the two main structures, the two main cleanup buildings. And we will have a ventilation system so we will not have a possibility of having a repeat of the problem we had before.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. So why do you need the ventilation system? Is the contamination such that you——

Mr. HUIZENGA. There were low—there were relatively low levels of contamination. But, indeed, there is some contamination on the pad in these buildings, in one of the buildings in particular.

Mr. FRELINGHUYSEN. Is this required by the EPA?

Mr. HUIZENGA. Ultimately, this was basically thought to be the best approach.

Mr. FRELINGHUYSEN. Okay. Mr. Simpson, thank you.

Mr. SIMPSON. Thank you. I do not have anything else. I just was going to ask you how you handle differing professional opinions,

and how you handle whistleblower complaints and that kind of stuff. Because I handle them as a big deal, and whether people believe that safety is a big issue and that you are concerned about their concerns. Understanding that sometimes people that have different professional opinions or have concerns about whistleblowers are going to hold to their opinion no matter what you do sometimes. And being able to at least say you have addressed them is a big issue, so I appreciate your previous answer.

Mr. HUIZENGA. Relative to the differing professional opinion, this example of erosion/corrosion, that is a particular area that a gentleman has been concerned about for some time, and he has been respectfully working through the system. Ultimately, he filed a DPO. But I think that he finally—now, he actually forwarded me the letter that he worked on to forward to the contractor to tell them to address this issue. So he is seen, he is engaged in seeing action, he is actually part of resolving the issues that he has raised.

Mr. FRELINGHUYSEN. Good. I appreciate it, thank you. The Paducah plant is facing some difficult choices, including a real possibility of closing down. It is in Richmond. What happens, do we end up taking it back, or what does that mean?

Mr. HUIZENGA. Ultimately, I am sure, of course, the Paducah facilities will come back, just like Portsmouth did and the facilities at Oak Ridge. The timing is important to us. We hope that the USEC Corporation can continue to operate the facility for another year or more as they are also trying to bring the ACP facility on in Ohio. It is a little unclear right now as to whether there is a business case for that. And we have been working actively with them to try to look for ways to continue to have USEC operate Paducah.

Mr. FRELINGHUYSEN. Is there any funding in question in the budget relative to this?

Mr. HUIZENGA. Not for USEC itself, obviously. We are working with them on various ways to look for opportunities to——

Mr. FRELINGHUYSEN. But taking the facility back.

Mr. HUIZENGA. Oh, I am sorry, I misunderstood. No, that is a pretty clear answer, there is no—we have no money in our budget to actually take over for USEC in 2013. If they are unable to continue their operations, we will have to be back up here talking with you.

Mr. FRELINGHUYSEN. You invoked in your opening statement Oak Ridge. The Department has recently proposed an alternative approach for removing Uranium-233 from Oak Ridge, which would save a significant amount of funding from the previous plan of record, which required expensive building modifications to down blend the materials. You expect savings from the original plan? And, if so, how much?

Mr. HUIZENGA. I cannot quantify it, I have to take that for the record. But I can tell you that, again, this is an area, when faced with the fact that we have some real financial constraints, we looked for better solutions, working smarter not harder. So about half of the material that was at risk in this building is going to be—some of it will be reused and shipped to the Nevada site for NNSA to use the material.

[The information follows:]

As a result of the Phase 1 alternatives analysis, documented in January 2011, the Department decided to pursue direct disposition (involving either the transfer of valuable U–233 components to other DOE Programs for additional mission use, or the direct disposal of eligible components without processing) of approximately half of the U–233 inventory. For the remaining inventory, decisions are yet to be finalized regarding the location and detailed plans for required processing, but will likely remain onsite. The final Draft Phase I Alternatives Analysis Report screened all of the Oak Ridge National Laboratory (ORNL) hot cell facilities for availability and suitability as potential alternatives to the use of Building 3019 for dissolving and down blending the remaining inventory to meet waste acceptance, security, and safety requirements. Buildings 2026 and 3047 were identified as the two most suitable facilities at ORNL, and both of these facilities are being further examined in the Phase II analysis. The Phase I report also suggested that the baseline plan involving construction of a new annex for drying and packaging the down blended material could be avoided by co-processing with a larger, existing waste stream at ORNL that needs to undergo treatment in any case.

While a review draft of the Phase II analysis has not yet been completed, and no decision has been made, preliminary indications are that Building 2026 (which is located directly across the road from Building 3019) is the more attractive alternative due to cost and safety considerations and also because it has the least potential for competing programmatic demands. Building 2026 is not currently in use; the cost of any necessary modifications to Building 2026, as well as subsequent canister-by-canister processing, is expected to be far less than the original approach that involved retrofitting of Building 3019 and U–233 processing operations in a high security, high hazard environment. The Phase II report is also likely to endorse the Phase I conclusion that after waste is moved from Building 2026, co-processing down blended material with existing sludges at the Oak Ridge Transuranic Waste Processing Center (TWPC) is the most cost-effective and least risky approach for final preparation of an acceptable waste form to ship offsite.

The final cost savings are expected to be substantial when compared to the baseline estimate to process all of the remaining U–233 inventory in Building 3019 and a newly constructed an adjacent annex for drying and packaging.

Mr. FRELINGHUYSEN. This has been going on for years, has it not?

Mr. HUIZENGA. Yes, it has. But we found there was material there that actually had a use, I guess is the point I am trying to make. So, instead of trying to build a facility, a complicated, expensive facility, to turn something that had a use into trash and dump it, we are actually going to use it working with NNSA, or NNSA will use it. So we are transferring title to NNSA.

Mr. FRELINGHUYSEN. So there is a solution in the offing——

Mr. HUIZENGA. Yes, that——

Mr. FRELINGHUYSEN [continuing]. And a timetable of some sort?

Mr. HUIZENGA. We have already started shipping some of this material to the NNSA facility, so we are making steady progress.

Mr. FRELINGHUYSEN. Okay. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. The Department has asked for a large increase for the tank farm activities to prepare tank waste for reprocessing once WTP is operational, but we do not have an update from the Department on project execution for WTP, nor any details on preparations for the tank farm's needs to be completed. Why should the subcommittee support financially ramping up the tank farm when there may be imminent changes to the WTP program?

Mr. HUIZENGA. Yeah, that is a good question. But I think what has happened in the past is we had ramped up funding for WTP, and, frankly, we just recognized now that, ultimately, we need to have feed for the tank farms come at the right time for WTP. And we needed to actually beef up the funding and increase the funding

for tank farms to help them, basically, be able to provide feed when WTP is ready.

Mr. VISCLOSKY. So you are looking for the waste stream for the stock to catch up to the WTP?

Mr. HUIZENGA. Yes, sir. They are continuing to add infrastructure and improvements that need to be taken care of. Those tanks are, of course, many, many years old. They have characterization activities that are necessary to understand the nature of the feed that will be fed into WTP. They also have their own Consent Decree milestones relative to continuing to empty out the tanks. So they have a number of drivers and are trying to be responsive to those needs.

Mr. VISCLOSKY. And I did not know as I asked the question, I guess that is why I am asking the question. I am assuming the Subcommittee has information as to the time frames for both WTP and the tank farms, then——

Mr. HUIZENGA. As to——

Mr. VISCLOSKY [continuing]. So that they will be coincidental as far as the waste stream?

Mr. HUIZENGA [continuing]. Linking those up? If you do not, I am sure that we would be happy to provide it.

[The information follows:]

The baseline for the Tank Farms Project continues to be aligned with the baseline for the WTP Project in terms of when waste feed, secondary waste treatment, and immobilized waste storage will need to be available. Recently, the project has also initiated a One System approach that is focused on preparing for the startup and operations of the WTP under a single manager with staff from both the Tank Farms and WTP contractors. This approach represents a significant evolution in focus from design and construction of the WTP to preparations for commissioning, startup and eventual operations of this facility. This One System approach will integrate Tank Farms and WTP Project contractual, schedule, technical and other elements in preparations for the start of and sustained tank waste treatment operations at Hanford.

Mr. VISCLOSKY. Okay. One other question, if I could, on baselining of major construction projects. EM has a number of ongoing construction projects that either are trending behind schedule or over budget. WTP and the Salt Waste Processing Facility in Savannah River now require restructuring of their project execution plans to make up for the delays. What is the end process for rebaselining these programs and staying in touch with Congress so that as there is a re-baselining, there is going to be congressional support for the financing?

Mr. HUIZENGA. We are going to have to have repeated dialogue with the WTP over the course of this year. Our intention is to—the contractor is now developing a proposed new baseline for our consideration, it will be prepared sometime in August time frame. And then we will take a look with our internal review, do an independent cost estimate of their proposal, and sometime by the end of the year or early next year, we would hope to have the new baseline in the contract renegotiated and in place.

On salt waste processing, we ran into some difficulties with 10 of the vessels, similar to the vessels you mentioned that we welded the heads on at WTP. They are similar vessels that will be used in the Salt Waste Processing Facility, and they are being manufactured more slowly, frankly, than we had hoped. So we are having to do some pretty significant workarounds. We are having to keep

part of the roof open so we can lower these vessels in as soon as they are delivered, which we hope is going to be within the next few weeks. But after the vessels get in, we are going to have to take a look at the remaining baseline, and we will have to come back up and consult with Congress on that, as well.

Mr. VISCLOSKY. May I encourage your efforts on the re-baselining and getting some resolution, because—and, again, you and I have not had this conversation, but I have had this conversation with witnesses over several administrations, and it would be a relief not to have this conversation again. So I just encourage you, and whatever we can do, we are at the end of our rope here and we are serious about this.

The first conversation I had with the Secretary when he was nominated is, and I am not being facetious here, I do not care what your energy policy is, but if you cannot manage some of these major projects and have the taxpayers' money controlled by Federal employees who are charged with running these, you are never going to be able to implement your policies. So I just really encourage, and I have a lot of faith in both of you, but just anything we can do, because, man, I am tired of having this conversation.

Mr. HUIZENGA. I do not blame you, and I would love to not have this conversation with you, again, sir.

Mr. VISCLOSKY. That may be one reason why you are leaving town.

Mr. HUIZENGA. The good news is, at Idaho, we are making the final preparations to start up the Sodium Bearing Waste Treatment Facility, one of our major construction projects. And if things come together as we hope they do, we will start it up and finish the job by the end of the year as the consent agreement requires us.

Mr. VISCLOSKY. Work hard and good luck.

Mr. HUIZENGA. Yeah. I have spent some time with Gene Aloise shortly after coming to this position to try to understand GAO's issues and what they have been, what their concerns have been. So I think that we have—they are institutionalizing the project reviews, working closely and getting out in the site, understanding their issues, not letting them fester or be able to build up and be surprises later on. I think we are making some steady progress.

Mr. FRELINGHUYSEN. Mr. Huizenga, you have worn many hats.

Mr. HUIZENGA. I have.

Mr. FRELINGHUYSEN. Did you start with EM and then move over to NNSA?

Mr. HUIZENGA. I started at Hanford in 1985 and came to Washington in 1987 on a three-month detail. But then we worked together on nonproliferation issues for about a decade when I was in the former Soviet Union locking up materials.

Mr. FRELINGHUYSEN. We hope they are locked up.

Mr. HUIZENGA. Glenn actually helped us on a couple of those, as well, sharing lessons learned from his security experts with our Russian colleagues.

Mr. FRELINGHUYSEN. From those closed nuclear cities, right?

Mr. HUIZENGA. Uh-huh.

Mr. FRELINGHUYSEN. Well, you said such kind and positive things about Idaho, I guess that means I have to yield to Mr. Simpson.

Mr. SIMPSON. That is all right, I am done.

Mr. FRELINGHUYSEN. You are done? I do have a question related to your reductions for protective forces. I know there is always a balancing act here. Can you talk a little bit about what that means?

Mr. HUIZENGA. That, actually, is a good news story, thank goodness.

Mr. FRELINGHUYSEN. And before you leave here, at Defense hearings, I often pose the question, is there any question that we did not ask you which you thought we ought to know about? So when you respond to this, if either of you would like to make any comments about things that perhaps we have overlooked that are important that you would like to highlight, we would welcome that.

Mr. HUIZENGA. Yes, sir. Relative to the security budget and the safeguard budget, the Department undertook an effort to harmonize, I think is the word they were using, the approach between the Defense Department, DOE and NNSA on securing materials. And we found some areas that we may—Glenn may know more about this than I do, because he might have been more directly involved. But the fact of the matter is, we might have been overprotecting material, which is good, but if you do not need to, you do not have to spend the money on it. So we found ways to actually adequately protect material for less cost. So, in some areas, we reduced the cost, not because we are setting ourselves up for failure, but because we actually believe we can do this in a more cost-effective way.

Mr. FRELINGHUYSEN. So, Mr. Podonsky, you are implementing a new safety and security reform plan, you are moving in that direction. How do you view——

Mr. PODONSKY. Well, Mr. Chairman, we are looking at how we can spend limited resources more wisely and more effectively. And in a post 9–11 environment, when none of us really understood what was going on 10 years ago, we even had tanks on top of Hoover Dam, but we did not know what we were dealing with. And, as Mr. Huizenga has said, we are looking at how do we save cost but still provide effective security?

And what him and other elements of the Department are doing in following guidance that is coming out of my organization is we are looking at what the threat is at our sites, and how we are protecting it with our physical protection, and can we use other strategies, can we use technologies? The traditional guards, gates and guns is not necessarily always the most effective when we look at the world events today. So the department, in partnership with DOD, as well as NRC, are examining what the threats are and how best to protect, and there are cost savings to be made. I would, if I might——

Mr. FRELINGHUYSEN. Yeah, jump in.

Mr. PODONSKY. There is one thing that in your opening statement, Mr. Chairman, you asked how can we do—how can HSS do our expanded responsibilities with the budget going down? And I would tell you that we will continue to do our mission and we are

prioritizing our costs so that we can, indeed, increase our nuclear safety and nuclear security oversight for the department. Where we are cutting our own budget that the President gave us and the Congress approved last year and the one that we are coming into now is we are cutting out programs that are not adding any value. We are cutting out programs that are redundant in others areas that we have covered. It is called being fiscally responsible.

We are not in this business to always ask for more. We are going to do more with less, because that is what we have to do. We have a responsibility that came out of language from last year's Appropriations Bill to have us look at safety construction in the projects, and we are going to be able to do that with the plus-up in our oversight, and taking away from areas like some of our headquarters' security posture that we have. We are also responsible for headquarters security. We do not need all the funds that we currently have, and that is why our budget reflects a $5 million decrease.

Mr. FRELINGHUYSEN. We appreciate that effort, that degree of conscientiousness. Mr. Huizenga, anything further for the record?

Mr. HUIZENGA. Well, I looked over my list of questions I thought you might ask, and you did a pretty good job, so I am not going to suggest. But if I may, I would just point out, we submitted a request that was lower than we have for the last couple years. And we recognize that you have constraints, but we are right down to the bone now relative to meeting our compliance agreements, and we are hoping that you are going to be able to do what you can do support the request. Because I think we are demonstrating that we are making a difference at these sites and making a difference for the taxpayers, and we would like to continue to do that work.

Mr. FRELINGHUYSEN. Well, I thank you both. Before you get out of Dodge here, I have one question. Mr. Huizenga, this is the fourth year in a row that the department has attempted to reauthorize Federal industry contributions into the uranium enrichment D&D fund as part of its budget request. Why should this subcommittee go forward now and instruct the domestic nuclear industry to take on additional obligations?

And, secondly, when do you predict that the fund will be exhausted, and what work have you done to understand the full cost of the cleanup efforts? I know that is a rather all-encompassing way to finish out the hearing here, but we want to——

Mr. HUIZENGA. We know, Mr. Chairman, that ultimately this money, of course, is for the D&D of Portsmouth and Paducah facilities and the facilities at Oak Ridge that the fund is short. So that is why we actually are hoping to actually make a contribution to it again this year. We would request, I think, 20 million more than we are actually hoping to pull out so that that money can stay in there and earn some interest, and ultimately benefit us. Relative to the industry's view on this, I am sure they will have a view and we will have to take that, you will have to take that into account. But we know we are going to need more money than is in the fund at this point, so sooner or later, we would like to try to build it back up.

Mr. FRELINGHUYSEN. All right. Mr. Visclosky, anything further?

Mr. VISCLOSKY. Nothing, Chairman.

Mr. FRELINGHUYSEN. Thank you both, and all the people who worked with you, we appreciate your work. Meeting stands adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

ENVIRONMENTAL MANAGEMENT & OFFICE OF HEALTH, SAFETY, AND SECURITY
FISCAL YEAR 2013 BUDGET HEARING

WEDNESDAY, MARCH 21, 2012

URANIUM ENRICHMENT D&D FUND

REAUTHORIZATION OF INDUSTRY PAYMENTS TO D&D FUND

Subcommittee. Mr. Huizenga, this is the fourth year in a row the Department has attempted to reauthorize federal and industry contributions into the Uranium Enrichment D&D Fund as part of its budget request.

Why should this subcommittee go forward now and instruct the domestic nuclear industry to take on additional obligations?

When do you predict the fund will be exhausted and what work have you done to understand the full costs of the cleanup efforts?

Mr. Huizenga. The last report to Congress on the adequacy of the Uranium Enrichment D&D Fund (December 2010) projected a shortfall of $11.8B and estimated that the fund would run out by 2020. Reinstituting the policy for the domestic nuclear utilities to pay annual contributions into the Uranium Enrichment D&D Fund will decrease the projected shortfall for the D&D of the three gaseous diffusion plants.

FISCAL YEAR 2012 REQUIREMENTS REGARDING CONGRESSIONAL NOTIFICATION

Subcommittee. Mr. Huizenga, the fiscal year 2012 appropriations Act requires the Secretary to notify the Committees not later than 30 days before any uranium transfer takes place. Twice now, as recently as last Wednesday, the Department has violated the provisions of this statute. Why is this legislation so difficult to follow?

Mr. Huizenga. While my office has complied with the intent of the legislation by notifying the Committees within the required 30 days, it was not done under the Secretary's signature. The notifications were provided under delegated signatures, rather than the Secretary of Energy's signature. Future notifications will carry the Secretary's signature.

PORTSMOUTH REDUCTIONS

Subcommittee. Mr. Huizenga, the budget request for cleanup at Portsmouth is only $178 million, a reduction of 25% and a dramatic turnaround from the large ramp up in funding DOE sought in previous years.

Why has EM squared its sights on cutting funding so dramatically at Portsmouth? How does this reduction best support the needs of the EM program as whole?

Mr. Huizenga. Priorities within the Environmental Management program across the DOE complex are based on many factors including risk to human health and the environment, regulatory commitments, worker and public safety, and national security. As a result of these complex wide considerations, Portsmouth's FY 2013 request is $67.8M lower than the FY 2012 appropriated amount.

The FY 2013 Congressional Budget Request for Portsmouth was developed to support the ongoing work scope and ensure compliance with FY 2013 state regulatory cleanup milestones. In addition to the funds included in the FY 2013 Budget Request, the Department will continue to transfer uranium and to support the cleanup efforts at Portsmouth. These funds will ensure that the cleanup efforts at the Portsmouth site will remain compliant in FY 2013.

Subcommittee. The budget request also cuts in half funding for security at Portsmouth, stating requirements have gone down as a result of "efficiencies." How can you propose to reduce security so drastically without impacting the security posture of the site?

Mr. Huizenga. Recognizing the transition in the mission of the gaseous diffusion plant to full deactivation and decommissioning, the Department has conducted comprehensive evaluations of the safeguards and security posture of the plant led by security professionals from DOE Headquarters and from other sites in the DOE complex. These evaluations indicate that the site may be protected from all threats without loss of effective security by realignment of the protective force and restructuring security interest areas on a graded approach consistent with all requirements for protection of classified matter, nuclear material, other government property and personnel. DOE will continue to seek the most efficient use of

security funding while achieving site security in accordance with all DOE requirements and other pertinent Federal regulations.

Subcommittee. Will there be layoffs at the site at this funding level? If so, how many people would be impacted beyond the layoffs that would have occurred as a result of the change in contractors?

Mr. Huizenga. We are working with the site contractor to evaluate the FY 2013 mission priorities, workforce requirements and skills mix needs to support the cleanup of the Portsmouth site. The contractors will make decisions regarding whether any and how many layoffs may be necessary, based upon their evaluations of the skills and number of employees needed to complete the ongoing work.

SELLING NICKEL AT PORTSMOUTH

Subcommittee. Mr. Huizenga, the DOE possesses thousands of tons of nickel left over from cleanup activities. This material is radioactive, but if cleaned up could have a significant value.

What is your current estimate of the value of this metal?

Mr. Huizenga. The potential value of the DOE nickel depends on the cost to declassify and decontaminate the nickel, and the potential end uses of the decontaminated "clean" nickel. DOE is developing a nickel disposition strategy and its Portsmouth site contractor is seeking industry input on technical and business issues to inform this effort. Specifically, the site contractor is requesting information on any viable decontamination technologies that are in DOE's best overall economic interests.

Subcommittee. Do you consider it an asset or liability?

Mr. Huizenga. DOE's classified and contaminated nickel is a liability in its current form.

Subcommittee. Have any proposals been offered to take this material off the government's hands, including buying it? If so, what is the status of these proposals?

Mr. Huizenga. Proposals were received in response to the May 14, 2010, Request for Proposals for a sales agreement of 15,300 tons of contaminated nickel at Oak Ridge and Paducah sites not for general commercial use, but for radiologically-controlled applications. DOE concluded that a re-evaluation of requirements, policies, and business practices was needed to determine whether more cost-effective strategies were feasible and cancelled the sales agreement on July 22, 2011.

Subcommittee. Are you considering using this metal as another source of funds to augment appropriations for cleanup? What steps will you take to ensure this attempt does not violate the miscellaneous receipts Act?

Mr. Huizenga. No decision has been made regarding the disposition of this material. Nevertheless, any proceeds obtained by the Department through the disposition of the nickel would be managed and used in accordance with applicable law.

PORTSMOUTH CONTRACT & THE STEELWORKERS

Subcommittee. The issue of benefits for workers who transferred from USEC to the D&D contractor Flour-B&W Portsmouth has been an issue recently. Specifically, the local Steelworkers union has raised concerns that the former USEC workers are being improperly kept out of the benefit plan previously established for Portsmouth's cleanup contractors. What, if anything, is the Department doing on this front?

Mr. Huizenga. In August 2010, the Department of Energy awarded a contract to Fluor-B&W Portsmouth (FBP) for environmental cleanup and decontamination and decommissioning at Portsmouth. Consistent with its contract with DOE, FBP has provided jobs to all union employees, supported hiring preferences, provided equivalent pay for at least the first year, and provided a signing bonus. Not only were the U.S. Enrichment Corporation (USEC) employees involved offered the opportunity to continue work, but they were also offered a very generous benefits package that is extremely competitive with the market.

Former USEC employees are eligible to participate in the Multi Employer Pension Plan (MEPP) and Multiple Employer Welfare Arrangement (MEWA) if they meet the plan eligibility requirements. Many USEC employees who moved to employment with FBP are already eligible for retirement under the USEC pension and retirement medical benefit plan; those individuals can elect to retire in the USEC plan and immediately receive a pension as well as post-retirement medical benefits from USEC. They can then elect to accept jobs offered by FBP and be offered the market-based benefit plans. Employees who are vested in the USEC plan but not retirement-eligible will receive benefits from USEC based on years of service upon reaching the retirement age. Employees who do not meet the plan eligibility criteria for participation in the MEPP and MEWA will receive a generous package of market-based benefits from FBP.

Consistent with the requirements of the USEC Privatization Act, approximately $600 million was transferred to the USEC pension plan to cover the existing pension and post-retirement medical benefit liabilities of participants and beneficiaries from Portsmouth and Paducah.

USW believes that FBP should have assumed the collective-bargaining agreements (CBAs) of USEC and LPP and that even individuals who do not meet MEPP and MEWA eligibility criteria should be eligible to participate

in the MEPP and MEWA with credit for prior service. The Department disagrees with USW's position that the FBP contract is a follow-on or successor contract to the USEC Cold Shutdown contract for a number of reasons. DOE's relationship with USEC is different as compared to DOE's relationship to FBP, or even other EM contractors. The key distinctions are as follows:

- DOE leased the facilities to USEC for commercial operations. USEC maintained its independent operations when DOE then bought services/maintenance with cold stand-by and cold shutdown funding.
- It is customary for DOE to approve the bargaining parameters for DOE collective bargaining agreements with DOE contractors. DOE had no role in approving the economic bargaining parameters for the USEC collective bargaining agreement with USW. USEC operates as a private company.
- In the usual DOE facility management contract transition, DOE has the authority to direct the previous DOE contractor to transfer pension plan sponsorship and to the new DOE contractor, who assumes the pension liability. This did not happen with USEC, as USEC is a private company and its pension and medical plan assets are not available to fund benefits for FBP employees.

In addition to the differences in DOE's relationship with USEC as compared to DOE's relationship with its contractor, there are also material differences in the scope of work between DOE's contract with USEC, a vendor who provided services and DOE's contract with FBP, a DOE prime contractor. Allowing the USW-represented USEC employees, who would not otherwise meet the MEPP & MEWA eligibility requirements, into the plans has an estimated present value of future cost of $74 million (through 2024).

WASTE TREATMENT PLANT

SAFETY CULTURE AT THE WASTE TREATMENT PLANT

Subcommittee. The Defense Nuclear Facilities Safety Board (DNFSB) recently signed off on DOE's proposed action plan for improving the safety culture. Can you explain how the Department plans to address the Board's recommendation?

Why did it take so long for DOE to accept the findings of the Board on the deterioration of the safety culture at the project? Couldn't you have started these types of actions two years ago when Mr. Podonsky produced his first report on the safety culture?

DOE sent a letter to the DNFSB requesting the details of their investigation before you responded to the recommendation. Did you ever receive information on these details and do you still need this information to move forward with your strategy?

Mr. Huizenga. In response to the Board's finding, a formal Implementation Plan was prepared and sent to the Board. That Plan can be found at: http://www.hss.doe.gov/deprep/2011/TB11D27B.pdf. Following the initial HSS report, DOE and its contractors began efforts to improve the nuclear safety and quality culture on the WTP Project. For example, following the first HSS assessment, the Deputy Secretary of Energy held All Employee meetings at Hanford, as well as smaller employee round table discussions to reiterate senior management's attention to and focus on safety culture issues. Additional assessments were also conducted to further identify specific areas for improvement. The DOE recognizes the need for continuous improvement, and remains committed to achieving and maintaining a strong nuclear safety and quality culture.

The Board responded to DOE's letter inquiring about the details of its investigation. Although the letter did not identify the specific aspects of its investigation, other sources such as the Independent Nuclear Safety and Quality review chartered by the WTP contractor, and the second HSS review completed in late December 2011, provided the necessary information for the Department to identify the necessary actions to be taken to address the DNFSB recommendation.

LARGE SCALE VESSEL TESTING

Subcommittee. This subcommittee directed EM to develop cost estimates by February 1st for the large scale vessel testing recommended by the DNFSB to resolve one of the technical nuclear safety issues with the design. We are still waiting for those estimates.

Have you provided funding for large scale vessel testing for the Waste Treatment Plant in your budget request? How do you intend to create a testing program that will address these outstanding technical problems?

What information do you hope to gain from your testing? Do you think these tests will result in any design changes or changes to how much of the waste can be processed with the existing facility design?

How much funding have you provided in the fiscal year 2013 budget request in support of your testing program?

Mr. Huizenga. The Department of Energy (DOE) has committed to performing Large Scale Integrated Testing to evaluate the mixing, sampling and waste transfer processes associated with both the Waste Treatment Plant (WTP) and the Tank Farms. The major elements of the Large Scale Integrated Testing program are being reviewed by an External Review Team of nationally recognized technical experts and closely coordinated with the Defense Nuclear Facilities Safety Board. Through this program, the Department will gain valuable insight into vessel mixing, sampling, and transfer system performance. This information will be used in conjunction with information regarding the performance of tank farm systems used to mix, sample, and transfer waste feed to the WTP to establish waste acceptance criteria (WAC). DOE has requested approximately $61.7M for Large Scale Integrated Testing in the Fiscal Year 2013 budget request. The Department is finalizing a comprehensive cost estimate for this testing and will deliver the estimate in a report to Congress, as requested by the House Appropriations Subcommittee on Energy and Water Development.

PROJECT MANAGEMENT: DESIGN WHILE UNDER CONSTRUCTION

Subcommittee. Mr. Huizenga, the Department has said it will no longer begin construction on projects before the design is complete as part of its efforts to get off the GAO high risk list. Yet, just this past August, your decision to allow the contractor to weld shut the vessel heads is another very recent example where the Department continued construction despite the existence of unresolved design issues.

How have the project management 'lessons learned' actually resulted in changes to the way you are managing EM projects?

What are you doing at WTP in particular to re-sequence your plan for construction where the outstanding design issues exist that might still cause a need for further design changes?

Mr. Huizenga. Lessons learned from managing EM projects are incorporated in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. This Order was updated and reissued in November 2010. This Order requires final design to be completed or sufficiently mature to start construction. EM also conducts Technical Readiness Assessments (TRA) to provide an evaluation of the maturity level of a new proposed technology prior to insertion into the project design and execution phases to reduce technical risk and uncertainty. A TRA evaluates technology maturity using the Technology Readiness Level (TRL) scale that was pioneered by the National Aeronautics and Space Administration (NASA) in the 1980s. TRL analyzes key requirements against available technical capabilities, material applications, and currently available design solutions. The TRL scale ranges from 1 through 9. Other more detailed requirements related to ensuring the design process is sound and meets current requirements are included in DOE Order 413.3B.

With respect to Waste Treatment Plant, DOE has refocused work to first resolve the remaining technical issues that are primarily associated with the Pretreatment Facility. See question #9 below for further information related to the welding of the vessel heads.

DIFFERING PROFESSIONAL OPINION PROCESS

Subcommittee. Mr. Huizenga, when you approved the contractor's request to weld shut the vessel heads, there was an open Differing Professional Opinion (DPO) on the vessel's design. Once the vessels were welded shut, it would be cost prohibitive to make any major design changes, and some employees felt strongly the design issues and the DPO should have been resolved before the decision to go ahead was given.

With this open DPO and an imminent, potentially high risk decision at hand, why did you give the ok to proceed with welding shut the vessels?

Why couldn't you delay this decision to allow time for consultation with an independent third party to resolve the design dispute? Were cost and schedule pressures the main factor?

Aren't you concerned what these types of decisions say to the employees who go through the DPO process - that they followed your process for lodging major concerns, but those concerns were ultimately disregarded in actual decision making?

What are you doing to improve the DPO process, to ensure that imminent high risk or high consequence issues can be fast tracked and the concerns will be taken seriously by the decision makers?

Mr. Huizenga. The decision to weld the vessel heads was made by the Waste Treatment Plant (WTP) Federal Project Director (FPD) after careful evaluation. Management in the field and at Headquarters worked closely with several key staff to assess several data points, including the most recent test data available, impacts to the fabricating vendor, ability and costs associated with potential modifications after the vessel heads were welded compared to impacts and costs associated with postponing this work. A management decision was made to institute a hold point for the installation of the vessels, and proceed with welding the vessel heads in place. The hold point requires confirmation of the vessel's ability to operate to safety and within design specifications before they are installed in the Waste Treatment Plant (WTP).

Relative to the DPO, the Department did procure an independent panel in 2011 to investigate the DPO initiated by a Department employee. After an extensive review of materials and interviews, the panel concluded that while the DPO was valid, the welding of the heads on the vessels was strictly

management's prerogative and judgment, and should be risk-informed. The panel recommended that the basis for proceeding be appropriately documented and explained. The DPO panel went on to state that many of the potential mitigation actions identified to address design vulnerabilities posed by suspension and removal of large, dense particles can be made with the vessel heads in place. The panel concluded that the appropriate hold point was to restrict placement of the vessels in the WTP until technical issues are either eliminated or mitigated. The Department agrees with the conclusions of the DPO panel and is maintaining the appropriate hold point at installation of the vessels.

The Department remains committed to building and sustaining a robust nuclear safety culture at all of its sites, facilities and projects across the country. An essential component of a strong safety culture is the ability for employees to raise technical and other concerns, have those concerns heard and addressed in a timely manner, and results communicated. As such, the Department is taking proactive steps to strengthen tools such as the DPO process and Employee Concerns Program so that our employees can have confidence that their concerns will be captured and resolved. The Department recently issued a revised DOE Order for the DPO program, which applies to both Federal and contractor employees. The revised DPO order requires the Department to notify employees quarterly of their right to report technical concerns to the DPO process, directs the Department and contractors to provide reasonable time and resources for employees to use the process, and directs that employees who use the DPO process must be protected from reprisal or retaliation.

WHISTLEBLOWER INCIDENTS

Subcommittee. At the same time problems of the safety culture at the WTP project were coming to light, there were not one, but two whistleblower incidents where employees have alleged they were the victims of negative employment actions as a direct result of their strong advocacy for technical safety improvements in the project design. How much stock does DOE put in whistleblower complaints?

Is there any process within the Department for validating claims by employees made through the Whistleblower Process, or do you rely solely on employees going through bureaucratic Departmental processes for resolving technical disputes, processes that have been the subject of much criticism by employees?

Mr. Huizenga. The Department has existing processes for addressing employee concerns, including an Employee Concerns Program, which has broad jurisdiction to consider DOE and DOE contractor employee concerns of illegality, impropriety, or threats to health and safety. The Department also has a Differing Professional Opinions (DPO) program for DOE and DOE contractor employees. Most issues should be resolvable through routine discourse and processes. However, employees will sometimes differ on the best approach to address an issue, even after it has been thoroughly evaluated. In some cases, employees with dissenting opinions may think that a technical issue could have sufficiently negative impacts to the environment, safety, or health such that it is appropriate to raise the issue to a higher level. The DPO process is designed for those cases. Deputy Secretary Poneman recently issued a Memorandum reminding all employees of the importance of this program, stating "An employee who concludes that it is appropriate to raise an issue to the DPO process should be able to do so without fear of retaliation or reprisal. DOE Federal and contractor managers are prohibited from discouraging or retaliating against an individual for using the DPO process."

In March 2012, Secretary Chu launched the Office of the Ombudsman, an important new avenue for Federal headquarters and field employees who want to speak with a neutral, independent DOE official about workplace issues in a confidential environment. The Office of the Ombudsman will help ensure that issues that fall within existing processes are properly directed. Where no process exists to handle a matter, the Office of the

Ombudsman will provide innovative resolution services. The Office of the Ombudsman will also identify systemic issues that need senior management attention and work with appropriate offices to resolve those issues.

NUCLEAR SAFETY AND SECURITY

DOWNSIZING SECURITY

Subcommittee. NNSA is now proposing a 5 percent cut to protective forces at its sites and, Mr. Huizenga, you've likewise proposed to reduce protective forces at Portsmouth and Savannah River. It was just a few years ago that we had major security issues at the labs, and considerable work was supported by Congress to bolster physical security.

Mr. Podonsky, security of all DOE sites comes under your purview and DOE has recently begun implementing a Safety and Security Reform Plan, with a goal of "providing contractors with more flexibility in tailoring safety and security programs without excessive federal oversight."

How can such cuts to protective forces be implemented without impacting the security posture of our sites?

What analysis was conducted to support these protective force reductions?

If DOE provides contractors with more flexibility, how will DOE ensure that it provides adequate oversight at its facilities?

Mr. Podonsky. The overall approach to nuclear security protection has changed considerably over the last decade. The Secretary of Energy has directed and encouraged line management to adopt risk management philosophies in the management of their security programs. Empowered line managers are now exercising risk-informed decision making to tailor security controls that are appropriate to security assets being protected.

The tenets of the DOE Graded Security Protection (GSP) policy and the associated tactical force doctrine have revolutionized the Department's protection program, transforming it from a static, reactive security posture to a more tactically-based and mobile response force. Oversight mechanisms are in place to assure that the enhanced system of barriers, detection systems and more agile but smaller protective force remain ready and effective to protect our nation's nuclear security assets. The combination of the modifications to protection strategies, enhancements to protective force tactics and the application of a rigorous oversight program have significantly shifted the tactical advantage from the adversary to the protective force. The

site tactical advantage is further enhanced by: extending detection to the further-most practical point; forcing adversaries to take hostile actions very early in the attack sequence, furthest from the intended target; prohibiting large vehicle access to DOE facilities; channeling the adversaries' approach into prepared defensive positions; enhancing the survivability and weaponry of the protective force; initiating attrition of the adversaries at the outer-most security layers; and constructing barriers and/or facilities that provide significant delay against advanced explosive breaching techniques. In addition to the implementation of these multiple integrated systems, DOE, including the National Nuclear Security Administration (NNSA), has made significant strides toward reducing the overall footprint of Category I/II special nuclear material holdings.

Integrating advanced security technologies, coupled with highly skilled response forces, minimizes the reliance on costly manpower-intensive solutions and results in protection systems that are more versatile in effectively mitigating a broader spectrum of current and emerging threats. The advent of focused site assistance visits which leveraged the combined expertise of HSS, NNSA, EM, the Offices of Nuclear Energy and Science, to identify and analyze site-specific security measures enhanced DOE's understanding of site protection performance, and highlighted site-specific security enhancement opportunities (e.g., efficiencies, technology integration, etc.)

The integrated systems approach that DOE, including NNSA, took to address the GSP policy was based upon detailed, site-specific Vulnerability Assessments and numerous performance tests, including Force on Force exercises, alarm response assessments, limited scope performance tests, and oversight based inspections. Rigorous reviews were performed in accordance with the GSP policy that effectively shifted the evaluation of GSP implementation from an autonomous site effort to a broader line management function that enhances performance, risk management, inspection results, and compliance. Review processes were instrumental in ensuring a comprehensive and consistent application of credible threats and the numerous countermeasures comprising each site's protection posture. Once the representative adversary attack scenarios were agreed upon, the effectiveness of the protection posture was assessed, identifying potential efficiencies, and determining compliance with the GSP. As a result, DOE has a much greater corporate level understanding of each site's nuclear security protection program and has instituted the necessary processes to

ensure that oversight functions are employed and appropriately utilized to assess safeguards and security program effectiveness.

DOE, including NNSA, has employed a multitude of analysis tools in concert with leveraging the nuclear security community's expertise over a multi-year period. The results of these efforts give us confidence that the identified reductions can be accomplished without adverse impact on the effectiveness of the security strategy at each DOE site.

REVISING SAFETY AND SECURITY STANDARDS

Subcommittee. Mr. Podonsky, your office has been undertaking an "expedited review" of several guidance documents which set the standards for environment, safety, and health at the DOE sites. Why do these standards need to be revised?

Is this review just to reduce the costs or administrative burden of meeting stringent safety and security requirements?

Will these costs and administrative efficiency improvements result in a reduced safety or security posture at DOE sites?

Mr. Podonsky. In March 2010, the Deputy Secretary of Energy charged HSS with performing a comprehensive review of DOE's internal management directives related to safety and security. The objective of this review was to ensure that the Department's safety and security directives are fully supportive of achieving the Department's missions while continuing to ensure adequate protection of workers, the public and the environment. The DOE's safety regulations were not part of this review. Today, this effort is essentially complete, with one remaining DOE Order revision in process, and the majority of the approved directive changes implemented in DOE organizations.

DOE periodically reviews and updates its internal safety directives as a good business practice to make sure they are current and accurate. This review differed from the normal practice in that it examined all of the safety and security directives concurrently. This provided the added benefits of a clear management priority and the ability to readily identify and eliminate duplicative directives and administrative-type requirements. DOE used a very methodical approach to revising the internal management directives that required involvement from a broad array of our highly experienced safety professionals and concurrence from all Departmental programs and functional offices. Changes were made very deliberately and after thorough consideration. Where requirements were streamlined through consolidation or elimination of duplicative or unnecessary provisions, the reduction was solely to improve clarity and usability – hence the effectiveness – of requirements, not to reduce DOE's expectations for high standards of safety and security. In some cases, after performing a detailed requirement-by-

requirement review of the directives, gaps were identified and additional safety and security requirements were added where necessary.

The revised safety directives, combined with DOE's long-standing safety regulations, are appropriate for the hazards associated with DOE's operations and will effectively support the Department's missions in a safe and efficient manner.

HUMAN CAPITAL NEEDS

Subcommittee. Mr. Podonsky, the Department has been criticized for relying too heavily on it M&O contractors for support in making highly technical nuclear safety decisions. What type of technical support apart from the contractor do federal project managers have, and are these resources consulted regularly when making major project decisions?

What additional resources or capabilities might be needed to truly perform robust, independent safety oversight? How do we bolster oversight without creating duplication or bogging down the process?

Mr. Podonsky. In addition to technical resources that are available through the Chief Nuclear Safety and Chief Defense Nuclear Safety functions of the Under Secretaries, HSS maintains an Office of Nuclear Safety that is ready and able to provide technical assistance to Federal Project Managers. These resources are available to complement existing line management resources whenever called upon, and are separate and distinct from our independent oversight activities.

HSS independent oversight processes were recently revised in response to a General Accountability Office audit, with a focus on minimizing impacts on mission accomplishment while providing robust independent oversight of nuclear safety. The periodic large team inspection format was replaced by a more effective and flexible process that uses real-time operational awareness to inform decision-making for prioritizing, smart sampling, and optimal timing of oversight activities that corresponds with unique site and/or facility conditions. These changes have already enhanced our ability to conduct increased independent oversight of complex nuclear safety issues.

HSS currently has four vacancies for its nuclear safety independent oversight program. HSS continues to recruit the technical personnel necessary to fill these critical hires in order to sustain an appropriate level of internal independent oversight. Currently, these additional resources are necessary to fill all site lead program positions after some recent personnel losses, and to focus on the major DOE nuclear facility construction projects as they continue to advance toward commissioning and operations.

HSS REVIEW OF NNSA NUCLEAR SAFETY

Subcommittee. Mr. Podonsky, another area of significant concern with respect to safety is the plutonium infrastructure at Los Alamos. NNSA recently performed some upgrades, but there's some indication additional work is needed there. Can you explain more about how HSS performs nuclear safety oversight of the NNSA, as a semi-autonomous agency within DOE? Has your office been involved in performing safety oversight at Los Alamos?

Are there differences with how you conduct your work with NNSA, when compared with how HSS interacts with other DOE offices?

Mr. Podonsky. HSS Independent Oversight has had a significant presence at Los Alamos, particularly since January 2010 when a site lead was assigned to the site during the pilot phase of the Site Lead Program. The program for HSS independent oversight of nuclear safety includes two key elements. The first element is the Site Lead Program wherein a designated nuclear safety professional from the HSS Office of Enforcement and Oversight is assigned to monitor the activities at each DOE site with one or more nuclear facilities or activities. The Site Leads are responsible for maintaining operational awareness of nuclear facilities and operations and using this information to plan and coordinate independent oversight review activities that are specifically tailored for the facilities, activities and conditions at a particular site. The second element is a Targeted Review Program that is utilized to look across the Department at specific nuclear safety topical areas. Topics are selected based on information derived from metrics, data analysis, performance trends, changes in requirements, and the need for information.

Specific to the Los Alamos National Laboratory (LANL), HSS Independent Oversight is currently engaged in a review of the upgrade to the plutonium facility's Documented Safety Analysis and Technical Specifications Requirements and is developing a report for a recently completed review of Preparedness for Severe Natural Phenomena Events that included the plutonium facility. Other recently completed reviews associated with the current LANL plutonium infrastructure include: Integrated Safety Management/Integrated Work Management of Research and Development and Programmatic Work at the LANL; Nuclear Facility Configuration Management Program Implementation; and Fire Suppression System

Upgrade to Safety Class at TA-55. Additionally, several reviews of the Chemistry and Metallurgy Research Replacement Project have been completed recently with a focus on quality assurance, safety basis and safety culture.

Operationally, there is no difference in how HSS conducts independent oversight of nuclear safety at NNSA sites and projects versus those of other DOE entities.

ENVIRONMENTAL CLEANUP

HANFORD CLEANUP

Subcommittee. In contrast to the problems of the WTP project, there has been notable success in cleaning up the river corridor. Yet, the funding requested for Hanford is $13 million greater than last year's level. If so much work has been accomplished, shouldn't the request for these activities be going down, as they did last year?

What is driving up these costs, while funding requested for other EM sites is going down?

Mr. Huizenga. The Richland Operations Office (RL) is responsible for environmental remediation of the River Corridor and the Central Plateau of the Hanford site. RL is on track to complete the vast majority of the cleanup along the River Corridor by 2015. This will effectively reduce the footprint of the Hanford site from 586 to less than 75 square miles, and help ensure the Columbia River's important resources are protected. In support of this 2015 cleanup vision, the Department's fiscal year (FY) 2013 request for RL is a 1.42 percent increase from the FY 2012 appropriation. The FY 2013 request increases the RL levels for deactivation and decontamination activities at the Plutonium Finishing Plant (PFP) to address more complex contaminated glovebox removal challenges, new health and safety requirements, and operational upsets; to support mission critical infrastructure upgrades, replacements and repairs for both RL and the Office or River Protection; and to support increased K-West Basin activities for the Spent Nuclear Fuel-Stabilization and Disposition Project.

U-233

Subcommittee. The Department has recently proposed an alternative approach for removing uranium-233 from Oak Ridge which could save a significant amount of funding from the previous plan of record, which required expensive building modifications to down-blend the materials. Do you expect savings from the original plan, and if so, how much?

What decisions still need to be made to provide a solution for all the U-233 material at Oak Ridge and what is your timeline?

Mr. Huizenga. As a result of the Phase 1 alternatives analysis, documented in January 2011, the Department decided to pursue direct disposition (involving either the transfer of valuable U-233 components to other DOE Programs for additional mission use, or the direct disposal of eligible components without processing) of approximately half of the U-233 inventory. For the remaining inventory, decisions are yet to be finalized regarding the location and detailed plans for required processing, but will likely remain onsite. The final Draft Phase I Alternatives Analysis Report screened all of the Oak Ridge National Laboratory (ORNL) hot cell facilities for availability and suitability as potential alternatives to the use of Building 3019 for dissolving and down blending the remaining inventory to meet waste acceptance, security, and safety requirements. Buildings 2026 and 3047 were identified as the two most suitable facilities at ORNL, and both of these facilities are being further examined in the Phase II analysis. The Phase I report also suggested that the baseline plan involving construction of a new annex for drying and packaging the down blended material could be avoided by co-processing with a larger, existing waste stream at ORNL that needs to undergo treatment in any case.

While a review draft of the Phase II analysis has not yet been completed, and no decision has been made, preliminary indications are that Building 2026 (which is located directly across the road from Building 3019) is the more attractive alternative due to cost and safety considerations and also because it has the least potential for competing programmatic demands. Building 2026 is not currently in use; the cost of any necessary modifications to Building 2026, as well as subsequent canister-by-canister processing, is expected to be far less than the original approach that involved retrofitting of Building 3019 and U-233 processing operations in a high security, high hazard environment. The Phase II report is also likely to endorse the Phase I conclusion that co-

processing down blended material with existing sludges at the Oak Ridge Transuranic Waste Processing Center (TWPC) is the most cost-effective and least risky approach for final preparation of an acceptable waste form.

The final cost savings are expected to be substantial when compared to the baseline estimate to process all of the remaining U-233 inventory in Building 3019 and a newly constructed an adjacent annex for drying and packaging.

SPRU CONTAMINATION RELEASES

Subcommittee. DOE was criticized by the EPA for a number of failures at SPRU, such as not properly evaluating whether there was a risk of releasing contamination to the environment.

Do you agree with the EPA's criticism that EM does not adequately evaluate the potential of emissions as part of planning for environmental cleanup work?

Mr. Huizenga. The Department disagrees that EM does not adequately evaluate the potential of emissions releases as part of planning for environmental cleanup work. With respect to the Separations Process Research Unit (SPRU), the Contractor did evaluate the impact of emissions to the public as required by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS); however, there were calculation errors in the site-specific application of the required NESHAPS model. This resulted in EPA criticizing EM for not properly evaluating the potential for release of emissions as part of planning environmental cleanup work. When the calculations were corrected, the Department noted that revised results showed that there was adequate protection to the public. At SPRU, the contract technical requirements were modified in 2011 to ensure that environmental cleanup work is planned and performed to prevent release of emissions.

Subcommittee. Were work planning practices at SPRU similar to those performed for other EM sites, and are there lessons learned that can be applied to cleanup at other sites?

Mr. Huizenga. The Contractor work planning practices at SPRU are similar to those at other DOE sites. DOE's Type B Accident Investigation Report on the SPRU contamination event revealed several contributing causes, including an observation that the Contractor did not follow its own requirements on work package controls or radioactive contamination controls. It also identified an over reliance on the use of a fixative (similar to a high-grade paint) to lock down radioactive contamination inside the vessel that was cut up in the SPRU H2 Building. Regarding lessons learned, the Type B Accident Investigation Report was shared with and remains available to all sites. The lessons learned have been discussed across the

DOE complex in regularly occurring conference calls with Field Managers and Federal Project Directors.

Subcommittee. As part of the response, DOE has constructed tent enclosures around the worksite and is installing specialized air intake and exhaust systems; can you speak to why this level of system was necessary? Was this required by EPA and is it more than is typically required at EM work sites?

Mr. Huizenga. The tent enclosures and ventilation systems were not initially required by the EPA NESHAPS requirements; rather, the contractor proposed and DOE agreed to accept the change in technical approach for conducting the demolition effort. DOE considered the change in technical approach appropriate because of the loss of confidence resulting from the September 2010 release of radioactivity. In the recently signed Compliance Order on Consent between EPA and DOE, EPA made a requirement that the tent enclosures and ventilation systems be completed before demolition activities commenced. (The application to construct the ventilation systems was approved by EPA on November 30, 2011, and did not affect the SPRU project schedule.) DOE notes that open air demolition of contaminated facilities can be done safely when the contractor follows its safety programs and work controls. The specific requirements for conducting demolition activities at sites are developed on a project-specific basis to address the unique hazards and conditions of each site.

RESTARTING SPRU WORK

Subcommittee. DOE could be in a position to resume cleanup at SPRU sometime in fiscal year 2013, but you have only requested $24 million for the site. Would you need additional funding to restart cleanup at this level?

I understand the Department is waiting to resolve a series Requests for Equitable Adjustment (REA); when will the Department understand the full extent of reasonable Federal obligations?

Mr. Huizenga. DOE did receive a series of Request for Equitable Adjustments (REAs) during calendar year 2011, totaling $45 million. The contracting officer found that there was no merit to $42 million of the $45 million requested. The Contractor may accept the contracting officer's decision or choose to appeal it. The remaining $3 million value in the REAs has not been resolved. In addition to the $45 million in REAs that have been submitted, there are additional resources and associated changes that are also necessary to make repairs to a hillside that became unstable as a result of rainfall associated with Hurricane Irene. To date, the contractor has submitted a proposal and an REA related to hillside repair. An additional proposal related to these repairs is also expected. DOE expects to know the full extent of these costs later this year for shoring along the road associated with the hillside stabilization repair and once it has completed its technical evaluation of the proposal and REA.

Subcommittee. Given that REAs are submitted after the work is complete, how will the Department bring resources to bear if the $24 million is insufficient to cover the additional scope as a result of the REAs?

Mr. Huizenga. The Department is holding the contractor accountable for completion of the Separations Process Research Unit (SPRU) site within the terms of the task order. The task order includes a cost cap, over which the contractor is responsible for all costs within their work scope. The $24 million requested in FY 2013 includes funding to address activities associated with impacts from Hurricane Irene and the subsequent tropical storm, but recognizes that uncertainties exist on this project.

TECHNOLOGY DEVELOPMENT

Subcommittee. The budget request includes $20 million for Technology Development. With lower funding levels possibly impacting EM jobs at some sites, what is the benefit of continuing to devote this level of funding to technology development?

What technologies are you developing and how will they support meeting existing compliance agreements?

Mr. Huizenga. Technology development is essential for DOE's Office of Environmental Management (EM) to meet its compliance agreements and to deal with cleanup activities in which existing technologies prove inadequate or incapable. The technologies enable work to be accomplished in a safer manner while reducing costs and shortening schedule. Some examples are:

- In Situ Decommissioning Sensor Network-Meso Scale Test Bed (ISDSN-MSTB) Demonstration Project is being pursued with Savannah River National Laboratory and several universities as a safe alternative to demolition and disposal, given that the program must address more than 3,100 excess radioactively contaminated facilities.
- Technology development is being pursued to address contamination of soil at levels where groundwater may be impacted and to develop and justify approaches for enhancing natural degradation of contaminants in the subsurface. Analytical tools and procedures are being developed to establish appropriate criteria for transitioning from active to passive (e.g., natural attenuation) remedies for contaminants. This effort provides the technical basis to regulators and stakeholders to justify less costly remedies.
- Technology is being pursued to immobilize mercury in contaminated building materials and soils. Stabilization could dramatically reduce the disposition cost for the quantities of mercury-contaminated D&D debris at DOE's Oak Ridge Reservation.
- The scope of DOE's cleanup program at Hanford and Savannah River Site (SRS) involves nearly 90 million gallons of radioactive liquid tank waste. Some technologies being developed include: 1) cold crucible induction melters that operate at a higher throughput rates

thereby reducing mission life, resulting in significant life-cycle cost savings; 2) advanced glass formulations that may enable significant reductions in glass volumes for disposal; and 3) a next-generation cesium solvent is being developed to improve processing throughput and decontamination factors for tank waste at Savannah River, thereby reducing mission duration and the total life-cycle cost.

PRIORITIZING EM ACTIVITIES – LOS ALAMOS

Subcommittee. At Los Alamos, you've requested an increase of $13 million, or 11%, just for soil and groundwater remediation. Why increase this funding when there are higher risks of contamination reaching drinking water supplies at places like Paducah, where the contamination is located close to the river?

EM is not on track to meet the consent agreement with the state of New Mexico, and another agreement with the state must be renegotiated. What is the status of negotiations?

Mr. Huizenga. At Los Alamos National Laboratory (LANL), the $13M increase in funding accelerates remediation activities at Material Disposal Area C, Technical Area-21, material disposal areas and Solid Waste Management Units. Risks to groundwater are present at both LANL and Paducah, and EM is addressing those risks.

In January 2012, following enactment of the FY 2012 Appropriation, the Department acknowledged it would not meet the Consent Order milestone for completing cleanup of Area G by the end of 2015. The Department of Energy and the State of New Mexico's Environment Department developed a Framework Agreement that addressed the highest priority environmental remediation priorities at LANL. Among these high priorities are the protection of regional water resources, including groundwater and surface water resources of drinking water systems and the removal of vulnerable above-ground transuranic waste. A timetable has not been established to renegotiate the Consent Order, although the Department has expressed its desire to begin discussions.

PRIORITIZING EM ACTIVITIES – HANFORD

Subcommittee. Another large increase requested is for Tank Farm Activities at Hanford to prepare tank waste for processing once WTP is operational. Yet, we've receive no updates from the Department on changes to the project execution for the WTP project, nor any detail on when preparations at the tank farms need to complete. Why should this subcommittee support ramping up tank farm activities when there are imminent changes to the WTP program in the works that might drive the schedule for these related activities?

Mr. Huizenga. Funds for tank farm activities are necessary to maintain Consent Decree milestones with the State of Washington for tank waste retrievals and closure actions.

PROJECT MANAGEMENT

GAO HIGH RISK LIST

Subcommittee. Mr. Huizenga, you have the unenviable position of being responsible for a large portion of the projects that are responsible for the Department's inclusion on the GAO High Risk List. Can you detail what you are doing to ensure that the Department has some real prospect of dropping from this list after more than two decades?

Mr. Huizenga. In its February 2011 High-Risk Update, GAO found that DOE-EM had taken many steps to address contract and project management weaknesses and had met three of the five criteria it uses to determine if an Agency can be removed from the High-Risk List: strong leadership commitment, development of a corrective action plan and demonstrating implementation of corrective measures. The remaining two criteria are (1) commit sufficient people and resources to resolve its contract management problems and (2) monitor and independently evaluate the effectiveness and sustainability of its corrective measures. Some highlights of the improvements we have made in those two remaining areas since GAO's last review include:

- EM has assigned a HQ-level project sponsor for all capital projects in the new organizational structure implemented in February 2012 to provide more direct oversight of performance and prompt disposition of issues. EM has also instituted an independent peer review process for all capital projects using expertise from within DOE, contractors, national laboratories, and the Army Corps of Engineers. EM believes these actions are responsive to the GAO concerns and will lead to improved project performance.
- EM has also put in place performance metrics to monitor progress to ensure the corrective measures are effective and improvements are sustained. In addition, our senior leadership continues to provide strong commitment and has led two major summits on this subject in the past 18 months.
- Our Headquarters and Site Office staffs have been sharing our improvement efforts with GAO in an open and transparent manner and we are confident that GAO will agree that EM has demonstrated meeting the remaining two criteria of committing sufficient people

and resources, and putting processes in place to ensure sustainability of our corrective measures.

Detailed action taken and results seen:

- EM is strengthening its partnership with the U.S. Army Corps of Engineers (USACE) by supplementing selected project peer review teams with USACE personnel to benefit from their construction project and contract management expertise.
- EM established metrics that flow into the annual performance plans of EM management through a formally signed Annual Performance Agreement between the Assistant Secretary and all his direct reports.
- Target criteria is 90% of EM's Cleanup Capital Asset Projects completed at Critical Decision 4 within the original scope baseline and within 10 percent of the original approved cost baseline (baseline established at Critical Decision 2).
- As reported to GAO, EM successfully completed 32 of 34 cleanup projects (94% success rate) over the Fiscal Year period 2009 through 2011.

REBASELINING MAJOR CONSTRUCTION PROJECTS

Subcommittee. EM has the most number of ongoing construction projects that are either trending behind schedule or over budget. WTP and the Salt Waste Treatment Plant at Savannah River now require major re-structuring of their project execution plans to make up for continued delays in critical path activities. What is the EM process for re-baselining these projects?

There's no guarantee that Congress will agree with the way you've restructured these projects. DOE spent years revising the funding profile for WTP and those decisions were ultimately not supported. How will EM do a better job of working with the subcommittee during your re-baselining efforts to make sure the changes you propose are supportable?

Mr. Huizenga. EM has three ongoing construction projects: the Waste Treatment and Immobilization Plant (WTP), the Salt Waste Processing Facility and the Sodium Bearing Waste Treatment Plant. Department of Energy Order 413.3B, Program and Project Management for the Acquisition of Capital Assets, provides the framework by which all Departmental elements manage their capital asset and line item projects. Within the guidelines of this Order, specific requirements for the execution of baseline changes are defined. Line item construction projects, such as WTP and Salt Waste Processing Facility, rise to the highest level of departmental approval for baseline changes as the Senior Acquisition Executive (SAE), the approval authority, is the Deputy Secretary of Energy. The Order requires the submission of a Baseline Change Proposal (BCP) that provides a complete description of the proposed change to the approved performance baseline including the resulting impacts on the project scope, schedule, design, methods, and cost baselines. In conformance with appropriate administration of baseline changes of these high profile projects and in compliance with Congressional direction, the Department requires both an External Independent Review (EIR) be conducted and an Independent Cost Estimate be prepared to validate the baseline change proposal prior to AE approval.

The following steps summarize the EM process for re-baselining large capital asset line item projects.

- First, Federal site personnel will work with the respective contractors to revise projected estimates and accordingly revise each component

of the projects' Performance Baselines (technical scope, cost and schedule), as necessary. The baseline will include a risk analysis and sufficient contingency to address the identified risks and their probability of occurrence. The result of this effort will be documented in a BCP package for submittal to the approval authority, which is the SAE for projects with a total project cost greater than $750 million.

- Federal personnel will negotiate, but not finalize any contract modifications that may be required should the BCP be approved. The result of this preliminary negotiation will be included in the BCP package for SAE approval and authorization.
- The proposed baseline will be validated by the Department's Office of Engineering and Construction Management (OECM) through an EIR. OECM will perform an Independent Cost Estimate on the proposed project concurrent with the EIR effort.

EIRs are more than a review of cost and schedule. They help bound risks and assumptions about the project. In addition to determining whether the performance baseline should be executable through project completion, the EIR should determine whether:

- Scope, cost, and schedule are firmly supported with sound underlying technical, economic, and programmatic basis, assumptions, and front-end planning.
- Design is mature enough to support definition and development of credible and sufficiently accurate cost-and schedule baselines.
- The Federal Project Director (FPD) is certified at the appropriate level and is prepared to manage the project or program.
- An Integrated Project Team (IPT) with an appropriate complement of personnel having the requisite skill set, commitment, and effectiveness is in place and prepared to successfully execute the project.
- Appropriate management systems and processes are in place and functional.
- Thorough risk management plans were prepared, and relevant and comprehensive risk and contingency analyses have been conducted and properly documented by DOE and its contractor.

- An acceptable Federal Project Execution Plan (PEP) has been completed, coordinated, and approved.
- The scope being designed reflects the mission need, functions, and requirements.
- All required safety aspects were satisfactorily addressed and documented by ensuring that appropriate safety inspections and reviews were performed and requirements have been met.
- All National Environmental Policy Act requirements were satisfied.

The FPDs will formally present their respective BCP packages including the bounding risks and assumptions to the Environmental Management Acquisition Advisory Board (EMAAB) and the Energy Systems Acquisition Advisory Board (ESAAB). The SAE will chair an ESAAB meeting, where he will be advised by Senior DOE management regarding BCPS. The SAE will disposition the BCPs only after receiving input from members of the EMAAB an ESAAB.

An SAE-signed decision memo will serve to disposition the BCP. Any authorized changes will be incorporated into a revised Performance Baseline and revised project documents, including contract modifications, as necessary.

DOE will keep Congress informed as it provides specific rebaselining direction to the SWPF contractor.

For the WTP, DOE has already engaged with the subcommittee on the rebaselining effort and the Department's rebaselining direction to the contractor reflects the historically supportable $690 million per year funding profile.

PRIORITIZING EM ACTIVITIES

Subcommittee. GAO has recommended in past reports that EM adopt a risk assessment framework for cleanup in order to appropriately weigh costs against risks. A new DOE IG report also questioned whether a risk-based strategy applied throughout the complex would target work better in a reduced funding environment. Why hasn't EM adopted such a framework?

Mr. Huizenga. The recent *Audit Report on EM's Budget Allocation Plan* concluded that "EM had implemented a risk-based process to manage and plan for declining budget allocations that incorporates the myriad factors that must be considered in making difficult budgetary decisions." These factors include safety, environmental risk, compliance with legal requirements and agreements, as well as best use of the taxpayer's money when prioritizing workscope. The result is that the EM approach to cleanup prioritization is already based on a framework of achieving the greatest risk-reduction per radioactive content across the complex. EM must take into account site-specific compliance in addition to risk-reduction activities when developing a prioritized list of activities.

EM is continually evaluating ways to improve its workscope prioritization, including consultations with independent groups such as the National Academy of Sciences, as suggested by the IG in their *Special Report: Management Challenges at the Department of Energy*. In a reduced funding environment, EM recognizes that lower-risk activities might not be accomplished on schedule. Thus, using the risk-informed framework, EM strives to ensure that the highest risk activities are identified and funded.

MANAGEMENT AND ADMINISTRATION

RELEASING CONTRACTOR FEE PERFORMANCE EVALUATIONS

Subcommittee. Mr. Huizenga, DOE has been heavily criticized for failing to release data on how you evaluate contractor performance and award feeds. The NNSA Administrator publically stated that he was going to reverse this practice. Recently, the set of information released by EM on Paducah was the most limited information provided to date. Typically, EM has released information on a site by site basis, with some sites providing significantly more information. What's EM's position on releasing such data?

Do you feel that this information could be important for Congress and the public to build trust in your oversight of contractors?

How does normalizing the sites to a "consistent standard" – one that is actually more restrictive in certain cases - an improvement in transparency?

What is EM doing to improve the amount of information provided to the public on how EM contractors are paid?

Mr. Huizenga. EM issued a memorandum on April 3, 2012, to our site managers that addresses this issue. For purposes of satisfying the one page fee report or scorecard requirement at this time, the site managers have been directed to publish award fee determination letters and calculations of performance-based incentives (PBIs) for EM contracts as discussed below.

The award fee determination letters issued after April 3, 2012, must, at a minimum, address certain basic topics that summarize the rationale for the award fee earned. That includes:

- the contractor's name;
- the amount of award fee available for the period;
- the amount of award fee earned;
- percentage of award fee earned;
- whether they met or exceeded a majority of the performance goals and objectives for the period;
- significant achievements or deficiencies that led to the rating (at a summary level); and

- a discussion that demonstrates how the Department executed the Performance Evaluation and Measurement Plan (PEMP) and award fee review process for the period.

This process is consistent with the President's policy on transparency in Government. In keeping with the President's Memorandum on Transparency and Open Government, issued on January 21, 2009, this policy promotes accountability and provides information for citizens about what their Government is doing. It respects the presumption of openness by publishing information online and proactively uses modern technology to disseminate useful information, rather than waiting for specific requests under the Freedom of Information Act.

We believe that it aligns with Administrative Procedures Act requirements set forth in Title 5 of the United States Code at section 552. It provides the public an opportunity to understand how EM has ensured the EM fee decision process supports efficient, effective and appropriate use of award fee payments and how the procedures incentivize contractors to achieve contract objectives.

REORGANIZATION UNDER NNSA

Subcommittee. Mr. Huizenga, it has not yet been a year that your organization was moved under Tom D'Agostino as the Under Secretary for Nuclear Safety. How has that transition been going? Has it resulted in any change in the way you do business?

Mr. Huizenga. This alignment allows the Department to capitalize on the expertise that exists between NNSA, EM, LM, and the Chief Nuclear Safety Officer on areas related to project management, nuclear materials and waste, and nuclear safety and security. The Department is already realizing the benefits of this alignment.

At Savannah River, EM and NNSA are working closely together to utilize EM's H-Canyon facilities to maximize the use of this facility while supporting multiple missions including: converting about 3.7 MT of Plutonium into suitable feed for NNSA's Mixed Oxide (MOX) Field Fabrication Facility; R&D to remove contaminants on plutonium to make it amenable for use as MOX feed; and, reducing the amount of plutonium that EM needs to package to send to WIPP for disposal as transuranic waste.

In another example, EM has established a partnership with NNSA to build upon their success with the Supply Chain Management Center. Leveraging buying power across the combined EM and NNSA complexes for commonly used goods and services with the objective of realizing cost savings for the EM program similar to those achieved by NNSA

OFF–BUDGET TRANSFERS AND BARTERS

Subcommittee. Mr. Huizenga, the Department is increasingly relying on off-budget resources to meet short term needs, such as those proposed for USEC, Portsmouth and a possible re-enrichment program at Paducah. We've discussed some of the details here today regarding the GAO finding that the uranium barter arrangements are a violation of the miscellaneous receipts act. How is the Department integrating and evaluating where it is appropriate to use these off budget financing methods?

I understand that Nuclear Energy is charged with the uranium management plan. Which program is actually responsible for the barter transactions, EM or NE?

Mr. Huizenga. While NE is responsible for development and update of the Department's Excess Uranium Management Plan, other DOE programs are responsible for the barter transactions authorized by specific Secretarial Determinations. EM is responsible for the transactions conducted to support Portsmouth cleanup.

Subcommittee. How are you ensuring, or are you, that the various planned uses of off-budget transfers and barters are consistent with the Department's published management plans for the uranium stockpile?

Mr. Huizenga. Although the Department's current Secretarial Determination on uranium transfer was approved to support the acceleration of cleanup activities at Portsmouth, it is possible that future transfers, if any, could be considered by us to fund Paducah activities. However, currently planned cleanup activities of Paducah are supported by appropriated funds. Decontamination and decommissioning of the actual Gaseous Diffusion Plant is not within EM's current baseline scope because the United States Enrichment Corporation currently leases and operates these facilities.

QUESTIONS FROM CHAIRMAN FRELINGHUYSEN OF NEW JERSEY

PLANNING FOR THE FISCAL ENVIRONMENT

Chairman Frelinghuysen. Mr. Huizenga, can you speak to what the EM organization is doing to evaluate the implications of a reduced budget might mean to the Department's cost and schedule projections of meeting consent milestones?

How will the Department work with the Congress and the impacted localities to resolve the issues that will enviably arise from a new assessment that incorporates the current budget challenges?

Mr. Huizenga. In FY 2013, the President's budget request will allow EM to maintain a safe, secure complex, and will position EM to meet all FY 2013 enforceable milestones. To address future challenges posed by the fiscal environment required the Budget Control Act of 2011 and cases in which there are technical or other non-funding related challenges, the Environmental Management program has initiated a strategic planning effort with its stakeholders. We are engaging intergovernmental organizations and our site-specific advisory boards to discuss the schedule impacts and to renegotiate, where necessary, new or alternative compliance milestones.

Chairman Frelinghuysen. Is there a timeline for completing at least a preliminary analysis?

Mr. Huizenga. As a part of our normal budget process, EM intends to discuss these issues with stakeholders over the course of the next several months.

INTERNAL DOE REVIEW OF SAFETY CULTURE

Chairman Frelinghuysen. In the final fiscal year 2012 Omnibus, this subcommittee directed the Department to undertake an internal review of how its own management of its contractors could adversely impact safety culture of a project and to report back to the subcommittee by May. What is the status of the Department's review?

These issues are not just coming to your attention now and will not be easily fixed. Given the complexity of the challenges the program is facing and the consequences of failure, what are you doing right now to take action and improve this situation?

Mr. Huizenga. The Department is committed to instilling and holding managers accountable for leadership behaviors that foster a strong safety culture, and driving these behaviors through its Headquarters organizations, field organizations and its projects, such as the Waste Treatment and Immobilization Plant (WTP). We are undertaking several efforts to ensure that this occurs and our senior managers will be held accountable for doing so. The Department has accepted the recommendations made by the Defense Nuclear Facilities Safety Board (DNFSB) with respect to the safety culture at WTP, and adopted an Implementation Plan for DNFSB Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*. The Department has also accepted all recommendations of the Department's Office of Health, Safety & Security (HSS) January 2012 report on the safety culture at WTP. The Secretary and Deputy Secretary articulated the values and expectations for nuclear safety at all U.S. Department of Energy (DOE) facilities and have communicated these expectations in a December 5, 2011, memorandum addressed to the Heads of All Departmental Elements. The Secretary and Deputy Secretary reiterated that all employees are expected to energetically pursue the safe performance of work and encourage a questioning work environment. The memorandum states that DOE's culture should not only embrace, but also actively seek out evidence of potential problems so that they may be promptly corrected and that no one who expresses a safety concern need fear retribution or penalty for stepping forward with a concern.

The Department, led by HSS, is currently conducting an extent-of-condition review of five DOE projects similar to WTP to determine whether safety culture weaknesses exist at those design/build projects. We have also

assembled an internal team to respond to the Congressional request for a review of safety considerations at the five nuclear facility construction projects with a total project cost greater than $1 billion. This team is currently reviewing all relevant practices including contract type, fee structure, project and contract management policies, and Federal oversight, guidance and practices at each of these projects to determine how they have helped to foster, or hinder, a positive nuclear safety culture at each project. DOE will take any necessary actions to ensure that the safety culture issues identified at the WTP project are not repeated.

HSS REVIEW OF SAFETY CULTURE AT WTP

Chairman Frelinghuysen. Mr. Podonsky, your office recently concluded its independent assessment of the safety culture at WTP, the second such review you've performed over the past two years. Can you give us some insight into your findings and recommendations for improving the safety culture of the project?

In your opinion, has the safety culture improved since DOE first heard about the potential for these problems in your initial report, or have conditions continued to deteriorate?

Do you feel that your recommendations have been taken seriously by the contractor and within EM, including the federal project management? Are you able to continue to monitor the resolution of these problems?

Mr. Podonsky. The HSS independent assessment of the safety culture at WTP focused on DOE organizations with site-level line management responsibility for WTP, the DOE Office of River Protection (ORP) and its DOE WTP Project Office (DOE-WTP), as well as the project contractor, Bechtel National, Incorporated (BNI), and its subcontractors. In addition to evaluating safety culture, HSS evaluated management of nuclear safety concerns by WTP organizations.

The HSS Independent Oversight team determined that most personnel at WTP believed safety was a high priority. However, during the safety culture evaluation, a significant number of staff within ORP, DOE-WTP, and BNI expressed reluctance to raise safety or quality concerns for various reasons. Fear of retaliation was identified in some BNI groups as inhibiting the identification of problems. The willingness of employees to raise safety concerns without fear of retaliation is an essential element of a healthy safety culture and, therefore, significant management attention is needed to create an environment at WTP in which employees feel that they can raise safety concerns without fear of retaliation. While the Office of Environmental Management (EM), ORP, DOE-WTP, and BNI managers espoused support for a healthy safety culture, our report found that they did not have a full appreciation of the current culture or the nature and level of effort needed to foster a healthy safety culture, including a well established and effective safety conscious work environment, and the WTP community had not been sufficiently engaged in creating a mutually shared and desired

culture. In addition to concerns about the safety culture, the Independent Oversight team identified significant concerns about ORP, DOE-WTP, and BNI processes for nuclear design and the safety basis, and for managing safety issues. If not addressed, concerns in these areas could adversely affect efforts to achieve a healthy safety culture.

In many respects, the results from the two reviews conducted by HSS, at WTP, were similar. Both reviews concluded that a significant number of employees were hesitant to raise safety concerns for various reasons and that this condition was sufficiently prevalent to warrant increased and timely management attention to address safety culture issues. The second review identified that a few aspects of the safety culture had degraded since the first review, in large part because the design and safety basis issues had become more acute as the work in that area was progressing and the underlying issues had not been addressed. HSS believes that the recommendations in our reports are being taken seriously by EM, ORP, DOE-WTP, and BNI. HSS is continuing to monitor the resolution of these issues at WTP. HSS plans to review the corrective action plans developed by ORP and BNI in response to our reviews and will be conducting a follow-up evaluation in 2013. The Secretary and Deputy Secretary have also fully embraced the recommendations of the HSS reports and are providing strong leadership in addressing the issues raised.

TAILS TRANSFERS

Chairman Frelinghuysen. Mr. Huizenga, the GAO has ruled that the Department's past use of uranium transfers to fund cleanup work at Portsmouth is illegal, violating the "Miscellaneous Receipts" statute. Is the $178 million you've requested for Portsmouth the total amount of cleanup work that you plan on funding in fiscal year 2013, or do you plan on using tails transfer authority again in contravention of law?

Mr. Huizenga. The Department respectfully disagrees with the GAO's position on uranium transfers to fund cleanup work. The Department believes that we have authority under the Atomic Energy Act of 1954 to barter uranium. We hope to accelerate our cleanup work at Portsmouth by continuing to send some of the natural uranium to the contractor in return for work to be completed for the Department.

As our FY 13 Budget Request describes, we plan to transfer up to 1,750 metric tons of uranium in FY 2013. This uranium transfer will allow for environmental remediation and decontamination and decommissioning activities at the Gaseous Diffusion facilities. The actual value of the material is subject to final amounts transferred quarterly and the market value at the time of the transfers. However, we currently estimate the value will be between $200 and $225 million.

Chairman Frelinghuysen. We agree that cleaning up our responsibilities is important, but why are you using tails transfers to only support work at Portsmouth? Why not Paducah?

Mr. Huizenga. Although the Department's current Secretarial Determination on uranium transfer was approved to support the acceleration of cleanup activities at Portsmouth, it is possible that funding from future transfers, if any, could be considered by us to fund Paducah activities. However, currently planned cleanup activities of Paducah are supported by appropriated funds. Decontamination and decommissioning of the actual Gaseous Diffusion Plant is not within EM's current baseline scope because the United States Enrichment Corporation currently leases and operates these facilities.

Chairman Frelinghuysen. The FY 2012 conference agreement directed you to "provide the full details of any proposed barter, transfer or

sale of uranium" in your budget request. How much additional funding do you expect to generate for cleanup activities through these transfers and why weren't you able to provide this information in your budget request, as so clearly directed?

Mr. Huizenga. DOE plans to transfer up to 1,750 metric tons of uranium in FY 2013. The expected value based on the current market value of the material transferred is $200 million to $225 million. However, the actual value of the material transferred under the contract is subject to the final amounts transferred, the market value at the time of the transfer, and adjustments made for transfer and transaction costs.

The Portsmouth D&D contract specifies that in exchange for the uranium the contractor shall accomplish a portion of the performance work scope of the Portsmouth D&D contract. The portion of work is commensurate in value to the transferred uranium. That is, the transferred uranium will be used to accomplish work on all elements of the project scope. Information related to the Department's plans to transfer uranium was included in the budget request within the narrative details on EM's planned activities at Portsmouth (page 165 of Volume 5).

TAXPAYER FUNDING FOR CONTRACTOR INTERNAL REVIEWS

Chairman Frelinghuysen. In November, DOE paid $1.3 million for the contractor at the Waste Treatment Plant to commission its own safety culture assessment which concluded "there was no widespread evidence of a chilled atmosphere adverse to safety," in complete contradiction to the findings of the Defense Nuclear Facilities Safety Board and to what would soon be concluded in the 2nd HSS review.

If a contractor is having problems with its culture, why should the taxpayer pay for this sort of internal review by the contractor? Was there any thought put into whether the contractor was even in a position to commission an objective and independent review, particularly when the contractor has so much at stake on getting a positive outcome?

Why did the contractor's assessment come out so clearly opposite the findings of the Board and HSS?

So, was there any value at all for the taxpayer in EM agreeing to $1.3 million for this review? This is a significant sum for a review.

Mr. Huizenga. The WTP has a cost-type contract. Under that contract type, the contractor generally is reimbursed for costs related to maintaining internal management controls. The Department pays for various independent reviews at WTP and at other EM projects. These include Construction Project Reviews, Environmental Management Advisory Board reports, and Consortium for Risk Evaluation with Stakeholder Participation studies. The Department also expects its contractors to foster a robust nuclear safety culture. In order to improve safety culture, periodic reviews, assessments and surveys are required. The BNI-commissioned Independent Safety and Quality Culture Assessment, along with the DNFSB Recommendation, and the most recent HSS review of WTP safety culture all provide important insights and data points to help us achieve our goal of improving safety culture. While each of these assessments of safety culture at WTP may have highlighted different aspects of safety culture that need focused attention, there were also several similarities. Most importantly, both the Department and BNI are actively working to improve the safety culture of WTP and ORP.

The BNI-commissioned review was led by individuals with tremendous knowledge, experience and credibility. The review was independent from the contractor in the sense that the contractor selected individuals from outside of its corporate organization. These types of reviews provide valuable insight and data. They also enable contractors to continuously improve their processes and organization. The Department, however, does not rely upon contractor's reviews, whether independent or not, to provide an independent perspective for DOE. DOE's Office of Health, Safety and Security commissioned its own independent review on behalf of the Department.

Both the contractor and the Department understand the importance of continuous emphasis on the importance of a robust safety culture and the need to remain vigilant in striving to improve it. The BNI-commissioned experts pointed out several areas that needed to improve in order to ensure a robust safety culture. The workforce and management at WTP and ORP have benefited from these diverse expert perspectives on this issue. As a result, the taxpayers will benefit from the BNI and other reviews since a strong safety culture helps ensure technical issues are raised earlier in the process and can therefore be resolved earlier as well.

TEMPORARY STORAGE AND YUCCA SHUTDOWN

Chairman Frelinghuysen. DOE often identifies congressional funding uncertainty as the biggest risk to completing construction of the Waste Treatment Plant and meeting our cleanup milestones at Hanford – yet we've heard nothing about the risks added as a result of this Administration's decision to shutdown Yucca Mountain. There are reports you may now need large storage facilities to store high-level waste at Hanford and Savannah River.

What costs are we adding to the cleanup at these sites to temporarily store waste that would have gone to Yucca and is there any funding requested in fiscal year 2013 for any of these activities?

Mr. Huizenga. There is no near-term impact to the DOE sites. Currently, the Department is working to treat and package the defense related HLW and SNF at its sites for continued safe interim storage and future disposal. These activities are expected to continue for several decades. While interim storage can continue safely onsite many years, permanent disposition is ultimately needed for the Department to complete site cleanup activities and fulfill regulatory commitments.

Chairman Frelinghuysen. Are there any other new costs that EM must now plan for as a result of this Administration's decision?

Mr. Huizenga. As stated above, there is no near-term impact to the DOE sites.

H-CANYON AND SAVANNAH RIVER SITE OPERATIONS

Chairman Frelinghuysen. Mr. Huizenga, the FY 2013 budget proposes that the Savannah River Site H-canyon facility transition to a "modified operations" mode. What are some of the activities that you have planned, and do these include the reprocessing of spent nuclear fuel?

How are your office and the other program offices working together to identify how to use the facility in the future, as directed last year by the subcommittee?

Mr. Huizenga. H-Canyon will be fully operational in FY 2013. H-Canyon will be processing some vulnerable spent nuclear fuel. Additionally, surplus non-pit plutonium not suitable to be used as feed for the National Nuclear Security Administration's (NNSA's) Mixed Oxide (MOX) Fuel Fabrication Facility will also continue to be packaged in HB-Line for eventual disposal at the Waste Isolation Pilot Plant (WIPP), while other space in HB-Line is being used to demonstrate a process for removal of contaminants in some surplus plutonium that will enable more non-MOXable plutonium to be converted to MOXable plutonium.

The Office of Environmental Management has and continues to work closely with other program offices within DOE to identify potential uses and missions for the H-Canyon facilities.

TUESDAY, MARCH 27, 2012.

DEPARTMENT OF ENERGY—ENERGY EFFICIENCY AND RENEWABLE ENERGY & FOSSIL ENERGY & OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY—ASSISTANT SECRETARY

WITNESSES

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

PATRICIA HOFFMAN, ASSISTANT SECRETARY, OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY

CHARLES McCONNELL, ASSISTANT SECRETARY (ACTING), FOSSIL ENERGY

Mr. FRELINGHUYSEN. Good morning.

Ms. HOFFMAN. Morning.

Mr. FRELINGHUYSEN. I would like to call this hearing to order; the Subcommittee on Energy and Water Development meets this morning to hear testimony on the fiscal year 2013 budget request for the Department of Energy's research and development programs for Energy Efficiency, Renewable Energy, Fossil Energy, and the Electricity Delivery System.

We would like to welcome Henry Kelly, the Acting Assistant Secretary for Energy Efficiency and Renewable Energy, Patricia Hoffman, the Assistant Secretary for Electricity Delivery and Energy Reliability, and Charles McConnell, Acting Assistant Secretary for Fossil Energy.

Dr. KELLY. Morning.

Mr. FRELINGHUYSEN. Good morning. Our country continues to face the prospect of even higher gasoline prices. While the public might think that the Department of Energy, and specifically the programs represented here today might be responsible for setting this country's energy supplies on a more secure footing, I suspect they should not expect much change from a year ago.

We still import nearly two thirds of the oil we use and 96 percent of our trucks, cars, and planes still depend on oil, while demand is skyrocketing in countries like China and India for the same energy sources we rely upon, and with much of the world's oil supply in the hands of those who do not like us, we must focus on our own backyard and take a look at what should be made more accessible.

The President makes a strong call in the State of the Union Speech for the "all of the above" energy strategy and I would like to take him at his word. Unfortunately, his budget request appears to be more ideologically driven than driven by practicality. It cuts the very account, fossil energy, which could have the most immediate impact on the prices at the pump and electricity.

Nuclear energy, which we considered before this Subcommittee a few weeks ago, is the other major source for today's electricity.

That same request would cut its budget by more than 10 percent. At the same time, the request would increase energy efficiency and renewable energy by 28 percent.

Even the rosiest scenarios for renewable energy predict only a marginal contribution to job creation coming from this sector. In other words, the President's budget request would accept higher prices for gasoline and electricity today in order to dump hundreds of millions of dollars into energy sources, which will only provide a marginal amount of power for years to come. These priorities are raising questions among members of Congress, and across the country, and many people at home are rightly upset.

In the Energy Efficiency and Renewable Energy account, the Administration is asking for hundreds of millions of dollars to improve electric vehicles, solar, wind, and energy efficient technologies, and to increase the sources that we actually depend on each and every day.

The story for American based manufacturing, a top priority of mine and I know for my ranking member, is more mixed, while the cuts to nuclear and fossil energy research and development would certainly be a setback for American innovation and may likely continue the flight of companies to less regulated world markets. The request would more than double funding for advanced manufacturing research and development within EERE.

Precisely how that funding would be used and to what advantage is not fully clear in the budget request materials. And I expect we'll have much time today to explore this this morning.

I ask that each of you 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. And at this point I turn to Mr. Visclosky, the ranking member, for any comments he wishes to make.

[The information follows:]

OPENING STATEMENT

The Honorable Rodney Frelinghuysen
Chairman, Energy and Water Development Subcommittee
House Committee on Appropriations

Hearing on the Fiscal Year 2013 Budget Request for
Energy Efficiency and Renewable Energy, Fossil Energy, and
Electricity Delivery and Energy Reliability
March 27, 2012

Good morning. I'd like to call this hearing to order. The Subcommittee on Energy and Water Development meets today to hear testimony on the fiscal year 2013 budget request for the Department of Energy's research and development programs for energy efficiency, renewable energy, fossil energy, and the electricity delivery system.

I'd like to welcome Henry Kelly, the Acting Assistant Secretary for Energy Efficiency and Renewable Energy; Patricia Hoffman, the Assistant Secretary for Electricity Delivery and Energy Reliability; and Charles McConnell, Acting Assistant Secretary for Fossil Energy.

It seems that each year at this time, this country faces the prospect of higher gasoline prices. While the public might think that the Department of Energy – and specifically the programs represented here today – might be responsible for setting this country's energy supplies on a more secure footing, our energy supply situation is not noticeably different than a year ago. We still import nearly two-thirds of the oil we use, and ninety six percent of our cars, trucks, and planes still

depend on oil, while demand is skyrocketing in countries like China and India for the same energy sources we rely upon.

The President made a strong call in his State of the Union speech for an "all of the above" energy strategy, and I'd like to take him at his word. Unfortunately, the budget request is more ideological than practical – it cuts the very account, Fossil Energy, which could have the most immediate impact on our prices at the pump as well as on electricity prices. Nuclear Energy, which we considered before this subcommittee a few weeks ago, is the other major source for today's electricity. The request would cut its budget by more than 10%. At the same time, the request would increase Energy Efficiency and Renewable Energy by 28%. Even the rosiest scenarios for renewable energy predict only a marginal contribution in the coming decades. In other words, the President's budget request would accept higher prices for gasoline and electricity today, in order to dump hundreds of millions of dollars into energy sources which will only provide a marginal amount of power for years to come. These priorities are raising questions among members of Congress, and across the country.

The story for American manufacturing – a top priority of mine, and I know of my ranking member – is more mixed. While the cuts to nuclear and fossil energy research and development would certainly be a setback for American innovation, and may likely continue the flight of companies to less regulated markets, the request would more than double funding for Advanced Manufacturing research and development within EERE. Precisely how that funding would be used, and to what advantage, is not fully clear in the budget request materials, and I expect we'll have time today to explore the merits of the proposal.

I ask that each of you 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'll turn to Mr. Visclosky for any comments he may have.

Mr. VISCLOSKY. Thank you very much, Mr. Chairman. I understand my statement and its entirety will be entered into the record. Good morning, Doctor Kelly, Ms. Hoffman, and Mr. McConnell, and along with the Chairman, thank you very much for being here today.

The U.S. Energy Sector faces myriad challenges that pose a persistent threat to our economy, national security, and environment, cars and trucks of our citizens. The ships, planes, and tanks of our military rely heavily on petroleum fuels, much of which is imported from overseas. Power prices continue to increase and our electricity supplies depend on energy sources, they give off emissions, and operate on an aging electric power grid.

Today we consider the budget request for applied R&D activities at the Department of Energy aimed at addressing the many difficulties we face. These programs, Energy Efficiency, Renewable Energy, Fossil Energy, the Office of Electricity Delivery, and Energy Reliability are all critical.

The budget request for Energy Efficiency and Renewable Energy represents a large increase of 30 percent over this year's level. Doctor Kelly, in this budget setting, I hope that you have come prepared to discuss how this large increase could be used efficiently and effectively in pursuit of our energy independence.

I am particularly interested in your justification for the large increase to the advanced manufacturing office, formerly known as the industrial technologies program. I believe that strengthening American manufacturing and returning to making things in America is not only the best source of job creation and economic recovery, it is an imperative.

I am hoping that the Department has a sense of urgency in this area and can provide details on your plan. The request for fossil energy represents a reduction of 21 percent from the program level of 2012. I appreciate and understand the Administration's belief in renewable energy and that it is its preferred path towards our future.

While I agree that renewable energy is a necessity, Mr. McConnell, I hope that you can explain why the reduction in fossil energy is appropriate at this time. Given that fossil fuels meet around 83 percent of U.S. energy demand, and I don't anticipate that is going to significantly change next month or by this summer, I would like to understand what the Department is doing to deliver technologies that can provide cleaner, low carbon electricity generation using domestic sources of coal and natural gas.

The budget request for the third participant in the hearing, the Office of Electricity, Delivery, and Energy Reliability is approximately equal to 2012 levels. Given the importance of the electricity grid, I would like to understand how this program will allow the nation to maximize existing resources and allow the expansion of clear energy generation through the modernization of the nation's electricity transmission and distribution system. Mr. Chairman, thank you for the time.

[The information follows:]

Visclosky Opening Statement at Hearing on FY13 Budget for Energy Efficiency and Renewable Energy, Fossil Energy, and Electricity Delivery and Energy Reliability

March 27th, 2012

Subcommittee Ranking Member Rep. Peter Visclosky

Good morning. Dr. Kelly, Ms. Hoffman, and Mr. McConnell thank you all for being here today.

The U.S. energy sector faces myriad challenges that pose a persistent threat to our economy, national security, and environment. The cars and trucks of our citizens, the ships, planes, and tanks of our military rely heavily on petroleum fuels, much of which is imported from overseas. Power prices continue to increase, and our electricity supplies depend on energy sources that give off harmful emissions and on a congested and aging electric power grid.

Gas prices are again rising, putting pressure on the wallet of every American. While there is no "magic bullet" available to the government to immediately drop the price of gasoline, on-going federal research in vehicle technologies is starting to yield dividends with the market introduction of automobiles utilizing technologies that will displace some portion of gasoline for power. While the adoption of these vehicles has not been as swift as projected, higher prices for gasoline are increasing the market demand for vehicles that utilize bio-fuels and battery storage technology. I hope to hear today what the Department is doing to advance the nation's knowledge in these areas and to increase the domestic manufacturing sector that utilize these technologies.

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 Delivery and Energy Reliability —are all critical areas of our nation's energy portfolio.

The budget request for Energy Efficiency and Renewable Energy represents a large increase, 30 percent, over the 2012 level. Dr. Kelly, in this budget setting I hope you have come prepared to discuss how this large increase could be used efficiently and effectively in pursuit of our energy independence. I am particularly

interested in your justification for the large increase to the Advanced Manufacturing Office, formerly known as the Industrial Technologies program. I believe strengthening American manufacturing and returning to making things in America is not only the best source of job creation and economic recovery, it is the only viable option. I am hoping that the Department has a sense of urgency in this area and can provide more detail on your plans.

The request for Fossil Energy represents a large reduction of 21 percent to the program level from 2012. It is pretty clear that the increase in EERE came at the expense of the Fossil program. I understand and appreciate that the Administration believes renewable energy represents the preferred path forward towards a more secure energy future. While I agree that renewable energy will, by necessity, be a large factor in the future, Mr. McConnell, I hope you can explain why this reduction for Fossil energy R&D is appropriate at this time. Given that fossil fuels meet around 83 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 budget request for the third participant in this hearing, the Office of Electricity Delivery and Energy Reliability is approximately equal to 2012. Given the importance of the electricity grid, I would like to understand how this program 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. FRELINGHUYSEN. Thank you; Doctor Kelly. Thank you for being here and your remarks, in total, will be on the record, but please proceed.

Dr. KELLY. Thank you, sir. Mr. Chairman and ranking members, members of the Committee, for letting me come here and talk about the fiscal FY13 Energy Efficiency and Renewable Energy budget proposal. And——

Mr. FRELINGHUYSEN. You may have to move that microphone a little closer.

Dr. KELLY. All right.

Mr. FRELINGHUYSEN. Thank you.

Dr. KELLY. Or talk a little louder. In the State of the Union, as the Chairman mentioned, the President called for an economy that is built to last and one that is built to support his commitment to safely and responsibly harness all of America's energy resources in an all of the above energy strategy. And renewable energy and energy efficiency are a key part of that strategy.

So EERE has built its portfolio around three major challenges. The first is to reduce the nation's dependence on petroleum based fuels for transportation by developing affordable fuels from more renewable sources. Vehicles capable of using electricity, natural gas, and hydrogen, and extremely efficient conventionally powered vehicles.

Second, we are seeking to diversify and expand the nation's electricity sources by developing renewable electricity that is competitive with other sources of electricity without subsidies.

And finally, to help families, businesses, and government offices save on their energy bills by optimizing the efficiency of our homes, buildings, and factories. These goals are central to a strategy for addressing the nation's energy and environmental challenges, and meeting them will play a critical role in spurring the U.S. economic growth and job creation.

The U.S. economy has always depended on innovation. And clean energy technology supported by the EERE budget will spur business and job growth in manufacturing and in many other parts of the economy. And the clean energy market has been increasing very rapidly and has been a key source of economic growth in the U.S. and worldwide; its increase almost a factor of five since 2004. But the global competition is fierce and retaining America's leadership role will require significant public and private sector investment in the next generation of renewable energy technologies and energy efficiency solutions.

Since 2007, EERE investments have resulted in the issuance of hundreds of patents supporting innovative clean energy research. EERE investments in clean energy technologies have played a part in many important commercial successes. For example, nearly every hybrid electric vehicle sold in the U.S. uses better technology developed under EERE.

Since 2007, EERE has successfully leveraged $60 million worth of research investment to secure more than $1.6 billion of private capital investment. Innovations in wind turbines developed with the support of EERE at reduced costs and increased reliability, allowing for 47 gigawatts of installed wind capacity in the U.S. and 35 percent of all new capacity installed in the last four years.

Standards issued since 2009 will save consumers hundreds of billions of dollars in energy costs through 2030. Now EERE plans to build on these successes by making strategic investments that compliment those of the private sector. In FY13, our reviews of opportunities and gaps in the private investment resulted in a budget in which 60 percent of the funding is directed towards energy efficiency activities, and 40 percent to renewables.

EERE's FY13 budget request of $2.3 billion emphasizes key investments in energy solutions and renewable technologies, where the potential impact is largest and where federal funds are most critical. To give some examples, the vehicle technology program will incorporate a new grand challenge to develop technologies to make electric drive vehicles competitive and multiple light duty vehicle markets by 2020.

This grand challenge will emphasize the accelerated R&D and advanced battery technologies, with a major concentration on better design optimization and innovative battery manufacturing. Biomass activities will be focused on converting non food cellulosic feed stocks to hydrocarbons such as jet fuel, that can be directly substituted for conventional fuels at competitive prices.

Our photovoltaic SunShot Program is on target to meet our goal of a dollar a watt installed costs by the end of the decade. On shore wind, as I said, has been a commercial success, and we are now going to concentrate on the next generation of challenges and opportunities, including a new focus on capturing America's enormous offshore wind resources at competitive prices.

And because residential and commercial buildings drive our electricity consumption, something like 70 percent of electricity goes into buildings, we continue to emphasize energy efficient products and integrated building systems for both new construction and for retrofits of existing buildings.

Major emphasis has been placed on the advanced manufacturing program, which supports the research focused on innovative energy efficient manufacturing processes and advanced materials. And these new approaches will reduce energy consumption and manufacturing cost, making American businesses more competitive, and they will play a key role in driving down the costs of all clean energy products.

So in closing today, the U.S. has poised its harnessing ingenuity of American science, the industriousness of American workers, and the creativity of American entrepreneurs to help secure America's future prosperity and global leadership.

This 2012 budget request reflects tough decisions over a balanced and diverse portfolio, with the understanding that EERE's technologies will play a critical role in addressing the nation's urgent energy and environmental challenges. The Department appreciates the leadership of this Committee and providing the resources needed to accomplish our shared goal of creating a secure and efficient clean energy economy, and I would be pleased to respond to any questions that you may have. Thank you.

[The information follows:]

STATEMENT OF

DR. 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 27, 2012

Mr. Chairman, Ranking Member Visclosky, Members of the Subcommittee, thank you for the opportunity to testify on the President's Fiscal Year 2013 (FY13) budget request for the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE).

In his State of the Union speech, President Obama presented his plan for a U.S. economy built to last. Central to this effort is the President's commitment to safely and responsibly harness America's domestic energy resources in an "all of the above" energy strategy. Renewable energy and energy efficiency play key roles in this strategy, and EERE supports research, development, demonstration and deployment activities for innovative technologies and practices in those fields.

To further ensure that EERE directly supports the President's portfolio approach to energy and the Nation's ability to compete in an increasingly global and competitive marketplace, EERE has explicitly designed its portfolio so that all work done by the program is directly applicable to at least one of three broad energy challenges: 1) to reduce the Nation's dependence on petroleum-based fuels for transportation by developing affordable fuels from renewable sources, vehicles capable of using electricity and hydrogen, and highly efficient conventionally fueled vehicles; 2) to find ways to make the unsubsidized cost of electricity derived from renewable resources competitive with other sources of electricity; and 3) to optimize the efficiency of our homes, buildings, and factories. In doing work that addresses these three challenges, EERE will help address our Nation's economic, energy security, and environmental goals: spurring economic growth and job creation in the U.S.; reducing dependence on oil; and minimizing the environmental impact associated with energy production and use.

Over the last seven years, the global investment in clean energy market has increased dramatically. The United States cannot afford to relinquish leadership in this increasingly critical market. The FY 2013 budget request will enable EERE to build on its long record of driving innovation for the development of clean energy industries. In the last thirty years, investments in EERE technologies have played a part in many important commercial successes, including, but not limited to:

- Nearly every hybrid electric vehicle sold in the U.S. today uses battery technology developed in part with Energy Department support.
- As of 2009, refrigerators were half the price they were in 1972 and 75 percent more efficient; EERE investments in refrigerator-freezer compressors have saved Americans more than $7 billion since the early 1980's.
- EERE investment in low emission (low-e) coatings for windows has played an important role in developing cost-effective windows three times more efficient than those from the 1970s. First introduced to the market in 1983, windows with low-e coatings now account for nearly 75% of home windows sold.
- Innovations in wind turbines developed with the support of EERE's Wind Energy Technology Program have reduced costs and increased reliability. According to one industry assessment, the U.S. currently has 47 GW of installed wind capacity in the U.S. and 35 percent of all new installed capacity over the last 4 years.
- Over the past ten years, breakthroughs in biomass feedstock logistics, pretreatment, enzymatic saccharification, and fermentation have helped reduce the costs of cellulosic ethanol produced via biochemical conversion from over $9.00 per gallon in 2001 to a minimum modeled cost for mature technology of $2.62 per gallon gasoline equivalent in fiscal year 2011. This trend is expected to continue, with a minimum modeled cost for mature technology of $2.15 per gallon gasoline equivalent projected by the end of fiscal year 2012.
- Advanced vehicle technology R&D sponsored by the Vehicles Technology Program helped enabled engine manufacturers to improve diesel engine efficiency, which has improved diesel engine efficiency by 5 percent since 2002, saving businesses an estimated $7 billion in diesel costs from 2002 to 2008 and helping manufacturers increase fuel economy.
- Hydrogen and Fuel Cell Technologies Program-funded efforts have helped reduced the cost of automotive fuels cells by more than 80 percent since 2002, assuming high-volume manufacturing of 500,000 units per year from state-of-the-art components.
- EERE investments in reciprocating engines used in combined heat and power facilities led to improved engine efficiencies across the market, by supporting R&D with engine manufacturers that later accounted for a sizable majority of U.S. natural gas engine sales in 2010. The number of CHP facilities has increased nearly 6 times

since 1970, helping manufacturers with these facilities to nearly double the combined efficiency of their heat production and electricity generation.

- Through its Federal Energy Management Program, EERE has provided the services, tools, and expertise to Federal agencies to help them achieve their Federal energy management goals. Through guaranteed cost savings achieved through its Indefinite Delivery, Indefinite Quantity Energy Savings Performance Contracts, FEMP has saved Federal facilities over $5 billion in energy costs since 2006.

And recently, we have made strides in the following:

- *Appliances:* Standards issued since 2009 will save consumers up to hundreds of billions of dollars through 2030; building on this, EERE plans to issue nine new standards through 2013 that aim to deliver net consumer savings of hundreds of billions additional dollars over the next three decades.
- *Solar:* Since 2007, SunShot's Incubator program has successfully leveraged $60M in EERE research funding to secure more than $1.6B in private capital.
- *Weatherization:* Since 2009, the Weatherization Assistance Program has improved the energy performance of approximately 860,000 homes for low-income families and other Americans. On average, these upgrades save these households more than $400 on their heating and cooling bills in the first year after implementation alone. At the height of the Recovery Act, these activities directly supported more than 15,400 new full time jobs, as well as additional indirect jobs throughout the supply chain.
- *Batteries*: Argonne National Lab licensed EERE-sponsored battery technology to private industry. This technology can pack 50-100 percent more energy into the same space compared to conventional cathodes, enabling smaller, lighter batteries.
- *Fuel Cells*: Following EERE demonstration funding for around 400 fuel cell lift trucks, industry placed orders for over 3,000 additional fuel cell lift trucks with no further DOE funding.

Retaining our leadership role in this increasingly competitive global market will require significant public and private sector investment in next generation renewable energy technologies and energy efficiency solutions. Domestic job creation and economic growth have historically been driven by inventing, manufacturing, and deploying innovative technologies and the same will be true in the growing clean energy sector.

EERE's strategic investments complement those of the private sector. The EERE portfolio consists of competitively selected projects with the largest potential to help achieve economic, strategic and environmental goals and for which federal funds are most critical. It balances investments in higher-risk, early-stage research with private-public partnerships that accelerate the transfer of innovations into the marketplace. The diverse set of technologies supported by EERE helps ensure that the U.S. has many options for meeting its energy needs. To that end, since 2007, EERE investments have resulted in the issuance of hundreds of patents supporting innovative clean energy research. EERE management is dedicated to building on these successes by providing a framework wherein highly innovative projects are competitively selected from the Nation's top universities, companies, and national laboratories to address the Nation's critical energy challenges and tap opportunities presented by new technologies.

Transportation Portfolio:

The Vehicle Technologies Program's R&D seeks technology breakthroughs that will enable the U.S. to greatly reduce transportation petroleum use and greenhouse gas emissions while enhancing vehicle performance. The Program focuses on a suite of technologies that ranges from transportation electrification and lightweight materials to advanced combustion engines and lubricant technologies and non-petroleum fuels interactions and utilization. The FY 2013 budget request includes a more than 25 percent increase for the Program compared to FY 2012, mainly in its Battery and Electric Drive Technology activities. In FY 2013, the program will support the launch of *EV Everywhere*, a new clean energy grand challenge to make electric-powered vehicles as affordable and convenient as gasoline-powered vehicles for the average American family within a decade. By emphasizing accelerated R&D on advanced battery and electric drive technologies, *EV Everywhere* will enable companies in the United States to produce electric vehicles at lower cost, with an improved vehicle range and an increased fast-charging ability. Major concentrations will be on advanced battery design optimization and innovative battery manufacturing processes.

Additional research will focus on developing high performance, low cost power electronics and electric motors that require reduced or no rare earth materials. The program also supports early demonstration, field validation, and deployment of advanced technologies and efforts to reduce the vehicle miles traveled by the public.

The Biomass Program funds a portfolio of projects to provide the Nation with domestically grown alternatives to fossil fuels that are compatible with our existing infrastructure. In FY 2013 Biomass funds will build on prior year successes in producing low-cost lignocellulosic sugars for ethanol. These advances can also be leveraged to develop cost-competitive transportation fuels such as renewable gasoline, diesel, and jet fuel from lignocellulosic material through biological or catalytic conversion routes. In addition, DOE is seeking authority to transfer funds under the Defense Production Act to more closely coordinate drop-in biofuel development for military applications with the Navy and USDA. Projects supported by the Biomass program are enabling scientists and engineers to overcome challenges across the bioenergy supply chain – from the development of a sustainable and economically viable feedstock logistics system; to the conversion of biomass into a variety of end uses, including biofuels and bioproducts. Laboratory-scale research projects are advancing the science of novel technologies, while first-of-a-kind biorefineries are validating and assisting in the commercialization of integrated technologies.

The Fuel Cell Technologies Program aims to enable the widespread commercialization of an alternative energy system to power cars, trucks, and off-road vehicles. While the emphasis is on transportation technologies, cross-cutting activities will have stationary applications as well. The Program's R&D portfolio is designed to improve the durability of fuel cells, reduce costs, and improve the performance of hydrogen production, delivery, and storage technologies. The Program aims to enable fuel cells technologies capable of achieving cost-parity with internal combustion engines for vehicles by 2017 and to enable renewable hydrogen technologies capable of being competitive with conventional fuels by 2020, based on modeled costs projected from component technologies to systems in high-volume production. In addition to technological advancements, the program seeks to reduce institutional and market barriers to the commercial deployment of hydrogen and fuel cell technologies.

Renewable Electricity Generation Portfolio:

The Solar Program will continue to focus on the SunShot effort in FY 2013 and is on target to achieve $1/Watt installed costs by the end of the decade. This work includes continued efforts to drive down the cost for module manufacturing and investments in reducing balance-of-system costs – both hardware components and "soft costs" such as permitting. The Program's photovoltaic (PV) technology activities focus on lowering the cost of PV through increased conversion efficiency and manufacturing improvements. The concentrating solar power (CSP) technology activities support development of thermal storage and the systems research and optimization to enable CSP to provide base-load power on demand. Additionally, the Program will work on systems integration and market transformation to support cost goals for the deployment of solar technologies by addressing grid integration issues, balance-of-systems, non-hardware installation costs and other market barriers.

The Wind Energy Program develops technology to improve the reliability and affordability of land-based and offshore wind energy systems. FY 2013 activities will increase the focus on advanced technologies and designs and on offshore wind demonstration projects that will help inform applied R&D priorities and reduce the costs and technical risks of offshore wind power plants in U.S. waters. The Program also supports wind resource assessments, advanced turbine and system modeling, and improved approaches to systems interconnection and integration to the electric transmission grid. It also helps to reduce market barriers that impede investment and development such as wildlife, siting, and other market challenges.

The Geothermal Technologies Program (GTP) conducts RD&D in partnership with industry, academia, and the National Laboratories to discover new geothermal resources, to develop innovative methods of accessing those resources for base-load electricity production, and to demonstrate high-impact technologies. The FY 2013 budget request increases GTP's budget by more than 70 percent compared to FY 2012. The increase in funding will support enhanced geothermal systems (EGS) field-test sites and projects and improved resource characterization efforts in EGS that offer the potential for widespread base-load renewable electricity. The Program will also concentrate on improving exploration technologies that offer the potential for reducing the

costs and risks associated with geothermal development by more efficiently and effectively identifying viable, economic geothermal resources.

The Water Power Program works to accelerate technology development for cost-effective and environmentally responsible renewable power generation from water. The reduction in funding reflects the substantial progress and completion of multiyear projects associated with Conventional Hydropower research and development. FY 2013 activities will focus primarily on marine and hydrokinetic (MHK) power, which includes a suite of technologies that harness the energy of wave, tidal, and current resources. Specifically, MHK research will focus on development and use of advanced open water test infrastructure for MHK devices and research into the costs and performance of innovative, early-stage MHK systems and components. The Program also supports resource assessments, cost assessments, environmental studies, and advanced modeling aimed at determining and demonstrating the viability of emerging water power technologies and reducing the market barriers to their deployment.

Efficient Homes, Buildings and Manufacturing Portfolio:

The Advanced Manufacturing Office (AMO), formerly known as the Industrial Technologies Program (ITP), supports RD&D focused on innovative, energy-efficient manufacturing processes and materials technologies. AMO's requested FY 2013 budget of $290 million is more than double ITP's FY 2012 budget of $116 million. This increase reflects the Administration's commitment to enhancing innovation in the manufacturing sector and improving the competitiveness of U.S. industries. The Program pursues cross-cutting manufacturing process technologies and advanced industrial materials to enable reductions in energy costs for U.S. manufacturing while improving process quality and accelerating product development. To that end, the Program seeks to research, develop, and demonstrate at a convincing scale new energy-efficient manufacturing processes and materials technologies to reduce the energy intensity and life-cycle energy consumption of manufactured products. AMO also promotes a corporate culture of continuous improvement in energy efficiency among manufacturers and their facilities. The Critical Materials Energy Innovation Hub, initiated in FY 2012, is continued within this program in FY 2013.

The Building Technologies Program (BTP), in partnership with the buildings industry, develops, promotes, and integrates energy technologies and practices to make buildings more efficient, affordable and comfortable. The FY 2013 budget request includes a more than 40 percent increase in funding for BTP, which will enable BTP to position itself to meet the Department's goal of reducing building-related energy use by 50 percent by 2030, saving consumers tens of billions of dollars per year. The funding increases will largely go towards the development of emerging technologies, to move building technologies along the RDD&D continuum from lab testing to prototype validation; and towards equipment standards activities, to address market challenges or failures in the adoption of energy efficient technologies. The Program undertakes the following suite of activities 1) R&D on building components (such as lighting and advanced heating and cooling devices) and integrated building designs; 2) model building efficiency codes; 3) equipment and appliance standards; 4) market integration activities such as Better Buildings, Building America, and the ENERGY STAR partnership with EPA; and 5) the Energy Efficient Building and Systems Design Energy Innovation Hub.

The Federal Energy Management Program (FEMP) enables the Federal Government to meet the relevant energy, water, greenhouse gas, and transportation goals defined in existing legislation and Executive Orders by providing interagency coordination, technical expertise, training, financing resources, and performance contracting support.

The Office of Weatherization and Intergovernmental Activities (OWIP) supports clean energy deployment in partnership with State, local, U.S. territory, and tribal governments. The FY 2013 budget request increases OWIP's budget by about fifty percent compared to FY 2012. This increase goes to the Weatherization Assistance Program (WAP), which under the request receives $139 million in FY 2013, up from its historically low FY 2012 enacted funding of $68 million, but still below its FY 2011 enacted funding of $174.3 million. WAP lowers energy use and costs for low income families by supporting energy-efficient home retrofits through State-managed networks of local weatherization providers. OWIP also runs the State Energy Program, which provides technical and financial resources to States to help them achieve their own energy efficiency and renewable energy goals through policies,

strategies and public-private partnerships that facilitate adoption and implementation. Funding also supports energy efficiency and renewable energy projects that meet local needs. OWIP's Tribal Energy Program supports feasibility assessments and development of implementation plans for clean energy projects on Tribal lands.

The Office of Strategic Programs provides cross cutting services including the development of strategic planning, portfolio-wide analytical tools, shared tools and resources for public education and engagement, international programs, and cross-cutting programs in innovation and deployment. The FY 2013 budget request increases Strategic Programs' budget by almost $34 million, in large part through increased funding for innovation and deployment activities. This increase will allow for new collaborative work with DOE's Office of Science to accelerate the transition of novel scientific discoveries into innovative, prototype clean energy technologies. It will also accelerate deployment and adoption of EERE technologies through improved collaboration with education and training institutions.

In closing, today the United States is poised to harness the ingenuity of American scientists, the industriousness of American workers, and the creativity of American entrepreneurs to help secure America's future prosperity and global energy leadership. This FY 2013 budget request of $2.337 billion reflects a balanced and diverse portfolio with the understanding that EERE's technologies will play a critical role in addressing the Nation's urgent energy and environmental challenges.

SIGNIFICANT FUNDING CHANGES – FY 2012 to FY 2013 Request ($ in millions)

Vehicle Technologies (FY 2012 $328.8; FY 2013 $420.0) ..... +$91.2
In FY 2013, there will be increased emphasis on advanced battery technology as part of the *EV Everywhere* grand challenge, including specific concentrations on advanced battery design optimization and battery manufacturing to significantly improve performance and reduce system cost. Additional R&D will focus on high performance and low cost power electronics, improved motor drive technologies that require reduced or no rare earth materials, and technology that allows electric drive vehicles to charge from the electric grid conveniently and efficiently.

In addition, other R&D will focus on high-efficiency Heating Ventilation Air Conditioning (HVAC) system technologies, and lightweight materials. The materials research will be targeted to high performance light-metal joints, manufacturing of low-cost carbon fiber composite components, and application of modeling and simulation techniques to the design of lightweight vehicle structures.

Biomass and Biorefinery Systems R&D (FY 2012 $199.3; FY 2013 $270.0)..... +$70.7
The overall increase in funding will support expanding efforts in research to produce hydrocarbon fuels from biomass, as well as the innovative pilot program that will support the transition of promising new technologies for the production of drop-in hydrocarbon fuels into pilot-scale biorefineries. In addition, DOE is seeking authority to transfer funds under the Defense Production Act to more closely coordinate drop-in biofuel development for military applications with the Navy and USDA. FY 2013 activities also include an increased focus on bio-oil and downstream process technologies to produce final products. The FY 2013 request provides an additional installment for the full-fledged construction of demonstration and commercial scale integrated biorefinery projects that were competitively awarded in 2007 and 2008 and that will be operational in 2014

Hydrogen and Fuel Cell Technologies (FY 2012 $103.6; FY 2013 $80.0)..... ..... -$23.6
The reduction in funding reflects substantial progress made in research innovations in the areas of fuel cells and hydrogen fuel production, delivery, and storage. A robust R&D program remains in fuel cells and renewable hydrogen production. In addition, FY 2013 activities will focus on some high impact fuel cell deployments, such as ground-support equipment and other early market fuel cells, with industry and government partners.

Solar Energy (FY 2012 $289.0; FY 2013 $310.0)..... +$21.0
Under the Solar program, innovative research on photovoltaic (PV) and concentrated solar power (CSP) energy technologies continues, to drive the advancements that will make solar energy cost competitive, across the Nation and without subsidies, before the end of the decade. In FY 2013, efforts to address PV module manufacturing cost drivers will be increased since modules make up 50 percent of the cost structure for this $1/W goal. There will also be increased effort to address "soft" market barriers such as the permitting time and costs associated with solar installation.

Wind Energy (FY 2012 $93.3; FY 2013 $95.0)..... +$1.7
With the commercial success of on-shore wind energy, EERE's efforts will now focus on the next generation of wind technologies and on capturing America's enormous offshore wind resources at a competitive price. The FY 2013 request reflects the shift from on-shore toward offshore wind technology research. FY 2013 activities will increase the focus on advanced technologies and designs and on offshore wind demonstration projects that will help inform applied R&D priorities and reduce the costs and technical risks of offshore wind power plants in U.S. waters.

Geothermal Technology (FY 2012 $37.9; FY 2013 $65.0)..... ..... +$27.1
Geothermal work will concentrate on exploration capabilities and on developing new technologies for enhanced geothermal systems (EGS) that offer the potential for enormous resources for base-load power across America. The increase in funding in FY 2013 will support the EGS field test sites and projects and improved resource characterization efforts in EGS that offer the potential for round-the-clock renewable electricity. In addition, FY 2013 activities will focus on: safely accessing geothermal reservoirs faster and at lower costs, identifying and

characterizing blind hydrothermal resources, and innovative means by which EGS reservoirs can be created and monitored throughout their lifetime.

Water Power (FY 2012 $58.8; FY 2013 $20.0)..... -$38.8
The reduction in funding reflects the substantial progress and completion of multiyear projects associated with Conventional Hydropower research and development. FY 2013 activities will focus primarily on marine and hydrokinetic (MHK) power, which includes a suite of technologies that harness the energy of wave, tidal, and current resources. Specifically, MHK research will focus on development and use of advanced open water test infrastructure for MHK devices and research into the costs and performance of innovative, early-stage MHK systems and components.

Advanced Manufacturing (formerly Industrial Technologies) (FY 2012 $115.6; FY 2013 $290).....+$174.4
In FY 2013, Advanced Manufacturing initiatives will support the important role the Department, and the U.S. Government as a whole, play in creating and maintaining a pipeline of innovative manufacturing ideas though its investments in research. Increased funding will support development and demonstration of innovative energy efficient manufacturing processes and materials technologies. It will allow the program to accelerate development of cross-cutting manufacturing process technologies and advanced industrial materials that will enable U.S. companies to cut the costs of manufacturing by using less energy while improving product quality and accelerating product development. Increased funding will include support for later stage scale up of manufacturing processes and advanced material technologies seeking to demonstrate these materials and processes at a convincing scale to prove reductions in energy intensity and in the life-cycle energy consumption of manufactured products.

The program will fund partnerships with industry to support these pre-competitive, high-risk, next generation innovations through the technology pipeline. Government support for these activities is critical due to the high cost and risk associated with the development and demonstration of complex technologies at relevant scales under time, quality and cost constraints. The transition to commercially-relevant manufacturing requires significant investments to create processing innovations, prototypes and ultimately produce the data that can support the case for commercialization.

Building Technologies (FY 2012 $219.2; FY 2013 $310.0)..... +$90.8
In FY 2013, there will be increased emphasis on research for advanced building HVAC systems, the building envelope and windows, and enhanced sensor and control technologies for building energy management. Additional emphasis will be placed on demonstrating and testing new, cost-effective technologies in retrofitting commercial and residential buildings, to validate the significant energy savings that can be achieved in these sectors.

In addition, FY 2013 funding will increase the scope and effectiveness of energy conservation standards by accelerating the test procedure and standards rulemakings that are currently scheduled, allowing for the increased use of DOE's existing authorities to establish standards for additional products that have large energy savings potentials.

Federal Energy Management (FY 2012 $29.9; FY 2013 $32.0)..... +$2.1
This increase will support the restart of the Federal Energy Efficiency Fund (FEEF), which has been authorized since 1992. The FEEF will provide direct funding and leveraged cost-sharing for other Federal agencies for capital projects and other initiatives to increase the energy efficiency, water conservation and renewable energy investments at agency facilities. Grants from the Fund will be competitively awarded based on criteria that include the life cycle cost effectiveness of each proposal, the amount of energy and cost savings anticipated to the Federal Government, and the overall return on investment.

Weatherization and Intergovernmental Activities (FY 2012 $128.0; FY 2013 $195.0) .....+$67.0
In FY 2012, Congress provided the latitude to allocate weatherization appropriations reflecting the balances accumulated while States were drawing down Recovery Act awards. With the anticipated expenditure of accumulated balances, the increase in the FY 2013 request will sustain essential weatherization production,

training, and infrastructure for grantees as Recovery Act projects are completed and old balances are drawn down.

Strategic Programs (FY 2012 $25.0; FY 2013 $58.9)..... +$33.9
This substantial increase will allow for new collaborative work with the DOE Office of Science through joint solicitations to accelerate the transition of novel scientific discoveries into innovative, prototype clean energy technologies. It will also accelerate deployment and adoption of these technologies through improved collaboration with education and training institutions. The Program will also continue to guide, strengthen, and communicate work on EERE technologies, and to help build U.S. businesses' domestic and international competitiveness in these technologies.

Mr. FRELINGHUYSEN. Thank you, Doctor Kelly. Madame Secretary, welcome.

Ms. HOFFMAN. Good morning. Good morning, Mr. Chairman and members of the Committee. Thank you for the opportunity to appear before you today to talk about the President's fiscal year 2013 budget for the Department of Energy's Office of Electricity Delivery, and Energy Reliability.

Our office's mission is to lead the national efforts to modernize the electric grid, enhance the security and reliability of our nation's infrastructure, and facilitate recovery from disruptions to energy supply. This is a complex and crucial mission that involves action on a number of fronts, including research and development of new technologies, cyber security, policy coordination and implementation, and energy assurance.

Our fiscal year 2013 budget request is $143 million, a three percent increase over the fiscal year 2012 appropriations. This request will keep us moving strategically and steadily towards a more reliable, flexible, efficient, and resilient grid.

To begin my discussion of our 2013 activities, I would like to highlight several areas of the budget request that we see as critical to the success of our mission. First, we are proposing establishing a new electricity systems hub that will bring together experts to solve system level challenges of grid modernization.

The nation's electric grid is a complicated system that is evolving. Now it is time to tackle some of the critical issues and barriers associated with integrating, coordinating, and facilitating the numerous changes that are happening system wide. These changes include the addition of renewable energy resources, like wind, fluctuations of load, and the growing use of digital communications and controlled technologies.

Given the regional nature of many of these conditions and needs effecting the grid, such as electricity use patterns, generation sources, energy policies and regulations, we are proposing to establishing two to three regional hubs, which may be the best way to address both the unique demands of each region, and the commonality shared at the national level.

Therefore, the President's request includes a $20 million request for the establishment of these regional centers, consistent with the quadrennial technology review. Another priority is cyber security; there are numerous challenges with protecting the grid from cyber attack. Most cyber security solutions are developed for desktop information technology systems or IT systems, and these are not designed to meet the unique requirements of the energy delivery system.

Another challenge is protecting the legacy devices that were installed before cyber security became an issue. We continue to be active in this area, as seen by our recent risk management maturity model initiative, which will provide a tool that allows electric utilities and grid operators to assess their own cyber strength and weaknesses and prioritize investments.

The release of risk management process guidelines provides a consistent, repeatable, adaptable process for the electric sector. Our roadmap to achieve energy delivery system cyber security, which

was released last September, provides a strategic direction of goals for public private partnership activities over the next 10 years.

We are also involved in other efforts such as facilitating timely sharing of actionable information. The 2013 budget also includes a continued investment of $30 million to support the development of a wide range of next generation cyber security technologies.

Another priority is advanced modeling of the electric grid. Our 2013 budget request provides $10 million for advanced modeling grid research to focus on accelerating the performance and predictive capability of operational systems, which uses real time data from the increasing number of sensors built out nationwide, with the Recovery Act funding.

Researchers will develop computational mathematical understanding needed to transform the tools and algorithms that underpin the electric systems planning and operation, and applying new scientific insights in advanced computation to grid data.

This work will involve collaboration with the Office of Science and universities, and will lay the foundation for the next generation computational modeling programs for the private sector. We will continue funding the permitting, citing, and analysis program that will provide technical assistance to the states and regions on the electricity policies and programs.

As utilities have increased their investment in next generation energy technologies, we have seen an increase in the number of requests from states' electricity officials for technical assistance on topics such as repairs for energy efficiency, and demand response from renewable energy.

Our 2013 budget also provides continued support for the infrastructure security and energy restoration programs work, enhancing the security and resilience of the nation's critical energy infrastructure and facilitating disruptions from the energy supply. As the lead sector specific agency for the energy sector, we closely monitor and assess the potential impacts of events, such as tornadoes, hurricanes, and geomagnetic disturbances on the electric grid. When a disruption to the energy infrastructure occurs, we serve as a focal point for responding and restoration efforts.

Additionally, we have worked closely with other government agencies in the North American Electric Reliability Corporation to evaluate and enhance planning and operational practices, to address potential risks of geomagnetic disturbances, such as the recent solar storms, on the power system.

The President's all of the above strategy marries today's need for affordable energy with a modernized electric infrastructure that will build a stronger future. Our 2013 budget request allows us to continue to follow a steady, constant, focused path towards grid modernization. This concludes my statement, Mr. Chairman. I look forward to answering any questions you may have.

[The information follows:]

STATEMENT OF
PATRICIA HOFFMAN
ASSISTANT SECRETARY
FOR ELECTRICITY DELIVERY AND ENERGY RELIABILITY
U.S. DEPARTMENT OF ENERGY
BEFORE THE
UNITED STATES HOUSE OF REPRESENTATIVES
APPROPIATIONS SUBCOMMITTEE ON
ENERGY AND WATER DEVELOPMENT
MARCH 27, 2012

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) 2013 budget for the Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE).

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 electricity grid is a fundamental enabler for the success of technological advances in electricity generation technologies being pursued elsewhere in the Department and by private industry. OE not only invests in applied research and development projects, but pursues tools and techniques and helps improve policies and state laws to modernize the grid and enhance the capabilities of the system in the following ways:

- *Reliability* – high quality, consistent power flow;
- *Flexibility* – the ability to accommodate changing supply and demand patterns;
- *Efficiency* – delivery of electricity with reduced losses and greater asset utilization rates; and
- *Resiliency* – the ability to withstand disruptions and maintain critical function.

Together, improvements in these four operational capabilities describe a modern grid. Inherent within them is an emphasis on end-to-end security as a key component both of a modern grid and of the Department of Energy's mission – we cannot achieve energy security for the nation without a secure grid. Security solutions for energy delivery systems are most cost-effective when they are designed into devices, and OE has been working with the electricity sector for more than a decade to enhance cybersecurity protections and build resiliency into the grid.

In the face of threats from manmade and natural events, DOE is, and must always be, prepared to respond and assist in recovery, and OE executes the Department's responsibilities as the Sector Specific Agency for the electricity grid. In this role, we maintain ongoing efforts to promote reliability and resiliency in the energy sector, and public-private partnerships are critical in this regard.

A more reliable, flexible, efficient and resilient electric power system will better support all types of power generation, but there are unique challenges associated with each,

making collaboration throughout DOE essential as we work towards transforming our Nation's energy systems. The 2011 Quadrennial Technology Review (QTR) established a shared set of priorities across DOE, and in doing so put in place effective methods of collaboration and coordination among the Department's energy programs on crosscutting activities. As we began the process of formulating our FY 2013 budget request, the QTR findings helped to inform our priorities and strategic decisions.

Our FY 2013 budget request prioritizes activities that increase electricity reliability and security nationwide by taking a systems-level approach to grid modernization, developing the computational capabilities to improve system planning and operations, and emphasizing the physical and cybersecurity of both new technologies and legacy energy systems. The request also reflects strategic choices to avoid potential overlap and maximize the value of the Departments' investments, such as the decision to delay requesting new funding for Power Electronics at this time. This decision reflects the fact that ARPA-E is pursuing awards for a wide variety of potentially game-changing power electronics devices. Once ARPA-E's projects are complete, some of the technologies could be well suited for further development into grid-scale applications through OE's research and development program.

OE's FY 2013 request of $143 million will maintain progress towards the goal of modernizing the electricity system. The request includes $103 million for Research and Development (R&D) to develop next-generation technologies in transmission systems, smart grid, energy storage, and cybersecurity, and includes funding to establish the Electricity Systems Hub. It provides $6 million to assists States, regions, and tribal governments that wish to change their own electricity-related policies. Finally, the request includes $6 million to support the reliability and resiliency of critical energy infrastructure and facilitate recovery from disruptions to the energy supply.

HIGHLIGHTS OF THE FY 2013 REQUEST

At $143 million, the FY 2013 budget request is a 3 percent increase from the FY 2012 appropriation, and maintains the Department's commitment to create a modern energy infrastructure. This request is essentially level for the office as a whole, but targets funding to the areas where advances are most critical for success. Priorities include $20 million to establish the new Electricity Systems Hub, $30 million for cybersecurity solutions focused on the unique operational requirements of energy delivery systems, and $10 million for Advanced Modeling Grid Research to develop a greater understanding of the electricity system's operating characteristics. Through our relationships with DOE program offices, industry, academia, and other Federal agencies, we determined that these three areas offered the best balance between nearer-term results and long-term benefits to support the development of a reliable, efficient, and resilient electricity delivery system.

Establishing the Electricity Systems Hub – The electricity grid is a complex system of systems that serves as a key enabler to facilitate energy independence and increased economic prosperity. OE's FY 2013 request includes $20 million to establish the Electricity Systems Hub focusing on the seam between transmission and distribution – a pinch point of grid modernization where power flows, information flows, policies and

markets intersect – to tackle the critical issues and barriers associated with integrating, coordinating, and facilitating the numerous changes that are happening system-wide. The hub activities will accelerate new technical adoption within a policy and regulatory framework that allows for efficient utilization of assets and capital investment, including minimizing consumer costs for grid modernization

As we modernize the grid to adapt to changes in the generation mix (renewable energy resources, distributed generation, increased use of natural gas, etc.), changing loads (electric vehicles, energy storage, LED lighting, etc.), and the increasing use of digital control and communications technologies (building energy management systems, demand response, sensors, phasor measurement units (PMUs), etc.), it is vital that a systems-level approach is taken to achieve seamless systems integration.

The integrated Hub concept brings together a multidisciplinary group of experts covering applied science, technology, economics, and policy to address the grand challenges of system-wide modernization. This management structure encourages creative risk-taking and accelerates innovation by providing flexibility for dynamic course correction in an integrated environment. The topics addressed through the Electricity Systems Hub are different from those that have been addressed through the Department's other Hubs, in that conditions and system needs – such as electricity usage patterns, generation sources, energy policies and regulations, and population densities – vary throughout the country, and must be incorporated into national solutions. In this spirit, two or three regional hubs may be pursued to address the complex regional and local issues associated with grid modernization. By understanding the unique demands of each region, we can identify the needs common to all, and develop solutions that apply nationwide but accommodate local differences.

Potential research topics include advanced devices, components, software, and systems. Exploration of utility business models, improved system understanding, and the cultivation of multidisciplinary thought leaders can help establish an electricity services economy. Additionally, policy and market analyses can help reduce barriers to innovation and system transformation.

Developing Cybersecurity Solutions for Energy Delivery Systems – Reliable and resilient energy infrastructure is vital to our Nation's economy, human health and safety, and national security. Cybersecurity for energy delivery systems has emerged as one of the Nation's most serious grid modernization and infrastructure protection issues. The Stuxnet worm, designed to attack a specific control system used in the energy sector, underscores the seriousness of the threat from targeted cyber attacks on energy delivery systems. There are a number of challenges associated with energy system cybersecurity, including protecting legacy devices that were installed before cybersecurity was an issue, the growing sophistication of attackers, and the fact that most cybersecurity solutions are developed for desktop information technology (IT) systems, and cannot be implemented on energy delivery systems that control real-time physical processes without risking a power disruption that rivals that of an intentional cyber attack.

OE's FY 2013 request includes $30 million for CyberSecurity for Energy Delivery Systems to develop advanced cybersecurity solutions designed specifically to meet the

unique requirements of high-reliability energy delivery systems, and to reduce the risk of energy disruptions due to cyber events. The funding supports activities that include:

(1) development of resilient networks and communications for the smart grid;
(2) national SCADA Test Bed research;
(3) vulnerability assessments, and mitigations;
(4) next-generation technologies to enhance cybersecurity of energy delivery system platforms;
(5) secure, resilient smart grid architectures and components, including developing secure, real-time communications that protect the privacy of multiple participants in the shared data stream of advanced metering infrastructure; and
(6) enhanced cybersecurity protective measures for synchrophasors, a critical smart grid component that provides engineering data needed for wide-area situational awareness of grid operation.

Enhancing System Understanding through Advanced Modeling Grid Research – The electricity system will have to operate closer to its limits than ever before. Integration of large amounts of variable generation, mass deployment of electric vehicles, and actively engaged end-users will greatly increase uncertainty in grid operations and planning. To address the growing complexity of the grid, OE's FY 2013 request provides $10 million for Advanced Modeling Grid Research to develop the computational and mathematical understanding needed to transform the tools and algorithms that underpin electricity system planning and operations.

In FY 2013, the Advanced Modeling Grid Research program will focus on accelerating the performance and predictive capabilities of operational systems – which use real-time data from sensors nationwide – to enhance grid resilience and better detect events that drive cascading blackouts. In partnership with universities and industry, the program will apply new scientific insights in advanced computation (working collaboratively with the Office of Science) to electricity system data for improvements in grid planning and operations, including modeling of resource generation, energy markets and electricity flow. This research will enable system models that better predict system behavior and improve large-scale system planning, reducing operational redundancies and maximizing the use of existing electricity infrastructure.

Explanations of the other elements in the FY 2013 request are provided below.

RESEARCH AND DEVELOPMENT

OE supports the applied research, development and demonstration of technologies that modernize the electric grid, increasing its reliability, flexibility, efficiency and functionality. The Research and Development (R&D) program is OE's largest, accounting for more than 70 percent of our total FY 2013 request. Through collaboration with private industry, academia and public entities, as well as with other DOE programs including ARPA-E, the Office of Energy Efficiency and Renewable Energy, and the Office of Science, our R&D activities promote national energy independence through the development of an adaptable, reliable, "smart" electricity transmission and distribution system.

The FY 2013 request of $103 million for the R&D program reflects an emphasis on innovative tools and technologies that will enable greater adoption of variable resources and facilitate the transition to low-carbon energy sources and away from the consumption of oil through the electrification of transportation. In addition to those previously discussed, the request includes funding for: Transmission Reliability and Renewables Integration, Smart Grid Research and Development, and Energy Storage.

The *Transmission Reliability and Renewable Integration* activity, funded in FY 2013 at $14 million within the Clean Energy Transmission and Reliability subprogram, focuses on developing advanced transmission-level sensors, analysis tools and capabilities. More sophisticated transmission technologies and power system information is essential as the demand for higher quality electricity and the integration of renewable resources grows. This activity focuses on using real-time data from advanced sensors that monitor the flow of electricity and provide information on system health – known as phasor measurement units (PMUs) – to improve transmission system planning and operations. It supports the development of technologies, tools and operational approaches that use this information to enhance the flexibility and reliability of the Nation's power system.

The *Smart Grid Research and Development* activity focuses on developing the next generation technologies that can integrate two-way communications and digital technology into electricity distribution systems, while encouraging consumer involvement to enable intelligent control over energy use. By providing consumers with information about their usage, along with the ability to participate and communicate with the power system, we can facilitate the potential of energy conservation and demand response to reduce peak demand and increase system reliability. The FY 2013 request of $14.4 million for Smart Grid R&D prioritizes projects studying distribution automation to reduce system outage duration and frequency; analysis of high penetration of distributed renewable resources; and outreach to both consumers and state regulators on smart grid. It scales back research into the integration of the charging and discharging of plug-in electric vehicles (PEVs) into the grid, as well as the development of microgrids.

The *Energy Storage* subprogram, funded at $15 million in the FY 2013 request, is designed to develop and demonstrate new and advanced energy storage technologies that will enhance the stability and reliability of the future electric grid. Large grid-scale, megawatt-level energy storage systems, or multiple, smaller distributed storage systems, have the potential to significantly reduce transmission system congestion and manage peak loads, increasing the overall reliability of the electricity grid. OE is focused on lowering the cost of storage devices, proving their performance in utility applications, and facilitating industrial development. The request for energy storage reflects scaled-back research into lithium-ion and sodium-ion batteries. It supports the development of a suite of technologies (e.g. lead-carbon, sodium metal halide, metal air, and advanced flow batteries, and flywheel and compressed air storage) that span the range of services associated with grid applications including frequency regulation, wind and solar ramping, and energy management; as well as different scales suitable for central (large) stations, distributed, and end-user deployment.

PERMITTING, SITING, AND ANALYSIS

With a requested $6 million in funding for FY 2013, OE continues to provide technical assistance to State and regional entities that wish to change their own electricity-related policies. Electricity planners from both the public and private sectors are facing new challenges as the Nation moves towards a clean energy future. 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 subjects of demand response, renewable energy, natural gas and clean coal. In FY 2013, we anticipate increased requests for assistance on reliability issues associated with implementation of EPA regulations and on the impact of cheaper natural gas from increasing shale gas development on utility resource planning.

Maintaining reliability and affordability while the generation portfolio evolves in a number of ways is a challenge. As the deployment of variable renewables grow, much of which can be remote from where the electricity is needed, greater cohesive, regional thinking by state and local officials will be needed. Accordingly, the FY 2013 request supports 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 2013 budget request includes $6 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 threats from aging infrastructure, human error, natural disasters, and deliberate attacks – represent significant challenges for the energy industry. As the Sector-Specific Agency for Energy, OE is responsible for collaborating with Federal, State and local governments and the private sector, facilitating the assessment of the sector and encouraging risk management strategies to protect against and mitigate the effects of attacks against the energy sector. We have built close relationships with the owners and operators of energy infrastructure as well as other government agencies, and have developed a thorough understanding of the tools and technologies needed to support secure and resilient energy infrastructure. This places OE in a unique position to help discover potential 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 tools for natural gas and petroleum modeling visualization tools, 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 threaten national energy security. And we will work with Federal, State and local officials to strengthen mitigation measures through tabletop exercises, forums and workshops that increase understanding of critical infrastructure protection and security issues, including the potential impact of geomagnetic disturbances, such as solar storms, on the grid.

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 2013 budget request includes $27.6 million for Program Direction, which supports Federal staff that provides executive management, programmatic oversight, and critical technical and administrative support necessary for the effective implementation of the OE program. The request, essentially level with FY 2012 appropriations, funds 112 Full Time Equivalents (FTEs) in FY 2013, based in Headquarters and at the National Energy Technology Laboratory in West Virginia. The request includes support for FTEs that provide critical technical project management and monitoring of ongoing Recovery projects, which will continue for several years.

CONCLUSION

Through our investments in 21st Century technologies and energy assurance capabilities, OE will continue to provide leadership to ensure that the Nation's electricity grid has the capabilities to provide all Americans with reliable, accessible electricity. This is not a short-term goal, nor is one that can be addressed once and forgotten; constant progress towards a modern power system that is reliable, flexible, efficient, and resilient is key to economic prosperity and protecting one of our Nation's critical infrastructures.

President Obama has laid out an ambitious, "all-of-the-above" strategy for American energy, one that marries the immediate need for inexpensive energy with the development of affordable renewable energy options to secure energy independence in the future. As the recent decrease in natural gas prices shows, we cannot always predict the energy source that will offer the least expensive electricity for American consumers. What we do know is that, regardless of its source, electricity will always need to be transported to consumers reliably, efficiently, and securely.

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

Mr. FRELINGHUYSEN. Thank you for your testimony. Mr. McConnell.

Mr. MCCONNELL. Thank you, Chairman and members. I appreciate the opportunity to present the Office of Fossil Energy's proposed budget for fiscal year 2013. The Office of Fossil Energy's mission is to ensure that we remain able to utilize our nation's abundant resources of coal, oil, and natural gas by developing technology based energy options that enhance the U.S. economy, provide environmental sustainability, and ensure energy security.

Fossil also manages the Strategic Petroleum Reserve, the Northeast Home Heating Oil Reserve, and the Naval Petroleum Reserves.

The FY '13 budget request includes $420.6 million for the Fossil Energy research and development, which is focused on advancing technologies for carbon capture, utilization, and storage, or CCUS.

This is a business driven, not regulatory driven approach to capture and to utilize CO_2 from fossil facilities, and through this utilization, to safely and permanently store or sequester the CO_2 from the atmosphere. The bulk of this R&D is directed at carbon capture technology development, CO_2 storage, and utilization options, as well as CO_2 monitoring, verification, and accounting, advanced power systems that support CCUS and cross cutting research.

We are currently developing commercial scale demonstrations of first generation CCUS technologies, focusing on a range of carbon capture options. Through our regional carbon sequestration partnerships, we are also pursuing CO_2 storage in a variety of geologic formations, and the CO_2 utilization will be accomplished via enhanced oil recovery, or EOR, in oil bearing formations.

The benefits of EOR are very significant. EOR increases domestic oil supplies. It creates jobs, improves our balance of trade, and ensures that CO_2 is safely and permanently stored. Our mission will ensure that measuring, monitoring, and verifying the CO_2 in these formations will be permanent and safe.

Because of CO_2, EOR's substantial economic benefits and its potential to catalyze the commercialization of CCUS technology for the future, EOR must be an important element of our R&D. With six major CO_2 EOR demonstration projects underway across the country, we are moving in that direction.

We're also exploring additional pathways to CO_2 utilization, and our current R&D to lower the cost of carbon capture for the future is fundamental to this.

So in addition to these first generation technology demos, we are also concurrently conducting and supporting long term R&D to develop second generation technologies, to further lower the cost of CO_2 separation, and enable the utilization and low cost sequestration for the future. Our oil and natural gas technologies budget includes $12 million for oil and natural gas technology R&D, centering on the sustainable development of unconventional oil and natural gas. This request also has $5 million for methane hydrates. Efforts in FY '13 will focus on continuing collaborative R&D with the EPA, the DOI, and the U.S. Geological Survey to minimize the potential impacts and to ensure the sustainability of shale gas through fracking.

This is in alignment with the recommendations of the Secretary of Energy Advisory Board Subcommittee which called for improved safety and environmental performance of fracking in shale gas formations. And we are currently developing a joint MOU amongst those agencies to ensure interagency alignment and collaboration.

The FY '13 request also includes $10.1 million for the Northeast Oil Home Heating Reserve, which provides the Northeast with a 10 day supply buffer against disruption in heating oil supplies. The reserve's stock now is comprised exclusively of low sulphur heating oil, and it provides for storage and operation of a one million barrel reserve. This request also includes a $6 million rescission of prior year funds.

The FY '13 budget also includes $195.6 million for the management, operation, and security of the Strategic Petroleum Reserve. The SPR has a capacity of 727 million barrels to protect our nation against disruption in U.S. oil supplies, and it also allows the U.S. to meet its IEA obligation to maintain emergency oil stocks.

Key projects for the upcoming year at the SPR include moving the degasification plant, pursuing a capacity maintenance program, cavern volume creep, and cavern remediation.

Finally in FY '13, the SPR will initiate plans to repurchase oil sold in the IEA's 2011 Libya Collective Action, using the remaining proceeds from that sale.

The Office of Fossil Energy is committed to developing the science and technology that allow the nation to fully utilize its abundant fossil energy resources in an environmentally and economically sustainable manner. The FY '13 budget request will be supportive of DOE's goals to address issues of energy security and environmental security and sustainability. Thank you.

[The information follows:]

Statement by Charles D. McConnell
Assistant Secretary for Fossil Energy (Nominated)
U.S. Department of Energy

FY 2013 Appropriations Hearing
House Committee on Appropriations
Subcommittee on Energy and Water Development

March 27, 2012

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 2013.

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, which provide 83 percent of U.S. energy consumption, are expected to continue to play a critical role in meeting our Nation's energy needs for the foreseeable future. To help meet this demand, the Office of Fossil Energy Research and Development (FER&D) program advances technologies related to the reliable, efficient, affordable, and environmentally sound use of fossil fuels, which are essential to our Nation's security and economic prosperity.

To that end, the program's mission is to create technology and technology-based policy options that enhance U.S. economic, environmental and energy security. This mission is achieved by developing technologies to enable the environmentally responsible use of domestic fossil fuels with the goal of achieving near-zero atmospheric emissions power production, including a specific focus on dramatic reductions of global carbon emissions at acceptable cost. FER&D will also address concerns associated with the environmental, health, and safety risks of shale gas development.

The bulk of FE's current R&D program activities focus on: 1) carbon dioxide (CO_2) capture technology applicable to both new and existing fossil-fueled facilities; 2) CO_2 storage, CO_2 measuring, monitoring, verification and accounting; 3) advanced coal-fueled power systems that support carbon capture and storage (CCS) and CO_2 utilization , 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 (EOR). While EOR is a known production method that has been in commercial use for decades, it catalyzes the demonstration of CCS technology in some cases, and thereby helps in the areas of research that need the most attention, Carbon Capture and Measuring, Monitoring and Verification (MMV), as well as to leverage more private funding to support those public benefit goals. There are currently six major CO_2 EOR demonstration projects underway across the U.S. As with other projects employing geological

storage, CO_2 EOR projects will be subject to rigorous monitoring, verification and accounting procedures and technologies to ensure their safety and effectiveness.

Our program is only supporting economic utilization of captured CO_2 to the extent that it results in permanent sequestration of CO_2 that would otherwise be released into the atmosphere. It will consist primarily of reducing the cost of carbon capture, or storage monitoring and verification activities: measuring the quantity of CO_2 that is injected and not subsequently recovered in the oil production process and then verifying that the CO_2 left in the ground is permanently and safely sequestered and not eventually re-released into the atmosphere through fractures, abandoned wells, or other processes. In addition to the environmental benefits noted, this program will also increase domestic oil production, create jobs, and improve the Nation's domestic energy security.

In addition to EOR, we are exploring other pathways and novel approaches to beneficially utilize captured CO_2, such as the conversion of CO_2 to useable products and fuels, again with the overarching objective of assuring permanent sequestration of CO_2 that would otherwise be released into the atmosphere. To date, the program has focused on the most valuable products with the largest potential markets (other than EOR), including production of chemicals, building materials, and curing for cement.

FE's current portfolio of funded projects is on course to meet the goal to commence, by 2016, the operation of four to six CCS demonstration projects from the suite of coal power plants and other large-scale facilities through the Clean Coal Power Initiative (CCPI), FutureGen 2.0, and Industrial Carbon Capture and Storage (ICCS) programs. In parallel to demonstration of first generation CCS technologies, we are conducting and supporting long-term, high-risk R&D to significantly reduce coal power plant emissions (including CO_2). This R&D is exploring ways to 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 Office of Oil and Natural Gas Technologies oversees the prudent and sustainable use of federal funds to develop our natural gas resources. The FY 2013 budget request will redirect natural gas R&D within FER&D to support a coordinated, interagency effort by DOE, the Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS) to conduct research and development aimed at understanding and reducing the environmental, health, and safety risks of natural gas and oil production through hydraulic fracturing. The program also is studying hydrates in the Arctic via controlled *in situ* depressurization and CO_2 injection. The program recently drilled a fully instrumented hydrate well in Alaska at a cost of $8 million. Leveraging funding from Japan (up to $7 million) and $5 million from the FY 2011 Basic Energy Science budget (in DOE's Office of Science), the testing of this well will take place in 2012 and be completed in FY 2013.

FE also manages the Nation's Strategic Petroleum Reserve (SPR). The SPR, with a capacity of 727 million barrels, serves as the largest stockpile of government-owned emergency crude oil in the world. The SPR helps ensure U.S. energy security by providing energy and economic protection against disruptions in U.S. oil supplies. It also allows the United States to meet, in combination with commercial stocks, its International

Energy Agency (IEA) obligation to maintain emergency oil stocks. In June 2011, the SPR sold 30.6 million barrels of oil to meet U.S. obligations under the IEA's Libya Collective Action.

The FY 2013 budget provides for the continued operations and readiness of the SPR to meet its critical mission of protecting the Nation against potential disruptions in U.S. oil supplies. In FY 2013, the SPR will initiate plans to repurchase oil sold in 2011 using the proceeds from that sale.

In addition to the SPR, FE oversees the Northeast Home Heating Oil Reserve, which provides a short-term supplement to private home heating oil supplies in the Northeast in the event of a supply interruption. The Office also manages the Naval Petroleum Reserves.

Fiscal Year 2013 Budget Request

President Obama's FY 2013 budget requests $650.8 million for the Office of Fossil Energy (FE) to support improved energy security and rapid development of climate-oriented technology. The request includes $420.6 million for Fossil Energy Research and Development, $195.6 million for the Strategic Petroleum Reserve, $10.1 million for the Northeast Home Heating Oil Reserve (and includes a $6 million rescission of prior year funds), $14.9 million for the Naval Petroleum Reserves and $15.6 million for the Elk Hills School Lands Fund.

Fossil Energy Research and Development

The President's FY 2013 budget requests $420.6 million for FER&D, with a strong focus on advancing carbon capture, utilization and storage technologies. This effort supports the recommendations of President Obama's Interagency Task Force on Carbon Capture and Storage, as well as DOE's overall mission to achieve national energy security in an economic and environmentally sound manner by developing the technical capability to dramatically reduce carbon emissions to achieve near-zero atmospheric emissions power production.

To achieve this goal, the program is focused on developing and demonstrating advanced power generation and carbon capture, utilization and storage technologies for existing facilities and new fossil-fueled power plants by increasing overall system efficiencies and reducing capital costs. The near-term focus is on developing advanced technologies that increase the power generation efficiency for new plants and technologies to capture CO_2 from new and existing industrial and power-producing plants. In the longer term, the goal is to increase energy plant efficiencies and reduce both the energy and capital costs of CO_2 capture, utilization and storage from new, advanced coal plants and existing plants. These activities will help allow coal to remain a strategic fuel for the Nation while enhancing environmental protection.

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, utilization and storage technologies to ensure clean, reliable,

and affordable electricity for the United States. The 2013 budget request does not provide any demonstration funds because these projects are already strongly supported through the 2009 American Recovery and Reinvestment Act (ARRA). The ARRA provided $3.4 billion for CCS.

CCS and Power Systems R&D

The CCS and Power Systems R&D FY 2013 budget request of $275.9 million represents just over 40 percent of FE's total FY 2013 budget request. The program directly supports the mission of FER&D by providing 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, utilization and storage. The FY 2013 request includes $35 million for NETL staff to conduct in-house coal R&D.

Coal activities include research, development and demonstration of technologies that will improve the competitiveness of near-zero emissions coal-fueled electricity generation in future energy supply markets through technologies that cost-effectively capture, utilize, and store CO_2, providing a domestic, low-cost, low-CO_2 energy supply option.

In FY 2013 and through the Recovery Act, the Coal program continues aggressive funding for carbon capture, utilization and storage activities. These activities include large-scale demonstration of injection and storage in geologic formations or beneficial utilization of CO_2 through the Regional Carbon Sequestration Partnerships, as well as large-scale demonstration of carbon capture technologies through the Clean Coal Power Initiative and Industrial CCS activity.

Carbon Capture. The President's budget requests $60.4 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 as well as industrial sources. 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. Industrial sources may provide unique challenges to CO_2 capture at these facilities. The decrease in funding for post-combustion R&D reflects a level sufficient to maintain focus on the current scope of activities, while the decrease in funding for pre-combustion capture systems represents program prioritization on post-combustion capture technology development.

Carbon Storage. The FY 2013 budget requests $95.5 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 reducing the cost-of-electricity impacts and providing protocols for CCS demonstrations as they are designed to capture, transport, store, and monitor the CO_2 injected in geologic formations. No funding is provided for reforestation or other terrestrial carbon sequestration.

The request includes $67 million for Regional Carbon Sequestration Partnerships, which are an essential component of the carbon storage program, unite more than 400 public and private entities in an effort to complete and evaluate CO_2 injection tests across the nation. Funding for other geological storage activities, including small and large-scale field tests in other geologic storage classes, gives priority to near-term research areas to meet goals for safe, permanent storage of CO_2.

In FY 2013, 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. This activity will culminate in a set of best practices for the deployment of carbon capture, utilization and storage technology.

Advanced Energy Systems. The President's Budget requests $55.2 million for Advanced Energy Systems research. This activity is focused on reducing the cost of gasification and enabling affordable CO_2 capture, while increasing plant availability and efficiency, and maintaining the highest environmental standards. The program supports gasification-related R&D to convert coal into ultra-clean synthesis gas (syngas) that can, in turn, be converted into chemicals, hydrogen, liquid fuels and electricity.

The President's FY 2013 budget reflects a shift in focus toward technologies that have potential benefits to both existing and new fossil-fueled power plants. Consequently, DOE reduces funding for Advanced Combustion Systems R&D, Gasification Systems R&D, and hydrogen turbines.

Cross-Cutting Research. The FY 2013 budget requests $29.8 million for Cross-Cutting Research. This sub-program serves as a crosscutting bridge between basic and applied research. It fosters 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 Advanced CCS and Power Systems. This program area develops computation, simulation and modeling tools focused on optimizing plant design and shortening developmental timelines. It also addresses advanced and cross-cutting issues, including plant optimization technologies, environmental and technical/economic analyses, coal technology export, and integrated program support.

As with the request for Advanced Energy Systems, the request for Cross-Cutting Research represents the shift in focus toward technologies that have potential benefits to both existing and new fossil-fueled power plants. The funding request is broken down as follows:

- ***Plant Optimization Technology*** -- $7 million for sensors and controls;
- ***Coal Utilization Science*** -- $17.2 million for computation systems dynamics and computational energy science;
- ***Energy Analyses*** -- $0.95 million for environmental activities and technical and economic analysis;

- ***University Training and Research*** -- $3.25 million for university coal research, historically black colleges and universities education and training; and
- ***International Activities*** -- $1.35 million for multilateral collaboration with organizations such as the International Energy Agency, the United Nations, the World Energy Council, and the Carbon Sequestration Leadership Forum, as well as bilateral activity with key countries such as China and India.

Natural Gas Technologies R&D

The President's budget requests $17 million for Natural Gas Technologies program, which is being reprioritized to launch a collaborative research and development initiative together with the Environmental Protection Agency and the Department of the Interior's U.S. Geological Survey to understand and minimize the potential environmental, health, and safety impacts of natural gas development through hydraulic fracturing , consistent with the recommendations of the Secretary of Energy Advisory Board's (SEAB) August 2011 "Shale Gas Production Subcommittee Ninety-Day Report." $12 million of the requested funding will center on continued implementation of the priority collaborative R&D initiative with EPA and USGS. The Department has been engaged with EPA and the USGS to determine top priority research projects, divide work responsibilities, and continue collaboration to share data and planning.

Petroleum Reserves

The Office of Petroleum Reserves manages the Strategic Petroleum Reserve, which provides strategic and economic protection to the Nation from disruptions in foreign and domestic petroleum supplies; the Northeast Home Heating Oil Reserve, 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 FY 2013 budget request of $195.6 million provides for the management, operations and security of the four SPR storage facilities with a combined capacity of 727 million barrels. It will also allow the relocation of the degasification plant to maintain SPR crude oil stocks at safe vapor pressure levels, cavern casing inspections and remediation as required to comply with state regulations and to assure storage integrity. The FY 2013 increase of $2.9 million reflects the moving of the degasification plant from the Bryan Mound site to the West Hackberry site; a capacity maintenance program; enabling SPR to regain the cavern volume lost to geologically induced cavern creep and an increased cavern remediation program. The increase is offset by no additional funding required for the Bayou Choctaw cavern replacement project and a reduction in security and power costs.

SPR receipts from the June 2011 sale totaled $3.24 billion and were deposited into the SPR Petroleum Account for the acquisition, transportation, and injection of replacement stocks. The FY 2012 Energy and Water Development Appropriations Act rescinded $500 million of the balances from the June 2011 emergency sale within the SPR Petroleum Account. The FY

2013 budget proposes to permanently cancel an additional $291 million of the balances from the sale from the SPR Petroleum Account.

Northeast Home Heating Oil Reserve. The Northeast Home Heating Oil Reserve was established in 2000 to provide an emergency stockpile of home heating oil to address the Northeast's vulnerability to winter weather shortages. 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 Northeast Home Heating Oil Reserve sold its 2 million barrels of high sulfur heating oil for conversion to ultra-low sulfur diesel (ULSD). The Heating Oil Reserve was concurrently reduced from 2 million to 1 million barrels. The 2012 Energy and Water Development Appropriations Act cancelled net sale receipts in excess of the cost to purchase 1 million barrels of ULSD and other related costs. The FY 2013 budget request provides for the storage and operation of a 1 million barrel reserve in the New England, with 500,000 barrels stored in Revere, MA and 500,000 barrels in Groton, CT. The FY 2013 budget request of $10.1 million continues operation of the Reserve, including the extension of the lease of commercial storage space. The request also includes a rescission of $6 million in prior year funds.

Naval Petroleum and Oil Shale Reserves. The FY 2013 budget request for the Naval Petroleum and Oil Shale Reserve program is $14.9 million. 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. The NPR-1oil field was sold in 1997 with residual requirements for equity finalization and environmental remediation. The Department continues to work on the cleanup and closure of its NPR-1 environmental remediation responsibilities. The Teapot Dome field (NPR-3) in Casper, Wyo., is the only remaining oil reserve managed by the DOE. NPR-3 is now a stripper field that also serves as an oilfield technology testing center (Rocky Mountain Oilfield Testing Center).

In April 2011, the Department reached a final equity settlement with Chevron for $108 million. As a result of that settlement, the Department is required under a State of California "Settlement Agreement" to compensate the California State Teachers' Retirement System for its longstanding claim to title of two sections of land within NPR-1. On August 3, 2011, the Department and the State of California agreed to a final payment of $15.6 million for the Elk Hills School Lands Fund. The President's budget requests $15.6 million in FY 2013 for the Elk Hills School Lands Fund.

In 2013, Fossil Energy plans to initiate a sale/disposition plan for the NPR-3 oil field, with final disposition of the property estimated to occur in FY 2015. NPR-3 will be utilized for production and testing operations in order to retain asset value during preparation to transfer to potential new ownership. Production facilities will remain operational as long as they remain economically feasible. The program will continue Rocky Mountain Oilfield Testing Center (RMOTC) testing for 100 percent funds-in projects and those projects wholly funded by DOE's Energy Efficiency and Renewable Energy's Geothermal Technology Program.

Environmental remediation of NPR-3 facilities will continue to facilitate the sale/disposition of the property in a manner consistent with an approved property sale/disposition plan.

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 environmental responsibility. The FY 2013 budget request will help maintain DOE's leadership role in addressing issues of energy and environmental security.

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. FRELINGHUYSEN. Well, Mr. McConnell, we could hear you loud and clear. I am not sure you need that microphone. You better push it away. So it is fine, I thought your statement was right on target. To Dr. Kelly and Mr. McConnell, I know we often invoke the future. What are each of you doing in your own way, in your areas of responsibility, to lower gas prices right now?

Dr. KELLY. Well, we are, of course, an integral part of the President's all-of-the-above energy policy. The administration is deeply concerned about the effect that gas prices or gasoline prices are having on families and businesses around the country, so we are pursuing things that can——

Mr. FRELINGHUYSEN. What sort of things? What are you doing now that could maybe give us a sense there might be some relief out there?

Dr. KELLY. Well, in the short term——

Mr. FRELINGHUYSEN. And more importantly, how is it reflected in your budget?

Dr. KELLY. Well, our budget is, of course, principally an R&D budget.

Mr. FRELINGHUYSEN. I realize that.

Dr. KELLY. And so we are looking at things that have—the things that are paying off now are things that we have invested in in the past. We have lots of things coming out of the pipeline all the time. One of the things that we are doing is——

Mr. FRELINGHUYSEN. Is there anything you have done in your recent history that is reflected in the price of gas and its production now?

Dr. KELLY. Well, we have a successful biofuels program that has—roughly 10 percent of the gasoline sold in the U.S. is now ethanol based. We are now moving toward cellulosic ethanol at a very rapid rate. We think we will have a competitive product there. We have done a lot of work on material for vehicles that have helped lower the weight of vehicles. And the very large gain in fuel economy that has been proposed in the recent fuel economy standards are made possible at least to some extent by the technology that we have developed to lower the weight of vehicles, and to make engines more efficient, and, of course, now to move towards electrification.

Mr. FRELINGHUYSEN. In your position, I assume people often come to you to get your opinion on an issue which is pretty critical to our constituents, how do we lower gasoline prices now. How would you react to that? How do we do that? I am going to ask the same thing to Mr. McConnell.

Dr. KELLY. Well, there is not a——

Mr. FRELINGHUYSEN. We understand, obviously, we have got the possibility of the Strait through Hormuz and things that have happened in the Gulf that shut down production, but is there anything specific that you would like to suggest that would help us reduce gasoline prices?

Dr. KELLY. Well, the——

Mr. FRELINGHUYSEN. In the short term.

Dr. KELLY. In the short term, you know, again, our operation is an R&D operation.

Mr. FRELINGHUYSEN. Yeah.

Dr. KELLY. So the impact we have had is based on initiatives that we have funded in the past. And I think we have had a significant impact on making fuel economy more efficient, making it possible to introduce alternatives to petroleum very rapidly here in the next 10 years. To me, the thing that we need to do is to have a sustained, predictable, and very efficient investment in R&D and moving these technologies out as soon as we possibly can, doing it in partnership with industry.

Mr. FRELINGHUYSEN. And in terms of gasoline production, is that reflected in your budget?

Dr. KELLY. That would be within the Fossil Energy Office. What we are doing is looking at ways of using electricity as a fuel, natural gas as a fuel, and, of course, biological resources as a fuel.

Mr. FRELINGHUYSEN. Mr. McConnell.

Mr. MCCONNELL. I believe a large part of current gasoline prices is concern about overseas speculation and a lot of concern about energy security. A big part of what we have focused our efforts on and really begun to launch is this whole concept of utilization of carbon dioxide in carbon capture utilization and storage. The concept of being able to take advantage of domestic oil supplies that we have here in this country through the utilization of CO_2 and enhanced oil recovery will go a long way toward improving our energy security, as well as creating jobs and other benefits associated with it, and not losing our mission of also permanently and safety storing CO_2 from coal fired, oil fired, natural gas fired power plants and commercial industrial facilities. That is one part of the mission that we have shifted. And I think to the——

Mr. FRELINGHUYSEN. If we were to give you $50 million to add to your portfolio, what would you do with those dollars to address the current high prices of gas? Could you do anything with those dollars?

Mr. MCCONNELL. Well, sir, I suppose if you asked me as a person if I had more in my checkbook at home to do more for my family or my neighbors or my church, I would tell you yes. And there are things that we have in our portfolio that are very important and we are enthused about. And if you are asking me if I could do more if I had more, yes.

Mr. FRELINGHUYSEN. I am asking you—you have a position, and, you know, you have a responsibility. If we were to add $50 million to your operation to address an immediate issue, how would you spend the money?

Mr. MCCONNELL. I would not change anything in our portfolio in terms of what we are doing. The activities, and the amount of demonstrations, and the continuation of the mission that we are on is strategically correct. And I believe that if we continue on that mission, we will go a long way toward addressing your question, as well as all of the questions associated with the all the above strategy. So strategically, I would not change anything. But if you are asking me if I could do more if I had more, surely I could.

Mr. FRELINGHUYSEN. So if we were to give you money, there would—nothing you could do in the short haul to address lowering gas prices?

Mr. MCCONNELL. The short haul that you are referring to would be the strategic alignment of what we have in our department

today, which I believe, in the short and long run, goes a long way toward improving our energy security and our supply of oil, natural gas, and the generation capacities that we have in fossil.

Mr. FRELINGHUYSEN. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Doctor Kelly, the Committee has been concerned over the multi-year grants that had become common in the Department's Energy and Science Offices. The practice not only inhibits programs from adapting to new technology and market conditions, but it also promises, most importantly to the Subcommittee, future money that your programs simply do not know will be appropriated.

To address the issue, in the fiscal year 2012 Appropriations Conference Report that was signed in the law, there was direction for the Department to transition away from these types of grants. The Department, in late February, announced a grant opportunity to lower the cost of solar energy called Bridging Research Interactions through Collaborative Development Grants in Energy. The grant announcement promises $9 million in grants, but the Congress has not yet appropriated $6 million of those.

In March, the Department issued a press release entitled Energy Department Announces $180 million for Ambitious, New Initiative to Deploy U.S. Offshore Wind Projects. Another March release said that offshore wind gets $180 million boost from DOE.

The problem is that only $20 million of that $180 million is actually available, and the rest depends on appropriated funds in future years. How and why was it decided to highlight these two programs with monies that have not been appropriated to the department?

Dr. KELLY. Well, we, of course, read the Committee report and take it very seriously and are in the process of transitioning to a system where we are going to be fully funding many—a much larger fraction of our program. The Committee report also did recognize that there were some areas where multi year funding was going to be essential. And we fully informed the Committee of our intention certainly on the offshore wind project. We are not going to be able to make the full transition in one year, but we are certainly moving as quickly as we can. Each program has a slightly different set of subprograms. But in terms of the offshore wind, we communicated fully with the Committee—certainly at the staff level.

Mr. FRELINGHUYSEN. Would the gentleman——

Mr. VISCLOSKY. Absolutely.

Mr. FRELINGHUYSEN. You know, last August you announced some sort of a biofuels initiative, is that right?

Dr. KELLY. With the Department of the Navy.

Mr. FRELINGHUYSEN. With the Department of the Navy, yeah. These sorts of announcements raise expectations here. We have to pay the bill here. You have not raised our expectations in terms of what the Department of Energy is doing relative to maybe some immediate issues like gas prices, but you seem to be coming out of a panic pretty quickly to sort of announce new programs without, shall we say checking to see whether we have the necessary appropriations to meet them. Back to you, Mr. Visclosky.

Mr. VISCLOSKY. Doctor Kelly, if I could follow up for one second. If we are short $160 million here on the offshore wind, and the De-

partment does not get the full request, have the staff thought about what the configuration of that project will look like?

Dr. KELLY. Well, the early stages of the project are the least expensive parts. And, of course, everything that—the competition makes it very clear that everything is subject to appropriation. So there are very clear stage gates in this project, and if funds are not available, we can stop.

Mr. VISCLOSKY. Okay. Also, relative to congressional direction, for the budget request for 2013, there are a number of initiatives in the budget documents from DOE that state they were started in fiscal year 2011. The 2013 request includes funding for the advanced grid modeling research and the innovative manufacturing initiative.

As you know, in fiscal year 2011, your program was funded under a full year of continuing resolution that prohibited any new starts without congressional approval. And I am not aware that the two initiatives that appear were begun in 2011 as new starts were ever communicated to the Subcommittee, nor approved by us. Were these two started in 2011 or am I mistaken?

Dr. KELLY. Well, I think that the grid modeling is a new program. The innovative manufacturing initiative funding was issued in 2012. Am I right on that? Yes.

Mr. VISCLOSKY. Okay. So I am mistaken. On the grid?

Ms. HOFFMAN. For the advanced grid modeling, we will be running a solicitation that should be coming out this year for the advanced grid modeling activity. The activities that were related were under the renewables integration and the work from our transmission reliability part of our organization, looking at the sensors and the analytics around visualization.

So we have existing activities that were funded under our transmission reliability line that were looking at sensors and how we will visualize system impacts.

But for the grid modeling activities, those activities will be funded by a solicitation that will be released this year.

Mr. VISCLOSKY. So, Ms. Hoffman, you are suggesting that the advanced grid modeling research was not begun in 2011?

Ms. HOFFMAN. Yes.

Mr. VISCLOSKY. And, Doctor Kelly, you are saying that the innovative manufacturing initiative was not begun in '11?

Dr. KELLY. No. The solicitation was issued in 2012.

Mr. VISCLOSKY. Okay. Mr. Chairman, I am done for now.

Mr. FRELINGHUYSEN. Mr. Womack.

Dr. KELLY. It did use 2011 funds.

Mr. FRELINGHUYSEN. So it does represent a new start? You started something without giving us a heads up, is that——

Dr. KELLY. Well, we issued this thing in 2012, and we are trying to use the funds available from previous years.

Mr. FRELINGHUYSEN. Mr. Womack.

Mr. WOMACK. Thank you, Mr. Chairman and thanks to the panel here this morning. In all three cases I want to thank you personally for the splendid cooperation you give me and my staff on these very important matters. I want to read a couple of snippets out of this morning's Wall Street Journal which will form the basis of a lot of my questions this morning.

And the headline says, Steel Finds Shale Sweet Spot. I don't know that you have seen the article, but let me just read a couple of snippets. Production for so-called tubular goods used for pipes, tubes, and joints in gas drilling has doubled in two years at U.S. Steel. With prices of natural gas down more than 35 percent to 2.21 a gallon, a pretty significant number when compared to a lot of our overseas competitors.

And after posting losses in the last three years, the company stock price, and in the interest of disclosure, I am not a stockholder, I am only reading, is up 13 percent in the last 3 weeks. And then the price of natural gas, down 35 percent in America, 2.21 a gallon, in Europe it is 11.25 and in Japan, nearly $16. Now help me out, Doctor Kelly. We have a crisis on our hands right now. An absolute crisis, and people in my district and across America are going to the pump and more and more of their discretionary income is being taken up by higher and higher gas prices.

The numbers and the basis of this article that I quote this morning, relates basically to stationary power for U.S. Steel. But with these kinds of price differentiations, if that is the word, it seems to me that we are missing an opportunity to harness an energy source. And I will come back to Mr. McConnell later about what the numbers suggest in so far as our long-term capacity.

But with these kinds of prices and this kind of supply availability, what is your vision for how natural gas fits in to the overall, all of the above strategy that this president seems to want to champion?

Dr. KELLY. Well, it certainly is fortunate that we have this resource. And again, we certainly share your sense of urgency about trying to make sure that transportation fuel stays as low as it possibly can. This metro gas is in fact a key element of this. We have discussed—well one of the things that is interesting of course is that we have been putting a lot of emphasis into domestic drilling and U.S. oil production is the highest it has been in eight years.

And in fact, imports is the lowest that they have been in 12 years. So we have been pushing very hard on this.

Mr. WOMACK. But we could do more.

Dr. KELLY. Yes, we could do a lot more.

Mr. WOMACK. So much more.

Dr. KELLY. So natural gas in transportation specifically, it certainly seems to make sense for heavy trucks. One of the things that we have been wrestling with is what the federal government can do to help, because the private sector, given those price differentials you have been talking about, has been very active. We know technically how to use natural gas in trucks and cars, so there is not really an R&D issue here.

It is purely a matter of getting the infrastructure in place. So I would say that what is going to happen fastest is that you are going to see truck fleet vehicles, fleet vehicles like taxis, and heavy trucks move towards natural gas quite quickly. But the natural gas is a wonderful addition for easy and expanded use of renewables because you can turn it on and off very quickly. So natural gas powered electricity generation and renewables is a nice combination.

Mr. WOMACK. Well, if I remember in the budget correctly, we have only allocated in this overall budget, Mr. Chairman, about $12 to $15 million toward this natural gas phenomenon. And I want to say, and Mr. McConnell you correct me if I am wrong, I want to say most of that money is dedicated toward insuring that fracking is environmentally friendly. Is that——

Mr. MCCONNELL. That is correct.

Mr. WOMACK. Is that pretty accurate?

Mr. MCCONNELL. Yes it is.

Mr. WOMACK. Okay. Now I have done a lot of budgeting in a previous lifetime, and usually you could look at someone's budget and get a clear idea of what their vision is. And in this budget, I do not get a clear idea that the vision is to harness this resource against the backdrop of our competitors overseas who do not have this capacity.

We do, and it is an incredible resource. And it is not just in my district, but it is all over this country. And I would like to know, what is our capacity long-term? What are the current projections as to how much gas there is, and if we were able to successfully harness it and make it important in both stationary and transportation power, how long could we sustain with available resources?

Mr. MCCONNELL. Well I would not do justice to the answer to your question with a projection. I could give you some ideas in terms of what is currently known today. And then there is another whole region of geologies that have not yet been explored and that potentially the proving of those additional reserves might answer your question quite a bit differently.

What I can say, is that I have heard the word fortunate used several times this morning about natural gas prices, and I think it is a combination of fortune, but it is also largely to do with the funding that the Department of Energy has had even back into the '70's when fracking was originally developed as a technology at The National Energy Technology Laboratory. And I could have sat here five years ago and everybody would have been certain that natural gas would have been $13 or higher here in the United States for the next 20 years.

And then this technology that had been developed in the '70's came about and we are in an incredibly fortunate position today. And that is through largely a lot of the development work that the DOE did along with industry. In terms of the future, the other thing we all know is, is it is a bad deal in energy to bet on any one thing. And having a portfolio for the future is incredibly important.

And so it is important that we continue to harness natural gas as you have described. I believe it is also important to continue to focus on ways to improve and help our domestic oil production and oil supplies. But in terms of the rest of our portfolio, renewable power, solar, wind, all of the things that we have in our portfolio, it is incredibly important for the future for anybody doing business planning to have a portfolio approach.

Mr. WOMACK. Okay. Mr. Chairman, I have got one more question, and I am going to give this question to Doctor Majumdar when he comes in on ARPA–E, because I think it has got an ARPA–E component to it because of the risk involved. And I am

going to throw this out on the table and any three of you, if you would like to comment, fine. If not, it is just in my mind. I know why the discerning public, using a normal gas-powered engine, cannot fill up, if you will, at home. I get all of that. That is loaded with complications.

But we are talking about electrification where you plug in a car at home and power it up so that you can get a certain amount of mileage around town. But I have got natural gas at my house. Is it possible with a little bit of investment, maybe in the ARPA–E area going forward, is it possible that we could develop the type of cylinder, if you will, that you could drive home at night, or I could drive into Mr. McConnell's neighborhood and knock on his door and say, hey I am running a little bit low, can I gas up here? Then we might have solved the infrastructure problem. So is that crazy?

Dr. KELLY. Actually, it is not crazy. It may be difficult, but it is certainly something that we have been looking at. And one of the dilemmas on putting natural gas in cars, is getting—as you said, getting the tank in. We have been working with ARPA–E on trying to find ways to make a pressurized tank that looks more like a conventional gasoline tank.

And some of these advanced materials that we have got like carbon fiber, will let you make more complicated shapes so you are not stuck with these big cylinders. Safety and other issues associated with actually letting people charge at home is challenging, but it is certainly not to say that it is impossible, and we are definitely looking at it.

Ms. HOFFMAN. I definitely think from the electric vehicle side, it is possible and folks are looking and doing—plug-in hybrids at home and looking at plugging and charging the car. The greatest opportunity is giving consumers that choice of what fuels, and being able to decide what fuels are most cost effective for them to use as they run their vehicle on a daily basis.

Mr. MCCONNELL. And I will go back the previous question that you—or comment that you raised. I think that environmental sustainability in the fracking industry today is not mutually exclusive from the ability to harness that energy supply for the future and make sure that people in neighborhoods and people down the street can live in an environment with fracking that is occurring.

And so a big part of our focus will be that sustainable and environmentally correct manner in which we are able to get natural gas and be able to enjoy that abundant resource that you have referred to.

Mr. WOMACK. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Thank you, Mr. Womack. Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman. I have a number of questions and I do not know what order to do them in. Let me start with you, Mr. McConnell. It has been a number of years—I am now in my 20th year of Congress, I am convinced that at least for the last 10 years, we have been talking about carbon capture, sequestration, and such. And yet, I have no real sense of what the progress has been.

Now you spoke in rather general terms about carbon capture, separation. You used sequestration and utilization. I think there were really three functions among those terms. One capture, one

which must include some separation, and then sequestration and how you store it, and then you also used utilization. And you said, I think, that there were options in which your office is involved for each of those, if I may use capture and storage and utilization as terms that I understand best.

Is there a plan for the research that is going on in your department that lays out what those options are and what the stages are of the research? So that sort of summarizes what the status of the research is in each of these areas, because each one of the options that you have—if you have five different options for capture in the first place, then each one of those might be used in one or more of the utilization modes that you are talking about, and also of the intermediate mode of separation, sequestrations, storage.

So is there some kind of a broad roadmap that one can see as to where those things are? I would love to see how much money we have spent on each of those and which ones seem to have the best prospects for the future. Now I do not expect you to be able to give me much of an answer other than is there such a plan and is it possible to see such a document that would show those factors?

Mr. MCCONNELL. Well, let me try to give you a halfway decent answer, if I could. I think any of us sitting here, 5–10 years ago, as a lot of the development went on in CCS, Carbon Capture and Sequestration, anticipation of climate legislation, etcetera, driving industry and many in industry concerned about sequestration of CO_2 from the atmosphere.

And as we sit here today, the absence of that legislation has caused us to look into other areas of CO_2 capture and sequestration and pursuing business-based opportunities to actually utilize that CO_2 in the sequestration. That is really the strategy that we have moved to and begun to shift to.

To answer your question, yes, there is a large portfolio of carbon capture technologies that is being explored in industrial applications, whether it is for stationary power, industrial applications, manufacturing facilities. All of these opportunities for us to bring in second generation and third generation technology through the R&D development to be able to lower the cost of CO_2 separation, and ultimately to be able to utilize that CO_2.

Just to digress just a little bit, the enhanced oil recovery industry has for years, utilized CO_2. But in today's environment, there is not enough CO_2 to continue to develop this industry at the pace in which it could make a meaningful impact to our domestic oil supplies. So now we have a business opportunity to drive forward in terms of developing this carbon capture technology for the future, for the purposes of not just enhanced oil recovery, but in the process of doing so, also to safely and permanently store this CO_2 through a process such as this.

Mr. OLVER. Well that is what I am looking for. I am trying to find out whether you have some sense of where we are in the sequence of how much research and development is required before there is a commercial end product that one can use in any of these. And I do not see how these options in capture and in storage and in utilization fit together at all.

Mr. MCCONNELL. Well in fact sir, what will be occurring—over the next several years, we are in the process of developing and ac-

tually constructing several of the large scale, commercial scale facilities that have been funded and we anticipate starting up those facilities by the 2014–2015 timeframe.

Mr. OLVER. How much money has been appropriated already to do this?

Mr. MCCONNELL. There was over $3.4 billion of——

Mr. OLVER. How much of that has been expended?

Mr. MCCONNELL. A small portion of it. As many of these projects in the stage gates that they are in are in the development stages. And so the ordering of the equipment, the installation of that equipment, and the purchases, we will see a large amount of that funding actually being spent over the next two to three years.

Mr. FRELINGHUYSEN. John, if we could go to Mr. Nunnelee in a minute, please.

Mr. OLVER. Let me—if I can write out a question properly that you can answer in detail, that would be great, with documentation. And I will try to do that. Let me just say that you mentioned at one point the issue of methane clathrates. Well there is an enormous amount of methane clathrates in deep waters and in the permafrost.

And there is so much and methane is so critical as a very strong greenhouse gas, that that one really deserves a lot of attention, but I do not think any—very much at all has been given to it yet. So let me just leave it at that.

Mr. FRELINGHUYSEN. Thank you, Mr. Olver. Mr. Nunnelee, thank you for your patience.

Mr. NUNNELEE. Thank you, Mr. Chairman. Mr. McConnell, you oversee the Strategic Petroleum Reserve. Just give me an overview. What is the function of that? And tell me how you manage the deposits and withdrawals of the SPR.

Mr. MCCONNELL. Several years ago, the United States made a commitment to the IEA to participate in a global capability for oil storage for the purposes of international disruption, whether they are weather-related, wars, disruptions as such. The United States maintains roughly half of the global supply of crude oil for those interruptions and we operate four sites along the Gulf Coast in Texas and Louisiana, where we utilize underground, large, salt dome cavern storage of crude oil. We have a nameplate capacity of 727 million barrels of oil, which is roughly 90 days of supply here in the United States for imported oil. And that is part of the responsibility that we have undertaken as a nation to the International Energy Agency. It is a responsibility that we have. Our department funds and oversees the day-to-day O and M, Operations and Maintenance of that facility, and projects associated with it, to keep it in a ready-to-run and safe and in a sustainable position so that when policy decisions are made to release oil or bring oil in, et cetera, we make sure it is ready to go and safely done.

Mr. NUNNELEE. All right, and you released 31 million barrels last year. Is that right?

Mr. MCCONNELL. Thirty, yes, sir.

Mr. NUNNELEE. Thirty, all right. And I keep hearing that you are considering releasing more this year. Is that something that is being considered?

Mr. MCCONNELL. It is being considered and our job at Fossil Energy is to ensure that if the decision is made, we will be ready to respond and if the decision is something different, we will be responsive to that, as well. And, so, our job at Fossil is really to have all of the facilities in a ready-to-go condition and safely operated.

Mr. NUNNELEE. All right, so, if it is being considered, what is the triggering emergency that is causing it to be considered?

Mr. MCCONNELL. Well, that could be anything. This past summer, of course, the Libyan Crisis generated an international response to the IEA that the United States responded to as part of an international reaction to that activity. As things move forward, those policy decisions and determinations are not made at Fossil Energy, but, certainly, we have a responsibility to be ready to respond however they are.

Mr. NUNNELEE. Okay. And then the 30 million that was released last year, has that been replenished?

Mr. MCCONNELL. No, sir, it has not. That money has been set aside and there is a repurchasing plan in place between 2013 and 2017 where that oil, over time, will be replaced, but we continue to maintain the caverns and the capabilities of that remaining oil to be able to respond. So, just roughly, rather than having 90 days of supply, today, we have approximately 80 days of supply.

Mr. NUNNELEE. Okay, so, the release last year lowered our availability by 10 days.

Mr. MCCONNELL. Yes, it did.

Mr. NUNNELEE. Or roughly 11 percent.

Mr. MCCONNELL. That and a combination of several other maintenance and project-related activity, today, we sit at approximately 81 days of capacity, yes, sir.

Mr. NUNNELEE. All right.

Mr. Chair, I will yield back at this point and go the next round.

Mr. FRELINGHUYSEN. Okay, thank you, Mr. Nunnelee.

Dr. Kelly, I want to just get back to one issue that I mentioned a few minutes ago. And grants from your Department of Energy Supply and Research Program I think we know when you make announcements, can affect nationwide markets. And I want to talk about that August 16 press release, where you touted the $510 million program, which includes $170 million for the Department of Energy to build jet biofuel refineries. This practice of putting out press releases when there is no funding attached to it, how do you explain why you do that?

Dr. KELLY. Well, this was a Memorandum of Understanding between the Navy, U.S. Department of Agriculture, and the Department of Energy, and it was a Statement of Intent to work together. Obviously, all three agencies had to work with their appropriations organizations in order to provide that funding.

Mr. FRELINGHUYSEN. There was not much enthusiasm on the Department of Defense side. The Navy was interested in it.

Dr. KELLY. Yes, but——

Mr. FRELINGHUYSEN. The committee on which both Mr. Visclosky and I serve on, Defense Appropriations, did not fully embrace the purposes for which you were signing that memorandum.

Dr. KELLY. Well, clearly, the memorandum depends on appropriated funds and——

Mr. FRELINGHUYSEN. Yes, I know, but I think there is a potential for affecting markets here, and I think there is a degree of inappropriateness here, and I think this is something which registers high on the irritation scale.

My second concern, and I am not sure we heard your last words, the issue of new starts, you issued on June 24, 2011, a financial assistance FOA, Funding Opportunity Announcement, for innovating manufacturing initiatives.

Dr. KELLY. Yes.

Mr. FRELINGHUYSEN. How does that not constitute a new start?

Dr. KELLY. Well, it was issued in 2012. Our intention was to send——

Mr. FRELINGHUYSEN. No, wait, wait. The issue date here is June 24, 2011.

Dr. KELLY. June 2011. Okay, I was just misinformed in that case.

Mr. FRELINGHUYSEN. Well——

Dr. KELLY. Okay, but our intention is to spend FY12 money——

Mr. FRELINGHUYSEN. Well, you spent 2011 money.

Dr. KELLY. No, this——

Mr. FRELINGHUYSEN. Fifty million dollars.

Dr. KELLY. If I am understanding this correctly, these IMI grants have not actually been funded yet. Well, the selections have been made. I was not aware that there was sensitivity about using FY11 money on it. If there is, we can sit down and discuss this with you.

Mr. FRELINGHUYSEN. Well, there is some sensitivity. Your budget calls for $100 million for the IMI and you are going to tell us a little bit about what it does in a few minutes, and we are a bit surprised to find out that half of this is to pay mortgages and awards first made with fiscal year 2011 funds. So, when Mr. Visclosky asked you was the IMA a new program in fiscal year 2011, you said no.

Dr. KELLY. I was mistaken about the date when it came out. But it is certainly going to be funded this year.

Am I getting this right? This is into a detail that—so, the funding will be FY——

Mr. FRELINGHUYSEN. The information we have—

Dr. KELLY. Yes, yes.

Mr. FRELINGHUYSEN. Is that you had spent 2011 funds.

Dr. KELLY. I have got to double-check this, but, so far, we have not spent any——

Ms. HOFFMAN. The awards——

Dr. KELLY. Yes, the awards are being made and if we are prohibited from using FY11 funds, we will certainly not use FY11 funds.

Mr. FRELINGHUYSEN. Okay, Mr. Visclosky?

Mr. VISCLOSKY. Just following-up on the Chairman's remarks here for a moment, relative to the program with the Navy, I think his concern is that those types of announcements can also move markets and lead people to make decisions in anticipation of events. There was an Energy Trade Journal article dated January 23, and I am quoting from it: "To get a commercial plant in operation, United Airlines and its partners plan to tap into the $510 million investment that the Departments of Agriculture and En-

ergy, as well as the U.S. Navy dedicated to advance to drop in biofuels in August."

In our earlier discussion, Dr. Kelly, you also referenced "stage-gates." Are those milestones when you use the term?

Dr. KELLY. Yes, they are places where you build certain performance expectations into these agreements and to say further funding is dependent on meeting those expectations.

Mr. VISCLOSKY. Are you moving in that direction as far as your grants and agreements with individuals that use federal monies?

Dr. KELLY. Yes, absolutely, and we are moving very aggressively in that direction and also really making sure that we have very effective program management so that we follow the progress in each one of these very carefully and make sure that when they claim that they have made a stage-gate that they actually have.

The one thing I would like to say on the Navy agreement, one of the things, that if we are actually going to be getting drop-in fuels for the Navy, the Navy cannot use ethanol. They need really a substitute for the jet fuel and for diesel, and we are trying to find a way to accelerate the introduction of the fuels. Of course, the airlines need the domestic—there are a lot of other domestic uses for this. If you can move from an alcohol fuel to something that is a direct substitute for jet and diesel, that is a huge breakthrough and we think we are poised on being able——

Mr. FRELINGHUYSEN. Will the gentleman yield?

Mr. VISCLOSKY. Yes.

Mr. FRELINGHUYSEN. Is it financially feasible? And the question might be asked: Why has the commercial sector not invested in it themselves or have they?

Dr. KELLY. Well, because of the Recovery Act, we have a number of commercial and pilot-scale operations underway. We expect the information from that to allow us to move to a much larger scale fairly quickly, and that was what this project was intended to do. It is very risky. One of the things about energy markets is the uncertainty makes it very difficult for investors to take very big risks——

Mr. FRELINGHUYSEN. Well, that is all the more reason not to be announcing things before we really have things nailed down.

Dr. KELLY. Well, it was to demonstrate first of its kind production of this stuff. It was, in fact, not funding a commercial operation, it is to invent a commercial operation, and, so, we are working with USDA on developing new feedstock supply chains and Navy would be——

Mr. FRELINGHUYSEN. We want to make sure, if the gentleman will yield, that it is financially feasible here.

Dr. KELLY. Yes. Well, we are saying it only makes sense if it is economically-competitive with conventional supplies of jet fuel and diesel.

Mr. FRELINGHUYSEN. Is it?

Dr. KELLY. Not now, but——

Mr. FRELINGHUYSEN. It sure is not.

Dr. KELLY. No, it is not, and that is the reason that we are doing this development work and——

Mr. FRELINGHUYSEN. I thank the gentleman for yielding.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Dr. Kelly, my sense is historically the department has used bilateral agreements on these milestones where both parties would have to agree for a termination. My understanding is you are going more in a direction with these stage-gates milestones, that if certain criteria are not met, then unilaterally, the government can terminate these agreements.

Dr. KELLY. Yes, and this is understood by the recipient at the beginning that if they do not meet the mark there, we have to make a tough decision.

Mr. VISCLOSKY. I, for one, appreciate you moving in that direction and I encourage you.

Dr. KELLY. Thank you.

Mr. VISCLOSKY. On mechanical insulation, buildings are responsible for about 40 percent of U.S. energy demand, and in the Fiscal Year 2012 Appropriations Conference Report, we had language encouraging the Department to continue working with the industry relative to the use of mechanical insulation as a means of energy efficiency and job creation. Currently, the Industrial Technologies Program has partnered with outside groups to execute a mechanical insulation campaign.

Besides that campaign, what other plans are there in EERE to promote energy savings through mechanical insulation?

Dr. KELLY. Well, we have been working with people that help train people in installing this material. We have several programs that are encouraging retrofits of existing industrial facilities in particular to upgrade their plants. There is something called the Industrial Assessment Centers, which take teams of engineers and students in to help develop proposals for small and medium-sized businesses to upgrade their facilities, and, often, the recommendations will include this kind of insulation.

Mr. VISCLOSKY. With encouragment in that regard, I just think many of these issues are unseen by the general public, but can translate into great energy conservation.

One other question, if I could, Mr. Chairman, for this round. Dr. Kelly, my question is about waterpower. My understanding is the fiscal year 2013 request would reduce funding for research and development in this area by 66 percent. Why?

Dr. KELLY. The reductions are primarily in conventional hydropower, and we have done a fair amount of work on the technology of turbines, particularly fish-friendly turbines in the past. Getting these things used is the most important activity. So, we are trying to make sure that we are doing work on identifying where you could upgrade facilities or where you could put power plants on existing dams that are not powered. That is much less expensive than doing the research. We are swinging the pendulum towards marine and hydrokinetics, which are more of a technology issue, which is, of course, our comparative advantage. So, we are looking at tides, waves, and other technologies in the water area.

Mr. VISCLOSKY. For that section of your water power budget, would that be an increase in funding as far as research dedicated to it?

Dr. KELLY. I believe it is about equal to last year. I could look that up and get back to you, but it——

Mr. VISCLOSKY. Yes. Are there other possibilities as far as inland waterpower besides dams specifically? Because, to be honest with you, being an accounting major, you never thought about various types of turbines and lifts and buoys and the oceans. Makes a lot of sense to me once somebody acknowledges it. Are there other things people are looking at as far as inland water systems?

Dr. KELLY. Some of our projects, actually, we have funded last year looking at things in rivers, canals, and other inland areas.

Mr. VISCLOSKY. Okay.

Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Thank you.

Mr. Womack.

Mr. WOMACK. I want to go back to vehicles for a minute. I will stay away from natural gas. I think I made my point there.

Secretary Hoffman and Dr. Kelly, the budget request puts a large emphasis on energy storage research and in particular on batteries. These are important technologies for the energy sector and could be vital in manufacturing, but there are significant risks that most advanced batteries invented through your programs end up being manufactured overseas. So, let us not forget that while we invented the lithium battery used in most portable electronics, that most manufacturing for these projects has been moved offshore in the last several decades.

So, what can you do to ensure that the innovations that we are developing here in this country lead to manufacturing jobs here in this country?

Dr. KELLY. Well, thank you. First of all, actually, the lithium ion battery manufacturing, we are hoping is a success story. We had almost lost that business completely, but because of the Recovery Act, we are able to make significant investments in domestic manufacturing. There is now a very active lithium ion battery manufacturing enterprise in the U.S. We are going to have to make sure that we continue to maintain this and grow it, but the general point you are making is one that we care about very deeply, that we are frustrated by seeing American-developed technology ending up creating production jobs overseas.

There are several things we can do. One is in the case of clean energy technology to make sure we have a high demand for it and the president has called for a national clean energy portfolio standard that would certainly help. We have a 48C tax incentive that is designed entirely to try to encourage investment in domestic manufacturing.

And, in our case, we have been trying very hard to work with industries in a way that would encourage them to build their prototypes and their first plants here in the United States. We have something called the Affordable Manufacturing Initiative that is trying to get production back in the U.S. It is a place where we had a 40 percent market share a decade ago and it is now 4 percent. So, we really need to jumpstart domestic manufacturing in that area.

So, as you may know, there are certain restrictions on what we can do with intellectual property, but within those restrictions, we are trying to be as creative as we possibly can to encourage any of our recipients to produce domestically.

Mr. WOMACK. Secretary Hoffman.

Ms. HOFFMAN. And I would echo what Dr. Kelly started for our activities. We are looking at energy storage system for the bulk power system. So, we look at flywheels, batteries, flow batteries, different energy storage in support of the electric system and we do as much as possible to encourage manufacturing within the United States, and, of course, that the deployment of the product is directly related to the electric system asset.

Mr. WOMACK. And then my last question is: I have a company in my district that staff of DoE's have visited in the past, Arkansas Power Electronics, which I guess part of its genesis came out of ARPA-E. But it produces a silicon carbide electronics component used in electric vehicles and it is a very impressive facility. It is a source of a number of jobs in my district.

As EERE looks kind of toward the future on the Vehicle Technologies Program, knowing that I think, if I remember in the budget correctly, about 40 percent of the Vehicle Technologies Program was electrification, Where do you see the silicon carbide component these technology solutions?

Dr. KELLY. So, in the electronic program, obviously, batteries are the best cost driver and they are a significant portion of what we are doing, but we are also looking at power electronics and control systems where these silicon carbide devices would be very crucial to getting high efficiencies and low cost and low volume. Of course, we are also looking at efficient electric motors. But the silicon carbide is also a key part of our Program because the power electronics associated with turning the DC, the solar cells, into AC that we can use goes through an inverter and the inverters would benefit enormously by the advances in silicon carbide technology.

Mr. WOMACK. So, it has a place.

Dr. KELLY. It has many places.

Mr. WOMACK. Okay. I yield back, Mr. Chairman.

Mr. FRELINGHUYSEN. Thank you, Mr. Womack.

Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman. Ms. Hoffman, you deal with the electricity grid, essentially, with General Power and the quality of the grid. Now just for clarity, conventional water power would probably be in your portfolio then, I take it, because we do produce a lot of electricity that generally goes into the grid through the conventional land-based power system.

Ms. HOFFMAN. Actually our efforts are generation technology neutral. So what we do is actually look at the system to ensure the system is flexible to accept any form of generation. And then our goal is actually to look at how do we optimize that generation portfolio, so we have an efficient system. So hydropower was originally under the energy efficiency program. We do not do generation technologies under our portfolio.

Mr. OLVER. Okay. All right. I continually get confused as to who's got what in their portfolio. To you, my sense is that natural gas fired turbines and coal fired turbines and nuclear fired turbines, nuclear powered turbines all produce at least 10 percent; 20 percent in the case of nuclear and 50 percent within coal. And water powered, what is the water power amount in what presently is our grid electricity?

Dr. KELLY. I will give you the right number but it is in the order of 8 percent.

Mr. OLVER. Eight percent? All right. So that is the fourth one. At first I did not have the water power component and should have. But there are at least four major components that get you to that kind of percentage. Oil is now below that, I think, by a good deal.

In the case of renewable energy, let me switch over to you, Dr. Kelly. The major things in renewables seem to be your sea-based research and development issues in water power. There is wind. There is solar. There is geothermal. There is biofuel, but biofuel really is mainly in transportation. That would not get into grid, particularly. That is not a grid-related issue.

Dr. KELLY. It is a little bit of biopowered——

Mr. OLVER. Yes. Well there are a few burners that do that. But I do not think that we ever expect that the accumulation of wood burners is going to get up above the one percent. Do all of those have a potential to produce, all the ones that I have talked about, have a potential to produce one percent or more of renewable energy?

Dr. KELLY. Well, absolutely. This is the core of the all-of-the-above strategy. And of course, the big new contributor in the last few years is, it has been on-shore wind. Something like 35 percent of all capacity added in the last three years has been on-shore.

Mr. OLVER. We are above one percent on on-shore wind.

Dr. KELLY. Definitely.

Mr. OLVER. We have almost no off-shore wind yet.

Dr. KELLY. Well, we have zero off-shore wind, to be exact.

Mr. OLVER. Okay. Well on-shore and off-shore wind are a little bit like a separation between on-shore water power and off-shore water power, in a sense. And my real question is sort of similar to what I asked Mr. McConnell earlier, which is, is there a document, a planning document—it could be fairly long, I suppose, that gives a sense of what the expectations might be, what the status is for the research and development on each of these programs, and if each of these programs has significant subprograms that are a significantly different path in the way you have to function? Some of them might take years and years and years, and some of them are fairly close. Is there a document that summarizes that so that one can see what it is that is in our overall portfolio? What should be in our minds, or if we were trying to think comprehensively about what looks to be available in renewable energy?

Dr. KELLY. Yes. Of course, there is the official forecast, the annual energy outlook by the Energy Information Administration that has their view of this. We have also done some internal planning work to say if we succeed in meeting our technology goals.

Mr. OLVER. Well a critical component of that would be, just where are we now at this stage of commercialization as to what the cost is per kilowatt hour, or whatever. We sort of know what it is for coal fired or natural gas fired or nuclear. Though in the case of nuclear, it is quite a bit of subsidization so it is a little hard to be certain whether you are getting it all. Is there something that brings that aspect in, the cost now and what our prospects for how long it is going to take to bring that cost down to the level of oth-

ers? And does it also include with it a sort of life-cycle costing program for what one has to think about over a 50-year period, since most of these facilities are going to last that long? Do you have a document that would do it?

Dr. KELLY. Well we have the information you need. In fact, some of it is actually summarized in the budget document. You will see these curves. And what these curves are doing is saying, what is the cost of electricity from the technology of today and what do you have to do to get to the end point, and how long do we think it will take to get there.

Mr. OLVER. The budget is a very long document. I will pass.

Mr. FRELINGHUYSEN. You are going to pass the baton onto Mr. Nunnelee, are you?

Dr. KELLY. Yes. Yes.

Mr. OLVER. Certainly.

Mr. FRELINGHUYSEN. Thank you very much, Mr. Olver. Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman. Dr. Kelly, I understand you are looking at regulating decorative gas fireplaces and log sets. Just give me an update on the status of that rule.

Dr. KELLY. Well we are sort of proud of the way we are setting rules like this. We have a very open process. We take comments. We have gotten comments. I believe that this is now a matter of litigation, so it is a little difficult for me to talk about it. But all I can do is assure you that the comments of all parties are being very carefully considered and we are going to have to wait for the outcome of this litigation.

Mr. NUNNELEE. You used the term proud. What does that mean? What does that imply?

Dr. KELLY. That means that we have a process for setting standards that is based on the best available data that is reviewed by experts. It is completely transparent and open. We get public comment and we have a process of adjudication that we think has worked very well.

Mr. NUNNELEE. I understand your hands are tied if it is in litigation. I just want you to give me your assurance that you are working with all parties. I am not sure how you come to the conclusion that these are heaters, but I will be anxiously following your progress on that road.

Dr. KELLY. Okay. I know that there are many opinions on this subject, and they are certainly all being fairly considered, is the one thing I can assure you.

Mr. NUNNELEE. All right. Also the 2012 report language included a commitment to manufacturing from this committee, including an investment of $12 million for state manufacturing improvements. And I just want you to give me your assurance that in FY2012 we are spending $12 million for solid state manufacturing improvements in your budget.

Dr. KELLY. If you told us to do it, I will assume we are doing it, but I would prefer to make sure that I double-check this with our guys.

Mr. NUNNELEE. Okay. Can you do that and get back with me?

Dr. KELLY. I will definitely get back to you with it.

Mr. NUNNELEE. All right. That is all I have, Mr. Chairman.

Mr. FRELINGHUYSEN. It is good to know what you are doing. Yes. Thank you. Mr. Fattah.

Mr. FATTAH. Thank you, Mr. Chairman. Let me apologize for being late but I had a cyber security briefing having to do with my other responsibilities on CJS. But I am here and I thank you for holding this hearing. And I want to thank all of the witnesses for the extraordinary work that the Department is doing, even in the face of a political dynamic that is unfortunate and not really focused on I think the real challenges, so let me try to set this up.

The European Energy Alliance has just announced in the last couple of weeks that, based on the efforts of what is being done here in the United States, that the European Union, in order to compete economically has to now invest in renewable energy and energy efficiency. They have set up a series of goals related to 2030 because they say that, given the emphasis that has been placed here, it is the only way their industries are going to be able to compete.

And, you know, I have been around. I have seen the fuel cell. I was out in New Haven, Connecticut visiting a new supermarket construction where they are using fuel cell technology. And, as you know, many new supermarkets are using fuel cells and they are very energy inefficient, generally. But now with the fuel cells, they can operate these supermarkets, which require a lot of energy.

And right in the Philadelphia area, Bloom Energy has now hired over 1500 people in a plant making fuel cells. UTC is making fuel cells. All of this is a result of the investments that you have made. And we have seen the same thing with industry in terms of trucks, based on investments made.

I went out and visited the Argonne Lab in Chicago, which is focused on batteries. And I know that these batteries have been licensed by the Department to the private sector and that they have a capacity that ranges between 100 and 300 times more than the normal batteries. So I think that a lot of work has been done.

I have been a big proponent of the renewable energy sector. Notwithstanding that, I mean, the Department has been working this term of art on all of the above, you know, the new nuclear plants that have now been licensed for the first time in 30 years, and on and on and on.

The politics of this, I cannot figure out. I mean, we are competing economically with China and the European union and others. I would like you to speak a minute about what our competition is doing in this regard and how you see our efforts relative to this competition for the kind of quality of life that Americans expect as a global leader, vis-a-vie, what our competitors—and we are fine with competition but it should bring the best out of us. So talk a little bit about what you see internally.

Dr. KELLY. Well countries all around the world understand that clean energy technology is a place that is going to be driving growth and they want their share of that growth. And places like China have made an extraordinary investment in capturing key parts of these markets. They have been pushing for manufacturing of photovoltaics for efficient lighting. Now they are getting into electric vehicles, and so we are, of course, very concerned. And the Europeans are also very active.

If you look at something like off-shore wind, there are major projects in Denmark, in Germany, in Korea, in Japan and China. So we think that we can out-innovate these guys but it is going to be tough competition. Of course, there are very aggressive government programs in many of these countries.

Mr. FATTAH. So the largest wind farm is now in Honduras? And you also have activity in South America. And on this front you have a lot of activity. So I just think that the community and we as a country should be aware and I think the committee is aware. I know the Chairman is because we have had a chance to visit some of these national laboratories and see the work. It is critically important that we make these investments because we are not shadow-boxing. And it is a cost to our industry if energy costs more here. I met with a host of CEOs of chemical companies in Philadelphia, which happens to be the home of a large share of the chemical industry, yesterday.

We were talking about how—because of the low cost of energy, mainly through natural gas and other vehicles, that they are able now to bring a lot of these jobs back home that had been outsourced. And so I think it is very, very important as we go forward that we keep in mind that the investments we make now are not just investments, vis-à-vis, what we can see clear to invest, but also relative to what our economic competitors are investing, and what it means if we lose this competition, if we lose the competition on batteries for vehicles.

The belief among the experts is that we would also lose the car industry itself. Whatever country wins on developing these batteries, that is where these cars are probably going to end up being made. And this is a competition that will impact not really many of us, because we are kind of over-the-hill or headed that way, but for our grandchildren and their quality of life, it will have a big impact. So thank you for the work that you are doing and thank you for your appearance, and I thank the Chairman.

Mr. FRELINGHUYSEN. Thank you, Mr. Fattah. Do you agree with Mr. Fattah's contentions that things are happening abroad that should concern us? And let us just focus for a few minutes on the American solar industry. How would you describe its state at the moment?

Dr. KELLY. Well, as I said, we had 40 percent world market share about 10 years ago and it is now 4 percent. We went from 40 percent to 4 percent. It is now around 4 percent, so we are very concerned. And, of course, we are now coming out with a new generation of technologies, technologies that are very efficient, a new generation of thin films and other things. And we are trying to make sure that all of these new technologies are going to be produced here, and we are making every effort to do that.

Mr. FRELINGHUYSEN. So we commend you for that. How do you actually protect that intellectual property?

Dr. KELLY. Well, you know, there is a Bayh-Dole Act which puts pretty clear guidance to what the——

Mr. FRELINGHUYSEN. Well, you are aware, obviously the Department of Commerce has announced new rules to address this sort of a subsidy issue, but what about the greater intellectual property issue here?

Dr. KELLY. Well in the case of Bayh-Dole, the smaller companies and the universities are given a hundred percent of intellectual property. That is just in the statute. And the idea was, you do not want the feds holding it; you want the private sector to have it.

Mr. FRELINGHUYSEN. We are not against That.

Dr. KELLY. Yes.

Mr. FRELINGHUYSEN. But I am just saying how do we actually maintain it here. Both Mr. Visclosky and I and every member of this committee are interested in what we could do to promote manufacturing jobs here and keep them here. Is that a pipe dream or what?

Dr. KELLY. We share your concern. And as Mr. Womack was pointing out, trying to find strategies for keeping this production in the U.S.——

Mr. FRELINGHUYSEN. So what would you suggest would be the strategy?

Dr. KELLY. Well, one thing is certainly to make sure that we have got a very strong domestic demand for clean energy technology and——

Mr. FRELINGHUYSEN. Which we do.

Dr. KELLY. Which we do, a lot of states have various kinds of renewable or clean energy portfolio standards. Getting a national one, we think would help the 48(c) tax credit, in our view, very successful in encouraging domestic manufacturing investments here in the United States.

Mr. VISCLOSKY. Which tax credit?

Dr. KELLY. It is called 48(c). We requested actually $5 billion for this, if I am correct. This is part of a program that was in place two years ago. I believe it was part of the recovery act, but it gave——

Mr. VISCLOSKY. Was that used to import windmills?

Dr. KELLY. No, no. This was to give tax credits to companies that build factories in the U.S. And it was solar factories, wind factories and——

Mr. FRELINGHUYSEN. How would you characterize where those factories stand today? We have made these investments. I assume you are familiar with how successful they have been.

Dr. KELLY. Well it is a little difficult to do a survey since it was a tax and went through IRS, but we are trying to track them down and make sure that we understand the effects. Of course they do not get the tax write-off if they do not do anything.

Mr. FRELINGHUYSEN. But collectively, certainly, the Department must have a pretty good idea who is out there. I mean, New Haven was mentioned. I think Connecticut has an indigenous fuel cell company, I assume.

Dr. KELLY. Right.

Mr. FRELINGHUYSEN. There used to be five or six that I was familiar with. So you have an overview of the landscape here?

Dr. KELLY. Well on that particular program I know they are collecting data. Exactly where it is, I will have to get back to you. But I know we are——

Mr. FRELINGHUYSEN. No. I wonder, because if we are going to match what you are doing to what is out there, it might be good to know what is out there.

Dr. KELLY. Well we are trying to track down—as I said, trying to work through the IRS to collect this information.

Mr. FRELINGHUYSEN. Yeah. But in reality, the Department of Energy is pretty good at coming up with—I forget what that component is—a lot of energy information, for that portion of your operation. I am sure some people would like to eliminate it, but in reality I like the idea.

Dr. KELLY. Well in this case we are trying to go out and contact the firms and find out exactly what is happening.

Mr. FRELINGHUYSEN. Well let us maybe work on that. I just want to focus for a minute. Our committee has been very supportive of the mission and goals of the Industrial Technologies Program. Every year we seem to undergo some sort of name change but now it is renamed the Advanced Manufacturing Program. But whatever it is called, we are supportive of things that strengthen American industry and manufacturing, and there is a lot more to be done on that front.

But setting the goals aside for a moment, I would like to discuss the implementation. We have serious concerns about the proliferation under the program of the last two years of a variety of different centers, all of which must require some sort of physical and permanent space.

In the last few years, within just the Advanced Manufacturing Program, the Department has established clean energy applicant centers, industrial assessment centers, manufacturing demonstration facilities, advanced manufacturing clusters and an energy innovation hub. To say the least, I have serious concerns about the out-year commitments that these centers require, a commitment which is $141 million in fiscal year 2013 for a program that had $160 million appropriated in the current year. This raises serious concerns about the propensity to start centers here, this issue of raising expectations. So I would like for you to comment on these different centers, first the Industrial Assessment Centers. Tell us a little bit about—you have, I think, $6 million in there?

Dr. KELLY. Mm-hmm.

Mr. FRELINGHUYSEN. Tell us about how many there are when you first asked them for them in your budget request, when they were established, how long we anticipate they are going to be around.

Dr. KELLY. They have been around for a number of years, I believe over a decade. What these are——

Mr. FRELINGHUYSEN. So how many are there?

Dr. KELLY. I do not know off the top of my head.

Mr. FRELINGHUYSEN. Could somebody in back of you maybe provide us with that information? Because I am going to ask you about the manufacturing demonstration facilities, which you devoted $28 million for those in fiscal year 2012 yet they are not mentioned in your budget request. So maybe we can put some meat on the bones here.

Dr. KELLY. Certainly. Well, the clean energy application centers were——

Mr. FRELINGHUYSEN. Well, what about the industrial assessment centers, the manufacturing demonstration facilities and then

maybe give the committee some information on the clean energy application centers.

Dr. KELLY. All right. The new facilities are the manufacturing demonstration facilities. The other ones have been in place for some time.

Mr. FRELINGHUYSEN. They are new but they are not mentioned in your budget?

Dr. KELLY. They are an implementation of the program that we described in the budget. Our thinking is that we have developed some very specific ways of implementing what we said we were going to do in there. So there are three concrete, three specific things that we are going to do that account for most of the growth.

Mr. FRELINGHUYSEN. Well, where are they going to be and how long—are they going to be around indefinitely? Here we obviously have set them up.

Dr. KELLY. Well, let me go through the new ones. As I said, there are a number of these things that have been created by statute and we are continuing that have been in the program for some time. The industrial assessment centers are university based. They train students. They do audits and retrofits for small- and medium-size businesses. They have been very successful from our point of view.

The clean energy application centers were established primarily to look at——

Mr. FRELINGHUYSEN. How much money do they get now?

Dr. KELLY. I would have to look that up.

Mr. FRELINGHUYSEN. Does anybody know?

Dr. KELLY. Yes, I can look it up. I just do not have it in my hand.

Mr. FRELINGHUYSEN. Okay. Well, let us start on the advanced manufacturing clusters. After some inquiry, the Department tells us that you would like an increase of funding for them from $6.7 million to $20 million, but your official request documents do not mention them at all. Can you give us some information on them?

Dr. KELLY. Certainly. There are a number of questions on the table so I can start going through them.

Mr. FRELINGHUYSEN. Yeah, there are and so we need just some basic facts on all these centers.

Dr. KELLY. The ones that have been existing are the clean energy application centers and the industrial assessment centers. Those have been—those continue and I can go into the details of the budget and find out what they are. The new things that we are proposing here are first a program that is going to be looking broadly at innovative proposals and research on advanced manufacturing and advanced material. And I can give you some examples of those, but these are things which both help improve the efficiency of the manufacturing process itself—and about 30 percent of our energy goes into manufacturing so it is energy, productivity, and manufacturing—but also driving down the cost of clean energy products is what we do throughout our organization. So we want to get cheaper lighting, cheaper photovoltaic, cheaper wind machines, cheaper batteries, and so on. All of that is a manufacturing or a lot of it is a manufacturing issue.

Mr. FRELINGHUYSEN. So where does the critical materials hub come into this?

Dr. KELLY. So the critical materials hub is a new proposal. It is funded in the FY12 budget. We will be putting out a solicitation for that probably within a month.

Mr. FRELINGHUYSEN. The issue here is that we have got all these centers and I am sure there are some remarkable people that are working to make them successful and would work to make the new ones successful, but I think we are going to find ourselves in one heck of a budget squeeze here. What would be your priorities in the overall—in this sort of a budget environment?

Dr. KELLY. Well, the critical materials hub——

Mr. FRELINGHUYSEN. We have to have some priorities here.

Dr. KELLY. Right, exactly, and we plainly show in the budget that we think manufacturing is a priority. This has come out of the concern of the entire administration and Congress. And we had a big commission put together by the President's Council of Advisors on Science and Technology that made a bunch of recommendations. They set up this panel that is chaired by the president of MIT and Dow that has been looking into this in detail and has had hearings around the country. So that is where this came from.

Mr. FRELINGHUYSEN. I think we value that contribution from the private sector and academia, but there seems to be an over-commitment here and I just want to make sure we do not raise expectations. That is related obviously to——

Mr. WOMACK. Will the gentleman yield?

Mr. FRELINGHUYSEN. Yes.

Mr. WOMACK. Do these programs ever go away?

Dr. KELLY. Yes, programs go away all the time.

Mr. WOMACK. These centers, these hubs, I mean, as technology changes, as emerging technologies—as evidenced by the line of questioning this morning—things now become important, rare earth, et cetera, et cetera. Do they take the place of other programs that have previously been authorized and funded by Congress?

Dr. KELLY. Well, the increase that you see here is not just building on the, perpetuating everything we were doing before. We cut a lot of things out to do this. For example——

Mr. WOMACK. What have you cut out—and maybe provide that for the record?

Dr. KELLY. Conceptually what we are doing, for example, in biomass we are moving from ethanol to drop-in fuel. In wind we are moving from onshore to offshore. In batteries we did nickel metal hydride batteries for a long time. They are now successful in commercial. We just declared success and got out of that, and we are now doing lithium. And a few years from now, we will move from lithium to something else.

Mr. FRELINGHUYSEN. Something else. Mr. Visclosky.

Mr. VISCLOSKY. I would like to follow up in just a bit of a different fashion on the comments my colleagues, including the chairman, have just touched upon. And it gets back to the issue of manufacturing where we have gone from 40 percent to 4 percent relative to solar as I understand the statistics. I, too, am very concerned about the proliferation of centers at the Department. We have got 46 frontier research centers. A colleague asked if we ever get rid of anything. We have three bioenergy research centers. We have a genome institute. You know, 13 independent programs with-

in your jurisdiction itself. And we went from 40 percent to 4 percent on solar, and we are spending hundreds of millions of dollars a year, billions of dollars a year, on research for energy in the United States of America. When asked by the chairman what we are doing to keep this intellectual property and these jobs in the United States, you mentioned that we need to ensure we have demand for this energy. I agree with you. And to an extent, the government has a role in developing that demand by buying the energy. But that is an external demand. You mentioned the 48(c) tax credit. That is not within your purview, although I understand you support it. That is terrific.

You also mentioned collecting data. As I like to tell my colleagues sometimes, we have been dialoguing with the Chinese on steel forever. Now they make four times more tonnage than we do, and we have been dialoguing. We are going to dialogue ourselves to death. And now we are collecting information.

If you could for the record, with solar—because we are at the end of our game now on solar and we are going to have more questions on solar tomorrow and batteries, there has been a lot of emphasis on batteries—if you could just concisely, simply, bullet-point what are you and your department doing to make sure all of this money we are spending stays here in jobs? I do not want to hear about green jobs. I am sick of green jobs. No, it makes me sick. I tell people I am going to talk to the Secretary in a minute about it. My green job is the United States steel industry using 30 percent less CO_2 since 1990 to make a ton of steel. That is a lot of trees. That is my green job. So I would ask for the record, besides the tax credit, besides increasing demand, besides collecting information, what are you doing to make sure we do not lose batteries and we do not lose that last 4 percent for the record?

Now talking about the various centers and hubs. Secretary Hoffman, there is a proposal this year for an energy innovative hub. We have five. You have made a request for another one. This is different in that as I understand it there would be multiple hubs. Will they be called hublets?

Ms. HOFFMAN. I said regional hubs.

Mr. VISCLOSKY. Hublets, sub hublets?

Ms. HOFFMAN. If you like the term hublets, but we are calling them regional hubs.

Mr. VISCLOSKY. Regional hubs. Besides New Jersey and Indiana, where does the third one go?

Ms. HOFFMAN. We will be running a solicitation so the hubs will be determined by a solicitation.

Mr. VISCLOSKY. All kidding aside, why do you need three? Why do you need three physical locations?

Ms. HOFFMAN. Actually we are looking at two to three, but it reflects the regional nature of our electric grid. In different parts of the country, we have different generation resources. So the generation mix in the southeast is very different than the generation mix in the west. We have different markets and policies that are being implemented differently across the United States. PJM is a market whereas in the southeast they operate under bilateral agreements. There are different state policies. So what we wanted to do with the regional hubs was to actually build upon some of those local

differences, to say how do we advance the electric grid in modernizing the grid, looking at data that we are getting in those regions, looking at the capabilities of how do we deal with cyber security in each of those regions considering the mix is different, the technology is different, the architecture is different. So we recognize that there are differences in the regions, but we want to pull that together and make sure that we can do a national effort.

Mr. VISCLOSKY. You cannot, with all the scientific knowledge we have at the Department of Energy, do that from one location? As my colleague from Pennsylvania, I am over the hill. I do not telecommute, but I understand a lot of people in the federal government do that. And a lot of research is done through the Internet and video conferencing, and you think we need two or three centers to do this?

Ms. HOFFMAN. We need two or three centers to reflect the different nature of the regions in the United States. There are parts of the centers that we can pull apart and do nationally as we look at demand response and the impact of demand response nationally. But we need those centers to really identify those regional differences. The wind integration and the renewables are primarily in the west. The east deals with a different generation mix and a different market and policy structure that has to be tailored to the needs of those regions.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. MCCONNELL. The pipeline is set up to deliver oil to distribution centers, most probably in the Cushing, Oklahoma area and ultimately end up in regional refineries along the Texas Gulf coast. 50 percent of the refining capacity in this country is along the U.S. Gulf Coast. That oil and the characteristics of that oil are well-suited to be refined in those refineries along the U.S. Gulf Coast.

Mr. FATTAH. And then what will happen with these refined products, in your judgment? Based on your knowledge of the industry.

Mr. MCCONNELL. Refined products are very likely to be consumed in the United States in the domestic market.

Mr. FATTAH. Okay. Now, we are a net exporter now of oil?

Mr. MCCONNELL. No.

Mr. FATTAH. No?

Mr. MCCONNELL. No. We are a net importer.

Mr. FATTAH. We are a net importer. So, then what do we import and how much do we import?

Mr. MCCONNELL. Well and again, if you are speaking about——

Mr. FATTAH. China was at, over the last five years, double the amount that it utilizes, right? I mean, where are we at in this? Are we growing in the amount that we are importing? Are we decreasing? Where are we at?

Mr. MCCONNELL. Actually, over the past several years we have decreased the amount of imported oil from approximately 70 percent to approximately 50 percent.

Mr. FATTAH. And the difference is being made up by less demand or what? Where is the difference being made up?

Mr. MCCONNELL. It is a combination of improved domestic oil supplies in the United States, demand, new technologies, and a good part of the all of the above strategy.

Mr. FATTAH. If you were looking forward, how do you see the next five years? Is the demand for imported oil going to be greater or less?

Mr. MCCONNELL. The way the policy and the way our efforts are aimed is to improve and continue to work at improving energy security in this country. Domestic production versus imported production are aspects of an energy security strategy, and a big part of what we are constantly working at in terms of a portfolio approach is to make sure that energy security at the top of the list is first and foremost.

Mr. FATTAH. Now, we are the wealthiest economy in the world, right? So like today there is an announcement they found oil in Kenya for the first time, right? And oil is on the world market, right? It would seem to me, logically, we would want to buy as much oil from other places as we possibly could and hold on to domestic supply. Is that illogical? Why was it in our national interest to make sure that oil was on the world market?

Mr. MCCONNELL. I am not sure I understand your question, directly, sir.

Mr. FATTAH. Okay. I am trying to understand why it is we insist, for instance—I mean, you know, our number one foreign policy goal vis-à-vis Venezuela is that it all be available on all markets, right? So, we want oil wherever it is found, right? To be sold on a world market. That is our government's policy. And I am trying to make sure that even though that was set a long time ago, that that is still a good policy going forward, in your judgment.

Mr. MCCONNELL. Well in my judgment, sir, I do not know that we are in a position to create a world policy on oil and its availability, and I think that is the biggest concern we all have in terms of energy security. There is not any world policy, there is only our ability to access oil as it is available, the price that it is available from, and the ability to secure supplies necessary for this country. So again, back to a portfolio approach of being able to access the most available oil at the most attractive prices. That is business.

Mr. FATTAH. Thank you very much. I want to have some other questions for the record. Thank you.

Mr. FRELINGHUYSEN. Mr. Olver.

Mr. OLVER. Thank you again, Mr. Chairman. I want to very briefly enter the comments about the hub—the grid-related hub. It sounds to me that it is more three parts because we developed it at an earlier stage, before we really started hubs, a group of biofuel centers which I do not think that—I have not seen a very different approach from those bio-research centers. And I forget just where they are. I guess they are under the Offices of Science—what you are describing.

It just does not seem to me that there is much difference between the universities—there are lots of utilities, our big four in terms of power generation remain coal, gas, nuclear, and maybe we ought to have wind. Wind, you say, is in the West, but we also have some substantial wind on-land production in the East.

So, I really do not see why there is a need for just regionalization. Although I am a supporter of the concept that one should not put all one's energy eggs in one basket. I am trying to see how—much of the questioning here as I have heard it this morning is

that this is a diffuse expanding universe of programs, in essence. It is almost like a cosmic expansion of the universe, which physicists tell us is going on and has been going on since the Big Bang in the first place. I just see it getting larger and larger and more diffuse in the process.

I wanted to ask Secretary Kelly. You have a critical materials hub that you are going to be going out for solicitations on that. That will be one hub?

Dr. KELLY. One hub, yes.

Mr. OLVER. One hub. The battery hub is not under you. The battery hub is under the Office of Science?

Dr. KELLY. Correct.

Mr. OLVER. And when they get finished with proving that things can be done scientifically, then it is your office's job to help them to commercialization. It is really taking it farther up the development chart from the relatively long research and early development to the development that gets you toward commercialization. So, you do not have—you will not have the hub, but you will get the partially-developed—the proven science. Your office would be the one that is supposed to try and find the companies that can do this and bring it to fruition. But you do have hubs. You are going to be putting up the critical materials, but you also have the building materials hub at the—I am sorry, but my colleague from Philadelphia has not yet raised it. In Philadelphia, it has been up there for a while. Give us a good positive reading of exactly where we are on that building efficiency hub.

Dr. KELLY. They are doing extraordinary work in Philadelphia.

Mr. OLVER. Okay.

Dr. KELLY. Lots of Philadelphians involved. Well first, on the battery issue. We have a tech team in the Department that includes ARPA–E, our office, and the Office of Science. They collectively put together the solicitation so we are in very close communication with them all the time.

Mr. FRELINGHUYSEN. The solicitation on the critical materials is one that is being done by this tech team? This?

Dr. KELLY. The battery one you mentioned. So, we actually have—the people all working on the basic science, the people working in ARPA–E and the people in EERE working on batteries are working very, very closely together, and doing exactly what you described.

Now, the Philadelphia hub. It has been up and running for about a year. We think it has got a tremendous opportunity to help us understand how buildings actually work. Its focus is on improving computing models of how buildings operate, how they could work with new technologies, how they could work as a whole, and then validate those models against real buildings. The good thing about having it in the Philadelphia Navy Yard is that they are going to be retrofitting a bunch of buildings in that area, and so they will be able to really do a first-rate job.

What they have done already is, they have built computing that is helping researchers all around the country work together and develop this work. They have built a very interesting 3–D visualization environment where architects and engineers and others can work together to both design the building and understand the en-

ergy implications of the way it is going to operate. They have actually installed the state-of-the-art or beyond state-of-the-art building sensors and control system in part of their own facility that is hooked onto a very sophisticated modeling tool.

If you compare the way energy systems operate in an airplane with the way energy systems operate in a typical commercial building, they are just light years apart. One of the things they are able to do is really build the kind of sophistication into buildings that can allow you to make sure that everything is operating correctly.

Until recently, sensors and controls were very expensive, but now you can actually imagine doing this, and that center has been really at the cutting edge of that.

Mr. OLVER. So we do not yet have any real sense of how this is going to spread out into the general economy?

Dr. KELLY. Well you know, it has attracted 22 partners, including a lot of industrial partners who have been participating in this. People are already using this 3–D visualization center.

Mr. OLVER. Okay, I wish you the best of luck. I mean, there really is an enormous amount of energy conservation. It is still the low-hanging fruit, there is no question about that.

Dr. KELLY. Yes, and it certainly is a lot cheaper, in most cases, to save electricity than to generate it. So there is a huge opportunity space out there.

Mr. OLVER. Thank you, Mr. Chairman, for your patience.

Mr. FRELINGHUYSEN. Thank you, Mr. Olver. Just a few brief questions. Secretary McConnell, recoverable shale oil? Can you talk about that? There is certainly a view that we have some real potential there.

Mr. MCCONNELL. We agree there is a real potential——

Mr. FRELINGHUYSEN. And what are we doing? What is the Department doing in that area?

Mr. MCCONNELL. Well as suggested previously, a lot of the work that went on in the '70s was a big part of hydraulic fracturing.

Mr. FRELINGHUYSEN. You gave us that history lesson. I thought that was valuable, but——

Mr. MCCONNELL. We do not have anything specific in our budget related to shale oil, sir, for the coming year.

Mr. FRELINGHUYSEN. But if we talk about diversity and all the above, this is not something which—you do not believe it has merit? Or do you think it is too complicated? It is not financially feasible? How would you characterize?

Mr. MCCONNELL. There are a lot of challenges to shale oil development. There is a tremendous amount of uncertainty. But also at the same time, potential for that resource.

We do not have anything on our budget for the coming year. We were required to make strategic choices in terms of the areas that we were going to focus on, and that was not one of them.

Mr. FRELINGHUYSEN. Is the private sector doing investments in this area? And how would you characterize those investments?

Mr. MCCONNELL. Yes, they are doing investments. It is very early on and very much in a discovery mode.

Mr. FRELINGHUYSEN. Okay.

Mr. MCCONNELL. And if I might?

Mr. FRELINGHUYSEN. Yes, please do.

Mr. MCCONNELL. If I could just pick up on something that I said earlier. I want to make sure based on the age of the Internet that I said exactly what gets picked up. I was not speaking about any specific release from the strategic petroleum reserve. The Administration has consistently talked about no options being off the table in terms of where we are with the strategic petroleum reserve, or in terms of any supply interruptions that have or may occur, but I was not speaking specifically of anything being considered right now, specifically.

Mr. FRELINGHUYSEN. Yes, well I did not characterize your statement as being imminent——

Mr. MCCONNELL. Thank you.

Mr. FRELINGHUYSEN [continuing]. I can assure you. I think it would be ill-advised, but we understand.

Mr. MCCONNELL. But just in case somebody else might. Thank you.

Mr. FRELINGHUYSEN. Whoever picked that up I am sure will correct the record.

Mr. MCCONNELL. Thank you.

Mr. FRELINGHUYSEN. Very briefly, for Secretary Hoffman and Dr. Kelly. There was an announcement recently about using the four power marketing administration's goals. Can you talk about that, to transforming the nation's electric sector?

Ms. HOFFMAN. Yes. The Secretary sent a letter out to the power market administrations, looking at some policies and looking at what the power market administrations can do to advance the deployment of renewable energy, look at energy efficiency, among other topics. The power marketing administrations are not under either Dr. Kelly or under my jurisdiction, but we expect further information to come out with respect to how that policy will be implemented with the administrations.

Mr. FRELINGHUYSEN. So that does not provide me with very much information.

Ms. HOFFMAN. We can provide you with more information for the record.

Mr. FRELINGHUYSEN. So, you are going to be involved in those activities?

Ms. HOFFMAN. We communicate on a regular basis within the Department of Energy on the activities.

Mr. FRELINGHUYSEN. Is this budgeted for? Or is this just talk? Is this just contemplated?

Ms. HOFFMAN. I do not have——

Mr. FRELINGHUYSEN. Has there been any direction?

Ms. HOFFMAN. I do not have any details on the direction. We could probably provide that for you, for the record.

Mr. FRELINGHUYSEN. Okay. Mr. Visclosky, anything further?

Mr. VISCLOSKY. If I could, Mr. Chairman, for just a few minutes. Keystone has been mentioned and it is relevant to the issue at hand, but it leads back to my concern about the attention of all three of you and your departments about the money we are spending to keep and create good-paying living wage jobs in the United States of America for the Keystone Pipeline. I disagree with the President's past position, potentially it is evolving. A great boon to job creation. The only problem is, almost every ounce of steel for

the pipeline was poured outside of the United States of America. Nobody was thinking about the steelworkers then, and I am not blaming anybody on the panel. I am just venting here a little bit. It will be fabricated in the United States—somebody poured it outside. It is a private pipeline, that is their prerogative.

On SPRU—and I know you have not even brought SPRU up today, Mr. Secretary. I heard nothing about SPRU. Well, the last time there was a release, there was a waiver of the Jones Act that allowed foreign flag vessels to transport the oil. The Jones Act is in place for a very specific reason, and I know that is not your policy decision either but I am trying to send a message here.

There is potentially an argument there is not enough U.S. domestic-created ships. Why? Because we are not doing enough to encourage ships being built in the United States of America in the first place to take this oil and put somebody to work in this country. Again, not a lecture to you. But, assuming all options are on the table, I would hope waiving the Jones Act is not one of them.

I would like to talk about coal, if I could just for a minute or two, Mr. Chairman. My understanding is in 2010 coal represented 21.3 percent of energy demand by fuel in the United States of America, and that the EIA estimates that by 2035, 46 percent of our electricity will continue to come from coal. I mentioned the steel industry saving 30 percent CO_2 per ton. A lot of trees.

I believe in global warming. I think we ought to move from a carbon-based economy. I absolutely believe that. As a pragmatist, I am looking at the statistics saying that almost half of our electricity is going to come from coal in 2035.

Why was the coal budget savaged? We worked on turbines for water to get more energy from the same amount of water in those waterways. Why not work to get more efficiency out of that ounce of coal we are going to continue to burn until 2035. Why take all that money out of coal?

Mr. MCCONNELL. I agree with everything that you mentioned, and when I took this job I made a commitment to do everything we can do with what we have available to do exactly what you just described. And that is what I am going to continue to do as leader of the Fossil Energy Organization.

Mr. VISCLOSKY. I assume you being a very bright individual, if you had additional resources at your disposal—mentioning your household income earlier, you would be able to put it to good use.

Mr. MCCONNELL. Whatever——

Mr. VISCLOSKY. If you volunteered to do so.

Mr. MCCONNELL. Whatever resources I have got available in fossil energy, you can bet we will put them to good use.

Mr. VISCLOSKY. Okay. Mr. Chairman, thank you very much.

Mr. FRELINGHUYSEN. Thank you. Anything else, Mr. Fattah or Mr. Olver? Anything else? Secretaries, we thank you all for your time and effort here this morning. Appreciate your testimony. We stand adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

DEPARTMENT OF ENERGY
OFFICES OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, ELECTRICITY DELIVERY AND ENERGY RELIABILITY, AND FOSSIL ENERGY RESEARCH AND DEVELOPMENT
FISCAL YEAR 2013 BUDGET HEARING

March 27, 2012

PROGRAM MANAGEMENT

TRANSITION AWAY FROM MULTI-YEAR GRANTS

Subcommittee. Dr. Kelly, the Committee has been concerned that multi-year grants have become so common in the Department's energy and science offices that many programs must devote the vast majority of funds each year paying off commitments to awards it gave out in prior years. Not only does this practice prevent your programs from adapting to new technology and market conditions each year, it also promises future money that your programs simply do not know will be appropriated.

To address this problem, the fiscal year 2012 appropriations conference report included direction for the Department to transition away from multi-year grants within the Department's energy programs.

Unfortunately, it appears that the Department is not following this direction. For example, in late February you announced a grant opportunity to lower the cost of solar energy, called "Bridging Research Interactions through Collaborative Development Grants in Energy." The grant announcement promises $9 million in grants. Unfortunately, the Congress has not yet appropriated six million of those dollars.

Dr. Kelly, is there any reason why these grants have to be funded by promising future-year funds? Couldn't, for example, the grant I mentioned carve out $9 million of fiscal year 2012 funds from the $290 million Solar program?

Dr. Kelly. This question is related to conference report direction to transition away from multi-year grants. As your staff has been briefed, we have a transition plan and EERE is committed to buying down existing out-year mortgages by 2015. In concert with lowering existing mortgages over the next several years, many awards were fully funded in FY 2012 and EERE is committed to begin fully funding awards in FY 2013 with limited exceptions for larger performance based awards for later stage demonstrations. These large demonstrations would be unaffordable for most EERE technology programs, and that is why the off-shore wind initiative will be one of those exceptions. We plan to confer in advance with Energy and Water Subcommittee staffers regarding these exceptions.

PROMISING FUTURE FUNDING

Subcommittee. The Committee has been pushing the Department to only commit funds to the private sector that it knows will be available — which means only promising funds that have been appropriated. The Department has been working with us, to some degree, and is starting to move in the right direction. But there are still some troubling patterns emerging, especially when we look at how the Department is messaging and publicizing the availability of funds.

Your offshore wind program is a prime example. In early March, the Department announced the new program, and touted the total funding level. The press release was titled, "Energy Department Announces $180 Million for Ambitious New Initiative to Deploy U.S. Offshore Wind Projects." Another news release said, "Offshore Wind Gets $180 Million Boost from DOE." The problem here is that only about $20 million of that $180 million is actually available. The rest depends on us having enough funding to appropriate in future years. I understand and appreciate that your program, Dr. Kelly, is working hard to make messaging like this more transparent, and we'd like to hear about what direction you're headed.

While we do not like when you commit future funding that is subject to appropriations, let's assume we're talking about a situation when you've decided to announce a program that does so. What do you believe is a responsible way to message that funding announcement?

Dr. Kelly. EERE is committed to fully funding almost all multi-year awards at the time of award. EERE is working with Subcommittee staff to establish a consultation process for exceptions for large multi-year demonstration awards. The $180 million Offshore Wind initiative falls into this category.

Subcommittee. How and why was it decided to highlight the total funding level of $180 million for this offshore wind initiative?

Dr. Kelly. In consultation with the Subcommittee staff, we determined that this large award would not be easily accommodated by the modest annual wind program budget and would be treated as an exception to the transition away from out-year mortgages.

Subcommittee. Do you believe that the messaging of the offshore wind press release was irresponsible? What if the Congress does not appropriate enough funding for you to fully fund the $180 million in future years? Have you misled the private sector?

Dr. Kelly. As stated above, we will proceed with the off-shore wind initiative as an exception to fully funding projects at award. All grants and cooperative agreements are subject to the availability of funds.

NEW STARTS IN FISCAL YEAR 2011

Subcommittee. Dr. Kelly and Secretary Hoffman, as we read through your budget request for 2013, we came across a number of initiatives that your documents said were started in fiscal year 2011. The 2013 request includes funding for Advanced Grid Modeling Research, and the Innovative Manufacturing Initiative, both which were apparently first funded in fiscal year 2011.

As you know, the fiscal year 2011 was funded under a full-year continuing resolution that prohibited any new starts without Congressional approval. As a result, there was significant deliberation between the Department and the Subcommittee chair and ranking members of both Houses to consider any new starts in that year. The two new initiatives I just mentioned, and a number of others, were never communicated to us, and certainly never approved by us.

Were these two examples in fact started with fiscal year 2011 funds?

Dr. Kelly. We coordinate heavily with the Office of Electricity Delivery and Energy Reliability to strengthen America's energy security through enhancements in energy efficiency and productivity. The cooperative partnerships are a key for addressing the immediate challenges that face the nation's future energy needs. But I cannot comment specifically on their funding of the Advanced Grid Modeling Research project, my understanding is that the Office of Electricity has invested in grid modeling for at least several years.

The Advanced Manufacturing Office (AMO) has historically invested in technology research targeted to save energy in manufacturing processes and materials. These innovations address core technical issues facing U.S. manufacturers—enabling significant gains in energy productivity, environmental performance, product yield, and economic growth. The emphases of the Innovative Manufacturing Initiative is on new processes and materials that can be commercialized within the next five to seven years, which is a focusing of historical program workscope as opposed to a new start.

Subcommittee. How could you have started these with fiscal year 2011 funds, when there was a specific statutory prohibition on starting new initiatives in that year?

Dr. Kelly. We believe that the funding provided for these projects did not constitute new starts, as they built on previous work funded in prior years.

DOE'S QUADRENNIAL TECHNOLOGY REVIEW

Subcommittee. The Department of Energy's Quadrennial Technology Review notes that in FY11, energy technologies addressing the transportation sector have been underfunded as compared to stationary energy by a ratio of 3 to 1.

Do you believe there should be a different balance between transportation and stationary energy within the DOE portfolio?

Dr. Kelly. Consistent with the DOE-QTR findings, the FY2013 budget emphasizes increased funding to technologies supporting the transportation sector.

Subcommittee. How does the fiscal year 2013 budget request address the QTR findings that energy for the transport sector has been underfunded compared to electricity?

Dr. Kelly. The Department provided a concerted effort to prioritize technologies related to the transportation sector across the Office of Science, ARPA-E and EERE, resulting in increased funding in technologies such as biofuels and advanced batteries.

ENERGY EFFICIENCY AND RENEWABLE ENERGY

MANAGEMENT CHALLENGES AT EERE

Subcommittee. Dr. Kelly, the Energy Efficiency and Renewable Energy (EERE) program has had considerable management challenges in the last three years. The office has seen considerable budget growth since 2007, in addition to the large additional funding appropriated in the 2009 stimulus bill. The office also has more than 13 independent programs, each focusing on a different technology or area, making top-down management a difficult task in any given year.

We've heard that the office has had significant problems overcoming these difficulties in the last year. All of us — this entire subcommittee and the Administration — have a vested interested in seeing that an office overseeing billion of taxpayer dollars is doing so efficiency and effectively.

What are some of the main management challenges for your office?

Dr. Kelly. EERE faces many of the same issues affecting other Federal agencies. Approximately one-third of EERE's Federal employees are eligible for retirement, and in the next five years, this proportion will rise to one-half of EERE's Federal workforce.

Reductions in travel and training budgets will be a challenge in maintaining and strengthening the technical competence of EERE's workforce and in actively manage Federally-funded RD&D projects through site visits.

Currently, EERE has a fragmented Enterprise IT architecture. At the corporate level, EERE has an array of outdated and underutilized IT systems. At the program level, there are a number of standalone IT systems ranging from sophisticated spreadsheets to web portals. Most of these IT systems do not interface, so there is an overdependence on manual entry. As discussed below, EERE is addressing these IT issues.

Subcommittee. What is the Department doing to address those management challenges?

Dr. Kelly. EERE is undertaking a comprehensive Workforce Analysis to establish a corporate and strategic approach to hiring. Through the Workforce Analysis, EERE is evaluating the composition of its current workforce and assessing its current and future hiring needs.

In addition, EERE is planning to implement new measures to strengthen its human capital. EERE is planning to institute new, in-house training programs, including technical training, new employee training (e.g., Program Manager Boot Camp), and a leadership development program. EERE intends to establish clear career pathways, so a recent graduate can be promoted to more senior roles and responsibilities over time.

EERE is developing a modern, flexible Enterprise IT architecture that enables and empowers its staff to perform their work. Data generated by one program will be automatically integrated with data from other programs, so senior management and program leadership can use the data to make investment decisions and analyze the results of prior investments.

Subcommittee. Let's start by discussing program managers — the civil servants who work the long hours to oversee each of the more than thirteen EERE programs. How many program managers in place today were in that position four years ago?

Dr. Kelly. EERE has ten Program Managers, three of which are in the process of being competed. Two of EERE's Program Managers were in place four years ago. EERE is following the ARPA-E model, recruiting the best and brightest from industry, universities, and national laboratories for limited terms (at least 3-5 years). Program Managers focus on strategic vision, external engagement, and technology development and deployment. EERE is hiring an Operations Supervisor for each program to oversee its operations, including budget formulation and execution, communications, strategic analysis and planning, data management, and procurement. In addition, EERE intends to appoint a Deputy Program Manager for larger programs in order to assist the Program Manager with day-to-day management and ensure stability in program governance over the long term.

Subcommittee. What led to such high turnover in program management?

Dr. Kelly. There has been a shift in emphasis over time. Historically, EERE recruited Program Managers based on their technical expertise. However, there was a period of time during which EERE sought to recruit Program Managers with business experience instead of technical expertise. Today, EERE seeks to recruit Program Managers with a combination of business experience and technical expertise.

Subcommittee. These managers are asked to oversee many federal employees, and also to oversee a portfolio of very technical activities in energy areas. ARPA-E's program directors fill a similar role, and ARPA-E has decided to recruit technical experts to fill those spots. I understand that EERE has not always emphasized technical expertise. When your office hired the current cohort of program managers, what qualifications did you emphasize, and was this a change from past policy?

Dr. Kelly. EERE is following the ARPA-E model, recruiting the best and brightest from industry, universities, and national laboratories for limited terms (at least 3-5 years). Program Managers focus on strategic vision, external engagement, and technology development and deployment. EERE is hiring an Operations Supervisor for each program to oversee its operations, including budget formulation and execution, communications, strategic analysis and planning, data management, and procurement. In addition, EERE intends to appoint a Deputy Program Manager for larger programs in order to assist the Program Manager with day-to-day management and ensure stability in program governance over the long term.

RENEWABLE ENERGY ADVANCEMENTS THROUGH HIGH PERFORMANCE COMPUTING

Subcommittee. As you know, the Advanced Scientific Computing Research program (ASCR) in the Office of Science is a critical program that enables science in other parts of the Department and across the country. I am particularly interested in learning more about how ASCR works with and enables research in the Office of Energy Efficiency and Renewable Energy (EERE). It appears to me that ASCR has well developed relationships with other Office of Science programs and even the Office of Electricity, but there doesn't seem to be specific efforts focused on EERE programs.

Could the programs in EERE, Dr. Kelly, and the power grid program, Secretary Hoffman, benefit from a more direct relationship with ASCR? If so, how will DOE develop this relationship?

Dr. Kelly. The Office of Energy Efficiency and Renewable Energy (EERE) has a variety of interactions with ASCR. For example, EERE and ASCR have held workshops to explore building energy simulation tools and modeling of wind energy resources. Currently, EERE staff are involved in the crosscutting Advanced Computing Tech Team, which includes the other applied technology programs--Fossil Energy, Nuclear Energy, Office of Electricity, Environmental Management, etc.--working together with ASCR. EERE recognizes the critical importance of advanced computing. In addition to the building simulation and wind resource modeling already mentioned, other areas of strong interest and activity within EERE include computational materials development--such as for hydrogen storage, and combustion research--such as for advanced vehicle engines, to name only a few. More can be done to further develop and strengthen the EERE-ASCR relationship, and EERE welcomes those opportunities.

ENERGY SYSTEMS INTEGRATION FACILITY AT NREL

Subcommittee. The Energy Systems Integration Facility (ESIF), a new facility at the National Renewable Energy Laboratory (NREL), has been completed recently and ready to begin operations.

Dr. Kelly, what are the goals of this facility, and how will it carry out its work?

Dr. Kelly. The Energy Systems Integration Facility (ESIF) is specially designed to accommodate the critical engineering, testing, optimization, and verification research needed for integrated engineering systems development for EERE programs. It is a "first of its kind" integrated test and validation facility for new renewable energy and related technologies and system operating protocol. The ESIF will allow U.S. industry members to test technologies in a controlled integrated energy system environment to evaluate and optimize the technologies to reduce technological and market risk. Developing engineering-scale integrated energy system capability is critical to optimizing technology penetration into the energy market.

Subcommittee. Do you consider it a user facility, or a research lab for NREL?

Dr. Kelly. EERE will operate ESIF as a DOE User Facility and, like other DOE User Facilities, will conduct work funded by EERE, other DOE entities, academia, and the private sector. The mix of work for any given year will be optimized to EERE's need and determined through peer selection.

Subcommittee. How are the operations for the ESIF funded? Is it funded like a user facility, where the Department pays for operations, or does NREL or the facility's users pay for operations?

Dr. Kelly. EERE, like the Office of Science, will provide annual funding to cover base or "hotel" load costs at ESIF. ESIF will recover incremental costs from users as is done at other DOE User Facilities consistent with DOE's accounting rules.

Subcommittee. Would it make programmatic sense to have an operating line item in the budget for this facility? What would the implications of that be?

Dr. Kelly. EERE has created the "Facility Management" subprogram under the Facilities and Infrastructure Program to fund ESIF operations starting in FY14 per Congressional direction.

MANUFACTURING

PROLIFERATION OF CENTERS WITHIN ADVANCED MANUFACTURING PROGRAM

Subcommittee. Dr. Kelly, I have been very supportive of the mission and goals of the Industrial Technologies Program — which is renamed to the Advanced Manufacturing Program in your budget request this year. The program has helped to strengthen American industry and manufacturing, and there is much left to do on that front.

But setting the goals aside for a moment, I'd like to discuss the implementation. I have serious concern about the proliferation under this program in the last two years of "Centers" and other activities requiring a physical and permanent space. In the last few years within just this Advanced Manufacturing Program, the Department has established Clean Energy Application Centers, Industrial Assessment Centers, Manufacturing Demonstration Facilities, Advanced Manufacturing Clusters, and an Energy Innovation Hub. To say the least, I have serious concerns about the out-year commitments these centers require — a commitment which is $141 million in fiscal year 2013 for a program that only had $116 million appropriated in the current year. This raises serious concerns about your propensity to start centers like these, often without asking for funding in the request. So I'd like to take each one of them up with you right now.

First, **Industrial Assessment Centers**, which get $6 million in your request. What do these do, how many are there, when did you first ask for them in a budget request, when were they established, and for how long will they be around?

Dr. Kelly. The current Industrial Assessment Center (IAC) program was established as the Commerce Department's Energy Analysis and Diagnostic Center program in 1976. Transferred to the Department of Energy in 1980, the IAC program began as, and continues to be, a workforce development initiative dedicated to creating the next generation of energy engineers. The curriculum for these new engineers includes a unique mixture of engineering and energy management expertise, as well as, hands-on experience acquired by working directly with small- and medium-sized industrial and manufacturing facilities across the country.

IACs are collectives of academic advisors and students located at Accreditation Board for Engineering and Technology (ABET)[1] accredited engineering programs at U.S. universities. These Centers are not physical building structures.

IAC status is awarded through a competitive solicitation – usually for a period of five years. The most recent awards, issued in September of 2011, resulted in 24 schools being selected. The award was for $30 million to be split over five years. Current plans are to continue to support the IAC program depending upon the availability of funding through at least 2016 when the current awards are scheduled to expire.

Over the life of the program, more than 50 universities have participated as IACs, and they have trained more than 3,000 students. As part of their training, IAC students have participated in more than 15,000 assessments and provided nearly 114,000 tailored recommendations to help small- and medium-sized manufacturing plants save energy. Since 2006, assessments have identified nearly $450 million in energy savings and nearly 3 million metric tons in CO2 emissions reductions. Nearly 60 percent of IAC graduates go on to careers in the energy industry.

Subcommittee. Second up, **Manufacturing Demonstration Facilities**. You devoted $28 million for these in fiscal year 2012, and yet they're not mentioned in the budget request. You ask for another $20 million in the request. Can you please answer the same questions — What do these do, how many are there, and in particular, when did you first ask for them in a budget request, when were they established, and for how long will they be around?

Dr. Kelly. The FY 2012 was a transition budget year to refocus the existing Industries of the Future Crosscutting activities and initiate accelerated R&D for energy-intensive industries under Next Generation

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[1] ABET is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. The organization is recognized by the Council for Higher Education Accreditation (CHEA). Accreditation through ABET is voluntary and is achieved through a peer review process.

Manufacturing Processes. As part of the planning for FY2012 and out-year funds, several concepts including Manufacturing Demonstration Facilities (MDFs) were explored.

The first MDF was proposed by Oak Ridge National Laboratory (ORNL) as a result of a DARPA solicitation in FY2011 and is being funded by AMO in FY2012 under its Next Generation Manufacturing processes subprogram. This MDF is focused on additive manufacturing and low cost carbon fiber production. Over 23 private entities have been or are in the process of establishing partnerships with this MDF. Results from the work conducted at these MDFs could find beneficial application in a variety of industries such as vehicles, aerospace, wind and water power generation among others. The proposed budget for this activity was $27.5 million over three years.

MDFs are collaborative communities with shared RD&D infrastructure focused on targeted technical areas of manufacturing. The MDFs are organized to enhance opportunities for U.S. manufacturers to develop, use, and promote energy-efficient, rapid, flexible manufacturing technologies. The MDFs will provide the manufacturing community access to physical and virtual tools as well as expertise for prototyping new technologies and optimizing critical manufacturing processes. The MDF initiative will work to reduce the technical risks associated with promising innovations; provide the manufacturing community with access to affordable equipment and resources; and leverage funding sources particularly for small and medium sized enterprises.

The planning for this activity was summarized in a general sense in the FY2013 budget under the Next Generation Manufacturing Strategy:

"Next Generation Manufacturing Processes will provide critical energy improvements and reduce energy-related environmental impacts while increasing the competitiveness of U.S. manufacturing industries. ... The focus of this thrust is on the development and demonstration of new manufacturing processes and of manufacturing simulation tools and technologies."

At this time, subject to appropriations, the funding for the MDFs from the FY2013 FOA could be about $20 million. MDF non-federal cost sharing, during the initial five year period, will be fifty percent. MDFs are expected to be self-sustaining at the end of this five year period, and award

determinations would be based in part upon an evaluation of the plan for each facility to achieve this goal.

Subcommittee. Next up: **Clean Energy Application Centers**. Your request doesn't actually tell us how much funding they get. Can you please answer the same questions for these facilities?

Dr. Kelly. Clean Energy Application Centers (CEAC) provide technical information, perform market assessments and conduct education and industry stakeholder outreach. These Centers are ensembles of technical experts – not physical building structures. CEAC activities accelerate the adoption of clean energy, combined heat and power (CHP) technologies, that in turn save affiliated manufacturers energy and money.

An initial pilot "Regional CHP Application Center" started in 2001and subsequently expanded to 8 regional centers by 2004. The Energy Independence & Security Act of 2007 (EISA; Pub. L. No. 110-140) renamed these Regional Centers as Clean Energy Application Centers (CEAC). EISA also included as part of Clean Energy CHP, District Energy (DE) and Waste Heat Recovery (WHR). Under EISA, CEACs may undertake activities to:

- Develop and distribute informational materials on clean energy technologies
- Conduct target market workshops, seminars, internet programs, and other activities to educate end users, regulators and stakeholders
- Provide and coordinate onsite assessments for sites and entities that may consider deployment of clean energy technologies
- Offer consulting support to sites considering deployment of clean energy technologies

Currently, there are 9 CEACs awarded competitively. These CEACs receive a total of $1.5 - $3.5 million each over the course of the 4-year program for a total of $18 million.

Subcommittee. Next, **Advanced Manufacturing Clusters**. After some inquiry, the Department tells us that you'd like to increase funding for them from $6.7 million to $20 million — but your official request documents do not mention them at all. Can you please elaborate on the same questions?

Dr. Kelly. Clusters are regional ecosystems that foster collaboration among industry, universities, and government to accelerate cost-shared investments in industrially-relevant manufacturing technologies.

The Advanced Manufacturing Office (AMO) activities in this area align with the new Presidential initiative called the National Network for Manufacturing Innovation (NNMI) that now incorporates the approach of the Advanced Manufacturing Clusters. The NMII builds upon recommendations from the Advanced Manufacturing Partnership, a national effort bringing together industry, universities, and the federal government, established, in turn, in response to recommendations from a 2011 report from the President's Council of Advisors on Science and Technology that engaged industry across the country. As part of the NNMI the Department of Energy is sponsoring an FY12 pilot Institute for Manufacturing Innovation, announced by the President on March 9, 2012.

AMO is funding the Pilot Institute through a contribution of $10 million and will provide ongoing technical oversight with the inter-agency team to ensure the Institute operates in a manner that effectively promotes the development, demonstration and exploitation of energy-efficient, rapid, and flexible manufacturing technologies

Subcommittee. And finally, the **Critical Materials Hub**. I think we're most familiar this one, because the request clearly asked to establish it last year, so we can table that for another question.

Suppose for a moment that we simply do not have the luxury of increasing funding for the Advanced Manufacturing Program in 2013. You would get $116 million to meet $141 million in commitments. What items would you terminate to meet this $25 million shortfall?

Dr. Kelly. The Advanced Manufacturing Office's (AMO) FY13 budget request reflects the President's priorities for Advanced Manufacturing. The activities covered by that request are selected to help advance those priorities on behalf of the nation. Should actual funding fall short of the level requested in AMO's FY13 budget, the Department of Energy would make a determination as to the best use of available funds.

Subcommittee. I must say, my strong support for the Advanced Manufacturing program makes me all the more concerned over how well it

is implemented. And I have deep concerns on two fronts that you'll need to continue to address: concerns around the process by which you're starting these centers, and concerns about these centers overcommitting funding within the program. It seems that you've already put the program in a bind, and we're going to have to sort our way through that.

BATTERY RESEARCH LEADING TO MANUFACTURING IN THE U.S.

Subcommittee. Secretary Hoffman and Dr. Kelly, the budget request puts a large emphasis on energy storage research — and in particular, on batteries research. These are important technologies for our energy sector, and could be a vital part of our manufacturing base. But there is significant risk that most advanced batteries invented through your programs end up being manufactured overseas. Let's not forgot that, while we invented the lithium batteries used in most portable electronics, but most manufacturing for these products moved to Asia in the last several decades.

How will you ensure that the battery innovations that come out of your programs lead to manufacturing jobs in the United States?

Secretary Hoffman and Dr. Kelly. The Recovery Act provided a tremendous boost to U.S. advanced battery manufacturing capacity – and associated manufacturing jobs. A few years ago, the United States had virtually no advanced battery manufacturing capacity. With Recovery Act funds, DOE competitively awarded 30 cost-shared projects to build domestic manufacturing capacity for advanced batteries and electric drive components. Today, because of these investments, we are among the leaders in the fiercely competitive global race for advanced battery production dominance. As of December 31, 2011, our Recovery Act projects had created a total battery manufacturing capacity of 145,000 batteries per year (based on a 10kWh battery equivalent capacity). At the same time, DOE supports a robust and comprehensive battery research program in partnership with industry to further reduce cost and improve performance. In some cases, the battery innovations are being developed by battery manufacturers directly, under DOE cost-shared projects, and in others, technology transfer is taking place through licensing agreements. Several major battery innovations from national labs and universities have been licensed to domestic battery manufacturers and materials suppliers – as an example, new electrode material developed at Argonne National Laboratory has been licensed by General Motors, BASF, Toda America, and Envia. With manufacturing capability in place, R&D innovations will transfer to these facilities. As the electric-drive vehicle market grows in the United States and worldwide, U.S. factories will be poised to meet rising demand, creating more jobs. Pike Research forecasts the global market for lithium ion batteries for transportation to grow from just under $4 billion

today to more than $14.6 billion by 2017, and it has identified three of DOE's Recovery Act grantees for advanced battery manufacturing as top "contenders" for global market leadership.[2]

Subcommittee. What is the state of the domestic manufacturing sector for these batteries? Haven't some of the companies had difficulties of late?

Secretary Hoffman and Dr. Kelly. The domestic lithium-ion battery manufacturing sector is in an early growth stage. Manufacturing facilities are being established with Recovery Act funding (and associated industry cost-share). The companies are installing capacity in phases to match market demand as much as possible, and battery output from these plants is being used to meet the needs of the power tool, military application, stationary energy grid storage, and electric-drive vehicle markets.

While the overall health of the domestic battery manufacturing industry remains strong in general, battery companies garnered media attention this year. In each case, however, the reported difficulties were not directly related to the battery technology itself. Ener1, which filed for bankruptcy reorganization on January 26, 2012, incurred a $73 million loss as a result of its investment in the vehicle manufacturer, Think. However, it emerged from bankruptcy based on the strength of its battery technology, and continues to operate, producing batteries for a variety of applications. On March 26, 2012, A123 Systems announced a product recall with an estimated cost of $55 million as a result of a manufacturing flaw that has since been corrected. A123 subsequently went through a bankruptcy process this past fall, emerging with indications that the Recovery Act funded facilities will continue to be operated for their intended purpose. While the plug-in vehicle battery market has developed more slowly than anticipated, the market is now growing quickly, with 2012 plug-in vehicle sales tripling versus 2011.

It is important to note that new technologies in any sector inherently involve additional risk, and companies seeking to establish new markets will struggle initially to gain a foothold. However, growth in consumer acceptance of electric-drive technology, beyond the core "early adopters," remains likely given high fuel prices and declining battery costs. The United

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[2] Pike Research, *Pike Pulse Report: Electric Vehicle Batteries, Assessment of Strategy and Execution for 10 Leading Lithium Ion Battery Vendors* (Published 1Q 2012).

States faces a major challenge with its dependence on petroleum. We spend about a $1 billion per day on oil imports. Transportation accounts for more than 60% of our petroleum use, and on-road vehicles are responsible for about 80% of the petroleum used for transportation. We must change the way we power our vehicles – not only for our energy security but also to help grow our economy – and electric-drive technology is a necessary part of the solution.

CRITICAL MATERIALS (RARE EARTHS) HUB UPDATE

Subcommittee. Dr. Kelly, the Department was given funding in the fiscal year 2012 appropriations Act to establish the Critical Materials Energy Innovation Hub. This initiative was meant to develop ways to produce more rare earths and other critical materials here in the United States, and innovations to wean us off of these materials altogether.

Where are you in the process of establishing this Hub? Do you have applications in yet?

Dr. Kelly. The Department of Energy (the Department) is developing the scope for the Critical Materials Hub ("the Hub") to guide the competitive solicitation for a high impact effort for the U.S. This scope has been informed by the NAS study and the recent DOE Critical Materials strategy. A workshop was held on April 3, 2012 in Arlington, VA at which stakeholders provided views and suggestions related to the Hub. From this workshop the Department received further information that helped it to identify gaps which currently exist in critical materials research and development (R&D). These R&D gaps are examples of the scope of work that will be pursued through the Hub. The Department is also engaged in similar conversations with other federal agencies to help plan the most potentially beneficial areas of focus and activity for the Hub.

A Critical Materials Hub Funding Opportunity Announcement (FOA) will be released in late spring 2012. The FOA will be open for several months to allow thorough responses by interested applicants. The Department plans to complete the selection process for this FOA by the end of the fiscal year.

Subcommittee. Are you gaining clarity yet into what the Hub will focus on?

Dr. Kelly. The Department is identifying important research focus areas for the Critical Materials Hub (the Hub). Suggestions for the focus areas will come largely from Hub applicants who are experts in the field. In suggesting focus areas, applicants will need to demonstrate their strengths and present support for their proposed approach for addressing today's critical materials and associated supply chain challenges. The Department of Energy (Department) will provide guidelines to aid in the selection of acceptable focus areas related to current or future domestic critical materials

supply chains. All proposals will be selected using Department merit review procedures. At the same time the Department is looking for the very best Critical Materials research needs without specifying a particular R&D focus for any Hub.

Subcommittee. What is your current vision of the Hub's five-year goals? In other words, if the Hub ends up being wildly successful, what specific things will it have accomplished by this time in 2017?

Dr. Kelly. Hub focus areas have not been selected. However, a few examples of successful Hub outcomes that would establish or re-establish domestic capabilities in critical materials include more complete thermochemical data of rare earth elements, allowing for more efficient separations; advanced manufacturing techniques for magnet production which substitute other materials for neodymium iron boron NdFeB, which contains the critical material neodymium; and more flexible and adaptable critical materials processing system design. Each of these efforts would have important outcomes for U.S. competiveness in clean energy as well as broader areas. The Department of Energy also anticipates that the Hub will provide a greater domestic knowledge base from which to address current and future critical materials issues.

Subcommittee. ARPA-E is funding some work in critical materials, and I'm sure the Office of Science is as well. As the body overseeing the Hub, how will you ensure that it collaborates and coordinates with these other DOE programs?

Dr. Kelly. ARPA-E and the Office of Science are actively participating in the development of the Hub Funding Opportunity Announcement and will fully participate in the Advanced Manufacturing Office selection and oversight process.

CRITICAL MATERIALS STRATEGY

Subcommittee. Dr. Kelly, I applaud the Department's efforts in developing an approach to critical materials. However, I am concerned that DOE's efforts and priorities are not aligned with those pursued by other agencies, including the Department of Defense. It seems that we need a coordinated, government-wide approach in order to bolster a strong critical materials supply chain in this country.

Can you comment on the need for coordinated federal activity in this area, and any barriers to doing so?

Dr. Kelly. The Department of Energy recognizes the need for a coordinated federal approach on the issue of critical materials. In fact, many federal agencies, including the Departments of Energy and Defense, are currently involved in the government-wide effort to address critical materials supply chains. Toward this end, the White House Office of Science and Technology Policy has established a National Science and Technology Council Subcommittee on Critical and Strategic Mineral Supply Chains. Agency activities are discussed between members of this subcommittee to ensure that agencies leverage but do not duplicate research and development activities related to critical materials.

Subcommittee. What is in the fiscal year 2013 budget to address the country's critical material concerns, including the Critical Materials Hub we funded starting in fiscal year 2012?

Dr. Kelly. The Advanced Manufacturing Office (AMO) is requesting $25 million in FY 2013 to support the Critical Materials Hub. The AMO Hub will be the focal point of critical materials activity within the Department of Energy (the Department). Current plans are for the Department's Office of Energy Efficiency and Renewable Energy (EERE) to continue to fund research and development for critical materials as they are related to specific EERE program activities. For example, the Vehicle Technologies Program supports projects that develop electric motors with less rare earth magnet materials.

Subcommittee. What type of federal support is necessary and warranted to support the development of a domestic critical materials

industry, and what is the private sector doing on its own to address our nation's issues?

Dr. Kelly. The Department of Energy (the Department) believes there is an appropriate role for the Federal government to support the development of capabilities that require a longer research and development (R&D) time frame. The private sector has traditionally focused on addressing short-term challenges to deployment. To harness the expertise of the private sector, the Department held a workshop on April 3, 2012 in Arlington, VA at which stakeholders provided views and suggestions to help inform the best balance of R&D priorities for the Critical Materials Hub ("the Hub"). From this workshop the Department received further information that helped it to identify gaps which currently exist in critical materials R&D.

The Hub will work closely with private industries on an ongoing basis to ensure industrial collaboration early in the R&D process, but will then transfer technology to the industrial partners.

Subcommittee. DOE programs do not typically reach far enough back in the supply chain to interact with critical materials development and processing — it would ordinarily be inappropriate for DOE to do so. For example, while lithium production is essential to electric vehicle battery production, lithium development and processing activities are not supported by the Department's vehicles or batteries programs. How far back in the supply chain do you believe is appropriate for DOE to offer support where critical materials are involved?

Dr. Kelly. Lithium is an isolated example where the private sector has taken the lead in addressing a national critical materials challenge. However our national scientific knowledge base and associated capabilities for other critical materials have weakened to the extent that domestic material processing capabilities are insufficient to address potential demand. As a result, DOE believes that long-term critical materials R&D, including critical materials production, is a focus area demanding immediate attention. DOE is currently conducting critical materials research across the supply chain; examples include rare earth separations, fundamental magnets research, applied motors research, and battery recycling. The Department believes that this level of engagement is both appropriate and necessary to strengthen the nation's critical materials knowledge base and domestic capabilities.

BIOFUELS AND BIOMASS

BIOFUELS STRATEGIC DIRECTION

Subcommittee. Dr. Kelly, the price of gasoline has risen steadily since the beginning of the year, and Americans are once again bracing themselves for the summer driving season, when prices rise even further. The Department's Biomass and Biorefinery Research and Development program plays a role in developing economic alternative fuels, and the budget request includes $270 million for this program.

The main thrust of the Biomass and Biorefineries program is to develop biomass and crop-based alternatives to gasoline and other fuels. By far, the single largest of these fuels currently in the market is corn-based ethanol. Thought plentiful, that fuel takes substantial energy to produce across its lifecycle, uses crops that compete with our food supply, and we can mix only so much of it into our gasoline right now. The Department has also been working on so-called "cellulosic ethanol," which doesn't compete with our food supplies by has the same problems as corn-based ethanol.

Most recently, there has been a significant push to develop so-called "drop-in fuels" — that is, fuels developed from plants, algae, and other grown sources that can go right into existing cars, planes, and other vehicles.

Where does your budget request put the emphasis across these different biofuel options?

Dr. Kelly. The Department does not invest in starch-based (corn) biofuels development. In FY 2012, we will be completing our research and development work on cellulosic ethanol. The program intends to continue funding ongoing pilot and demonstration scale integrated biorefinery projects that are validating a diverse set of feedstocks and fuels, including cellulosic ethanol and renewable diesel, and that have entered the construction and operation phases. The work on first of a kind demonstrations of cellulosic ethanol is near completion and we are completing our investment in these technologies anticipating that the first commercial scale refineries will be on line in FY 2014. The FY 2013 funding level broadens our support of drop in fuels building on our R&D success with cellulosic ethanol and includes work on algae and support of additional innovative pilot projects selected from the solicitation held in FY

2012. Approximately one fifth of the request supports completion of cellulosic ethanol biorefinery demonstrations and the remainder supports drop in fuels.

Subcommittee. How has the program's emphasis changed since last year, and since this Administration started three years ago?

Dr. Kelly. The program is shifting from demonstrating and validating multiple integrated systems for the conversion of biomass to ethanol and other industrial alcohols. FY 2012 will conclude the program's efforts in R&D of cellulosic ethanol technologies. The data from the program's effort directed at alcohol fuels will be available to industry and others looking to commercialize any of these technology pathway. During FY 2013 and beyond, the program will shift R&D efforts from alcohol fuels to producing drop-in fuels and bio-products to displace the entire barrel of imported oil. We will also look at advanced pathways for sustainable fuels that may not involve biomass.

Subcommittee. What major advances do you expect in biofuels in the next several years, and do you believe those advances are need in the science arena, or in the applied research and development arena?

Dr. Kelly. We believe that major advances will be needed in the science, applied research and development arena, as well as in development areas. These include but are not limited to:

- Advances in synthetic biology and tools to support development of new industrial organisms with the capability of converting a vast array of feedstocks to fuels, as well as genetic tools to support higher yield energy crops such as grasses that are more easily deconstructed to sugars or intermediates;
- Development and application of unconventional biomass deconstruction methods (i.e., improved methods for pretreatment);
- Emergence of hybrid biomass technologies in to order to come up variable or multiple transformation technologies (using biological and/or chemo catalysts);
    - Bio-oil upgrading;
    - Advanced separation technologies than can lead to process intensification.

- Better understanding of the necessary materials of construction pyrolysis reactors;
- Scaled up integration of new process configurations to validate engineering designs.

We believe that there will be a continuum of transformative technologies that are discovered in the basic science arena and then find applications in applied research, development and demonstration.

REPLACING THE WHOLE BARREL — DROP-IN BIOFUELS

Subcommittee. The Department has a newfound focus on utilizing biomass to replace the "whole barrel" of products from crude oil — not only gasoline, but also diesel, jet fuel, and petrochemical products. Today, a variety of companies are seeking to scale technologies to produce drop-in and direct replacement fuels that can be integrated into existing refineries, transported in existing pipelines, dispensed from existing tanks and pumps, and used to fuel any engine used today — as well as chemicals that can replace petroleum and natural gas derived products used in plastics, packaging, clothing, and other fibers.

How is EERE coordinating with ARPA-E and the Office of Science to address biomass conversion to drop-in and direct replacement fuels?

Dr. Kelly. The Department of Energy has established an interoffice team at the Under Secretary level that meets monthly to discuss key issues such as technical, economic, and market barriers to fostering the development of the U.S. biomass industry. This technical team focuses on setting goals that drive all three programs (Office of Science, ARPA-E, and EERE's Biomass Program) in a coordinated fashion. Additionally, staffs from all three programs meet quarterly to discuss progress, new opportunities and strategic direction. In December 2012, EERE's Biomass program sponsored a "road mapping" workshop, inviting other Federal Agencies, and included ARPA-E and Office of Science, industry, academics and national laboratories to present on progress to date, and to discuss new or remaining research barriers that exist to produce cost competitive drop in replacement fuels and the best solutions for overcoming these through research and development from fundamental science through to demonstration.

Subcommittee. How are these efforts designed to accelerate technology development toward commercialization?

Dr. Kelly. DOE is addressing the hurdles associated with the valley-of-death by funding a robust portfolio of projects that address the research, development, and deployments needs of the biofuels industry. We believe that continued RD&D is critical to driving the cost of production down so that the industry can attract private sector capital and stand on its own without government incentives. In addition to R&D activities, we are

funding 27 integrated biorefineries ranging from pilot to commercial demonstration scales. We are also working with the Department of Defense and USDA toward facilitating the deployment of commercial scale facilities for military grade advanced biofuels. DoD is an appropriate first user for advanced biofuels since they are the largest purchaser of fuel within the Federal Government system. We believe that the combination of these efforts and continued price volatility in the oil markets will create the conditions necessary for the industry to overcome the challenges associated with the valley of death. We have also provided expertise to the DOE and USDA loan guarantee programs.

Subcommittee. How have past efforts of DOE's programs on biofuel production helped to develop fuels that are bringing down gasoline prices right now?

Dr. Kelly. We believe DOE's R&D success to make cellulosic ethanol cost competitive will help moderate gasoline prices when it is blended 10-15%. As we create more diversity through energy efficiency such as hybridization and fuel economy standards and through greater diversity of substitutes such as electricity, hydrogen and cellulosic-based ethanol and drop-in fuels, we will be subjected less to high price and volatility associated with primary dependence on petroleum-based fuels. DOE has funded and continues to fund research, development and deployment (RD&D) aimed at reducing the costs of these advanced biofuels. The results of DOE program investment are significant. For example, modeled costs for biochemical and thermochemical production of cellulosic ethanol have been reduced from over $9/gallon 10 years ago, to values just above $2/gallon today, validated at pilot scale.[3]

[3] Available at: http://www.nrel.gov/docs/fy09osti/44517.pdf.

CONCERNS AROUND PROPOSED NAVY BIOFUELS INITIATIVE

Subcommittee. Dr. Kelly, the budget request proposes $40 million and legislative language to start a joint program with the Navy and Department of Agriculture to create a supply of bio-based jet and diesel fuel for the Navy. There is surely a benefit to our national security in reducing the military's dependence on foreign oil imports and disruptions, but I have some serious concerns about putting taxpayer dollars to this initiative.

First, the Department of Energy announced last August that, and I quote: "the U.S. Departments of Agriculture, Energy and Navy will invest up to $510 million during the next three years...to produce advanced drop-in aviation and marine biofuels to power military and commercial transportation." Now, at that time, the Administration had not included this new program in any budget request — the first we officially saw this proposal was six weeks ago in this year's budget request.

Would you say, Dr. Kelly, that the Department jumped the gun by more than a year when it announced the initiative last August?

Dr. Kelly. The Memorandum-of-Understanding states "Under this MOU, the parties will endeavor to fund this initiative at an aggregate of $510 million over 3 years, with that aggregate amount divided equally among the parties. Although the timelines and means through which the Parties will contribute to the initiative are subject to change...The above funding objectives are subject to the availability of funds and subject to each party's right to terminate this MOU as set forth below..." This is standard language that our project partners recognize as being subject to Congressional appropriations. In addition, we briefed the Senate Appropriations staff prior to announcing this initiative. We regret that despite such precautions a misunderstanding was created, and we will make sure we notify Congress more clearly in the future with any large appropriations request.

Subcommittee. Why, if you are budgeting $40 million, does the statutory language in your request say that up to $100 million may be transferred to the program?

Dr. Kelly. The statutory language in the request says that up to $100 million may be transferred to the program because $40 million is for the

biofuels Title III DPA initiative and $60 million is for an advanced manufacturing initiative.

Subcommittee. We should clarify that when the Department has not yet asked the Congress to fund a new program; when the Congress has not yet funded the program; and when the Department does not know if the Congress will fund it in the future, it is misleading and irresponsible to announce the program.

Let's move on to the merits of the proposal. The Department of Energy would fund biorefineries that produce these biofuels fuels for the Navy. As the theory goes, after a three-year investment, the price of these biofuels would come down enough to compete in the market without federal support. That, however, was the plan for cellulosic ethanol several years ago, and it's still too expensive to compete.

Is there a risk that this injection of federal support would not be enough to stand up a cost-competitive product, and that this jet and diesel fuel market couldn't survive without continued federal support?

Dr. Kelly. We recognize that creating an entirely new industry in a highly competitive fuels market is inherently risky, and in fact, this risk is one of the reasons Federal investment is necessary to spur the private sector toward eventual implementation. We have observed that Federal government investment in high risk areas have yielded promising results. An example is our investment in the area of enzymes that break down cellulosic materials to make them more amenable to conversion into fuels. Largely as a result of DOE investment in this area, the cost of enzymes has decreased over 30 fold and the enzyme industry has made investments in manufacturing of these enzymes for commercial uses. Progress of this magnitude can be achieved with sustained Federal government investment in key areas of need.

The three agencies involved in this effort bring a unique set of expertise and perspectives to the issue of alternative fuels. USDA has experience primarily in the growing of biomass feedstocks, and harvesting, collecting, and storing these materials. DOE has more than a decade of funding in a number of conversion pathways to convert the feedstocks into liquid fuels. Navy is an end-user of the fuel and brings the customers perspective to this

supply chain. This integration along the supply chain will help reduce the risks associated with establishing a new industry.

Subcommittee. What have you determined is the risk that after this investment, the fuels would still be too competitive to compete? What hard numbers do you have to quantify the risk?

Dr. Kelly. DOE has done preliminary techno-economic analysis of various pathways such as pyrolysis and gasification. These analyses have indicated that the fuels produced by these pathways are reasonably close to being commercially competitive with convention fuels. Our assessment is that there is a clear pathway to further reduce costs such that the technology will be cost competitive in 2017 through an aggressive research, development and demonstration program. DOE is funding 11 integrated biorefineries that are going to be producing hydrocarbon-based fuels from biomass at various scales from pilot to demonstration to evaluate engineering designs. DPA initiative will allow for the best of these and other technologies to scale up to commercial demonstration proving first of a kind economics. Because of the financial assistance provided through DPA, these technologies will have reduced capital investments and feedstock costs, facilitating their near term cost competitiveness, kick starting the industry.

Subcommittee. Under that circumstance, would you propose to continue funding the initiative for more than the initial three years?

Dr. Kelly. The DOE is committed to meeting the intent of the MOU to facilitate commercialization of military grade fuel in collaboration with USDA and DOD. In FY 12 DOE is initiating an innovative pilot program to initiate scale up of technologies that can produce military grade fuels. We also intend to participate in the DOD-DOE-USDA commercial demonstration opportunity. Our current request in FY 13 will bring our planned investment only part of the way to completion, so we will plan additional out year requests to meet the full effort as long as there is successful progress in the projects selected.

Subcommittee. If the Department of Defense is the customer for this initiative, why should the Department of Energy pay for a large portion the expenses?

Dr. Kelly. The Department of Defense is committed to be an early adopter of this technology but it is not the only customer to benefit from this initiative. In addition to DoD, commercial aviation, trains and trucking/shipping industries are extremely interested and will likely become customers. The three agencies bring a unique set of expertise and perspectives to the issue of alternative fuels. USDA has experience primarily in the growing of biomass feedstocks, and harvesting, collecting, and storing these materials. DOE has more than a decade of funding in a number of conversion pathways to convert the feedstocks into liquid fuels. Navy is an end-user of the fuel and brings the customers perspective to this supply chain. This integration along the supply chain will help reduce the risks associated with establishing a new industry. In addition, this initiative is a good strategic fit for DOE. We are successfully concluding efforts to reduce the cost of cellulosic ethanol and have diversified our portfolio to include hydrocarbon fuels from biomass. The advanced biofuels initiative with the Navy is an excellent fit in that strategic direction that will lead to commercially demonstrated technologies that when replicated in the private sector will lead to a diversified fuels portfolio for the Nation.

The MOU signed by the three Secretaries stipulates that the three agencies will share the funding burden equally. To achieve that objective, we have requested what we believe to be a reasonable amount of funding in FY13 for this initiative.

Subcommittee. I understand that several airlines have done test flights with biofuel blends, as has the Navy. What more needs to be done?

Dr. Kelly. Several airlines and the Navy have done test flights with biofuel blends and the tests have been successful. The issue is that the fuels are not cost competitive utilizing a diversity of feedstocks at the commercial-scale production. The industry needs to build commercial scale facilities and bring the cost of production down so that the fuels will be competitive with fossil-based jet fuel. The DPA Title III Biofuels Initiative will help achieve that purpose.

DOE FUNDING FOR NAVY BIOFUELS MOU

Subcommittee. In the summer of 2011, President Obama announced a $510 million Memorandum of Understanding (MOU) between the Secretaries of Energy, Navy, and Agriculture to assist the development and support of a sustainable industry for drop-in hydrocarbon biofuels to power the Department of Defense and private sector transportation. For fiscal year 2012, the Department did not formally ask for language in our appropriations bill to support this initiative, and the final Energy and Water Development appropriations Act did not include any related language. The fiscal year 2013 budget request asks for authority to shift up to $40 million in DOE biomass funding to the Defense Production Act to support pilot-scale demonstrations, rather than the commercial production envisioned by the MOU.

Has the Department's role in this program shifted since release of the MOU, and if so, how?

Dr. Kelly. There has been no revision of DOE's role in the MOU. DOE is planning on requesting an intended $170M over three years to fulfill its commitment which is subject to appropriations. This commitment will primarily come in two forms. First, we have requested $40M in FY 2013 funds, along with the authority to transfer these funds to the DPA, to support a competitive solicitation with DOD and USDA for a commercial scale biorefinery that produces military jet and diesel fuels. In addition, DOE has requested $20M in FY 2013 to competitively solicit innovative pilot scale demonstrations for producing military specification fuels. In FY 2012, we are also committing $20M for innovative pilot demonstrations. Additional funds will be requested in out years to meet the DOE share of the funding, subject to appropriations process.

Subcommittee. How did the Department determine the request for "up to $40 million" for FY13?

Dr. Kelly. The DOE fully supports the MOU between the DOD, USDA, and DOE. DOE is planning on a total of $170M to support the initiative. The funding was determined based on the total cost of the biorefinery being at least 50% cost-shared by the private sector and the recognition that the multi-year project does not need all of the money the first year. Furthermore, our experience in funding commercial scale

facilities suggests that the first year of funding includes critical go/no go decision points including NEPA compliance, and securing private cost share that will determine when they can move into the more expensive construction phase. In addition to this $40M, $20M is requested in FY2013 along with $20M in FY 2012 for innovative pilots that will demonstrate initial scale up of technologies to produce military grade fuels.

Subcommittee. Does the Department still hope to contribute funding on the scale of $170 million for this initiative?

Dr. Kelly. DOE continues to fully support the joint DOD/USDA/DOE MOU. DOE's intended commitment of $170M will be requested over approximately 3 years. In support of the overall goals of the initiative, DOE is initiating a pilot scale solicitation in FY 2012 ($20M) and FY 2013 ($20M) that will demonstrate technologies to convert biomass to fuels that meet military specifications such as JP-5, JP-8, and F-76. This effort ensures quality data is available to support scale up to commercial facilities and will support the overall commercial deployment planned in the DPA initiative. DOE has also requested $40M to support the DPA initiative along with the authority to utilize the mechanism.

Subcommittee. Does the Department still support use of the Defense Production Act to fund commercial scale advanced drop-in biofuels plants?

Dr. Kelly. Yes, DOE is fully supportive of the use of the Defense Production Act to fund commercial scale biorefineries and is requesting $40M under the President's FY 2013 budget request.

NEW FUELS ADDED TO RENEWABLE FUEL STANDARD

Subcommittee. Dr. Kelly, there has been some controversy relating to the EPA's move to add several feedstocks to qualify under the Renewable Fuel Standard, a standard established by a 2007 energy policy law. While this is under the EPA and not within this subcommittee's jurisdiction, it does relate to the biofuels research and develop funded within your program.

The EPA proposed to add advanced biofuels made from camelina oil, energy cane, giant reed and napiergrass to the Renewable Fuel Standard. How are those options different than the biofuels already included under the fuel standard?

Dr. Kelly. These plant species are simply different crops than those that have previously been approved by the EPA. They represent additional options for farmers, who may find them to be better options for their particular farming strategy and physical environment.

Subcommittee. Are these four new options a step more advanced, or a step back in technological sophistication?

Dr. Kelly. These options are technologically neutral from a producer point of view. They would represent new crops that have not been grown in the US previously on a large scale. As stated above, they provide additional options for producers to generate income, reduce risk, and more effectively adapt production decisions to the land resources available. Some of them wcould permit the profitable and sustainable use of marginal land on which traditional crops do not perform well.

Some of these crops may provide advantages to biorefiners. Advantages might include ways to mitigate risk associated with feedstock supply by delineating a different harvest window during the year than for other crops upon which they also depend. Additionally, one or more of these crops may enable higher yields of product on a per ton basis of feedstock.

Subcommittee. Which does your Biomass and Biorefinery research program focus on — the feedstocks already covered under the Renewable Fuel Standard, the four feedstocks that the EPA is proposing to add, both, or neither?

Dr. Kelly. The Biomass and Bioenergy research program addresses feedstock issues relevant to both of the categories mentioned. The barriers and challenges being addressed across the research program generally exist across the range of feedstocks currently covered under the Renewable Fuel Standard and being considered by EPA. An important component of the DOE Biomass and Biorefinery research program has been the construction of pilot scale systems covering all elements of biomass to biofuels supply chain which facilitate testing and evaluation of the potential for new cellulosic feedstocks that emerge as an option for the industry.

ALGAE RESEARCH UPDATE

Subcommittee. Dr. Kelly, among the many crops and biomass that can go into biofuels, algae is quite a unique option — complete with its advantages and its challenges. When it emerged as an option worth exploring several years ago, algae showed promise because it can be cultivated where no other crops can be grown, and using less land than plants. But there were also significant challenges.

What is the current state of algae biofuels research, and what research and development is your office supporting to advance algae biofuels?

Dr. Kelly. Most of the current algal biofuels RD&D can be characterized as a mixture of basic research, applied research, and process design and engineering. A few algal biofuels production companies are on a fast track to commercialization having raised significant amounts of capital in the past three years to build, construct, and operate integrated biorefineries. However, there is general agreement that it will take more than 10 years for algal biofuels to be economically competitive with petroleum-based fuels at the 1-5 billion gallon scale envisioned by the Energy Independence and Security Act of 2007 Renewable Fuel Standard 2.

Research and development opportunities exist that can propel the new algal industry forward by reducing the technical risks in commercialization, including innovations in 1) algal productivity, 2) sustainable and economic methods of cultivation, 3) more efficient mechanisms to dewater algae, and 4) more robust extraction technologies. The Biomass Program is funding a R&D consortium called the National Alliance for Advanced Biofuels and Bioproducts (NAABB), and other R&D activities, to address these critical areas. NAABB is supported by $49 million of DOE investment from American Reinvestment and Recovery Act, while the other efforts are supported by a combined $39 million in FY 2010 and FY 2011 appropriations. Chief among the non-consortium efforts are analyses on the techno-economic costs and greenhouse gases emission benefits of algal biofuels, as well as an understanding of the resource potential of the United States to support large-scale algae production.

Engineering know-how is also required to integrate and scale-up these technologies to fully operational algal biofuels production facilities. The Recovery Act also allowed the Biomass Program to invest in three algae

pilot and demonstration-scale integrated biorefineries- Sapphire Energy, Inc., Algenol LLC, and Solazyme, Inc., at DOE shares of $50 million, $22 million, and $25 million, respectively.

Subcommittee. Have there been any major recent advances?

Dr. Kelly. Since the FY 2009 Recovery Act solicitation, the efforts of the researchers, analysts, engineers and industrialists supported by the DOE Biomass Program have raised more than $77 million in non-federal cost-share on algae projects, filed more than 10 invention disclosures and published more than 50 new peer-reviewed original research articles.

Some examples of recent technological achievements in algal biofuels include:

1. Creating a special strain of green alga that can accumulate more than 75% of the cell mass in fuel precursor oils, which is nearly 10 times more lipids than the average green alga, elucidating the genetic pathways of importance that can then be transferred to industrially robust algae.

2. Demonstrating a national resource potential to replace up to 17% of domestic petroleum use with algal biofuels produced in America by using cutting edge geospatial and hydrological modeling technologies, showing the ideal locations to site future algae farms.

3. Launching a small technology company spin-out that is taking researchers' orders to manufacture the state of the art photobioreactors that can mimic outdoor light and temperature regimes, greatly facilitating measurements and predictions of how well strains will perform under real-world conditions.

INCREASE FOR BIOMASS LOGISTICS

Subcommittee. Dr. Kelly, your budget request proposes to triple funding for Feedstock "Logistics".

To bring us up to speed, can you describe what "Logistics" in this setting means?

Dr. Kelly. The term "Logistics" in the context of the Biomass Program refers to all of the operations related to getting cellulosic biomass from the fields where it is produced to the biorefinery storage yard. These operations are referred to using the terms below and typically include:

1. Harvesting (i.e., cutting, windrowing, baling, chipping, roadsiding)

2. Pre-processing (i.e., drying, size reduction, densification, blending)

3. Transporting to the biorefinery storage yard, and

4. Storage

Each of these operations has a cost associated with it, which depends on the type of crop (e.g., crop residue, herbaceous or woody), the terrain in which the harvesting operations occur (e.g., hilly, flat), field dimensions, spatial arrangement of fields on the landscape, sustainability constraints (e.g., soil erosion, water quality), quality of the material harvested (e.g., moisture content, soil contamination), transport distance, and storage conditions (e.g., time in storage, weather exposure).

The emerging cellulosic biorefinery industry has identified the delivery of stable, consistent, predictable, and affordable biomass feedstocks as a major barrier for continued expansion of the industry. The harvest and collection component of feedstock logistics is critical for ensuring sustainable land use practices, and the preprocessing, transportation, and storage components are critical for ensuring a stable and infrastructure compatible supply of biomass feedstocks which enable a national scale biofuels industry.

Our goal is to partner with National Labs, industry and universities to design, develop and demonstrate purpose-designed, systems that will

significantly reduce the delivered cost of large volumes of cellulosic feedstocks to biorefineries (relative to conventional systems).

Subcommittee. What work would this funding support? Are you funding laboratory research? Working with farms and the transportation sector? Or engaging in other activities?

Dr. Kelly. This funding will support RD&D activities at National Laboratories (primarily the Idaho National Lab (INL) and the Oak Ridge National Lab (ORNL)), universities and original equipment manufacturers (OEMs). Some of the work will be performed in laboratories, but a large portion of this work should be carried out at field scale, which is really the only way to understand biomass value chain logistics on the scale required. At this level of study, we will be working through the National Labs, universities, and OEMs to engage with private producers (farmers and plantation owners).

The Feedstock Logistics Working Group is a multi-agency consortium that includes DOE, USDA, EPA and DOT. It serves a cross-agency planning function to coordinate activities among the different stakeholder agencies that have a role in the development of the bioenergy industry in the U.S.

The involvement of DOT shows that we will be coordinating our efforts with the transportation sector, though DOE currently has no plans to fund any research in the transportation area, *per se*. Transport of materials from the field or forest to a processing facility is a critical element in the supply chain. Densification of material will reduce transportation costs by reducing water content and increasing energy density. This is just an issue of sound economics as some roads have load limits that may be exceeded without the removal of water. It should be noted, however, that the Program's resource assessment efforts do take into account the accessibility of potential biomass resources, which means that transportation routes factor into these resource assessment outcomes.

In addition we propose to fund ongoing R&D at INL to reach FY17 goals of developing technologies required to deliver at least 155 million dry tons of affordable, high quality feedstock for the biorefinery industry. This work will involve deployment of the INL pre-processing Process Demonstration Unit (PDU) in conjunction with industrial-scale projects. Because of the increase in biomass volume needed on a national scale, our efforts at

National Labs will expand to more types of feedstock materials grown in more types of environments, each of which presents somewhat different challenges that will need to be overcome on a case by case basis. The FY 13 request includes a solicitation of $11M in the area of feedstock logistics to encourage DOE-funded biorefineries (and others) to develop cost effective technologies and systems which overcome existing barriers. This solicitation may require collaborators to utilize the capabilities offered by the INL PDU. It may also require the involvement of OEMs in order to design, build and demonstrate industrial-scale, purpose-designed harvest, pre-processing, transport and/or storage equipment and systems for the biomass conversion industry.

Subcommittee. What warrants tripling funding for this program from $5 million to $16 million?

Dr. Kelly. An important consideration in answering this question is perspective on feedstock logistics funding over the past several years: FY09 - $14.5M, FY10 – $30.1M, FY11 – $18.8M, FY12 – $5.4M. Due to budgetary constraints and DOE priorities in FY12 the funding was reduced to a level that does not support reaching the R&D objectives for this critical element of reaching bioenergy goals. The increase in FY13 is essential to ensure that cellulosic feedstocks can be made available at an affordable cost to supply the needs of future biorefineries, in accordance with mandates established in the Energy Independence and Security Act of 2007 (EISA). It has been clearly articulated to DOE by our biorefinery partners that ensuring stable, consistent, predictable, and affordable biomass feedstock supplies remains a significant barrier for expansion of the emerging cellulosic biofuels industry. Our FY17 goal is to ensure that approximately 155 million dry tons of cellulosic feedstocks can be made available at affordable cost for use by biorefineries. This large volumetric national goal represents an immense increase in scope for the logistics research and the Program. It also represents a huge challenge to the nascent biorefinery industry, which will absolutely not be able to meet mandated volumetric goals for fuels without reliable access to large quantities of affordable, high quality feedstock materials.

There are two critical activities enabled by the increase in funding back to pre-FY12 levels.

1. A funding opportunity announcemnet in the area of feedstock logistics for $11M is planned for FY13. This accounts for at least part of the required increase in funding for FY13.

2. The magnitude of the challenge put before the nation and the Biomass Program by the relevant provisions of EISA, popularly known as Renewable Fuel Standard 2 (RFS2), is daunting. Approximately 155 million dry tons of biomass is estimated to be required annually to produce the 9 billion gallons of renewable fuels required by RFS2 in 2017. Because of this, we think that significantly increased budgets are required over the next few years. This increase would benefit efforts in the areas of feedstock logistics (focused on the scale discussed above), feedstock assessment efforts, and sustainability constraints (especially as they relate to feedstock supply and logistics).

ADVANCED BIOFUELS HURDLES TO COMMERCIALIZATION

Subcommittee. Today, many companies seeking to produce advanced drop-in biofuels and replacement fuels that are on the verge of commercialization. These companies have proven their technologies at the pilot and demonstration scales, but nonetheless face significant hurdles in building biorefineries at a scale whereby the product volumes are large enough to be cost-competitive with existing refineries. The capital required to deploy a commercial scale biorefinery is an order of magnitude higher than the cost of development or demonstration, and typically beyond the limits of venture capital. Moreover, private lenders generally will not offer low-cost debt to finance a first-of-its kind plant or technology.

How, if at all, does the DOE plan to help companies and investors address these hurdles, either through existing programs or new policy?

Dr. Kelly. Many of the projects selected in the Department's Biorefinery solicitations of 2007 and 2008, have encountered technical and financial barriers that have hindered their progress. These companies have used their partnership with DOE to improve their technology, debottleneck critical process improvements, and work with feedstock developers to negotiate agreements for supplies. We believe that by addressing these issues early in this demonstration phase the technology will become replicable and cost-effective. This will be done by reducing the amount of over-design inherent in these early facilities.

We believe that financing is not the only commercialization hurdle and continued RD&D is critical to driving the cost of production down so that the industry can attract private sector capital and stand on its own without government incentives.

Through the integration of new technology, improved engineering and lessons learned from the demonstration scale facilities private lenders will agree the inherent risk has been reduced and they can invest with some confidence.

This will be demonstrated in the future with the new policy directed to support the Department of Defense. DOE and USDA will partner with DOD by funding the construction and operation of new biorefineries via the Defense Production Act advanced biofuels initiative. DOD is an appropriate

first user for advanced biofuels since it is the largest purchaser of fuel within the Federal Government system. In addition, the EERE biomass program will continue to provide expertise to the USDA and DOE loan guarantee programs, as requested. We believe that the combination of these initiatives and continued price volatility in the oil markets will create the conditions necessary for the industry to overcome the challenges associated with introduction of any new fuel.

NATIONAL ADVANCED BIOFUELS CONSORTIUM

Subcommittee. The DOE's National Advanced Biofuels Consortium (NABC) has had great success in developing technologies to convert lignocellulosic biomass feedstocks to biofuels that are compatible with the existing transportation infrastructure.

How have the R&D successes of the NABC addressed technical risks of converting cellulosic material to drop-in fuels?

Dr. Kelly. The NABC was competitively awarded to bring together a multidisciplinary team of experts from academia, national labs and industry to assist the program in accelerating the development of biomass processing technologies for advanced biofuel production to industry-ready status. In Stage I of the NABC, six processing strategies were evaluated for their potential to successfully launch a pilot-scale bio-refining facility by 2014. This process resulted in two strategies that convert lignocellulosic sugars to hydrocarbon fuels to be selected to move forward to Stage II. One strategy utilizes catalytic conversion of corn stover and loblolly pine and the other uses a proprietary yeast strain and hydrocracking to produce a diesel and jet fuel blendstock. Additionally, the NABC identified two technology pathways which demonstrated considerable promise for achieving drop-in biofuels but were missing key data to fully complete the feasibility study. These pathways – hydrothermal liquefaction and hydro pyrolysis use thermochemical processing regimes to convert biomass to bio-oils, which can be subsequently upgraded to hydrocarbon fuels. These two technologies are on a track solely focused on addressing the primary technical and economic barriers that were identified in Stage I. This is the best mix of routes and allows the consortium to focus resources where they will have the greatest probability of providing the best benefits.

Subcommittee. How will the FY13 budget request support the continued activities of the NABC?

Dr. Kelly. Since the NABC was funded through ARRA, all money has been obligated, it will have to compete for follow-on work. Although the FY13 and outyear budget requests will not directly support ongoing activities in the NABC, it will support new competitive research opportunities into drop-in fuels. The NABC is focused on developing two pilot ready routes to producing hydrocarbon fuels, but there are numerous

other routes that show long term potential. The FY13 request supports a wide array of research, development, demonstration, and deployment research that focuses on routes to hydrocarbon fuels through biomass-derived oil and carbohydrate intermediates. Additionally, the Biomass Program will leverage an FY12 solicitation that targets the construction of pilot scale biofuel production facilities using terrestrial and algal biomass in FY13. The Biomass Program's diverse portfolio of research aims to enable many pathways by reducing the technology cost of producing cost effective lignocellulosic intermediate streams and final hydrocarbon fuels or blendstocks.

INTEGRATED BIOREFINERIES INVESTMENTS

Subcommittee. Dr. Kelly, the Department of Energy has invested hundreds of millions of dollars over the past several years into the Integrated Biorefineries program, which aims to make advanced biofuels refineries economical at commercial scales through demonstration projects. There has been some concern in the last several months that this program is producing plants that are not economical, and that shut down once they're built with taxpayer funds.

Dr. Kelly, how many plants have been built to date using grants from the Integrated Biorefineries program, and what is their total production capacity?

Dr. Kelly. The pilot and demonstration scale biorefinery projects being funded by the Department will validate the technical and economic viability as well as the environmental impacts of using biomass to produce advanced biofuels and co-products. DOE's technology investment portfolio includes fermentation, gasification, pyrolysis, algae, and hybrids of biochemical and thermochemical technologies.

The Biomass Program ran two competitive biorefinery solicitations, one each in 2007 and 2008. These two solicitations resulted in 11 awards: four commercial scale cellulosic ethanol biorefineries in 2007 and seven demonstration scale biorefineries in 2008. One of the demonstration scale biorefineries was acquired by another company after its stage gate. The new company decided not to proceed with its award which completed the project. Three of the projects have been mutually terminated because they were not able to meet the financial obligations of their awards. Three of these commercial scale biorefineries are under construction and scheduled to complete their start-up and commissioning early in Fiscal Year 2014. Two of the demonstration scale biorefineries have been delayed while they seek to raise sufficient equity for debt financing, they have moved forward with improving their technologies by conducting over 1,000 hours each of integrated pilot testing and additional R&D, and the last project has just completed a stage gate review for approval to proceed into construction.

Under the Recovery Act funding, 18 projects were selected. All 16 of the projects selected for pilot and demonstration scale facilities are being constructed with commissioning dates from May – September 2012.

The total annual production capacity of all the biorefineries under construction will be 80 million gallons. These are first-of-a-kind pioneer plants which require government assistance to validate risks, performance and economics. If they are successful, additional plants can be built by the private sector.

Subcommittee. How many of those plants are currently in operation?

Dr. Kelly. Three of the current biorefineries (two pilot scale and one demonstration scale) are expected to complete their start-up and commissioning within the next three months. These will be the first three facilities in operation.

Subcommittee. How many of those plants can now compete in the market without further government support or subsidies?

Dr. Kelly. Since none have completed construction and commissioning, it is still too early in the development of these biorefineries to determine if they can operate without government subsidies. It generally takes several years for a new commercial scale production facility to apply lessons learned during their early years of development to improve the operation of their production plant and provide a positive return on investment.

Subcommittee. Your budget request includes $54 million for more integrated biorefineries, and an additional $40 million for "drop-in fuel" integrated biorefineries. How do you justify continuing the program, and what will be the natural point to phase it out?

Dr. Kelly. Four of the remaining awards from the 2008 solicitation require a total of $94M to fulfill the total award amount. The Department has only obligated funds to allow the recipients to reach a critical stage gate review just prior to construction. The $54M in the FY13 Integrated Biorefinery request will fulfill the requirements on three of the four projects. The additional $40M is intended to support Biorefinery development through the DPA.

Many of the projects selected in 2007 and 2008, have encountered technical and financial barriers that have hindered their progress. These companies have used the time to improve their technology, debottleneck critical process

improvements, and work with feedstock developers to negotiate agreements for supplies. Even with all these positive outcomes, the financial community is reluctant to finance these first of a kind facilities because they still believe the inherent risk of these projects is too great without the government's participation.

DOE is completing its funding of cellulosic ethanol refineries when this set of projects is completed. It is believed that with the technical and engineering validation of this technology supported through DOE Biomass Program, industry is poised to replicate technology and grow the industry without additional technology support. The Program is shifting its focus to drop in fuels to fully displace a barrel of oil with renewable substitutes and is looking to accelerate this process through lessons learned and leveraged technology from the ethanol development and programs like DPA to secure early markets.

BUILDING TECHNOLOGIES

BETTER BUILDINGS CHALLENGE

Subcommittee. The budget request asks for $15 million for the Better Buildings Challenge. The request says that "through research and development, technical assistance, resources, and grants," the program will "deploy successful models that increase investment in commercial building energy efficiency and improve this efficiency by at least 20 percent by 2020." It's hard to tell from that description exactly what this program will do.

Can you please elaborate on the Better Buildings Challenge? What exactly will it do, what types of organizations will it fund, and for what type of work?

Dr. Kelly. Energy upgrades performed in the commercial building market are currently impacted by a variety of barriers including lack of public awareness, lack of successful models, lack of private sector investment, and lack of overall knowledge of proper specifications or resulting impacts. The Better Buildings Challenge is a voluntary leadership challenge to commercial and industrial building owners to commit to improving energy efficiency by at least 20% across their portfolios by 2020, to sharing specific and replicable models for success and to transparently sharing their energy consumption data as part of demonstrable success .In the commercial building area, BTP will be supporting the Challenge as part of its overarching strategy to demonstrate and deploy energy efficient technologies and solutions to new and existing commercial buildings. In FY 2013, BTP will be using the Better Buildings Challenge funding to:

- Release several Funding Opportunity Announcements to support the development of advanced envelope, window and HVAC technologies for commercial building retrofits.
- Supporting the deployment of the showcase projects and implementation models delivered by Better Building Challenge partners at scale across multiple sectors and geographies. Design strategy and build infrastructure to track the results of the showcase projects and implementation models drawn from Better Building Challenge partners in reducing energy consumption.

- Continue to develop the infrastructure and administrative support to manage partner relationships and the reporting and recognition aspects of the Challenge. DOE will track energy and financial savings data gathered from Challenge partners and allies, who will report their energy savings accomplishments and financial results as part of the reporting and recognition requirements of the program.
- Administrative support for the ongoing development of the Challenge website including expansion of the Better Buildings Challenge Solution Center to incorporate existing resources from BTP and new resources developed as part of the Challenge.
- Deploying a series of Better Building Challenge events, such as conferences, webinars and the annual Better Buildings Student Case Competition

Subcommittee. This initiative was funded in fiscal year 2012 at $2 million. What exactly is being done with those funds?

Dr. Kelly. In FY2012, the Better Buildings Challenge program was launched, with funds being used to build a series of tools to manage the Challenge, including the beginning of a data management and reporting system that will allow partners to report, and DOE to track, performance data and record and share case studies and models of success that are part of the Challenge. The funds are also being used to develop the backbone of the program, including: a website, the first stage of a comprehensive solution center, several partner events, and for an inaugural student case competition, which saw students from 19 universities tackle business and policy issues of energy efficiency.

INCREASE FOR BUILDING TECHNOLOGIES STANDARDS PROGRAM

Subcommittee. The request marks four years of steep increases for the Buildings Technologies Codes and Standards program. The request proposes to increase funding by $32 million, to a total of $98 million. Just four years ago, the program was $35 million.

What accounts for the increases in this program?

Dr. Kelly. The funding increase in 2013 will allow DOE to increase the scope and effectiveness of its energy conservation standards by accelerating the test procedure and standards rulemakings that are currently scheduled and allowing for the increased use of DOE's existing authorities to establish standards for additional products that have large energy savings potentials. The increase in funding for the Equipment and Appliance Standards Program will be used to initiate approximately 6 new energy conservation standards rulemakings and the corresponding test procedure rulemakings. DOE remains committed to meeting all of its legislatively mandated deadlines for covered appliances and equipment and actively enforcing its existing standards to provide a level playing field for all manufacturers. DOE will prioritize the selection of the new standards by evaluating the benefits resulting from such adoption. DOE will also expand its activities in certification and enforcement in order to increase the effectiveness of existing energy conservation standards. Certification and enforcement improvements will include updates to existing certification and reporting requirements for manufacturers along with increases in the frequency and scope of product testing to verify compliance with DOE standards.

Subcommittee. The "Standards" like gets most of the funding in the request — $83 million of the $98 million for Codes and Standards. What does Standards do, and how is it different than the other two budgetary pieces, ENERGYStar and Building Energy Codes?

Dr. Kelly. Equipment Standards and Analysis, or 'Standards', activities lead to improved efficiency of appliances and equipment by conducting analyses and developing energy conservation standards that are technologically feasible, economically justified and would save a significant amount of energy. Since minimum standards effectively eliminate inefficient

products from the market place, energy conservation standards ensure energy efficient technologies are purchased, installed and operated. The Standards program also develops the related test procedures to measure product efficiency and includes certification and enforcement activities to verify compliance with test procedures and specified efficiency levels.

DOE supports the ENERGY STAR program primarily by developing test procedures for ENERGY STAR products and conducting verification testing. DOE's verification testing program enables targeted testing to ensure that ENERGY STAR labeled products meet the relevant specifications.

The Building Codes program supports raising the standards for new and renovated buildings by providing analysis and support for upgrading the next generation of the IECC and ASHRAE 90.1 building codes with an emphasis on cost-effectively achieving 50 percent energy savings over the baseline. DOE also provides technical assistance to States to adopt, update, implement, and enforce their building codes.

NEW INITIATIVES IN COMMERCIAL BUILDINGS INTEGRATION

Subcommittee. The request increases the Commercial Buildings Integration program — excluding the proposed Better Buildings Challenge — by 44 percent to $46 million. It's impossible from your budget request documents to figure out how this will be spent.

Does this increase constitute an expansion of existing activities, or do you propose to start new activities under Commercial Buildings Integration? Again, setting aside the Better Buildings Challenge for a moment.

Dr. Kelly. Both expansion of existing projects and new projects are anticipated for FY13. The Commercial Buildings Integration subprogram (CBI) will expand the work of its successful Energy Alliances, which engage owners and operators of a variety of types of commercial buildings in project teams that tackle priority issues for their sectors. For example, the DOE has supported the development of technology specifications for high efficiency interior and exterior lighting that have been deployed across members' portfolios and applied in the procurement requirements of other organizations, such as the Washington Metro system. CBI will continue to develop specifications for products within the major end uses of commercial energy use: lighting, HVAC, refrigeration and plug loads. CBI plans to expand its market partnerships program in order to drive faster and more widespread adoption of the tools and solutions it develops. CBI also supports a market transformation team through the Alliances, and will expand the development and deployment of solutions such as the green lease library, as many of the fundamental barriers to accelerated uptake in the commercial market are business and organizational. In FY13, CBI will expand its work in data standardization and transparency across a number of projects, including developing a standard data taxonomy for buildings, as well as continuing to develop the tools and resources needed to drive market uptake of energy efficiency in new and retrofit buildings. Several of these projects will move from pilot or demonstration to full launch in FY13.

Subcommittee. What are those proposed new initiatives under Commercial Buildings Integration?

Dr. Kelly. CBI proposes several new areas of projects, including deployment of techniques and solutions to achieve at least 50% energy efficiency. Building on the success of a series of Advanced Energy Design

and Retrofit Guides, CBI will expand deployment of the solutions in the guides and on the techniques required to procure and implement energy savings projects. CBI also plans to expand its work in small and medium buildings, including in low- and no-cost solutions. Finally, CBI plans to expand its technology identification and demonstration program across the commercial sector.

HVAC RESEARCH

Subcommittee. The request nearly doubles funding for Heating, Ventilation and Cooling (HVAC) research and development within the Building Technologies program.

What's the opportunity here? What will success look like?

Dr. Kelly. In 2010, annual HVAC energy use includes 15.6 quads of primary energy (8.4 quads in residential, 5.9 quads in commercial, and 1.3 quads in industrial). Solutions EERE can develop and deploy offer nearly 7 quads of energy savings. This will require developing multiple advanced cooling (e.g., liquid desiccant) and integrated heating, cooling and ventilation (e.g., cold-climate and integrated heat pumps) equipment, demonstrating them at scale, and raising standards to the appropriate level.

Subcommittee. With this proposed increase, funding for HVAC research would leap-frog past the funding level you propose for solid state lighting research. I've heard arguments that the potential for energy savings nationwide is much larger from advances in solid state lighting than from improved HVAC systems. Is that true? How would you justify giving HVAC research more funding than solid state lighting research?

Dr. Kelly. In 2010, annual lighting energy use includes 5.7 quads of primary energy (1.6 in residential, 3.5 in commercial, and 0.6 in industrial). LED lighting presents a fantastic opportunity to save up to 4 quads of this energy use. Thus, HVAC offers a larger, but harder to capture, savings opportunity that justifies an appropriate investment.

SENSORS AND CONTROLS NEW PROGRAM

Subcommittee. The budget request starts a new $5 million research program for Sensors and Controls, which could provide energy savings in buildings by developing advanced sensing and controls solutions.

Can you explain more fully to the Committee what types of technologies this program will develop, and how they could save Americans money and energy?

Dr. Kelly. Commercial buildings in the U.S. have more than 70-billion ft^2 of floor space and consume about 18% of all U.S. energy consumption (Source: CBECS). An extensive quantity of evidence from case studies indicates that building systems often do not operate as intended, compromising operational efficiency and leading to energy waste. Nonetheless through implementation of more sophisticated, low cost and integrated sensors/controls technologies, our analysis shows that a reduction of approximately20% in energy consumption can be realized. Further research, development and commercialization activities in this area will enable penetration of attractive solutions into the marketplace. These technologies may include, but are not limited to, innovations in auto fault detection and diagnosis, wireless lighting occupancy sensors, self-learning thermostats, controllable power outlets, and self-optimizing, automated whole building control systems.

Subcommittee. Are the fruits of this research something the average American will benefit from? Or is this only targeted at new buildings or commercial settings?

Dr. Kelly. While the initial focus of this research program will be on the commercial buildings market, the same strategies, scaled appropriately, can be delivered to the residential market. Lessons learned from the development of integrated sensors/controls technologies for commercial applications will benefit, for example, enhancements to smart appliances, lighting solutions and residential HVAC components, as well as lead to the development of cost-effective whole house energy management systems.

SOLID STATE LIGHTING MANUFACTURING AND CONGRESSIONAL DIRECTION

Subcommittee. Dr. Kelly, manufacturing is a particular focus of this year's budget request. This Committee shares your concerns and focus on manufacturing. In fact, we've supported manufacturing in a variety of ways over the last several years. In the fiscal year 2010 House Committee report, we increased funding for the solid state lighting research program and encouraged the Department to fund activities that assist manufacturers…to lower manufacturing costs" for solid state lighting.

The fiscal year 2012 House Committee report once again reiterated its support for manufacturing, and the fiscal year 2012 conference report finalizes funding levels for solid state manufacturing improvements at $12,000,000.

After the budget request was released, we heard that the Department was not going to fund solid state manufacturing in fiscal year 2012 at the level directed by the Congress. I've since been told that the Department has fixed this, but I'd like to confirm with you: Is the Department devoting $12 million of its budget in fiscal year 2012 to its Solid State Lighting Manufacturing R&D grant program?

Dr. Kelly. The Solid-State Lighting (SSL) Program addresses improvements in lighting quality, efficacy, and cost; and has three elements in the R&D Portfolio: Core Technology, Product Development, and Manufacturing R&D. The first two elements are linked to manufacturing, as applied research and product development must relate to a manufacturable product. A balanced strategy with all three elements is needed to move the technology to market. In 2009, DOE started a specific Manufacturing R&D Initiative to reduce the cost of SSL sources and luminaires; improve product consistency (while maintaining high quality products); and encourage a significant role for domestic U. S. based manufacturing in this country. The R&D program planning entails a series of roundtables and workshops to engage the R&D community in preparation of "roadmaps" that note high priority tasks to appear in DOE solicitations. The portfolio of active SSL R&D projects presently has a strong emphasis on manufacturing, with the funding split out by: Core – 24%, Product – 18%, and Manufacturing – 58%. For FY12, approximately $5 million supported existing manufacturing projects, while approximately $7 million was allocated for new

manufacturing awards before the end of the fiscal year. For FY13, DOE will continue to place appropriate emphasis on SSL manufacturing R&D, with balance on other elements of the program. The Department plans to expand the FY13 Funding Opportunity Announcement for solid state lighting manufacturing grants for a total of $12 M.

NEGOTIATED RULEMAKINGS

Subcommittee. In its energy efficiency rulemaking program, the Department has recently begun using a "Negotiated Rulemaking" process, which can operate at an accelerated schedule while gaining better consensus between industry and government than the typical process.

What is your assessment of how well the negotiated rule process is working?

Dr. Kelly. The Department recently used the negotiated rulemaking process for the energy conservation standard rulemaking for distribution transformers. A representative group of stakeholders and experts (including electric utilities, transformer manufacturers, and energy efficiency advocates) met frequently in person and on conference calls to evaluate potential standards for liquid immersed, medium voltage dry-type and low voltage dry-type transformers, as well as for the Department's key methodologies, supporting analyses, assumptions and results. The robust dialogue continued over email and on a dedicated rulemaking committee web site. It is clear that the process fostered greater and more dynamic stakeholder engagement—not just with the Department, but with each other—than a normal, notice and comment rulemaking process. Ultimately, the stakeholders reached agreement on standards for 1 of the 3 groups of transformers at issue (medium voltage dry-type). However, the negotiated process fostered a great deal of give-and-take information sharing, which, over the course of the negotiation, improved the data and analyses that formed the foundation of DOE's proposed standards published in February 2012 (77 FR 7282 (February 10, 2012)).

Subcommittee. Does the Department intend to expand its use of this process?

Dr. Kelly. While the Department was encouraged by the success of the process and is optimistic about its future use in rulemakings, it is too early to know how much of that success and stakeholder engagement resulted from the process itself or the unique circumstances of the transformer rulemaking and its stakeholders. However, DOE does intend to explore more opportunities to use the negotiated rulemaking process and leverage the lessons learned from the recent experience with the distribution transformers rulemaking. DOE has formed the Appliance Standards and

Rulemaking Federal Advisory Committee to explore opportunities in this area.

Subcommittee. What are the budget implications of using this process rather than the traditional rulemaking process?

Dr. Kelly. The budget implications of using the negotiated rulemaking process depend on the individual rulemaking in question. In general, the negotiated rulemaking process has the potential to save resources. If the negotiations lead to consensus efficiency levels, then DOE could complete the rulemaking faster than using the traditional process. In addition, the information-sharing that occurs could lead to more robust analysis at the outset of the rulemaking. Both outcomes would save time and money. Additionally, if the rulemaking can be completed faster, then it gives DOE the opportunity to allocate resources to other activities.

MECHANICAL INSULATION

Subcommittee. Buildings are responsible for 40% of U.S. energy demand and 40% of all greenhouse gas emissions, making efficiency gains in this area crucial if we are to markedly reduce America's energy consumption. There remains a lot of conservation opportunities in this area, in particular with the commercial and industrial sectors, which together consume 2½ times more energy than residential structures. The fiscal year 2012 appropriations conference report contains language that encourages the Department to continue working with industry to tout mechanical insulation as a means of energy efficiency, job creation, environmental benefits and use of American-made manufactured products.

Currently, the Industrial Technologies Program has partnered with outside groups to execute the Mechanical Insulation Campaign (MIC). Could you please provide the Subcommittee with an update on the progress of the MIC?

Dr. Kelly. DOE's Advanced Manufacturing Office (AMO) -- formerly known as the Industrial Technologies Program (ITP) -- has worked with the National Insulation Association (NIA) to develop a Mechanical Insulation Education & Awareness Campaign that will be completed by the end of February, 2013. This effort included the following tasks:

- Completed research leading to improved quality of data on the potential energy savings, within the commercial building and manufacturing sectors, through increased use of mechanical insulation

- Developed online calculators (http://www.wbdg.org/design/midg_calculators.php) and a 5-module online training course on the benefits of improved mechanical insulation (https://www.nterlearning.org/web/guest/course-details?cid=233)

- Conducting a marketing and awareness campaign that centers around a full page ad developed for select publications to promote the mechanical insulation resources and tools developed under this effort. This task will be completed by the end of February 2013.

Subcommittee. Besides the MIC, what plans are there in EERE to promote the energy savings readily apparent from mechanical insulation?

Dr. Kelly. AMO is engaged in a number of broader industrial energy efficiency activities aimed at promoting energy efficiency in industrial settings, which includes mechanical insulation as part of facilities effort to improve energy efficiency. The current activities DOE AMO that AMO is undertaking include:

- The Better Plants Program and Challenge allows leading manufacturers to work with DOE to reduce their energy intensity by 25% over ten years, develop energy management plans, and track and report their annual progress

- The Industrial Assessment Center program in which teams of specially-trained engineers from 24 universities across the U.S. work directly with small and medium-sized manufacturers to identify and implement energy efficiency improvement opportunities

- The Superior Energy Performance certification program that provides industrial facilities with a transparent, globally accepted system for verifying energy performance improvements and management practices

REGULATION OF DECORATIVE VENTED GAS FIREPLACES

Subcommittee. Dr. Kelly, the Department is in process of establishing a rule that regulates the energy efficiency for residential heaters of various types. It appears that the Department is on the verge of including decorative gas fireplaces and log sets in this rule, labeling them as "heat sources" rather than as decorative items. Apparently, this could risk decimating that industry.

What is the status of this rulemaking — where are you in the timeline, and is there still room for adjustments before the final rule?

Dr. Kelly. In establishing the definitions pertaining to direct heating equipment in an April 2010 final rule (75 FR 20112 (April 16, 2010)), DOE recognized the aesthetic appeal of certain gas hearth products and included a provision in its definition of "vented hearth heater" that considered certain gas hearth products to be primarily decorative in nature, and excluded them from having to comply with DOE's minimum energy conservation standard otherwise applicable to vented gas hearth direct heating equipment. However, based upon manufacturer concerns regarding the exclusion expressed subsequent to the publication of the April 2010 final rule, DOE commenced a second rulemaking to address the issues and concerns raised. This rulemaking was completed in November 2011 with the publication of a final rule amending the criteria for certain vented gas hearth products to be considered as decorative products that are excluded from having to comply with standards (76 FR 71836 (November 18, 2011)).

Subcommittee. It seems that there is certainly some merit to the arguments that rule inappropriately labels these decorative products as "heaters." How would answer those criticisms?

Dr. Kelly. In recognizing the primarily decorative nature of certain products that are intended to be used mainly for aesthetic appeal, rather than as a heating product, DOE provided the exclusion in the April 2010 final rule to identify the primarily decorative products that should not be subject to the standards for vented hearth heaters. Further, in its November 2011 final rule, DOE amended its definition of "vented hearth heater" to modify the basis upon which such products would be considered primarily decorative in nature and, therefore, not subject to the DOE's minimum energy conservation standards for vented hearth heaters. DOE amended the

scope of the exclusion in order to achieve greater energy savings, promote consumer product choice, and ease manufacturer burdens. The amended definition in November 2011 improved upon the original 2010 definition by providing a clear, objective distinction between those hearth heating products that are primarily decorative and those that are primarily used for utilitarian heating and allows manufacturers to continue the production and sale of primarily decorative products that would not be subject to the standards for direct heating equipment.

Subcommittee. Why has the Department chosen, so far, to include these products in the rule?

Dr. Kelly. DOE has determined that hearth products that are primarily decorative in nature should be excluded from having to comply with DOE's minimum energy conservation standard otherwise applicable to vented gas hearth direct heating equipment.

Subcommittee. It seems that this rule could bring substantial risk to American industry and jobs. Are you actively working with all parties, including the industry, to ensure a reasonable outcome?

Dr. Kelly. As noted, this rulemaking was completed with the publication of a final rule in November 2011. DOE believes the amended definition addresses the areas of greatest concern to industry by excluding vented gas log sets and decorative gas hearth products (*i.e.*, those products which meet the set of criteria defined by DOE) from having to comply with the energy conservation standards for vented hearth heaters.

VEHICLE TECHNOLOGIES

NATURAL GAS VEHICLES

Subcommittee. Natural gas vehicles are one of only a few alternatives to cars and trucks that use petroleum-based fuels. With rising gas prices putting an increasing burden on American drivers, it seems wise to fully consider and support this alternative. ARPA-E recently announced a major one-time research program to advance natural gas vehicle technologies. But considering that ARPA-E focuses on "white space" — that is, areas in which no other Department program is focusing — this says to me that natural gas vehicle research is not part of your year-in and year-out program.

Dr. Kelly, what does your office do to advance natural gas vehicles and bring them into the mainstream?

Dr. Kelly. EERE's Vehicle Technologies Program (VTP) has worked very closely with the natural gas vehicle industry, engine and vehicle manufacturers, and end users to help develop and advance natural gas vehicle (NGV) technologies in a number of key areas. The primary focus has been on medium- and heavy-duty commercial truck and bus applications, for which natural gas technology is most viable. Virtually every heavy-duty factory-built truck and transit bus powered by compressed natural gas (CNG) or liquefied natural gas (LNG) in the United States today uses engines and components developed in partnership with VTP. Presently, VTP has competitively-awarded natural gas engine development projects with three manufacturers (Cummins, Navistar/ESI, and Doosan) to help to further expand the range of NGV product offerings. The engines developed as a result of these projects will fill an important market niche – the heavy end of medium-duty trucks – that is currently filled by engines that are either too large or too small for optimal application.

VTP also has ongoing deployment efforts designed to help remove barriers, provide technical assistance to LNG and CNG fleet users and natural gas fuel providers, and facilitate more widespread adoption of NGV technologies. VTP-developed resources include essential tools and information such as a natural gas fueling station locator and mapping service, cost calculators that fleets can use to evaluate NGV benefits and options, and safety and code related training and outreach programs for first responders and public safety officials.

In addition, VTP has provided competitively-awarded financial assistance to help advance NGVs and develop CNG and LNG infrastructure. Federal cost-share encourages both initial private-sector match and long-term investment in infrastructure development and other vehicle deployment initiatives. Through Recovery Act projects and other competitively-awarded deployment efforts, VTP projects will help to deploy more than 3,500 CNG and LNG vehicles and build 150 NGV fueling stations.

Subcommittee. What do you see as the main obstacles to making natural gas vehicles a viable alternative for the average American driver?

Dr. Kelly. The main obstacles to mainstream consumer use of natural gas vehicles (NGVs) are a lack of publicly-accessible and convenient compressed natural gas (CNG) fueling infrastructure, high incremental vehicle cost, and lack of light-duty, consumer-oriented NGV models from original equipment manufacturers. Currently, only one manufacturer offers a CNG factory-product for the individual consumer (Honda Civic GX), though aftermarket conversions are available for several other vehicle makes and models. The incremental cost of a light-duty NGV remains high, typically $5,000 or more. Home fueling is an option to address the lack of publicly-available fueling stations; however, the choices are limited, with only one manufacturer offering CNG home refueling appliances, with installed costs ranging from $5,000 to $8,000. The current ARPA-E solicitation includes a topic directed toward significantly reducing the cost of home re-fueling. If successful, this could ease the path to broader use of CNG vehicles among the general public.

Subcommittee. Mr. McConnell, your office deals specifically with fossil fuels. Does it conduct any work to advance natural gas vehicles as an alternative to the oil-based fuels that are putting such a punch on Americans' wallets?

Mr. McConnell. The Office of Fossil Energy does not have a natural gas vehicles program.

EERE's Vehicle Technologies Program (VTP) is investing in multiple aspects of vehicle efficiency technologies, including lower cost battery and electric drive component manufacturing, vehicle electrification deployment and infrastructure development , higher efficiency combustion engines, vehicle lightweighting, and alternative fuels utilization and deployment

because of the associated contributions to reduced transportation use. As part of this portfolio, VTP has worked with the natural gas vehicle industry, engine and vehicle manufacturers, and end users to help develop and advance natural gas vehicle (NGV) technologies in a number of key areas. The primary focus has been on medium- and heavy-duty commercial truck and bus applications, in which the use of natural gas technology is most likely to be viable. Presently, VTP has competitively-awarded natural gas engine development projects with three manufacturers (Cummins, Navistar/ESI, and Doosan) to help to further expand the range of NGV product offerings by developing optimized engines for . the heavy end of medium-duty trucks. .

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In addition, VTP has provided competitively-awarded financial assistance to help advance electric vehicle and alternative fuel infrastructure.

GAS MILEAGE IMPROVEMENTS THROUGH LIGHTWEIGHT-MATERIALS RESEARCH

Subcommittee. With gas prices at record highs for this time of year, it's important that we focus as much as we can on lowering how much Americans spend on gasoline as quickly as possible, and in as many ways as possible. I'm pleased to see strong support in the budget request for something along those lines, Dr. Kelly, the Materials Technology program. Increasing gas mileage of all types of vehicles by inventing cutting edge lightweight materials is a good idea that could help all Americans.

What is this program focusing on currently, and what does it propose to do in fiscal year 2012?

The request increases funding for this program to $38.8 million, an increase of nearly $10 million. What will that expansion of funds accomplish?

Dr. Kelly. Within the Department's Vehicle Technologies Program, the Materials Technology effort focuses on developing advanced materials and manufacturing techniques to reduce vehicle weight, as well as enabling light-weighting by downsizing the propulsion system through improved engine efficiencies in a cost-effective and deployable manner. The program supports the development of improved properties, manufacturing techniques, and computer modeling of third generation advanced high strength steels, aluminum alloys, magnesium alloys, and carbon fiber composites in lightweight vehicle structures, and advanced cast alloys for propulsion systems. Key accomplishments achieved in fiscal year 2012 include the following: the development of a plasma oxidation process to reduce the time (and therefore, cost) of preparing the fiber precursor prior to its conversion to a carbon fiber that meets automotive requirements (Oak Ridge National Laboratory); and the development of a magnesium alloy that can achieve similar energy absorption performance of the aluminum used in today's vehicles at a mass savings of greater than 20% -- this work is significant in that it improves the properties of magnesium but also does so without the use of rare earth elements in the alloy formation (previously, rare earth was required to achieve similar performance).

Ongoing work includes the demonstration of a multi-material vehicle 50% lighter than a 2002 standard light-duty vehicle that passes all requirements, including crash testing.

The Materials Technology FY2013 request of $48 million includes an increase over FY2012 funds to support further development of advanced high strength steel and new work in high performance advanced steel/aluminum joints. Third generation advanced high strength steels possess both exceptional strength and manufacturability, enabling weight reduction through the use of thinner sheet, more complicated shapes, and as a reinforcement for other light materials. In addition, lightweight vehicle structure could use a combination of advanced steels and aluminum to achieve optimal weight reduction, but effective and efficient methods for joining these materials in an automotive environment require considerable development. New research would explore manufacturing techniques for joining advanced steels and aluminum, with an emphasis on joint performance. The budget request also includes continued support for aluminum alloys, magnesium alloys, and carbon fiber composites, in addition to advanced high strength steels.

REDUCTION IN COMBUSTION ENGINE RESEARCH

Subcommittee. Dr. Kelly, gas prices are at record highs and putting a real burden on American drivers. Virtually the entire country drives combustion engine vehicles, and it seems that cutting-edge research could save all Americans money by making significant leaps in gas mileage.

Why does your request, then, actually reduce funding for Advanced Combustion Engine R&D?

Dr. Kelly. The Department agrees that cutting-edge research in advanced combustion engines can greatly improve fuel economy and intends to continue a significant effort in this area. However, even with a robust budget request for Vehicle Technologies, the program had to make difficult decisions, including a slightly lower request for the Advanced Combustion activity. The Department believes the combustion engine portion of the Vehicle Technologies budget request is appropriate to meet established research milestones and assist manufacturers in further improving fuel economy.

Subcommittee. Your budget request devotes at least half of its efforts in Vehicle Technologies on electric vehicles. Is that undervaluing work that could be done on combustion engine vehicles — which represent nearly all of the cars on the road today and for the foreseeable future?

Dr. Kelly. The Department believes the combustion engine portion of the Vehicle Technologies budget request is appropriate to meet established research milestones and assist manufacturers in further improving fuel economy. Significant advances in internal combustion engines (ICEs) are possible and these technologies can be transferred to the market quickly through existing manufacturing facilities and capability. In the very short term, increasing vehicle efficiency using advanced ICE technology is an important pathway to address reducing petroleum consumption and greenhouse gas emissions. To completely address these issues and break our dependence on imported oil, however, we must transition to electric drive. Advanced ICEs can play a role in this transition, as using advanced ICEs in hybrid electric vehicles and plug-in hybrid electric vehicles will enable even greater fuel savings benefits.

COLLABORATION WITH OFFICE OF SCIENCE ENGINE SIMULATION

Subcommittee. In the fiscal year 2012, the Congress appropriated $10 million for a new program in the budget request for the "predictive modeling of internal combustion engines". The idea was that computer models of combustion in these engines could help manufacturers adjust their engines to realize unprecedented increases in gas mileage.

How is your Vehicle Technologies program going to take advantage of that work in the Office of Science? Is there any collaboration?

Dr. Kelly. The Vehicle Technologies Program (VTP) has a long and productive history of collaboration with the Office of Science (DOE-SC) on efforts to increase engine efficiency and improve vehicle fuel economy. In fiscal year 2012, DOE-SC is supporting "Predictive Simulation of Internal Combustion Engines" (PreSICE) with enhancements to ongoing projects as well as new competitively-awarded projects. VTP continues to coordinate with DOE-SC, meeting regularly and co-sponsoring research and workshops, and anticipates providing competitively-awarded funding for applied engineering efforts to complement the DOE-SC awards. The ultimate objective of the DOE-SC/VTP synergy is to provide automobile and engine manufacturers with science-based, experimentally-verified engine simulation tools to help them further improve vehicle fuel economy.

FOCUS ON CARS VERSUS TRUCKS AND COMMERCIAL VEHICLES

Subcommittee. The need to reduce our vulnerability to soaring gas prices applies to all kinds of vehicles.

How much of your Vehicle Technologies budget focuses on cars, and how much is devoted to trucks and other commercial or fleet vehicles?

Dr. Kelly. The Vehicle Technologies Program budget supports activities specifically related to light-, medium-, and heavy-duty vehicles, but there is also work that cross-cuts vehicle classes, including enabling technologies and outreach, deployment, and analysis activities. With such cross-cutting work, a precise total division of funds for specific vehicle classes is not possible with certain accuracy. For FY2012, the program estimates that approximately $180 million supports work on light-duty vehicle technologies, approximately $40 million supports work related to medium- and heavy-duty technologies, and approximately $110 million supports activities that are broadly applicable to multiple vehicle classes. Estimates for the FY2013 budget request generally align with the estimates for FY2012. It is important to note that the program's support for light-duty vehicle technologies generally reflects their significant contribution to highway transportation use compared to other vehicle classes: light-duty vehicles account for 76% and heavy trucks account for 19% of U.S. highway transportation energy use (buses and medium trucks account for the remaining 5%).

Subcommittee. Is that a shift from prior years?

Dr. Kelly. The Vehicle Technologies Program budget supports work specific to certain vehicle classes but also includes cross-cutting activities, including enabling technologies, outreach, deployment, and analysis, that support multiple vehicle classes. Historically, the distribution of funds has generally favored light-duty vehicle technologies – there have not been significant shifts in this trend over time. The program's relative support for light-duty vehicle technologies generally reflects passenger vehicles' significant contribution to highway transportation use compared to commercial vehicles: light-duty vehicles account for 76% and heavy trucks account for 19% of U.S. highway transportation energy use (buses and medium trucks account for the remaining 5%).

BATTERY RESEARCH SEES LARGE INCREASE

Subcommittee. In the budget request for Vehicle Technologies, Batteries and Energy Storage for electric vehicles is the clear winner, at $203 million — nearly 40 percent of the entire Vehicles program.

What is the emphasis in this subprogram? Is it all research to improve the battery technology currently used in electric cars?

Dr. Kelly. The $203 million budget request supports both Energy Storage R&D ($158 million) and Power Electronics and Electric Motors R&D ($45 million). The request includes support to (1) strengthen U.S.-based manufacturing, significantly reducing the cost and improving the quality of batteries through novel electrode processing, equipment R&D, formation and metrology and materials, and (2) accelerate battery pack cost reduction through design and development of advanced pre-production battery prototypes, development of advanced battery computer aided engineering tools to speed up product development cycle, and standardized battery formats. The Power Electronics and Electric Motors R&D activity addresses the second building block of hybrid-electric and electric vehicles – the electric and electronic devices that deliver power stored in the battery to the vehicle's drivetrain. These include power control circuits, charging circuits, electric motors and magnetic materials, and other related components.

The lithium-ion battery technologies being commercialized today were developed with support from the Vehicle Technologies Energy Storage R&D activity. This activity now involves the development of next-generation battery technology, which places a greater emphasis on revolutionary materials such as higher capacity and higher voltage cathode materials, silicon alloy composite anodes, novel electrolyte solvents and salts, ceramic and polymer electrolytes, and battery chemistries including solid state lithium, lithium sulfur, lithium air, and others.

Subcommittee. The Department is currently working to establish a Batteries and Energy Storage Energy Innovation Hub in the Office of Science. How is the research in your program different than the Hub's research?

Dr. Kelly. The Vehicle Technologies Program Battery R&D activity is a mission-driven, applied R&D effort focused on high energy battery chemistries for use in all-electric and plug-in hybrid electric vehicles, and high power systems for hybrid electric vehicles. Higher energy and higher power electrode materials promise to lower system cost significantly by reducing the amount of material and the number of cells needed for the entire battery pack. The focus of this work will be the development of new materials and electrode couples that offer a significant improvement in either energy or power over today's technologies. Specifically, next generation lithium-ion technologies show a real possibility to reduce costs by 50-75%, a significant decrease that could enable the mass market penetration of electric-drive vehicles.

The Batteries and Energy Storage Hub follows a slightly different, interdisciplinary research and development approach to advance next-generation electrochemical energy storage technologies for not only electric-drive vehicles but also improving the reliability and efficiency of the electrical grid and better integrating clean, renewable energy technologies as part of the electrical system. Rather than focusing on a single technology or incremental improvements to current technologies, the Hub will deliver revolutionary research resulting in new technologies and approaches. The Department's vision for the Hub goes beyond current technology with a proposed research plan that leverages current programs and provides new avenues for interactions and information flow. To ensure it complements (and does not duplicate) existing efforts, the Hub's funding opportunity was developed with input from energy storage programs across the Department. The Department's battery "tech team," with staff from offices and programs involved in energy storage research, helps to ensure research plans, goals, priorities, and activities are well coordinated. In addition, to further clarify the roles of each DOE office with batteries and energy storage research, DOE held a public Batteries and Energy Storage Information Meeting to provide overviews of its energy storage activities, cross-cutting basic research and technology research for vehicles and the grid, including the proposed Hub.

Subcommittee. Dr. Kelly, if you had to choose — and with budgets tight, we will likely have to choose — would you fund the battery research in your program, or the Hub?

Dr. Kelly. The Energy Innovation Hub and the Vehicle Technologies Program Batteries and Electric Drive R&D activity have related – but different – roles in accelerating the development of electric-drive technology, which is critical to achieving U.S. energy independence by reducing dependence on petroleum. I support both efforts and believe that both should be supported with funding in line with the President's request.

"EV EVERYWHERE" INITIATIVE

Subcommittee. On March 7, the President announced an "EV Everywhere" initiative, to be conducted by the Department of Energy's Office of Energy Efficiency and Renewable Energy, Office of Science, and ARPA-E. At face value, the program aims to lower the cost of American-made electric vehicles.

It's somewhat frustrating when the Department sends their budget request up to the Congress in February, and then it announces a large multi-program initiative that is not mentioned a single time in that budget request. That implies to me that this initiative is either simply a marketing label on top of existing Department programs, or that the Department no longer finds it necessary to be explicit in its requests for funding from the Congress for new initiatives.

Is this initiative a change to the work on electric vehicles already ongoing in the Science, EERE, and ARPA-E offices, or is this a genuinely new program?

Dr. Kelly. EV Everywhere is a DOE Clean Energy Grand Challenge focused on enabling U.S. companies to be the first in the world to produce electric vehicles that are as affordable and convenient for the average American family as today's gasoline-powered vehicles, within the next 10 years (by 2022). The Challenge builds on current DOE FY2012 electric-drive vehicle activities in the Office of Energy Efficiency and Renewable Energy (EERE), Office of Science (DOE-SC), and ARPA- E that align with its goals, and the additional funds requested in the FY2013 budget would also support the Challenge.

EV Everywhere is the second in a series of Energy Department "Clean Energy Grand Challenges" to address the most pressing energy challenges of our time. The EV Everywhere Grand Challenge is modeled after the $1/Watt SunShot Challenge, which seeks to make solar power directly cost-competitive with electricity from fossil fuels by the end of the decade. These Grand Challenges focus on technical innovations and cost reductions that will enable clean energy technologies to compete directly, without subsidies, with the energy technologies used widely today.

Subcommittee. How much funding is the Department putting towards the "EV Everywhere" initiative in fiscal year 2012, and how much funding is in the budget request for fiscal year 2013?

Dr. Kelly. There is no FY2012 budget specifically delineated to the EV Everywhere Grand Challenge, but ongoing electric-drive vehicle R&D activities in the Office of Energy Efficiency and Renewable Energy (EERE), Office of Science (DOE-SC), and ARPA-E support Challenge goals. Relevant FY2012 R&D activities and related budgets include (1) $205 million from the EERE Vehicle Technologies areas of Vehicle and Systems Simulation and Testing, Batteries and Electric Drive Technology, and Materials Technology; (2) approximately $40 million from DOE-SC (the Energy Storage Hub, Energy Frontier Research Centers, and basic research projects); and (3) $142 million from ARPA-E Transportation Systems.

The FY2013 EERE Vehicle Technologies Program request includes additional funding for the Grand Challenge – specifically, an additional $85.85 million for Batteries & Electric Drive Technology, an additional $9.02 million for Vehicle and Systems Simulation and Testing, and an additional $7.65 million for Materials Technology. For ARPA-E, an additional $41.44 million is requested for Transportation Systems.

Subcommittee. Dr. Kelly, put simply, where can we find this in your budget request?

Dr. Kelly. Current and future planned activities related to electric-drive technology development will support and contribute to the EV Everywhere Grand Challenge. The FY2013 budget request for Vehicle Technologies includes descriptions of these activities on the following pages:

- Page 180 (left column, last paragraph),
- Page 183(left column, 1st and 2nd paragraphs),
- Page 185 (right column, last paragraph),
- Page 188 (left column, last paragraph), and
- Page 189 (left column, 3rd & 4th paragraphs).

Subcommittee. This initiative has goals for the year 2015 and goals for the year 2020. It will be important for us to know how this initiative will complement or supplant the existing Vehicle Technologies portfolio, which pursues similar research. How much does EV Everywhere overlap with

other activities, and what are the planned funding levels in the next several years?

Dr. Kelly. The EERE Vehicle Technologies Program (VTP) has established goals for 2015 and 2020, and the ongoing and planned activities in VTP's portfolio support the EV Everywhere Grand Challenge, which seeks to develop the technical innovations and achieve the cost reductions needed for clean energy technologies to compete directly, without subsidies, with incumbent conventional energy technologies by 2022. Similarly, ongoing and planned electric-drive R&D activities in ARPA-E and the Office of Science also support EV Everywhere objectives. Building on the Department's existing communication across offices and programs, EV Everywhere provides a unique opportunity for continued and improved Department-wide collaboration through regular information-sharing, joint-planning, and execution of activities in support of the Challenge.

Subcommittee. There are a number of other factors that impact the Administration's goal of electric vehicle deployment — events in the private sector, and government policies like vehicle tax credits and gas mileage standards. How will your programs interact with these other federal activities?

Dr. Kelly. The EV Everywhere Grand Challenge focuses on the technical innovations – the research and development needed to overcome cost and performance barriers – to the widespread use of electric-drive vehicles among mainstream consumers, enabling electric-drive vehicles to compete against conventional internal combustion engine vehicles without subsidies. This work complements policies and other activities to bring electric-drive technologies to market and facilitate early adoption. Successful R&D has enabled auto manufacturers to begin market introduction and will enable them to use vehicle electrification and other advanced fuel-efficient vehicle technologies to comply with government policies such as CAFE standards. Tax credits and other incentives encourage consumer early adoption, but market penetration – and full realization of the petroleum reduction benefits of electric drive – will depend on the technology's ability to compete with incumbent vehicle technologies that dominate the mainstream market today. That is why the research under the EV Everywhere Grand Challenge is so important.

SHORTFALL IN ELECTRIC VEHICLE SALES

Subcommittee. 2011 marked the first year that modern electric and plugin-hybrid were available to American consumers, and they arrived with some fanfare. Early this month, GM announced that its plug-in hybrid, the Chevy Volt, had lower than expect sales and they were suspending production for five weeks.

When thinking about the electric vehicle market, and the large investments your budget proposes, is this a cause for concern?

Dr. Kelly. More than 17,000 electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) were sold in the U.S. in 2011. This total is somewhat lower than initially anticipated and the Department is following these developments closely. For perspective, however, both the Chevrolet Volt and the Nissan Leaf sold more vehicles in 2011, their first year in the market, than did the 2000 Toyota Prius, which sold 5,562 in its first year, or the very first hybrid in the market, the Honda Insight, which sold 3,788 in its first year. Plug-in vehicle sales are currently on track to top 50,000 units in 2012.

Battery costs are widely expected to decrease significantly over the next several years and analysts project these cost reductions will lead to substantial increases in electric-drive vehicle sales. U.S. automakers remain very committed to the large-scale production and sale of electric-drive vehicles. In addition to GM, which is moving forward with plans to introduce another electric-drive vehicle, the Spark EV, in 2013, other major automakers such as Ford, Chrysler, Toyota, Honda, Mitsubishi, Hyundai, Volkswagen and Volvo remain on track to introduce PHEVs and EVs in the next few years. The Department will continue to monitor electric-drive vehicle sales and trends. It is important to note that new technologies in any sector inherently face risks and companies seeking to establish new markets will struggle to gain a foothold. However, growth in consumer acceptance of electric-drive technology remains likely given high fuel prices, and projected cost reductions for electric-drive technology will make these vehicles more attractive to mainstream consumers. The bottom line is the United States faces a major challenge with its dependence on petroleum. We spend about a $1 billion per day on oil imports. Transportation accounts for more than 60% of our petroleum use, and on-road vehicles are responsible for about 80% of the petroleum used for transportation. We

must change the way we power our vehicles – not only for our energy security but also to help grow our economy – and electric-drive technology is a necessary part of the solution.

Subcommittee. Why do you think the sales were less than expected?

Dr. Kelly. It is our understanding that Chevrolet Volt sales were impacted in late 2011 by concerns arising from a battery fire that occurred several weeks after a vehicle crash test. GM has addressed the issue with design changes, and the Department of Transportation confirms that the risk of fire in the Volt is no greater than one in a conventional vehicle (http://www.nhtsa.gov/About+NHTSA/Press+Releases/NHTSA+Statement+on+Conclusion+of+Chevy+Volt+Investigation). With these issues resolved, Volt sales have increased – and in fact the Volt set new monthly sales records in all of August, September, and October 2012.

According to news reports, Nissan maintained that the Leaf was still supply-constrained in early 2012 following the 2011 tsunami in Japan and resulting effects on parts suppliers. Also, the Leaf was available only in a limited number of states in 2011 and did not become available nationwide until March 2012. Since sales were expanded to all 50 states in late March, sales have surged: November sales were nearly three times the March level.

EVs, PHEVs, and HEVs were the fastest-growing segment in the U.S. auto market in the first quarter of 2012. Sales of these vehicles rose 200% in the third quarter of 2012, compared to a year earlier.

Subcommittee. Is it necessary for these vehicles to be eligible for HOV lanes to be viable? A recent announcement that the Chevy Volt would now be eligible in California seemed to generate some optimism.

Dr. Kelly. Removing HOV restrictions for alternative fuel vehicles can help secure a foothold for these vehicles in area markets and is one non-monetary incentive that has proven attractive to commuters. Area governments that removed HOV restrictions for clean and fuel-efficient vehicles, such as Northern Virginia and Southern California, reported some of the highest hybrid vehicle sales in the nation. At one time, California allowed 85,000 hybrid vehicles access to HOV lanes. As hybrids became more commonplace, California dropped the incentive in 2011. In certain markets known for significant commuter traffic, such an incentive can facilitate the transition of clean and very fuel efficient technologies to the mainstream market.

NATIONAL CLEAN FLEETS PARTNERSHIP

Subcommittee. Dr. Kelly, the Department of Energy announced early this month that it signed four more large companies on to its National Clean Fleets Partnership, a program announced last spring to help large organizations convert their fleets to use alternative fuels. By one estimate, companies in that program account for more than 12 percent of the nation's commercial vehicle fleet.

Converting fleet vehicles to alternative fuels seems like a good way to get large returns on small infrastructure investments. Can you elaborate on what this program aims to do, and how you're progressing towards that goal?

Dr. Kelly. Building on the established success of the Department's Clean Cities initiative, the National Clean Fleets Partnership focuses on the nation's largest fleets, providing technical assistance to help speed the adoption of alternative fuels, electric vehicles and fuel economy improvements. The nation's top 100 fleets, for example, own and operate more than one million vehicles. As such, not only can they provide a large return on relatively small infrastructure investments, but they represent immense potential for petroleum savings and the power to reshape markets by accelerating the adoption of alternative fuels, advanced vehicles, and more fuel-efficient operating practices. The Clean Fleets Partnership provides fleets with specific technical assistance, access to national laboratory experts, and the benefit of networking and coordinating with other fleets and stakeholders engaged in local Clean Cities coalitions across the country. First announced in April 2011, the Partnership now includes 18 of the nation's largest corporate fleets. Their commitment to the National Clean Fleets Partnership demonstrates the significant potential for reducing our nation's dependence on petroleum.

Subcommittee. The Department has supported the Clean Cities program for a number of years. How is this new partnership different than the traditional Clean Cities program?

Dr. Kelly. The National Clean Cities initiative is a government-industry partnership effort designed to help local communities bring together key stakeholders committed to working together to deploy alternative fuel and advanced technology vehicles, as well as the infrastructure needed to support them. Over time, many of the local coalitions have found it difficult

to coordinate with large national fleets whose headquarters are based in another city or state. Similarly, corporate fleet managers needing to make decisions regarding vehicle operations spanning across the county do not have the time or resources to independently coordinate with each individual Clean Cities coalition. DOE created the National Clean Fleets Partnership to facilitate this interaction, provide a more efficient way to coordinate with corporate fleet managers, and deliver the same kind of technical assistance, information, and tools that the Clean Cities initiative has developed for coalitions and more localized fleets. The National Clean Fleets Partnership is not a new stand-alone program, but rather a more effective way to leverage the tools and resources of the core Clean Cities initiative.

Subcommittee. Unfortunately, the National Clean Fleets Partnership does not appear in the budget request, nor has it in the last two years. How much funding has the Department devoted to this program, and for what purposes? How much funding is in this year's request?

Dr. Kelly. The National Clean Fleets Partnership is an enhancement to ongoing Vehicle Technologies deployment activities under the Clean Cities initiative. It is not a separate program with its own budget, and it does not award funds to partners. Rather, Vehicle Technologies staff work with fleet managers to identify opportunities for petroleum reduction, develop strategies, and build connections with local Clean Cities coalitions and stakeholders who, as partners, can facilitate implementation of those strategies. No new or additional funding has been requested to support this effort.

Subcommittee. This program was announced by the Administration last spring. When will it conclude?

Dr. Kelly. The National Clean Fleets Partnership is an ongoing initiative to coordinate and support deployment efforts among large national fleets. As a very low cost program that provides no grant funds, we believe it is appropriate to continue this assistance as the nation's fleets transition to the use of more efficient technologies.

Subcommittee. Going back to the Clean Cities program for a moment, your budget request includes $26.5 million for this program. Can you give us an update on the program and talk in some detail about what you are planning for 2013 should you receive this funding?

Dr. Kelly. Clean Cities is a government-industry partnership initiative to reduce petroleum dependence in the transportation sector. Established in response to the Energy Policy Act of 1992, Clean Cities provides tools, technical assistance, and resources to support local actions in transportation that reduce the use of petroleum. There are now nearly 100 designated community-based Clean Cities coalitions across the country, representing approximately 78% of the U.S. population. These communities are actively engaged in the deployment of electric-drive and alternative fuel vehicles, idle reduction efforts, and other advanced vehicle technologies and petroleum reduction practices. To date, Clean Cities coalition vehicle deployment activities have resulted in more than 3.5 billion gallons of gasoline and diesel fuel displacement and/or reductions.

The FY2013 budget request for Vehicle Technologies Deployment supports Clean Cities activities in four primary focus areas:

1. Local Community and Coalition Support: DOE helps convene key community and business leaders to develop and implement projects and policies, leverage resources, and address local barriers;

2. Public Information, Outreach, and Education: DOE-developed tools help consumers save money on fuel cost and help fleets understand their options for cost-effective alternatives to gasoline and diesel fuel;

3. Technical and Problem Solving Assistance: DOE experts help local leaders address permitting and safety issues, technology shortfalls, and other project implementation barriers; and

4. Competitively-Awarded Financial Assistance: Federal cost-share encourages initial private sector match and long-term investment related to infrastructure development and other vehicle deployment initiatives; the FY13 budget request includes a new open and competitive funding opportunity in this area.

$1 BILLION "NATIONAL COMMUNITY DEPLOYMENT CHALLENGE" LEGISLATIVE PROPOSAL

Subcommittee. Dr. Kelly, the President recently highlighted his proposal for a "National Community Deployment Challenge", which would give $1 billion to 10 to 15 communities to deploy electric and other alternative-fuel vehicles. Your budget proposed $200 million for a similar program focusing only on electric vehicles last year, and we did not fund it because the request lacked clarity on the proposal and we had some significant concerns that it wouldn't be a good use of taxpayer dollars. Now, this year's program is a legislative proposal and is not in your budget request, but it is still very relevant to your program and worth talking about here today.

What, exactly, would federal funds go towards in this proposal? Would it go towards regulatory reform? Charging stations? The purchase of electric fleet vehicles?

Dr. Kelly. Federal funds would be used to provide incentives for the most innovative and comprehensive area-wide initiatives for lowering the incremental cost of alternative fuel vehicles for consumers, as well as support for the development of local infrastructure. Projects would be cost-shared, leveraging local community resources and ensuring the commitment needed to ensure a sustainable, future market once Federal funding has concluded. Activities would focus on increasing consumer awareness and acceptance of alternative fuel technologies – electric-drive as well as others such as natural gas, supporting technician and first responder training, developing alternative fuel-friendly policies, and providing various incentives.

Subcommittee. When the Administration proposed a similar program last year to focus on electric vehicle infrastructure, the House and ultimately the Congress declined to fund the program because it was not clear what factors are predominantly preventing the adoption of these alternative-fuel vehicles. It could be infrastructure, but it could also be vehicle price, the distance a car can drive, the lack of vehicles on sale, or just simply that these are new kinds of vehicles people are not used to. What specific area would your proposal focus on, and how do you know — with $1 billion of taxpayer funds at stake — that federal funds are the answer?

Dr. Kelly. There is no easy, simple, or single answer for ensuring alternative fuel vehicle adoption. The vehicle market is extremely competitive and all of the aforementioned factors – vehicle price, driving range between fills or charges, product availability, infrastructure availability, and consumer familiarity – affect consumer acceptance and technology adoption. Each technology, whether electric-drive, natural gas, or another alternative fuel, requires a unique strategy and every region of the country has its own barriers, economics, and policy approaches that require tailored solutions for effective vehicle deployment.

The Community Deployment program is intended to accelerate significantly the use of multiple alternative fuels across the country. Projects would be selected for their innovative approaches to local deployment, including strategically-placed infrastructure and local solutions for building a strong consumer support base, as well as an ability to ensure a sustainable market beyond expenditure of Federal funds. For many communities, Federal cost-share would provide the critical boost needed to secure local and private-sector resources and lay the broad foundation for sustained market growth.

SOLAR ENERGY

LATEST EMPHASIS IN SOLAR TECHNOLOGIES

Subcommittee. Dr. Kelly, the solar industry has evolved pretty dramatically since the time the Department began its solar program decades ago. Your budget request proposes a large budget for solar research — $310 million — and I'd like to better understand the current technology landscape for solar energy, and how your budget proposal reflects that landscape.

Solar can take two main forms — concentrating solar power, and solar photovoltaic. Can you remind us how these two types differ?

Dr. Kelly. Concentrating Solar Power (CSP) relies on the conversion of sunlight to thermal energy first and then the subsequent conversion to electricity through a more traditional power cycle such as a steam turbine. CSP systems concentrate sunlight with mirrors to increase the temperature of a thermal fluid which could be water, oil, or molten salt that can then drive a steam generator. These systems tend to be large in size due to economies of scale and are typically sited in areas with high amounts of solar insolation as utility scale power plants. With thermal storage, the systems are able to smooth out intermittency due to cloud cover as well as shift generation into later in the day to match daily peak electricity demand. Photovoltaics (PV) converts sunlight directly into direct current (DC) electricity followed by conversion to alternating current (AC) electricity useable by the consumer. There are many different types of technologies for PV, including crystalline silicon, thin films, and Concentrating PV (CPV). These different technologies can be applied to 3 different major markets such as the residential rooftop market, commercial rooftop market, and ground mounted utility market.

Subcommittee. Where does your request put its emphasis between these two types of solar, and how have you arrived at that allocation of funds?

Dr. Kelly. The FY13 budget requests approximately $45M for CSP research and development and $66M for PV research and development. There are greater funds allocated to PV R&D because the technology is currently on a steeper cost reduction learning curve and has a greater market share. PV module prices for example have fallen from approximately

$1.70/Watt in 2010 to about $1.00/Watt at the end of 2011. If PV is to be widely competitive with conventional forms of electricity generation, the PV module needs to sell for approximately $0.50/Watt. Though significant reductions in prices have occurred in just 1 year, further investment will be required to keep innovation on track to deliver that goal as well as to ensure that US companies are significant leaders in the industry.

CSP has a great longer term potential because thermal storage allows the power plant to shift the supply of electricity to times of peak demand which may not necessarily coincide with peak supply, as well as ride through intermittent cloud cover. In order to achieve the SunShot goals, a number of advances are required such as reducing the costs of the solar field (mirrors) from about $175/m^2 to about $75/m^2 and raising the temperature of the thermal fluid to greater than 800 degrees C from today's operation at 565 degrees C. These are very aggressive goals that can be met with innovation that the research community is working on in laboratories across the US.

Subcommittee. How is that different than in the last two to three fiscal years?

Dr. Kelly. The enacted budget for CSP has been approximately flat in the range of $45 to $47M between FY11 and FY12, which is also flat with the FY13 budget request. The PV R&D budget changes significantly from $132M in FY11, down to $75M in FY12, to a budget request of $66M in FY13. Some of this significant change is due to a reclassification of some activities from PV R&D towards Innovations in Manufacturing. One example is the PV Manufacturing Initiative, which funds University/Industry/Government consortia focused on manufacturing R&D to enable US companies to better compete in the challenging global marketplace.

Subcommittee. Those two types of solar technologies are themselves evolving. Solar PV can mean crystalline silicon, or the newer "thin film", or other variations. Where are the most cutting edge technologies, and where do you see the biggest innovations happening in the coming years?

Dr. Kelly. The SunShot Initiative has set the goals for cost and performance. A number of technologies have pathways that potentially can achieve those aggressive objectives. We are pushing hard into several thin film based technologies. One example of this is CdTe technology.

Intellectual Property from DOE funded research at NREL on thin film CdTe solar cells was licensed in 2007 by Primestar, one of our incubator companies. They were subsequently bought out by a large U.S. corporation that is setting up a 300MW manufacturing facility in Colorado. This is an excellent example of federal R&D investment that evolved all the way from national lab R&D activity to a full scale technology transfer and product development within the U.S. Notwithstanding this success, we are not resting on our laurels; we are rapidly expanding our R&D activities in the CdTe space to explore pathways to get to 23-25% efficient cells (currently 17% in the laboratory). We are using similar approaches in the CIGS solar cell technology space as well. The program also invests in R&D in disruptive technologies in the silicon space, such as with Kerfless wafering (less silicon waste) and Implanted Selective Emitters (higher efficiency silicon cells). It is clear that in order for the US to compete in a highly competitive global marketplace for what has become a commodity product, innovation is a necessary (but not sufficient) ingredient. A second example of how SunShot is aggressively pursuing alternatives to standard Silicon solar technology is in exploration of concentrated PV approaches, which have not been as aggressively explored in the past. One benefit of manufacturing Concentrated PV (CPV) is that the U.S. is uniquely suited for the deployment given our strong direct normal incidence solar resources, and CPV will typically be manufactured where it is deployed.

Subcommittee. Programs can focus on advancing the solar technologies, or on lowering the cost of manufacturing. What percentage of your solar energy budget request focuses on each of these? Does that constitute a shift from last year?

Dr. Kelly. The FY13 budget requests approximately $110M for Innovations in Manufacturing and Technology Validation aimed at lowering the manufacturing costs associated with solar systems through manufacturing R&D. This represents approximately 35% of a $310M budget request. In FY12, this category represented about 30% of the budget.

SOLAR MANUFACTURING PROGRAMS

Subcommittee. Dr. Kelly, the Solar Photovoltaic (PV) program shifts quite a lot of its attention to manufacturing support, and seeks to help our companies compete in the global market. The request increases funding for the PV Manufacturing Initiative by $25 million to$110 million, and there are two programs under this I'd like to get some clarity on: "PV Manufacturing", funded at $24 million in request, and "Sunpath", funded at $86 million in request.

Can explain to us the difference between these two programs to us?

Dr. Kelly. The PV Manufacturing Initiative funds three University/Industry/Government consortia focused on manufacturing R&D to enable US companies to better compete in the challenging global marketplace. These consortia involve Manufacturing Development Facilities where industrial and academic researchers can work together on industrial scale equipment to innovate in manufacturing technologies that could lower costs and improve performance. Significant investments by state and private funding sources provide a 2:1 leverage of federal funds.

The SUNPATH program (Scaling Up Nascent Photovoltaics AT Home) is focused on increasing domestic manufacturing through investments that have sustainable, competitive cost and performance advantages. SUNPATH will help companies with pilot-scale commercial production scale up their manufacturing capabilities, enabling them to overcome a funding gap that often curtails domestic business at the critical stage of initial pilot scale production. By bridging this gap, SUNPATH will help ensure that innovative, low-cost solar technologies are manufactured in the United States. The first awards for SUNPATH were made in FY12 and had significant cost share by state and private funding sources providing a total of 3:1 leverage of federal funds.

Subcommittee. Neither of these initiatives are new in the 2013 request. What have they accomplished so far, and what is new about them in this year's budget request?

Dr. Kelly. The PV Manufacturing Initiative's public private partnership centers are progressing after the programs were initiated early FY 12. Each of the three centers have raised significant cost share from

industrial members, greatly leveraging Federal investment. One of the Manufacturing Development Facilities, the Photovoltaic Manufacturing Consortium, is already up and running, being employed by industrial users to optimize and develop novel thin films manufacturing process improvements. This organization has nine industrial members and engages with over 20 additional companies. The second Manufacturing Development Facility, based on crystalline silicon photovoltaics, has acquired the necessary manufacturing tools from US-based sources and is in the process of installation. The third public private partnership, a university based consortium, is underway and has selected research awards for their second round of projects. This consortium presently has 14 dues-paying industrial members, demonstrating interest and relevance. In FY13, the centers each have goals of engaging with new industrial partners and increasing the research performed in partnership with the industrial members.

SUNPATH awards were announced in the summer of 2012. Two out of the three awardees have moved into their new scaled-up manufacturing facilities. One awardee already has a functioning production line that is producing modules for the projects in the US first and will subsequently export to other countries (as well as keep installing in the US) – their overall capacity represents well over 10% of the total US PV manufacturing capacity. The other awardee is bringing up its first two production tools for an advanced process that is a drop-in replacement for solar silicon wafers. The third awardee has successfully transferred their process to a partnering large-volume foundry to supply customer orders, and has since achieved another world record in performance of its devices. These awards were also enabled by state and local grants and incentives as well as large private investments (with the overall cost-share of 75- 80%).

THERMAL STORAGE FOR SOLAR POWER

Subcommittee. Dr. Kelly, your request proposes to increase funding for solar power thermal storage technologies by 70 percent.

What is the need and opportunity for thermal storage technology improvements?

Is there a new opportunity there you've found this year to warrant an increase in fiscal year 2013?

Dr. Kelly. The daily load demands on our nation's electrical grid infrastructure closely but do not completely match the daily solar resource. With thermal storage, utility scale Concentrating Solar Power (CSP) systems are able to store energy to shift supply to better match the load, thereby providing enhanced value to the utility. Furthermore, with thermal storage, CSP can smooth out the intermittency on cloudy days, greatly stabilizing the electric grid. This allows grid operators to better plan for power delivery in advance. Studies have shown that greater amounts of solar generation can be enabled by enhanced thermal storage.
http://www.nrel.gov/csp/pdfs/52978.pdf

There are many opportunities to enhance thermal storage. Working in coordination with ARPA-E, we have identified opportunities to go to higher temperatures. Central Tower CSP systems typically operate at 565 degrees C today, by going to well over 800 degrees C, we can increase system and storage efficiency. This will require research into materials that can withstand those temperatures. A current Multi-University Research Initiative is focused specifically on High Operating Temperature Fluids. Increased funding in FY13 will address risk by allowing for multiple approaches to solve this very challenging problem including investing in research into solid thermal storage as well liquid thermal storage.

INCREASE FOR SOLAR "MARKET TRANSFORMATION"

Subcommittee. The request proposes to increase funding for "Market Transformation of solar energy by 32 percent to $42 million.

What specific activities are funded under this program, and what specifically is the increase for?

The market transformation activities seem far afield from the core technology development role of the Department of Energy. How would you justify these market transformation activities to critics of this program?

Dr. Kelly. In 2010, the costs of utility scale PV systems were approximately $3.80/Watt, with the PV hardware representing about half of that cost. In the past year, the price of PV modules has dropped by about 50% with further reduction opportunities still available and necessary. However, the non-hardware costs have only fallen by about 10%. These non-hardware costs such as installation, permitting, inspection, financing, and interconnection now represent a greater fraction of the total costs than the hardware. The issue is even more acute for smaller scale systems, such as in the residential rooftop market. A significant challenge is that there are approximately 18,000 local jurisdictions having authority over the permitting and inspection process for residential systems, each with very different processes. With programs such as the Rooftop Solar Challenge, we are working with states and local governments and other organizations to streamline and reduce times and costs for the non-hardware fraction of the total system costs. Examples of projects being funded within this category of Market Transformation also include implementation of information technology solutions to eliminate or reduce paperwork for permitting, inspection, and interconnection. Other IT solutions can also automate the design of rooftop PV systems to reduce the engineering time required so that each home installation does not require extensive customization. Though we still need to make investments in hardware technology R&D, the non-hardware costs need to be addressed for solar to become widely cost competitive without subsidies. The increase in investments in this area will go directly to fund new programs to develop solutions to reduce these non-hardware costs.

WIND ENERGY

SECRETARY'S COMMENTS TO PHASE OUT WIND ENERGY TAX CREDITS

Subcommittee. Two weeks ago, Secretary Chu conceded that it may be time to phase out the tax credits subsidizing wind turbines. Dr. Kelly, does this idea also apply to funding for wind energy research, development, and demonstration activities that fall within your program?

Dr. Kelly. Secretary Chu stated phasing out the tax credits subsidizing wind turbines would be appropriate at a future time – "So over a period of time, especially as — and no dates were discussed — but over a period of time, a road map of phasing out, you see where the prices are going and you can see" how to eliminate the credit.

Absent tax credits, wind energy is not cost competitive in most U.S. markets today. Continued funding for wind research is essential to enable competitive U.S. wind manufacturing and to enable the option of U.S. deployment of wind power in both land and offshore locations as part of a diverse US portfolio energy mix in a cost competitive, unsubsidized manner. Wind energy research, development and deployment should not be phased out at this time.

PORTFOLIO SHIFT FROM LAND-BASED TO OFFSHORE WIND?

Subcommittee. Dr. Kelly, by all accounts, the offshore wind resource is enormous but the technology is still unproven any significant distance away from the shoreline. That, surely, is where federal research could help, in comparison to land-based wind, which is a proven technology deployed by the private sector every day. I believe the Department agrees with this view, given your recent announcement of an offshore wind initiative.

With that backdrop, it's surprising that only just over a third of your wind energy budget request is for offshore wind activities. Why have you not shifted more of your budget to offshore wind technologies?

The balance of your program ostensibly applies to all wind energy — land-based and offshore. But wouldn't commonalities to land and offshore not need federal support? In other words, isn't it specifically the offshore conditions that need innovations to overcome? Can you expand on that, and justify how so much of the wind budget is so untargeted that it can apply to any type of wind energy?

Dr. Kelly. The Department agrees that Offshore Wind is a potential substantial future contributor to the overall US domestic electricity generation portfolio. But the Department also projects that land based wind power is a critical contributor of future growth of US domestic renewable power generation.

The Department recognizes that to mobilize the offshore wind energy market, that specific offshore wind technology and market deployment barriers must be addressed. Approximately one third of the wind budget is applicable exclusively to offshore. The majority of the remaining wind energy budget request is agnostic to wind location and is applicable to both land and offshore. Technology focus areas such as advanced aerodynamics and materials research serve all platforms. Essentially the majority of the overall wind program budget has already been transitioned to have direct applicability to offshore wind.

OFFSHORE WIND DEMONSTRATION PROJECTS

Subcommittee. In our FY 2012 Committee report, we made it clear that the Department should support offshore wind because, unlike land-based wind, certain types of offshore wind are technologically unproven. The Department has recently proposed $36 million for offshore wind, and has announced a large offshore wind demonstration project initiative.

That said, there are a number of privately-funded offshore wind projects moving forward. The Secretary of the Interior recently approved the first phase of Cape Wind, an offshore wind farm in New England, and the privately-funded Atlantic Wind Connection project is moving forward to provide transmission for offshore wind in the Mid-Atlantic region. These and other projects suggest that there certainly are types of offshore wind projects that can be funded solely by the private sector.

Can you clarify how the Department is funding offshore wind projects in uncharted technological territory, and not simply supplementing work already being done by the private sector?

Dr. Kelly. The objective of the Wind program is to enable US Offshore Wind technology that does not require subsidization to be regionally cost competitive.

The Department's Offshore Wind activities represent a unique federal role that is not being addressed bythe private sector, and includes activities ranging from deep water technology fundamental research to coastal market acceleration and deployment solutions and offshore demonstrations. In example, the department is funding development of cost competitive floating platforms and floating wind turbine designs optimized for deep water depths (>30m depth), which are predominant in US shorelines and not yet deployed in other countries around the world, which have focused on shallow water depths (< 30m depth).

Subcommittee. The Department of the Interior recently streamlined leasing requirements for offshore wind on the East Coast. Does this tell us that the market impediments to offshore wind are mostly regulatory, rather than technology-related?

Dr. Kelly. No. Offshore wind faces a number of challenges including regulatory, technological, financial, and those related to market deployment.

The Department of Interior streamlined leasing requirements are important improvements to aspect of the regulatory environment. However, there are also additional and substantial technological, market barrier and financial impediments which remain.

Subcommittee. The Department has a program to improve the regulatory environment for solar. Are you planning any similar activities for the wind sector?

Dr. Kelly. The Wind Program currently has a broad range of ongoing activities to specifically improve the regulatory environment. These current activities are similar to the solar program. Specifically, as related to offshore wind, on February 7, 2011, DOE released a National Offshore Wind Strategy with the Department of Interior and the two agencies are working together to improve the regulatory environment for the wind sector.

WATER POWER

WATER POWER PROGRAM REDUCTION

Subcommittee. Dr. Kelly, the Water Power research and development program is one of the few research programs whose funding is reduced in your budget request. The nation has vast untapped inland water energy resources, as well as vast ocean-based energy resources. We hear about other countries moving forward developing ocean-based energy technologies, and it looks like you have ceded this market to others.

Why reduce this program when proposing record increases for almost all other programs?

Dr. Kelly. A robust $59M budget in FY 2012, a nearly 70% increase over FY 2011, allows the Department to continue and complete a number of important water power technology research and development projects. The $20 million requested in FY 2013 would allow the Department's Water Power Program to continue its ongoing efforts to advance water power technologies and accelerate their market adoption. This funding level would allow DOE to support a number of water power technologies that can be developed for both conventional hydropower and the emerging marine and hydrokinetic (MHK) energy technologies. For hydropower specifically, DOE selected 16 new innovative hydropower technology development projects for funding in FY 2011. That work continued in FY 2012 and is continuing in FY 2013. DOE also expects to continue efforts under the Hydropower Advancement Project, which is developing standardized assessment guidelines for upgrades at existing hydropower facilities—one of the most cost-effective ways to add new renewable generation capacity in the United States. Additionally, DOE expects to continue its efforts to analytically quantify the benefits that conventional and pumped-storage hydropower provide to the electric grid, which can also support the integration of variable renewable resources like wind and solar. For MHK technologies, in FY 2013 activities are expected to focus on developing a suite of technologies that harness the energy for wave, tidal, and current resources. Specifically, MHK research is expected to focus on maintenance and development of advanced open water test infrastructure for MHK devices and research into the costs and performance of innovative, early-stage MHK systems and components. Finally, resource assessments were conducted in FY 2012 and are being conducted in FY 2013 to accurately

characterize all opportunities for water power development. DOE intends to use data from ongoing techno-economic MHK assessments to establish baseline costs, which DOE will use along with resource assessments to evaluate the need for further innovative water power R&D.

Subcommittee. What percent of our nation's electricity do you believe could come from ocean-based water power?

Dr. Kelly. If we consider only wave, tidal and ocean current technologies, the Department's preliminary resource estimates indicate a potential ocean energy resource of 500GW. However, while this represents a significant opportunity, there are technical, environmental and economic challenges associated with tapping this potential resource that must be addressed, and the Department is focused on assessing the realistic potential of ocean energy technologies. For planning purposes, our strategic vision predicts that 23 GW of ocean energy could be available and online by 2030.

Subcommittee. What is the total potential for additional electricity production if we were to use all of our inland water resources?

Dr. Kelly. The Department has recently completed a non-powered dams assessment report, which estimates that over 12 GW of power can be realized by adding power stations to existing non-powered dams. While further site-specific analyses will need to be conducted to determine which of these dams should be developed for hydropower, several of the report's findings indicate that a lot of this potential could be capitalized on. The greatest potential to develop hydropower at non-powered dams lies in facilities owned by the U.S. Army Corps of Engineers on the Ohio, Mississippi, Alabama, and Arkansas Rivers—mainly in areas with fewer wind and solar resources. Of the 12.1 GW potential capacity at dams that currently do not produce power, 3 GW lies on the top ten sites alone and the top 100 sites could provide 8 GW of capacity if developed. We further predict that an additional 10 GW can be realized by optimizing performance and improving the technology of our aging existing hydropower infrastructure. We are in the process of completing an in-stream hydrokinetic resource assessment, along with an analysis of opportunities for new hydropower development and these data will be available in FY 2013.

REDUCTION TO MARINE AND HYDROKINETIC WATER PROGRAMS

Subcommittee. Dr. Kelly, as you know, Marine and Hydrokinetic (MHK) technologies generate electricity from ocean waves, tidal flows, currents and in-stream sources. DOE recently released two nationwide resource assessments which speak rather highly of the potential contribution that waves and tidal currents off the country's coasts could make to the nation's electricity production. But despite these studies, and advances in the technological field, the Department has proposed to cut this program rather significantly—making it only one of two programs under your purview that are cut in the request.

Why has this program been cut so significantly?

Dr. Kelly. A robust $59M budget in FY 2012, a nearly 70% increase over FY 2011, allows the Department to continue and complete a number of important water power technology research and development projects. The $20 million requested in FY 2013 would allow the Department's Water Power Program to continue its ongoing efforts to advance water power technologies and accelerate their market adoption. This funding level would allow DOE to support a number of water power technologies can be developed for both conventional hydropower and the emerging marine and hydrokinetic (MHK) energy technologies. For MHK technologies, in FY 2013 activities are expected to focus on developing a suite of technologies that harness the energy for wave, tidal, and current resources. Specifically, MHK research is expected to focus on maintenance and development of advanced open water test infrastructure for MHK devices and research into the costs and performance of innovative, early-stage MHK systems and components. Finally, resource assessments will continue to be conducted in FY 2013 to accurately characterize all opportunities for water power development. DOE intends to use data from ongoing techno-economic MHK assessments to establish baseline costs, which DOE will use along with resource assessments to evaluate the need for further innovative water power R&D.

Subcommittee. What steps has DOE taken to support these technologies?

Dr. Kelly. DOE is pursuing an aggressive research, development and demonstration effort to determine the technical and economic viability of a wide range of MHK technologies. We seek to advance the technology readiness of MHK systems through cost-shared research and demonstration projects (27 projects in the pipeline), and we are developing a series of reference models that will computationally predict performance and cost-effectively optimize designs in order to achieve cost-competitiveness in an accelerated timeframe. DOE is also addressing environmental and permitting issues in order to proactively address environmental performance issues and lower these costs to developers. We have also established three National Marine Renewable Energy Centers that are centers of excellence for ocean energy, and these Centers will cost-effectively support industry demonstration and performance monitoring (technical and environmental) efforts. The Department intends to complete a comprehensive techno-economic assessment in 2013 that will assess the viability of MHK systems, and identify strategic opportunities to develop and deploy these systems in the near term.

Subcommittee. What are the technological and regulatory challenges to this sector?

Dr. Kelly. As with any new technology, especially with systems operating in the marine environment, there are very serious technological and regulatory challenges to the deployment of MHK technologies. An overriding challenge is cost-competitiveness. These systems must be robust enough to survive harsh marine ecosystems, yet flexible enough to capture a wide range of resource characteristics. As a nascent industry, developers face serious regulatory and permitting challenges as they are, in many cases, first-of-a-kind systems. Meeting these requirements is costly and time-consuming and requires approval from and consultation with numerous federal and state agencies. The Department is working with developers and appropriate agencies to help inform and, if appropriate, streamline these processes, largely by collecting data about the environmental effects of these technologies to help inform the regulatory process. However, we are confident that U.S. ingenuity can address these technological and regulatory challenges with support from parties like DOE.

WEATHERIZATION AND STATE ENERGY PROGRAM

UPDATE ON ALLOCATION OF FY 2012 FUNDS

Subcommittee. Dr. Kelly, the fiscal year 2012 appropriations Act allowed the Secretary to waive the Weatherization allocation formula in order to efficiently distribute funds to states and territories do not have remaining stimulus funds.

How has the process gone for allocating these funds without the formula requirement?

Dr. Kelly. The 2012 Consolidated Appropriations Act provided $65 million for allocation to Weatherization Assistance Program (WAP) grantees - a funding level that is less than one-third of the amount provided in the 2011 Appropriations for the WAP. Congress also provided the Secretary of Energy with the authority to waive the allocation formula established in the WAP regulations for Program Year (PY) 2012.

The Secretary exercised this authority and allocated PY 2012 funds to ensure two major outcomes: 1) grantees that spent America Recovery and Reinvestment Act of 2009 (ARRA) funds on time have adequate DOE funds to maintain their operations at pre-ARRA levels; and 2) all grantees have adequate funds to operate throughout PY 2012, given the fund balances that are already allocated but remain unspent. The allocations were based on the following criteria:

- Use of an appropriation amount of $210 million as the base "PY12 Target Allocation" for establishing funding for each grantee. A value of $210 million was chosen as the base because this was the amount applied to the formula under the funding provided in appropriation by Congress in 2010. A value of approximately $207 million ($210 million minus costs for DOE technical training and assistance), was then applied to the formula as established in regulation to determine each grantee's PY12 Target Allocation.

- PY 2012 Target Allocations were adjusted downward for grantees with ARRA balances that would be available for at least half of PY2012.

- Grantees with a prior year balance totaling more than the adjusted PY12 Target Allocation did not receive FY 2012 funding.

Subcommittee. How much of the $5 billion weatherization funding from the American Recovery and Reinvestment Act of 2009 is not yet spent?

Dr. Kelly. The current balance remaining from the $5 billion investments made into the Weatherization Assistance Program (WAP) by the Administration as part of the American Recovery and Reinvestment Act of 2009 (ARRA) is $100.6 million as of January 31, 2013. This figure includes the balance of funds available to weatherize homes ($64.1 million), costs already incurred by grantees but not yet reported ($25.7 million), and balances in Sustainable Energy Conservation Grants used to apply renewable energy technologies on already weatherized homes ($10.8 million). Based on projected spend rates, less than $8.3 million in ARRA funds is expected to remain when all grants expire on September 30, 2013.

Subcommittee. Are the states generally still operating at Recovery Act rates, or have they slowed operations to their pre-stimulus rate of operations?

Dr. Kelly. In general, grantees are making the necessary adjustments to return to pre-ARRA operating levels. For some grantees, the reduction of workforce and production capacity began in December 2012. Based on information as of January 2013, WAP grantees expended $4.736 billion or 98 percent of the $4.863 billion in ARRA funds provided to weatherize homes throughout the country – leaving a balance of $100.6 million in existing ARRA grants. This balance of ARRA funds is further reduced by costs incurred but not reported ($25.7 million) and funds associated with Sustainable Energy Conservation Grants which are used to apply renewable energy technology and not to weatherize homes ($10.8 million) – leaving an adjusted balance of $64.1 million available to continue weatherizing homes through the 2012 Program Year. This represents less than 1.3 percent of funds available through ARRA. At projected spending rates, DOE anticipates that all but $8.3 million of ARRA balances will be spent before the beginning of the 2013 Program Year.

Subcommittee. How do you plan to manage the 2013 funding? Is there any reason to continue with last year's criteria?

Dr. Kelly. The most recent spending information across the network indicates that nearly all prior year balances will be expended during PY2012. Over 75 percent of WAP grantees will have little or no funds available to begin their 2013 Program Year. Based on the Continuing Resolution in effect until March 27, 2013, the WAP will receive $68 million less any funds set aside for sequestration. DOE intends to use the formula waiver provision originally allowed for in the Consolidated Appropriations Act, 2012, to distribute WAP funds to the grantees. The exact nature of the revised allocation formula is still under discussion at DOE.

HYDROGEN AND FUEL CELL TECHNOLOGIES

HYDROGEN PROGRAM REDUCTION AND EMPHASIS

Subcommittee. Dr. Kelly, the budget request continued a trend for this Administration to reduce funding for the Hydrogen and Fuel Cell Technologies program. The Department has also shifted the program's emphasis since several years ago.

Can you explain the emphasis in the budget request, and how hydrogen for transportation and stationary purposes are prioritized?

Dr. Kelly. The fiscal year 2013 budget request for hydrogen and fuel cells allows the Department to continue emphasizing a broad portfolio of advanced technology projects in transportation, stationary, and also portable fuel cell activities. The funding emphasis is on fuel cell component R&D (such as catalysts and membranes) that crosscut more than one fuel cell application. For example, the projected fuel cell R&D subprogram spending plan for fiscal year 2012 includes about 61% for crosscutting projects that could apply to transportation, stationary, and/or portable fuel cell applications, 27% for transportation specific projects, 7% for stationary specific projects, and 5% for portable fuel cell applications. Hydrogen production, delivery, and storage projects crosscut all fuel cell applications where hydrogen is used.

Subcommittee. The request proposes to eliminate funding for Market Transformation, and to reduce several other subprograms. What was the thinking behind these specific terminations, and what activities were preserved within the Hydrogen program?

Dr. Kelly. The budget request for hydrogen and fuel cells represents a rebalancing of the Department's portfolio of advanced technologies. Funding has been reduced for aspects of the program with less impact on R&D progress needed for cost reductions, such as market transformation, technology validation, and codes and standards. The Department recognizes the importance of continued investment in clean energy technologies. For example, although not reflected in the FY 2013 budget request, the Department invested nearly $42 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. The Department collects and analyzes data

on the performance and cost of fuel cells for early market applications before determining future market transformation needs. Preliminary analysis shows that the Department has provided funding for about 400 fuel cell forklifts, and industry has placed orders for over 3,000 additional forklifts with no Department funding. This type of information is critical to understand where successes occur and where new needs have been identified. For example, about $2.5 million in FY 2012 funding is being planned to deploy ground support equipment at airport terminals, to replicate the success of fuel cell lift truck deployments, which stimulated and transformed the market. Thus, rebalancing the portfolio will allow the Department to focus on nearer term transportation technologies while maintaining a strong effort in hydrogen and fuel cells for the 2015 timeframe and beyond.

Subcommittee. Several companies are on the cusp of announcing reasonably competitive hydrogen fuel cell vehicles with much better range than their electric cousins, and some other countries are investing heavily to help them make it into the market. Is the budget request we missing the boat on this one by focusing so heavily on electric vehicles, and not on hydrogen?

Dr. Kelly. The budget request maintains hydrogen and fuel cells as an integral part of the advanced transportation technologies portfolio. The fiscal year 2013 budget request allows the Department to continue R&D programs that will have the greatest impact on all transportation technologies while positioning hydrogen and fuel cell technologies for the fuel cell electric vehicle announcements that are expected for the 2015 timeframe and beyond. In addition, in fiscal year 2012, the Department announced funding opportunities with 50-50 industry cost share to collect performance data from fuel cell electric vehicles – such as driving range and refueling time – and hydrogen fueling stations under real-world operating conditions. These projects will help identify key areas requiring further R&D and help inform future priorities. In addition, our Vehicles Program is funding key components such as batteries, lightweight materials and power electronics necessary for fuel cell engines and vehicle systems.

HYDROGEN FOR FLEET VEHICLES

Subcommittee. Dr. Kelly, a number of automotive companies are talking about introducing hydrogen fuel cell vehicles into the market in the next several years. In past hearings with your program and with Secretary Chu, we have discussed the difficulties of deploying infrastructure to support hydrogen vehicle use by the typical American driver. But it turns out that the technology may lend itself much more easily to commercial fleets — and could help those fleets reduce their exposure to today's high gas prices.

Has the Department seriously considered hydrogen vehicles for commercial fleets?

Dr. Kelly. Yes. The Department recognizes the advantages that fleet operations present, particularly for localized hydrogen refueling infrastructure. The Department has funded cost-shared projects to demonstrate more than 180 fuel cell electric vehicles (FCEVs), many of which were used in fleet or limited consumer applications. In addition to light-duty vehicles, preliminary analysis has shown that other fleet vehicles such as forklifts, airport ground-support equipment, buses, and short-haul trucks present opportunities for early commercial success and enabling infrastructure. Preliminary analysis indicates that DOE-supported deployments of about 400 lift trucks have led to planned purchases of more than 3,000 additional units by industry, with no further DOE investment. Other Department activities involving fleet vehicles include: working with DOD and the State of Hawaii to deploy a fleet of 16 FCEVs at military installations, providing FCEVs to deliver mail for the U.S. Postal Service, funding a hydrogen refueling station for Alameda County Transit buses in California, and collecting and analyzing data from demonstrations of fuel cell buses and early market deployments of lift trucks. The Department also has issued a $10 million funding opportunity announcement (FOA) for the demonstration of a fleet of zero emission cargo transport vehicles, for which fuel cells or other electric vehicles would qualify. DOE plans analysis activities to identify hydrogen infrastructure needs for various applications, including fleet vehicles.

Subcommittee. What activities in the budget request look into this option?

Dr. Kelly. The FY 2013 budget request continues to address the research challenges facing fuel cells—for a variety of applications, including fuel cell electric vehicles, lift trucks, and other applications that could be used in fleet operations. The budget request also enables the Department to continue to develop hydrogen production and delivery technologies. While the technologies already exist to produce hydrogen from distributed natural gas (at the refueling site) cost-competitively with gasoline (at high volumes), further advances in hydrogen production and delivery technologies will enable higher volumes of production from renewable resources, at central facilities.

Activities planned for FY 2013 that address fleet applications include: continued data collection and analysis from light duty fuel cell electric vehicles, fuel cell buses, and lift trucks; new projects from a current funding opportunity on zero emission cargo transport vehicles, which could include fuel cell–powered drayage trucks; and analysis activities to identify hydrogen infrastructure needs for various applications, including fleet vehicles. DOE is also planning a funding opportunity in FY 2012 (with 50-50 industry cost share) for fleet demonstrations of ground support equipment starting in early FY 2013, which will deploy fuel cell baggage tractors at commercial airports. Additionally, new projects (from currently open funding opportunities) on data collection and analysis from light-duty vehicles, hydrogen refueling stations, and advanced refueling components will be relevant to fleet vehicles as well.

Subcommittee. How widely are hydrogen vehicles deployed worldwide in fleet settings? Are other countries pursuing this avenue?

Dr. Kelly. Hundreds of FCEVs have been demonstrated in the United States, and a number of these are in use in fleet settings by a wide range of organizations, including local municipalities, universities, and the U.S. military. For example, the cities of Burbank, Santa Ana, and Santa Monica have operated small fleets of FCEVs, and 16 FCEVs are in use at military bases in Hawaii. There are also hundreds of FCEVs deployed outside of the United States, with the majority of these in Japan and the European Union, and it is likely that many of these are operated in fleet settings. In addition, there are currently more than 100 fuel cell buses in operation worldwide, with more than 20 in the United States and more than 35 in Europe. Fuel cell buses have been demonstrated in 10 cities throughout the world through the HyFLEET: CUTE (Clean Urban Transportation for Europe) project

(www.global-hydrogen-bus-platform.com/); buses are currently in operation in five cities through the Clean Hydrogen in European Cities Project (CHIC) project (http://chic-project.eu/); and large fleets of fuel cell buses were used for the Vancouver and Beijing Olympic Games. In addition, an airport shuttle service in Tokyo recently began using fuel cell buses, and the City of London is demonstrating taxi cabs that have been converted to electric vehicles with fuel cell range extenders and plans to operate a fleet of these during the 2012 Olympics.

Subcommittee. How well does the U.S. compete in this sector? Have we ceded leadership overseas?

Dr. Kelly. As stated in 52-3, the U.S. leads or is on par with the rest of the world in terms of deployments of transportation fuel cells. In early markets, such as fuel cell lift trucks, the U.S. is a clear leader in manufacturing and deployment. Preliminary analysis shows that cost-shared deployments of approximately 400 lift trucks has led to more than 3,000 planned purchases by industry (with no additional DOE funding). We have not ceded leadership overseas; in fact, fuel cells appear to have substantial export potential for U.S. companies. For example, the U.S. experienced about a 50% increase in the MWs shipped while the global shipments increased about 36% from 2009 to 2010[4]. The DOE Fuel Cell Technologies Program's efforts have enabled commercialization of more than 30 technologies and have led to more than 300 patents,[5] greatly strengthening the competitive position of the domestic fuel cell industry.

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[4] http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/2010_market_report.pdf
[5] http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pathways_2011.pdf

ADMINISTRATION'S DISTASTE FOR FUEL CELLS

Subcommittee. Dr. Kelly and Mr. McConnell, the Department's budget request demonstrates a considerable distaste for fuel cell technologies. Your request cuts the Hydrogen and Fuel Cell Technologies program in Dr. Kelly's office by 25 percent, and proposes to eliminate completely the Solid Oxide Fuel Cell program in Mr. McConnell's program.

Can you each speak to your fuel cell reductions, and whether — and why — there is a concerted reduction in fuel cell research?

Dr. Kelly and Mr. McConnell. The budget request for hydrogen and fuel cells has been reduced as part of rebalancing the Department's portfolio of advanced technologies. However, hydrogen and fuel cells remain an integral part of that portfolio with a strong effort to be maintained for the 2015 timeframe and beyond. The budget request for fiscal year 2013 allows the Department to focus on hydrogen and fuel cell activities that will continue to yield technology advancements in key areas—including ongoing reductions in the cost and improvement in the durability of fuel cells, reductions in the cost of renewably produced hydrogen, and improvements in systems for storing hydrogen. Small scale solid oxide fuel cell projects have been and continue to be funded within the Office of Energy Efficiency and Renewable Energy. Funding has been reduced for aspects of the Hydrogen and Fuel Cell Technologies Program with less impact on R&D progress, such as technology validation, codes and standards, and market transformation.

GEOTHERMAL

GEOTHERMAL FIELD SITES

Subcommittee. Dr. Kelly, the budget request proposes to increase the Geothermal program by nearly $30 million in order to establish field sites for companies, universities, and labs to test enhanced geothermal technologies.

The budget request is sparse on details about this item, so please walk us through some details about these sites. Would they be on federal lands, or elsewhere?

Dr. Kelly. Scoping for field site criteria and locations is currently underway; the Geothermal Technologies Program is working with representatives from three national laboratories to define the ideal characteristics of a field site for the purpose of enhanced geothermal systems (EGS) concept validation and technology testing. Concurrently, the team is investigating sites or regions that have high EGS potential. The program will rank these locations according to the established "ideal characteristics" and other logistical selection criteria, including proximity to transmission and population centers, water availability, lease status, etc.

The program anticipates that the sites will have a diversity of geologic characteristics in order to maximize the expected knowledge and insight from this effort. The sites will likely be on federal land (potentially including DoD) but could also be on either private, state or tribal lands, if a suitable location is identified.

Subcommittee. What are the costs associated with establishing these sites? Why does it cost $30 million, and how much of that cost is a one-time expense to establish the sites?

Dr. Kelly. Site specific costs would include permitting, initial data collection and physical site preparation. This includes one-time expenses such as facility-wide environmental assessment, site selection efforts, validation modeling, and site development plans. Not all sites will be established in the first year, so staggered site-specific permitting, data collection, and site infrastructure efforts will be required.

The key costs, however, are related to drilling and testing of technologies; geothermal wells can each cost between $6 million and $10 million dollars, and an EGS test site could require 3-4 wells. Additional costs arise from site operations and maintenance. These latter two categories comprise the majority of costs in the out years.

Subcommittee. If funded in 2013, what would the annual operating costs be of these sites?

Dr. Kelly. Like any significant R&D effort, the EGS test sites will require a number of years of funding to successfully and accurately quantify what tools and techniques work in which settings, and why. Permitting, drilling, testing and data analysis cannot all be accomplished in one year.

The annual operating costs for each site will vary and will be determined during the current scoping phase, but would be expected to be on the order of several million dollars per year. The operations figure is separate, however, from the costs to continue to drill wells and test technologies in order to more rapidly advance the development of EGS as a key renewable energy resource.

Subcommittee. Imagine for a moment that the overall Geothermal budget is not going to increase in fiscal year 2013. Would you still fund these sites? If so, would you cut the other geothermal research to do so?

Dr. Kelly. The FY 2012 budget for the Program is $37.8 million. If the FY 2013 budget remains at this level, more than half of this amount will be required to fund existing projects in the Program portfolio, leaving a relatively small portion for the pursuit of the EGS field site development.

Because of the high costs associated with drilling and technology development in high temperature, high pressure, and crystalline rock environments it would be difficult to initiate a technically viable test site effort with limited funding.

SHIFT FROM ENHANCED GEOTHERMAL TO OTHER APPROACHES

Subcommittee. Dr. Kelly, the Geothermal program focus all of its funds in fiscal year 2010 on Enhanced Geothermal Systems, and has since shifted its focus so that in the current fiscal year the program focuses a full half of its budget on other types of geothermal technologies.

What has led to this shift? Have there been other promising avenues uncovered, a problem discovered with the Enhanced Geothermal approach, or some other factor at play?

Dr. Kelly. In 2011 the Program convened a Blue Ribbon Panel comprised of renowned geothermal experts from industry, academia and the national laboratories. The panel recommended that the Program continue to invest in the promising potential of Enhanced Geothermal Systems but to also fund critical research needed to increase exploration success for hydrothermal resources.

The Program aims to balance its research portfolio to have both long and near term impacts. To that end, the Program currently invests both in high-risk, high-reward research and the development of Enhanced Geothermal Systems (EGS) that is expected to have a significant impact after 2020, and also has ongoing work to accelerate the development of more traditional hydrothermal resources. The FY 2013 budget request is framed around the same balanced approach.

The FY 2013 Budget request reflects confidence that EGS can be a viable and significant scale baseload energy resource and that it can be best advanced through the EGS test sites, with a $30 million allocation. Simultaneously, the Program will advance technologies needed to reliably identify new hydrothermal resources, thus developing a lower and more predictable risk profile for the industry to accelerate deployment.

Subcommittee. What are the most promising other technologies this program investigates?

Dr. Kelly. Some of the most promising technologies, among the more than 200 projects currently in the Program's portfolio, include innovative geothermal exploration technologies which allow the prediction or location of hidden hydrothermal resources. These technologies include advanced

geophysical, geochemical, and geochemical tools and techniques that are used to reliably predict subsurface temperature and permeability.

Another example of promising work that has the potential to benefit a variety of other sectors is geothermal mineral extraction technology. Strategic minerals, such as lithium used in advanced car batteries, are often dissolved in the geothermal fluids that are pumped to the surface to produce power. This technology extracts lithium from the geothermal brine, combined with electricity generation, before the brine is re-injected into the subsurface.

Finally, the Program is particularly interested in zonal isolation or diverter technology development, which is currently funded through our EGS program. The ability to develop voluminous fracture networks through which fluid can circulate and pick up heat is integral to EGS reservoir sustainability.

LESSONS FROM HYDRAULIC FRACTURING FOR GEOTHERMAL

Subcommittee. American industry has learned quite a lot about using hydraulic fracturing techniques for natural gas extraction in just the last ten years. From what I understand, enhanced geothermal systems use a similar or related technological approach to extract heat — instead of gas — from the ground.

What are the key similarities and differences between shale gas hydraulic fracturing and enhanced geothermal systems?

Dr. Kelly. Many of the key advances in fracturing rock currently being employed by the oil and gas sector, in fact came from early DOE-funded work in the 70's and 80's on stimulating and fracturing geothermal rocks, along with key R&D on tight sands and shales. This illustrates some of the connections between these sectors.

Key similarities include the need to drill high cost wells and "fracture" or "stimulate" rock in the subsurface, though the nature of the fractures produced are distinct. The oil and gas industry seeks to create new, large aperture fractures in the subsurface in order to fully extract the hydrocarbon resource. As a result they use large water volumes and proppants, which are used to help keep an induced fracture open. On the other hand, EGS requires the creation of more discrete fracture networks to allow more effective heat exchange in the subsurface, hence EGS uses just water to create predominantly "shear" fractures.

Drill depths can be broadly comparable, and many of the tools such as drill bits can be similar. Oil and gas, however, is developed in sedimentary rocks, while geothermal and EGS are developed in harder and more abrasive volcanic and igneous/granitic rocks, which present a unique set of challenges for drilling and tool development. EGS reservoirs are at higher rock temperatures making the use of many conventional oil and gas drilling and measurement tools impossible, which is why the Geothermal Technologies Program invests in these areas.

Subcommittee. Are we using any lessons — either technological or otherwise — from hydraulic fracturing in order to advance geothermal?

Dr. Kelly. The geothermal community is committed to using all applicable lessons obtained from the oil and gas sector experience. These include the use of purpose-built rigs, advances in bit technology, and new developments in measurement technologies. Polycrystalline Diamond Compact (PDC) bits, which have revolutionized oil and gas drilling, were originally pioneered by the DOE Geothermal Program. The nature of the oil and gas and EGS fracturing techniques are fundamentally different (hydraulic fracturing vs. shear stimulation), therefore, the greatest potential for cross over and technology leverage lies in the drilling and tool sector.

The Program is currently working with Sandia National Laboratory to test and optimize drilling technologies commonly used in both oil and gas and mining, including hydraulic and air hammer drilling methods. Successful transfer of these technologies to the geothermal industry could facilitate faster and lower cost drilling. The availability of more temperature hardened tools and the associated cost reductions as a result of mass production will benefit the geothermal industry significantly.

PROMISE & CHALLENGE OF ENHANCED GEOTHERMAL SYSTEMS

Subcommittee. Several reports in the last ten years point to the vast heat and energy resources deep underground that Enhanced Geothermal Systems could provide across the nation, if we could master the technology.

How close are we to being able to harness that vast domestic resource?

Dr. Kelly. The Program goal is to demonstrate the technical feasibility of Enhanced Geothermal Systems (EGS) by 2020, and to establish EGS electricity generation as cost-competitive at $0.06/kwh by 2030. The Program considers EGS to have a large resource potential, and as well could provide the opportunity for geothermal development throughout the country.

Subcommittee. Is it turning out to be harder than we thought?

Dr. Kelly. A critical step in successfully developing Enhanced Geothermal Systems is the creation of the reservoir. Therefore a significant portion of the Program's project portfolio is focused on advancing the design and implementation of geothermal reservoir stimulation.

Subcommittee. The Program's research and development effort is increasing our understanding of the challenges to harness EGS effectively, and is effectively identifying the means to overcome those challenges.

Have there been any successful demonstrations of a functioning Enhanced Geothermal System?

Dr. Kelly. Yes, there have been successful demonstrations in Germany, France, and in the U.S. Recent successes in projects funded by the DOE Geothermal Program include the Desert Peak project in Nevada where well injection rates went from almost zero to 70% of what is required to be a commercial geothermal well, a tremendous achievement for an early R&D project, and the Geysers Field in California where an EGS reservoir was developed within an existing geothermal field increasing the field production by 5 MW.

RECOVERY ACT INVESTMENT IN GEOTHERMAL

Subcommittee. The American Recovery and Reinvestment Act of 2009 provided $400 million for Enhanced Geothermal Systems research, development, and demonstration projects.

It's now about three years later. What have we learned from these projects, and what advances have come out of them?

Dr. Kelly. ARRA provided $368M for all geothermal RD&D, of which about $156M was allocated to EGS Research, Development and Demonstration. The other $212M was allocated as follows: $97M was to Validation of Innovative Exploration Technologies, $19M to Low Temperature, Co-produced and Geopressured Demonstration projects, $34M to the National Geothermal Data System design and population and $62M to Ground Source Heat Pumps.

The R&D effort from ARRA funds is ongoing, but a few examples of early results include:

- Demonstration of a process to extract lithium and other minerals integral to the manufacture of key battery components for electric vehicles and energy storage technologies using clean, zero waste production processes.

- Development of a computational test bed to predict stimulation response relationships for Enhanced Geothermal Systems. The model has already successfully modeled a 10% enhancement in a stimulated fracture network.

- Validation of a new geothermal exploration methodology using a combination of advanced seismic survey techniques, dilatational fault mapping, and remote sensing and getting promising results in the current drilling phase of the project.

- Development of new biphasic metal organic working fluids that utilize nano-technology to improve efficiency of power cycles without major modifications to power plant equipment or operating conditions.

Subcommittee. How much of that funding has been spent by the federal government so far?

Dr. Kelly. To date, $145M or 39% of the ARRA funding has been spent.

Subcommittee. Is something slowing down the progress of these projects?

Dr. Kelly. There are several factors which affect the pace of new geothermal projects, including EGS. The regulatory timeline for permitting can be challenging, and as a result we have commenced a regulatory roadmap exercise to address this. In addition, President Obama has signed an Executive Order to speed up the regulatory processes for energy infrastructure. Further, geothermal exploration can be high risk, requiring proponents to obtain outside funding to proceed.

ELECTRICITY DELIVERY AND ENERGY RELIABILITY

ELECTRICITY SYSTEMS HUB

Subcommittee. Secretary Hoffman, the budget request includes $20 million for a proposed Energy Innovation Hub for Electricity Systems. I understand that this Hub would be quite different from the Hubs requested in previous years. For example, this $20 million would actually fund three completely independent hubs, each focusing on a region.

What is your vision for this proposed Hub?

Secretary Hoffman. The Electricity Systems Hub will develop principles and functionalities that will redefine the critical seam between transmission and distribution, focusing on issues around the substation of the future. Innovation at this interface is necessary to enable the effective use of clean generation, electrification, and smart grid technologies. The Hub will serve as a platform to test and evaluate new technologies and concepts such as control architectures, devices, operating systems, etc. developed by the Hub, the DOE, or the industry. The Hub will bring together and integrate these technical advances with a systems approach, while emphasizing reliability and cost-effectiveness, and embed a culture of security needed in a modernized grid. Key stakeholders can convene at the Hub to observe, discuss, and understand the market, regulatory, and institutional implications of these advancements.

Subcommittee. This sounds less like a research Hub, and more like a regional planning office. Why should the federal government fund these regional efforts?

Secretary Hoffman. The Electricity Systems Hub is consistent with the Energy Innovation Hub model in that it will institute an integrated, multi-disciplinary, systems approach to address a critical issue facing the Nation. The structure, scope, and operation of each Energy Innovation Hub must be tailored to the specific nature of the problem being addressed to achieve the most effective and innovative results. The unique challenge the Electricity Systems Hub will address is innovation in the electric power system, a large and complex machine that physically spans the Nation with regional and local differences in resources, generation technologies, loads,

oversight, markets, and operations. The diversity, expansiveness, and multi-state connectivity inherent in the U.S. power system require an active Federal role that recognizes regional and local differences to accelerate innovation. The Hub will blend high risk applied R&D with needs for regulatory and policy actions that will enable the use of new technologies and concepts for the grid.

Subcommittee. The proposal would fund three regional Hubs — and there are more than three regions in the United States. Is it equitable to give only three regions this assistance? Would it be better to have a small technical capability in a national lab that any of these regions could tap?

Secretary Hoffman. The Electricity Systems Hub, ideally comprised of two to three regional hubs that will communicate, coordinate, and collaborate routinely, will provide insight into regional issues and impacts associated with new grid technologies and concepts. Sharing and comparing differences between the regional hubs will help identify nationwide solutions as well as address the unique regional challenges that are vital for a robust portfolio approach to grid modernization. The work scope, planning, leadership, and operation of these regional hubs will be defined by the applicants through the competitive solicitation process. Applicants will be encouraged to jointly apply with representatives from industry, academia, national labs, utilities, states, and other relevant stakeholders. Technical capabilities existing in national labs are crucial assets that should be leveraged within the broader scope of the Electricity Systems Hub. The decision to pursue one, two, or three regional hubs will depend on the cost-share generated to leverage the Federal investment and to ensure that resources dedicated to the Hub challenges will produce transformative and impactful solutions. It is anticipated that the applicants will define the regions, which given the complexity and diversity of the U.S. electric power system (NERC regions, interconnection regions, ISO/RTO regions, etc.) will be more varied than simple state clusters. A key value of the Electricity Systems Hub will be the generation of systematic and useful information that can be applied to most areas of the United States.

RESEARCH LEADING TO GRID MODERNIZATION GOALS

Subcommittee. Secretary Hoffman, your efforts to modernize the electric grid could help us meet some of the nation's energy and security goals. We'd like to better understand whether and how the investments in applied research and development in your program are enhancing the capabilities of the electricity system. Can you highlight for us how some recent activities within your programs are helping us to meet some of our energy-related goals?

Secretary Hoffman. The Office of Electricity Delivery and Energy Reliability (OE) is charged with leading national grid modernization efforts. In doing so, we focus our applied research and development efforts on improving the technical performance and demonstrating the technical viability of technologies that enhance the operational characteristics of electric grid in four areas, which together describe a modern grid:

- *Reliability* – high quality , consistent power flow;
- *Flexibility* – the ability to accommodate changing supply and demand patterns;
- *Efficiency* – delivery of electricity with reduced losses and greater asset utilization rates; and
- *Resiliency* – the ability to withstand disruptions and maintain critical function.

In the past year, we have made significant progress in the development of technologies that enhance the functionality of the grid in one or more of these areas, including:

Grid oscillation detection – This tool helps improve system reliability by monitoring changes in the characteristic fluctuations of electricity flows on the transmission system, and alerting operators when fluctuations fall outside of a normal range. OE recently demonstrated the tool's capabilities in a utility environment, and the awardee is now moving forward with plans to install the software at two transmission control centers.

Cybersecurity situational awareness – OE projects resulted in the release of two new cybersecurity situational awareness tools for industry use, including one for the Inter-Control Center Communications Protocol (ICCP), a very

complex protocol that electric utilities use to securely exchange system operating information. Larger utilities use it to exchange information between generation and transmission systems. We also launched the Electric Sector Cyber Risk Management Maturity initiative – in partnership with the Department of Homeland Security and energy industry stakeholders – to develop a consistent approach for grid operators to assess their own strengths and weaknesses in cybersecurity.

Energy storage device performance – Energy Storage devices improve system flexibility, reliability and efficiency by mitigating the fluctuations of variable resources and providing a way for excess energy from times of low demand to be used at times of high demand. OE recently developed two new batteries (Sodium Metal Halide and Enhanced Vanadium Redox Flow) with superior operating capabilities for ramping and peak load management applications. For example, the Vanadium Redox Flow battery was developed with a new chemistry that provides double the operational temperature range, 70% increased capacity, and 90% increased energy efficiency.

Distribution system efficiency – Smart grid technologies allow utilities to manage major swings in demand, improving system efficiency and reliability. In the last year, OE demonstrated a 10% improvement in load factor – the ratio of average demand to peak demand for a given period of time – on a distribution system through the integration of renewable and distributed systems.

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.

According to information provided by the Department, you still have more than $1.8 billion to be spent out from these programs. What is the actual status of these programs?

Secretary Hoffman. Under the Recovery Act, the Office of Electricity Delivery and Energy Reliability (OE) was provided $4.5 billion "to modernize the electric grid, to include demand responsive equipment, enhance security and reliability of the energy infrastructure, energy storage research, development, demonstration and deployment, and facilitate recovery from disruptions to the energy supply, and for implementation of programs authorized under title XIII of the Energy Independence and Security Act of 2007."

OE allocated $3.5 billion to implement Section 1306 of the Energy Independence and Security Act of 2007 (EISA) through the Smart Grid Investment Grant (SGIG) Program, and $685million to implement Section 1304 of EISA through the Smart Grid Demonstration Program (SGDP). In addition, as directed in the Recovery Act, Recovery funds supported worker training activities ($100M), transmission planning in the Eastern, Western and Texas Interconnections ($80M); and the development of interoperability standards implementation, as authorized in Section 1305 of EISA ($12M). DOE is also providing Recovery funds for assistance to public utility commissions ($48M) and state and local governments energy assurance planning activities ($52M), as well as $27 million for project management and oversight activities.

As of the beginning of April 2012, DOE has outlaid $2.6 billion of the $4.5 billion (57%). Overall, more than 90% of OE's total Recovery funds are projected to be outlaid by the end of FY2013.

The Smart Grid Investment Grant (SGIG) program is accelerating the modernization of the Nation's electric transmission and distribution systems

and promoting investments in smart grid technologies, tools, and techniques that increase flexibility, functionality, interoperability, cybersecurity, situational awareness, and operational efficiency. The 99 SGIG projects, selected through a merit-based, competitive solicitation, will be completed within 5 years (2010 – 2015) with deployments scheduled to be completed in the first three years followed by two years of data collection. As of the beginning of April, seven grantees have received 100% of the Federal funds and another 32 at least 67%. The SGIG program has outlaid more than $90 million per month for the each of the last 13 months and is currently $20 million above projected spending.

The Smart Grid Demonstration Program is essentially on track with current spending estimates. A large number of SGDP recipients will be conducting the majority of the required installation work from the summer of 2012 through the end of calendar year 2013. These projects required significant time to get to the stage of commencing the installation work because of the complexity and amount of work to design and implement the "interconnectivity" of the different smart grid technologies being deployed. After installation is complete, the demonstration phase for these projects to prove functionality will last about two years, resulting in a project timeframe of approximately five years.

In addition to the larger smart grid activities, the workforce training, assistance to public utility commissions, and state and local energy assurance activities are all well above their projected spending rates.

As progress in deployments is made, Recovery Act Smart Grid funding recipients are beginning to realize tangible benefits, such as: reduced operating and maintenance costs; quicker restoration and system recovery during such storm conditions; reduced overall energy consumption; improved reliability and enhanced customer engagement opportunities.

Asset Type	*SG Investment Grants (as of 3/31/12)*[6]	*SG Demonstration Program (as of 12/31/11)*
AMI Smart Meters	10,967,667 installed 9,576,864 operational	171,361 installed and operational

[6] For more data on deployments, visit www.smartgrid.gov

Customer Systems	400,000 assets deployed >2.5 million customers enrolled in time-based rate programs	7,612 installed and operational 58,922 active web portal accounts have been created
Distribution System Assets	3,000 distribution circuits with automation	382 automated feeder switches; 264 automated capacitors; 105 automated regulators; 12,947 feeder monitors; 1 transformer monitor; 428 smart relays.
Transmission System Assets	221 phasor measurement units installed and operational	dynamic capability rating systems (DCRS) on 11 transmission lines 11 phasor measurement units (PMUs) 4 phasor data concentrators (PDCs)
Distributed Energy Resources		176 distributed generation units with combined capacity of 1.05 MW 30 storage units with combined capacity of 1.43 MW 25 plug-in electric vehicle charging points

In addition to the accomplishments from smart grid projects, DOE's other Recovery Act activities are also producing results:

- The Workforce Training program has provided training to over 20,000 students and produced 9,000 graduates from grant-funded curriculum;

- Assistance to public utility commissions for increasing staff sizes to manage electricity-related caseloads associated with the Recovery Act funds has resulted in over 130 hires and impacted more than 4,500 cases nationwide;

- Assistance to states for energy assurance planning has resulted in 49 states and territories that have produced energy assurance plans and who have tested those plans in DOE-sponsored regional exercises;

- Under the interconnection activity, the Western Interconnection has produced a draft 10-year regional transmission plan and the Eastern Interconnection has produced Phase 1 of an analysis of futures report.

Subcommittee. What are you doing to ensure that you are not increasing the vulnerability of the grid to cyber attacks?

Secretary Hoffman. DOE takes very seriously the responsibility of managing and overseeing the Smart Grid Demonstration and Investment Grant Programs to protect taxpayer funds and ensure that projects are moving forward effectively to modernize our Nation's electric grid. The security of our electrical grid is of the utmost importance, which is why we developed a comprehensive cybersecurity approach for all of our projects. DOE required all recipients to develop cybersecurity plans that provided information about how they would identify cybersecurity risk, how those risks would be mitigated, and how the processes in place would ensure that a sufficient cybersecurity posture be maintained. The cybersecurity plans were intended to describe a process that, when implemented correctly, would establish and maintain an adequate cybersecurity profile and, at the same time, retain flexibility so that specific cybersecurity protections could be addressed as the project requirements became better defined from the design phase to the deployment phase.

All cybersecurity plans submitted by recipients were subject to a rigorous review by our cybersecurity experts, including iterations between DOE's cybersecurity and the recipient's cybersecurity experts prior to final approval. DOE approved cybersecurity plans for all smart grid projects. DOE did not approve any cybersecurity plan that failed to meet DOE requirements.

DOE will continue to ensure that the cybersecurity plans of the recipients are complete and are being implemented properly. DOE reviews the progress recipients are making in their cybersecurity implementations as an integral part of annual site visits. These interim assessments performed by

cybersecurity experts help ensure the recipients are implementing the cybersecurity actions and approaches outlined in their plans. As the projects mature over time, we will continue conducting on-site visits, sharing best practices, offering information-sharing sessions via workshops and webinars, and evaluating recipients' progress against their required cybersecurity plans.

REVERSAL ON TRAJECTORY FOR ENERGY STORAGE FUNDING

Subcommittee. Energy storage is an area the Department of Energy emphasized in both its 2011 and 2012 budget requests. Yet this year the Department has apparently reversed course, asking for a $5 million decrease for this program.

Are other parts of the Department picking this up, or is this truly a decision to reduce overall funding for this activity?

Secretary Hoffman. The reduction in funding for OE's energy storage program does not represent a transfer of specific programmatic responsibilities. However, the program will continue to leverage funding by collaboration with other DOE offices such as ARPA-E and the Office of Science's Basic Energy Sciences, as well as with ongoing American Recovery and Reinvestment Act projects.

Subcommittee. What is behind the decision to reverse course within your program?

Secretary Hoffman. The reduction in funding is not a change in commitment to energy storage research, but reflects strategic decisions in a financially constrained environment. OE's Energy Storage program will continue to research advanced storage technologies, develop devices with improved performance, provide bench and field testing for new technologies, and perform analytical studies on storage for integration of renewable generation and improving grid performance, while engaging industry in highly cost-shared projects.

UPDATE ON ADVANCED MODELING GRID RESEARCH

Subcommittee. Assistant Secretary Hoffman, last year the budget request proposed $19 million to start an Advanced Modeling Grid Research effort. Yet this year's budget request shows that the program was a new start in 2011 under the CR. We have no record of approving a new start in 2011 for this program, and you were forbidden from starting anything new without our permission.

Under what authority did you begin this program in 2011?

Secretary Hoffman. This is not a new activity in FY 2011, but was an area of research previously funded in the Transmission and Renewables Integration activity under the Clean Energy Transmission and Reliability program. The FY 2011 request increased funding and emphasis in this important research area, and accordingly displayed it as a separate activity in the FY 2011 request. In FY 2010, OE provided about $2 million to support research in new algorithms and computational methods to solve complex power system problems, activities captured in the Advanced Modeling Grid Research in subsequent budget requests.

Subcommittee. This is research and development FERC might require of its grid operators. What is the relationship of this program with the grid operators, and at what point will they pick it up?

Secretary Hoffman. The Advanced Modeling Grid Research program leverages the scientific advancements in mathematics and computation to enable wide-area, real-time protection and control. Without improvements in understanding of system dynamics through advanced simulations, control actions taken at the current state may lead to unreliable or unstable future operation. As the ultimate customer of the tools and techniques developed, industry plays a critical role in ensuring that the focus of the program is placed on relevant mathematical and modeling challenges, as well as integrating the approaches into operational tools and planning practices used by grid operators and planners.

CYBER SECURITY RESEARCH

Subcommittee. Funding for cyber security research has not increased substantially since 2009—the Department requested $30 million again this year, up from barely more than $10 million in 2009.

Which federal agency has the lead for power grid and related cyber security issues, and how does the Department engage with them?

Secretary Hoffman. Cybersecurity for the grid is a key part of the Department's mission in that our national goals for energy security, economic competitiveness, and national security cannot be achieved without a secure grid. DOE has been working with the electric sector for more than a decade to enhance cybersecurity protections for the grid. To guide our partnership, we jointly developed a roadmap ("Roadmap to Achieve Energy Delivery Systems Cybersecurity") and a common vision to enhance cybersecurity through the development of resilient systems that can survive a cyber incident while sustaining critical functions.

Under Homeland Security Presidential Directive 7 (HSPD 7), the Department serves as the Sector Specific Agency (SSA) for the energy sector and the Department of Homeland Security (DHS) has the overall responsibility for coordinating activities across the critical infrastructures. As the SSA, DOE has the responsibility to collaborate with all Federal agencies, state and local governments, and the private sector, to conduct vulnerability assessments of the sector, and to encourage risk management strategies for critical energy infrastructure. The Department leverages the capabilities of our National Laboratories and focuses on public-private partnerships to accelerate power grid cybersecurity efforts in research and development of advanced technology to create a cyber-secure and resilient electricity infrastructure; facilitating timely sharing of relevant actionable threat information and associated mitigation strategies; encouraging risk management strategies for critical energy infrastructure; and supporting development of a highly skilled and adaptive workforce with multi-disciplinary expertise in both power systems engineering and the computer science of cybersecurity.

DOE works closely and regularly with other Federal agencies that have responsibilities for cybersecurity and the grid including the Department of

Homeland Security (DHS), Federal Energy Regulatory Commission (FERC), and National Institute of Standards and Technology (NIST).

The Energy Policy Act of 2005 (EPAct 2005) authorized the Federal Energy Regulatory Commission (FERC) to promulgate and enforce reliability standards for the bulk electric system. The North American Electric Reliability Corporation (NERC), which was designated as the Electric Reliability Organization by FERC, per EPAct 2005, issues the detailed technical standards associated with these requirements. . DOE, FERC, and the DHS sponsored a set of reports which provided a technical threat assessment of geomagnetic disturbances and electromagnetic pulse, providing a more comprehensive understanding of the issues. FERC is also participating in the effort led by DOE, along with NIST, DHS, and NERC, to develop a risk management process for the electricity sector specifically aimed at providing the sector with a common and repeatable cybersecurity risk management process.

Subcommittee. Given that most of the grid is privately owned and managed, what is the Department doing to work with these utilities to ensure cyber security is given adequate attention?

Secretary Hoffman. The Department of Energy recognizes that neither government, nor the private sector, nor individual citizens can meet cybersecurity challenges alone. The Department's strategic approach to cybersecurity for the grid involves facilitating public-private partnerships to accelerate grid cybersecurity efforts, supporting research and development of advanced technology to create a secure and resilient electricity infrastructure, facilitating timely sharing of actionable threat information, and supporting development of risk management strategies and a highly skilled and adaptive workforce. DOE also leverages the capabilities of the DOE national laboratories, to build capabilities and provide assistance to industry, to support timely awareness of threats, forensics, and situational awareness. Through competitive solicitations and partnerships with industry, academia and national laboratories, DOE has supported the development of several advanced cybersecurity technologies that are now commercial and being deployed to enhance cybersecurity protections. In 2011, the Energy Sector Control Systems Working Group (ESCSWG), a collaboration of energy asset owners, DOE and DHS, released the *Roadmap to Achieve Energy Delivery Systems Cybersecurity,* an update to the 2006 *Roadmap to Secure Control Systems in the Energy Sector* . This marks a

continued collaborative effort by public and private energy sector stakeholders to enhance the resilience of energy delivery systems. The 2011 Roadmap builds upon the success of the energy sector since 2006, and addresses gaps created by the changing energy sector landscape and the increasingly sophisticated capabilities of cyber-threat actors. The Roadmap provides an industry-driven strategic framework toward achieving the common vision that resilient energy delivery systems are designed, installed, operated and maintained to survive a cyber incident while sustaining critical functions that our national security and economy depend upon. In updating the Roadmap, the ESCSWG drew on the expertise provided by more than 100 public and private energy sector organizations.

The 2009 American Recovery and Reinvestment Act (ARRA) provided unprecedented opportunity to make investments in smart grid technology and ensure the technologies are deployed in a secure manner. All Smart Gird Investment Grant recipients are required to submit a cybersecurity plan for review and approval by DOE. As part of its project management responsibilities, DOE reviews the status of the plans during annual site visits and works with the recipients to update the plans as the projects mature over time. These activities are ongoing.

To support the smart grid recipients in the development and management of their cybersecurity plans, the Department established a website and conducted webinars to assist grantees with obtaining a greater technical understanding of the cybersecurity requirements smart grid technologies (https://www.arrasmartgridcyber.net/). In addition, the Department hosted a smart grid information exchange (SGIE) workshop to share lessons learned from the site visits and provide a forum for the recipients to share best practices. We plan to conduct another information exchange later this year.

The Department has established the National Energy Sector Cyber Security Organization (NESCO)—a cost-shared private sector organization—to enhance information sharing through public-private partnership on cyber vulnerabilities, threats, and best practices across the energy sector, to analyze threats to the sector, and to identify gaps in existing standards.

The Department, in coordination with DHS and other government agencies, has conducted several cyber threat information sharing workshops with utility representatives to share and analyze classified threat information and

determine the impact to the sector, and develop flexible mitigations specifically designed to work for the sector.

The Department, in coordination with NIST and NERC, is leading a public-private collaborative to complete a cybersecurity Risk Management Process (RMP) guideline. The objective of this effort is to provide a consistent, repeatable, and adaptable process for the electric sector, and enable organizations to proactively manage risk.

The Department, in partnership with the DHS and in collaboration with industry and government representatives, is leading an Electric Sector Cyber Risk Management Maturity (ESCRMM) initiative. The initiative is an important step toward an objective, holistic way to manage the electric subsector's cybersecurity risks with an appropriate balance of protection, resilience, and restoration.

In September 2011 DOE issued the *Vulnerability Analysis of Energy Delivery Systems* report that describes common vulnerabilities found in assessments of control systems and components on energy sector supervisory control and data acquisition/energy management systems (SCADA/EMS) performed by Idaho National Laboratory (INL) as part of the DOE National SCADA Test Bed (NSTB) program. The purpose of this report is to provide recommendations to the SCADA vendor and/or owner to identify problems, integrate stronger security into next-generation systems, and reduce the risk of these vulnerabilities in their systems.

Subcommittee. What sort of a baseline of cyber security risk has been developed, and how?

Secretary Hoffman. Partnerships between private sector companies, Federal departments and agencies, and the intelligence community continue to facilitate an evolving understanding of the cyber risks. The Department's ongoing engagement with partner agencies such as the Department of Homeland Security (DHS), the Federal Energy Regulatory Commission and private industry facilitate channels through which perspectives unique to each group are shared, supports timely situational awareness, and awareness of current and emerging trends to support the electric subsector's ability to react quickly to cyber threats.

The Department is leading an initiative (the Electric Sector Cyber Risk Management Maturity initiative) to develop a common risk-based model to

measure cybersecurity capabilities within the electricity sector. This initiative is being led by DOE in partnership with DHS, and in collaboration with industry and government representatives. When complete, the initiative will allow both industry and government leaders to better understand the capabilities of the sector to manage cybersecurity risks. The initiative is scheduled to conclude at the end of May 2012 with the release of the model.

In addition, the electric sector Cybersecurity Risk Management Process (RMP) Guideline was developed by the Department, in collaboration with the National Institute of Standards and Technology (NIST), the North American Electric Reliability Corporation (NERC), and representatives from both the public and private sector. The primary goal of this guideline is to describe a risk management process that is targeted to the specific needs of electricity sector organizations. The RMP guideline is designed to build on an organization's existing cybersecurity program, policies and procedures, to help organize and clarify risk management goals, and to provide a consistent approach to make risk decisions. The Department closed the final public comment period in early April 2012. The goal is to publish the guideline by the summer of 2012 and begin several test pilots at utilities to refine the RMP and develop supporting materials for the electric sector.

Subcommittee. How would you currently characterize the threat the grid faces from cyber and cyber/physical attacks?

Secretary Hoffman. The cyber threat to the electric grid continues to increase in sophistication, and the capability to conduct targeted cyber-attacks against the energy sector is being made easier by the increasing availability of automated exploits that specifically target energy sector cyber-vulnerabilities. Cybersecurity for the electric grid must address not only the threats and vulnerabilities of traditional information systems, but also issues unique to electric grid technology (such as the lengthy life expectancy of energy control systems). The Department's cybersecurity program is focused on developing advanced technologies with cybersecurity capabilities tailored to the unique constraints of energy control systems and encouraging risk management strategies to manage the advancing nature of cyber threats.

Subcommittee. What will your budget request do to improve this situation?

Secretary Hoffman. Because cybersecurity for critical infrastructures is a shared responsibility, the Department's goal is to partner with the private sector to reduce the risk of energy disruptions due to cyber events. We utilize the Roadmap to Achieve Energy Delivery Systems Cybersecurity as an organizing framework and to prioritize resources. Our budget supports a portfolio of activities designed to address operational as well developmental needs to enhance cybersecurity in the energy sector. The portfolio leverages the technical expertise of the DOE national laboratories and builds on past successes in the commercialization of advanced technologies and in the vulnerability assessment and information sharing model created by the DOE National SCADA Test Bed.

In FY2013, we will near completion of R&D efforts on eight industry-led projects competitively selected in FY2010. One project, Watchdog, which utilizes white listing techniques to protect central control system communications and raises an alarm upon detecting unexpected behavior, will be completed ahead of schedule because of strong end-user demand for the technology. The other projects will enhance cybersecurity by developing capabilities to: prevent unexpected cyber-activity on substation computers (this protects against Stuxnet-like cyber-attacks); protect field device communications, and alarm on physical tampering; build a tightly-secured communications gateway between central control systems including innovative fast encryption and decryption techniques to protect measurements needed for wide-area awareness of power grid operations, including high-rate smart grid data; 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; create role-based access control tailored to the energy sector; secure data traveling multi-party smart grid networks; develop cryptographic key management for millions of smart meters; and secure energy-sector communication protocols, including smart grid. These products will join the commercialized products that the Department has already succeeded in bringing to market and that are strengthening our Nation's energy sector cybersecurity posture today.

Also in FY2013, we plan to issue a new competitive solicitation to research, develop, demonstrate, and expedite the commercialization of tools and technologies to further strengthen the cybersecurity posture for energy delivery systems.

To develop a broad-based capability in resilient systems, we are working 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 Department, in partnership with DHS and industry, for next-generation research that supports resilient and secure smart grid systems. TCIPG leverages and expands upon previous research funded primarily by the National Science Foundation. Examples of research activities that are currently in transition to the energy sector include practical vulnerability assessment tools, embedded system and Advanced Metering Infrastructure (AMI) cybersecurity advances, and next-generation technologies that further enhance cybersecurity of advanced measurements, such as synchrophasor data and inter-control center communications, needed for wide-area situational awareness of power grid operations including smart grid. TCIPG is prolific in high-risk/high-payoff research and has established itself as a thought leader in the community with strong industry participation.

DOE will continue to conduct cyber-vulnerability research using the National SCADA Test Bed (NSTB) national laboratories to partner 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 next-generation 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.

SMART GRID TO FACILITATE INFORMED CONSUMER DECISIONS

Subcommittee. Secretary Hoffman, in June of 2011 the National Science and Technology Council released "A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future" which outlined policy recommendations for a smart grid. One recommendation focused on research and other activities related to empowering consumers by facilitating informed decision making.

Has DOE worked with the NSF and other federal agencies to incorporate this kind of research into your programs in the 2013 budget request?

Secretary Hoffman. Although DOE has not worked directly with the NSF or other Federal agencies, the Department's Office of Electricity Delivery and Energy Reliability has been undertaking two initiatives in direct support of this policy recommendation. One initiative is to demonstrate and adopt data access platforms to allow consumers to better manage energy use, which led to the release of the DOE Smart Grid Data Access Funding Opportunity Announcement (FOA) in November 2011. The application period has closed, and all applications are being reviewed with selections for award pending. Another initiative is the DOE "Apps for Energy" competition, which is designed to create apps for mobile phones, computers, tablets, and software programs to make the best use of the data provided through the President's Green Button initiative to help consumers save money on their energy bills and reduce energy consumption. The competition officially launched in April 2012, with awards announcement targeted for May 22, 2012.

FOSSIL ENERGY

PROGRAMS TO ADDRESS GAS PRICES

Subcommittee. Secretary McConnell, gas prices are on everyone's mind these days, with the prospect of a gallon of gas costing $5 dollars a real possibility. Fears of instability regarding Iran may be behind much of this, but your programs could be pivotal in identifying new resources and technologies to help reduce our country's reliance on imported oil. What, specifically, are you doing to help?

How would you add $50 million to your budget request to help improve our country's supply of oil?

Secretary McConnell. The oil and gas industry has the incentive to develop the domestic oil resource and we would not propose using taxpayer dollars for activities that are being effectively pursued by industry. DOE's oil and natural gas research program, focuses on ensuring the safe and environmentally sustainable development of shale gas, which may provide an alternative transportation fuel to reduce our dependence on oil. We are currently requesting funding for shale gas and methane hydrate research in 2013 as part of the Department's goal to develop alternatives to oil for the transportation sector.

HYDRAULIC FRACTURING PROPOSED INTERAGENCY EFFORT

Subcommittee. Secretary McConnell, the Administration has also been focused on natural gas production from hydraulic fracturing. The Secretary of Energy's Advisory Board (SEAB) has released two reports recommending steps the federal government can take to improve the safety and environmental performance of natural gas fracking practices. The 2013 budget proposal includes a DOE, DOI, and EPA initiative to coordinate activities related to these recommendations.

The Department is primarily a technology research agency, not a regulatory body. What would DOE's role be in this interagency effort?

Secretary McConnell. The Department will focus on its core technical and scientific competencies., DOE's role in the initiative will focus on priorities identified by the interagency collaboration in a research plan to be formed over the next nine months within its area of core research competencies, including wellbore integrity,flow and control; green technologies; and systems engineering, imaging and materials.

Subcommittee. How would the Department work with industry to ensure the results of any effort will be utilized in the private sector?

Secretary McConnell. Most of the research will be conducted under competitive solicitations in partnership with industry to ensure that the work will address the needs of the private sector.

Subcommittee. How will the new coordinated initiative among DOE, EPA, and DOI differ from what DOE has already done? How will these activities be different than EPA's hydraulic fracturing/drinking water study?

Secretary McConnell. This will be a collaborative research program that will focus on timely, relevant science directed to research topics that provide results and technologies that support sound policy decisions by State and Federal agencies responsible for ensuring the prudent development of energy sources while protecting human health and the environment. This is a broader collaboration research effort among the agencies for unconventional oil and natural gas development, which is different than EPA's study on the potential impacts of hydraulic fracturing on drinking water resources.

UNCONVENTIONAL FOSSIL ENERGY TECHNOLOGIES

Subcommittee. Secretary McConnell, your Unconventional FE Technology line is again zeroed out this year. Its mission is to "provide information and technologies that will assure sustainable, reliable, affordable, and environmentally sound supplies of domestic fossil energy resources." Given that the country will need every available resource to meet our energy security requirements, how do you justify this continued position?

Secretary McConnell. America's abundant unconventional resources are critical components of our Nation's energy portfolio. The 2013 Budget refocuses the gas R&D program primarily on safe and environmentally sustainable development of unconventional natural gas resources, including shale gas and methane hydrate.

The FY 2013 budget request will focus on high priority recommendations received from the Subcommittee of the Secretary of Energy Advisory Board (SEAB). These research efforts will help to improve our understanding of the impacts of developing our Nation's unconventional natural gas resources and assist in developing new technologies that will enhance safe and environmentally sustainable exploration and production of these resources.

SHALE GAS AND HYDRAULIC FRACKING

Subcommittee. Secretary McConnell, your budget request includes $12 million for natural gas technologies. However, this funding is apparently solely for a joint effort with the EPA and Department of the Interior for environmental, health, and safety impacts. Elsewhere in your request, you propose to increase funding by hundreds of millions of dollars to improve the efficiency of other energy technologies. Is there nothing left to be done to help improve the efficiency of natural gas exploration, especially since improving efficiency may well have environmental, health, and safety benefits?

Secretary McConnell. While it is important to maximize production efficiency, the oil and gas industry has every incentive to do this on its own. The DOE FY 2013 Natural Gas budget request will focus on high priority research recommendations received from the Subcommittee of the Secretary of Energy Advisory Board (SEAB) that will enhance safe and environmentally sustainable development of these resources. DOE's role will be specified in the interagency research plan to be developed over the next nine months with in its area of core competencies including wellbore integrity, flow and control; green technologies; and systems engineering, imaging, and materials.

FOSSIL ENERGY OMITTED FROM CLEAN ENERGY INCREASES

Subcommittee. Secretary McConnell, once again the Administration's budget request goes long on renewable energy while cutting fossil and nuclear energy. This seems inconsistent with an "all-of-the-above" strategy as out lined by the President.

What energy source contributes the most to U.S. energy supply at this point?

What about in 20 years?

Secretary McConnell. Today, fossil fuels provide 70% of the electricity in the United States – 45% from coal, 24% from natural gas, and 1% from oil. According to the Annual Energy Outlook for 2012, in 2035 this contribution is projected to fall slightly to 67%, with the mix shifting to 39% coal, 27% natural gas, and 1% from oil.
As a percentage of primary energy, fossil fuels are projected to remain relatively flat as well – today, 37%, 21% and 25% of our energy comes from oil, coal, and natural gas, respectively. Estimates show that coal and natural gas will remain flat, with oil dropping to 32% of energy supplies.
These projections are subject to uncertainty –and must be understood within that context. EIA provides alternative cases that are also informative.

Subcommittee. With the reality that our energy supply will continue to rely on fossil fuels for the foreseeable future, why would you propose cutting the very accounts that support these sectors? Is there nothing left to be done to improve the efficiency and performance of our fossil fuel plants and recovery?

Secretary McConnell. The Office of Fossil Energy has always supported the development of emerging technologies, where appropriate and consistent with potential public benefits, to better utilize our natural resources. At the same time the oil and gas industry is highly profitable and is capable of conducting R&D itself. The recent increase in natural gas fracking was enabled in part by the Department's research in horizontal drilling and hydraulic fracturing methods. This technology has enabled the utilization of tight oil resources as well, and has resulted in a dramatic increase in U.S. domestic oil production.

Although the technologies may not be implemented immediately, carbon capture, utilization, and storage (CCUS) and the development of high efficiency integrated gasification combined cycle (IGCC) plants will enable more efficient, cleaner plants in the future that can meet the proposed EPA requirements, and will support continued use of one of our most abundant resources.

FALLING BEHIND IN COMPETITIVENESS FOR FOSSIL ENERGY TECHNOLOGIES

Subcommittee. Secretary McConnell, Bloomberg New Energy Financing has recently estimated that China has 30 per cent of active global Carbon Capture and Sequestration (CCS) pilot projects, on a megawatt basis. At least nine foreign companies are working there, largely because their government makes it attractive to work in pilot projects. At the same time, this budget slashes domestic research and development into the very projects that would keep us competitive. And regulations are forcing fossil fuel plants across the country to shut down.

What is the Administration doing to keep American fossil fuel companies working in the United States?

Secretary McConnell. The American Reinvestment and Recovery Act (ARRA) provided $3.4 billion for the development of CCUS projects, both for industrial uses as well as for coal fired power plants. One of the requirements of the Recovery Act was that the business be American owned and operated, in order to ensure that the technology is developed in the United States.

The Office of Fossil Energy is continuing to support research and development on second generation technologies that will enable more efficient capture processes, and ultimately bring down the cost of CCUS. The Regional Carbon Sequestration Partnerships have continued large-scale field tests of CO_2 storage in saline formations, and have developed some of the most advanced on-shore storage practices available today. Monitoring, verification, and accounting of the injected CO_2 is helping to prove the safety and permanence of the storage, all while working to lay the framework for future CCS plants in the United States.

CUTS TO COAL PLANT EFFICIENCY AND INNOVATION RESEARCH

Subcommittee. Secretary McConnell, given coal's importance our electricity sector, why do you propose such major cuts to coal plant efficiency and innovation research programs?

What areas are the ripest for additional funding to improve our coal plants' efficiency, which should also improve air pollution problems and increase American competiveness?

Secretary McConnell. Fossil Energy has continued the development of IGCC processes, investing in efficiency upgrades and better pollutant removal processes for future coal fired power plants, as well as the development of more efficient carbon capture processes. These plants, in the absence of carbon capture, provide a significant increase in the efficiency of coal-fired electricity generation. The focus has shifted to the development of near-term, high promise technologies such as oxygen separation membranes, sorbents, and solvents, which will dramatically reduce system costs.

DOE aims to prove the commercial viability of gasification plants operating with Carbon Capture. Studies have shown that IGCC plants equipped with CCS will ultimately provide the lowest cost option for coal to continue operation while capturing and storing their CO_2 emissions, though a combination of more efficient generation, and optimized processes for the removal of CO_2.

ROCKY MOUNTAIN OILFIELD TESTING CENTER

Subcommittee. In fiscal year 2012, we directed you to develop a long-term management plan for the Rocky Mountain Oilfield Testing Center, including a transition to a self-sustaining facility. What is the status of this plan?

Secretary McConnell. The disposition plan, which analyzes options for the Naval Petroleum Reserve No. 3 (NPR-3) and the Rocky Mountain Oilfield Testing Center (RMOTC), is currently being prepared. It is expected that the disposition plan will be completed by the end of the year.

RESCISSION FROM STRATEGIC PETROLEUM RESERVE

Subcommittee. Last year, the Administration sold roughly 31 million barrels of oil from the Strategic Petroleum Reserve to temporarily lower the price of oil. This year, the budget request proposes to rescind $291 million of the proceeds from that sale, and to buy back only 27 million barrels over a five year timeframe. This would reduce the size of the reserve, reducing our ability to protect ourselves in the event of a true disruption in supply.

The risk of supply disruptions in the world oil market exists today more than ever. Under those circumstances, it would seem sensible to increase the size of the SPR. What is the Administration's reason for doing the opposite?

Secretary McConnell. At the conclusion of the 2011 International Energy Agency (IEA) collaborative action, the IEA recommended that countries delay resupplying their strategic reserves to give the oil markets time to stabilize. The 2013 budget reflects repurchase of 27 million barrels of crude oil over a five year period beginning in FY 2013.. The SPR continues to be well-supplied, consistent with our IEA obligations, at 696 million barrels.

Subcommittee. The number of days of import protection provided by the SPR depends on the amount of oil we import as a nation. What happens if our economy starts growing more quickly and imports go up again? Or if the price of oil increases and the funds remaining in the Account are not sufficient to repurchase even the 27 million barrels the budget proposes? Shouldn't we wait until we have a better sense of these issues before deciding to use that money for other things?

Secretary McConnell. The SPR continues to be well-supplied, consistent with our IEA obligations at 696 million barrels of crude oil, Based on EIA data for 2010, imported oil accounted for less than 50 percent of the oil consumed in the United States for the first time in 13 years. The 2013 budget reflects plans to repurchase oil at a time in the future when oil markets are stabilized and prices will provide a good value to the Government.

Subcommittee. By not buying back the full amount of SPR oil, it looks like the Department is setting strategic energy security policy

primarily to fund research and development programs. Was this decision primarily guided by SPR policy or by budget policy?

Secretary McConnell. The FY 2013 Budget proposes to use the SPR Petroleum Account receipts to repurchase 27 million of the 31 million barrels sold in the SPR Drawdown by 2017, which will provide the Nation with sufficient import protection. The remaining funds of $291 are not required.

SELLING OIL FROM THE STRATEGIC PETROLEUM RESERVE

Subcommittee. Rising gas prices and the impact that has on the national economy and individual family budgets is certainly high on everyone's list of concerns these days. Administration officials over the past few weeks have repeatedly said that the possibility of tapping the Strategic Petroleum Reserve again this year is an option to be considered.

Is the Strategic Petroleum Reserve really an appropriate tool to use solely to try to address something as variable as gas prices? Or should it be used only to address a "severe energy supply interruption" as the law describes?

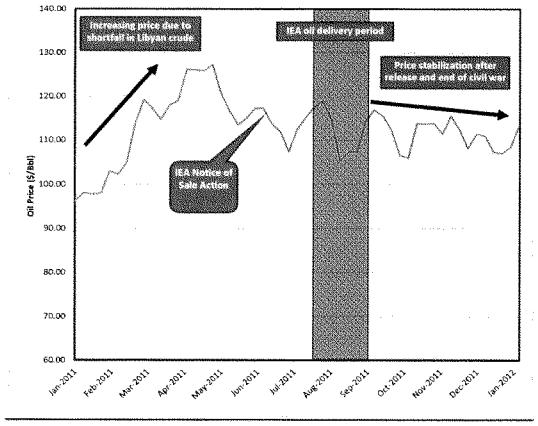
Secretary McConnell. The Energy Policy and Conservation Act (EPCA) (P.L. 94-163, as amended) prescribes the conditions which must exist for the President to order a drawdown and sale from the Strategic Petroleum Reserve (SPR). The mission of the SPR is to address actual or impending supply interruptions and not to manipulate market prices.

Subcommittee. Is a sale from the Reserve even effective for anything more than a very short term impact on gas prices?

Secretary McConnell. A drawdown of the SPR mitigates the impacts of supply interruptions in the market.

Subcommittee. What can we learn from last year's sale? Would you expect another sale this year to have any longer-term impact? If so, why?

Secretary McConnell. As noted by EIA. "Attributing observed price changes since June 23 to the IEA announcement is difficult because of the other factors that continually affect oil prices, such as changing expectations of world economic and crude oil consumption growth, uncertainty over supply disruptions, estimates of OPEC spare production capacity, and other physical and financial market factors. It is also impossible to know with certainty how prices would have behaved had the release not been announced. World crude prices initially fell following the IEA's June 23 announcement of release from strategic reserves, but then rose above their pre-announcement levels in late June and early July." .



Subcommittee. What would another sale of SPR oil do to the Reserve's inventory? Inventories are already down from last year's sale; how would yet another sale affect our ability to respond if a serious disruption occurred to global oil supply?

Secretary McConnell. Absent an actual or imminent supply interruption, there are no plans to release crude oil from the SPR. The SPR continues to be well-supplied, consistent with our IEA obligations, at 696 million barrels.

FOSSIL ENERGY — MAJORITY QUESTIONS

FUTUREGEN

Subcommittee. The Department of Energy devoting over $1 billion of Stimulus Act funds to pursue a FutureGen partnership with Ameren at a plant in Illinois. This project was expected to create 2,000 direct jobs, and another 1,000 indirect jobs. Last year, however, Ameren announced that it would close that plant due to stricter EPA regulations.

Did the Department communicate to the EPA that its new regulations would be putting more than $1 billion of U.S. taxpayer dollars at risk, in addition to 3,000 good jobs? If so, what was EPA's response?

Secretary McConnell. The Department had no specific communications with EPA relative to how its rules would impact FutureGen, which is fully expected to meet all new EPA proposed regulations. The Ameren facility that would be repowered as part of the FutureGen 2.0 program ("Unit 4") is one of four units at Ameren's Meredosia power plant. At the time Ameren received its FutureGen award, only two of these units were in operation, and Ameren operated Unit 4 on a very limited basis. The Department understands that Ameren's decision to end its participation in the FutureGen 2.0 program was not motivated by regulatory considerations but by cost and business concerns. It was only after Ameren decided to end its participation in the FutureGen 2.0 program that it announced its decision to close the entire Meredosia power plant. Ameren has told the Department that it intends to hold Unit 4 in a ready condition while the FutureGen Alliance, the other recipient in the FutureGen 2.0 program, explores whether it can take over Ameren's portion of the program.

Subcommittee. What is the current status of the project?

Secretary McConnell. The FutureGen 2.0 program consists of two projects: (1) retrofitting an existing electric generating unit in Meredosia, Illinois, owned by Ameren Energy Resources (Ameren) with oxy-combustion and carbon capture technologies; and (2) constructing a pipeline and injection system that would sequester the carbon dioxide captured from the unit in a deep geologic formation beneath Morgan County, Illinois. The second project is managed by the FutureGen Alliance (Alliance); the first

project is currently managed by Ameren, but it has decided not to pursue its project beyond Phase 1 (preliminary design).
Phase 1 of both projects is almost complete. The analyses undertaken during this phase resulted in an increased estimate of total program cost from $1.3 billion to $1.5 billion. This increase is attributable to identification of an additional $368 million in costs for Ameren's project. DOE understands that Ameren's decision not to proceed beyond Phase 1 was based in part on these cost increases.

The Alliance informed DOE that it intends to ask the Department to novate (transfer) the Ameren award to the Alliance and to authorize the Alliance to take both projects into Phase 2. DOE's decision on these requests depends on many things including the Alliance's ability to demonstrate that it has the technical, managerial, financial and other capabilities needed to pursue both projects. The Alliance's demonstration will be contained in "decision point applications" that it intends to submit to DOE in April/May 2012.

While Phase 1 was initially scheduled to end in September 2011, Ameren and the Alliance requested that DOE give them additional time so the Alliance could prepare the decision point applications and novation request. DOE authorized "no-cost extensions" of both projects to provide the Alliance with additional time and to allow both projects to conduct activities critical to maintaining the aggressive schedule of the FutureGen program should DOE decide to authorize the Alliance to proceed with both projects.

REGULATORY UNCERTAINTY

Subcommittee. It seems as if the future of clean coal in this country is jeopardized by the EPA's recent actions to enforce stricter clean air rules. Not only are older coal plants being forced to close, newer, more efficient and cleaner plants supported by your program are now wary of moving forward, not knowing what new regulations the EPA might have in mind. For instance, the FutureGen partner plant pulled out of the project in 2011, putting more than $1 billion of taxpayer dollars at risk, as well as 3,000 jobs. Similarly, AEP stopped its CCS project last year because of the "current uncertain status of U.S. climate policy", as well as the economy.

These projects are the future of American electricity supply, not the past. One might think that EPA's actions are just driving these technologies overseas. What are you doing to help provide some certainty to these companies and keep their innovations in the United States?

Secretary McConnell. The decision to develop and utilize innovations outside the United States is driven by many complex factors, but financial considerations are usually at the forefront. Driving down costs, over time, is one of the major achievements of the Fossil Energy (FE) Research, Development, and Demonstration (RD&D) program, which supports the development and use of innovations in the United States. It is a requirement of projects seeking Federal funding from the FE RD&D program that their project is developed and operates inside the United States.

SOUTHERN KEYSTONE XL PIPELINE EXPANSION

Subcommittee. The President announced last week that he would make the southern half of the Keystone KL pipeline a "priority", but offered few specifics on what that meant. He mentioned cutting through red tape and breaking through bureaucratic hurdles. Secretary McConnell, this tape, and these hurdles, represent the Administration's approval process for pipelines. If the President himself needs to force through projects, is the process broken?

Secretary McConnell. The President's announcements focused on prioritizing regulatory processes and indicate that he knows how important pipelines are. Any efforts to prioritize are merely trying to speed-up an approval process that is already efficient. That being said, any decision on the Keystone XL Pipeline will be made on the merits. There may be confusion about the reviews needed to approve the southern leg of the Keystone XL pipeline from Cushing, OK to Houston compared to the full Keystone XL project proposal. Any pipeline project that crosses the U.S. border requires that the State Department conduct an environmental review consistent with the National Environmental Policy Act (NEPA). However, the August, 2011 Environmental Impact Statement for the Keystone XL project proposal has already assessed the environmental consequences of the southern section of the pipeline. It was the recent change of routing through Nebraska that requires further environmental assessment before the NEPA review of the full Keystone XL pipeline proposal can be completed.

The President highlighted the importance of the southern leg because it will help relieve the crude oil congestion in the Cushing market. The lack of adequate export capacity from Cushing to the Gulf Coast is causing domestic crudes to be heavily discounted and hinders the continued development of our domestic oil resources.

KEYSTONE XL PIPELINE EXPANSION

Subcommittee. A year ago, we asked about the Department's position on the Keystone XL pipeline. TransCanada has announced it intends to file another permit application, and with oil and gasoline prices at historic highs for this time of year, the pipeline is once again relevant to our discussion.

How will an operational Keystone XL pipeline impact the availability of oil in the United States?

Secretary McConnell. The State Department's environmental review of the proposed pipeline concluded that the Keystone XL pipeline would not affect the availability of Canadian oil sands in the United States for the foreseeable future because of excess capacity to ship Canadian oil to the United States and other pipeline projects that would emerge to ship Canadian oil to the Gulf Coast. The State Department's findings partly relied on a study by EnSys Energy that was commissioned by the Department of Energy. It assessed the potential impact (through 2030) of the Keystone XL pipeline on U.S oil imports from Canada and other countries, use of Canadian oil within each of the five Petroleum Administration for Defense Districts (PADDs) and world-wide greenhouse gas emissions. The study indicated that, whether or not the Keystone XL pipeline is built, U.S. imports of Canadian oil sands need not change. The study did find that the volume of Canadian crude oil purchased by the U.S. could change if British Columbia pipelines were built to permit more exports of oil sands to Asian markets. The EnSys study did not determine whether there would be any relationship between the Keystone XL project and the likelihood of expanding oil-sands export capacity though British Columbia.

Subcommittee. How will the pipeline project likely impact domestic oil prices?

Secretary McConnell. Oil prices are set in international markets. World oil prices would not be affected by a decision to build or not build the Keystone XL pipeline because, as the Ensys analysis showed, building the Keystone XL pipeline would not impact Canadian oil production or world oil production. If world oil supply is not impacted, oil prices will not be impacted.

Subcommittee. How are your offices likely to be involved in the Keystone XL pipeline application?

Secretary McConnell. As previously noted, the Department of Energy (DOE) commissioned a study by EnSys Energy that has been provided to the State Department, and DOE will respond to any requests made by the State Departmentfor additional technical information as review a new pipeline proposal by TransCanada.

Subcommittee. In your answers to our questions last year, you explained that many opponents of the pipeline are concern "that it will facilitate an increase in Canadian oil sands production." I've heard others argue that the Canadian oil sands will be extracted and sold on the world market, regardless of whether we build the pipeline. Which of these two sides do you think is correct, and why?

Secretary McConnell. Opponents to the Keystone XL pipeline may still be concerned that it would encourage increased Canadian oil sands production. However, the State Department's Environmental Impact Statement concluded that it was unlikely that the project would have any impact on future Canadian oil sands production. In reaching this finding, the State Department partly relied on a study by EnSys Energy that reviewed the cost and feasibility of a variety of routings for shipping Canadian oil sands from the Western Canadian Sedimentary Basin to Asian and U.S. markets.

QUESTIONS FROM CHAIRMAN FRELINGHUYSEN OF NEW JERSEY

ANNOUNCING PROGRAMS BEFORE CONGRESS DECIDES TO FUND THEM

Chairman Frelinghuysen. Dr. Kelly, grants from the Department of Energy's applied research programs can impact energy industries and where many firms choose to put their capital. Even just your announcement of a new program can affect the investments the private sector makes.

That is why it's particular worrisome that your office has gotten into the habit of announcing programs and the availability of funding before you have those appropriations in hand — in other words, your office has too often announced programs before the Congress has decided whether to fund them or not.

Let me give a specific example. On August 16 of last year, the Administration issued a number of press releases touting a new $510 million program which include $170 million from the Department of Energy to build jet biofuels refineries. A formal request to Congress for this funding did not appear until the 2013 budget before us today, and we have some specific and well-founded concerns about this program — which is just to say, it's not a forgone conclusion that we will fund the program.

Dr. Kelly, do you think it's problematic that the Department announced this program before it knows it has funding for it?

Dr. Kelly. We appreciate your concern about the timing of the announcement and regret that a misunderstanding was created about the availability of funding. The program and funding announcement to build jet fuel refineries is part of a Memorandum of Understanding (MOU) between DOE and DoD. The MOU states "Under this MOU, the parties will endeavor to fund this initiative at an aggregate of $510 million over 3 years, with that aggregate amount divided equally among the parties. Although the timelines and means through which the Parties will contribute to the initiative are subject to change...The above funding objectives are subject to the availability of funds and subject to each party's right to terminate this MOU as set forth below...." This is standard language that our project partners recognize as being subject to Congressional appropriations. In

addition, we briefed the Senate Appropriations staff prior to announcing this initiative. We regret that despite such precautions a misunderstanding was created, and we will make sure to notify Congress more clearly in the future with any large appropriations request.

Chairman Frelinghuysen. I think this is more of a problem that you're conceding, Dr. Kelly. Let's look at the jet biofuels example. That program has not been funded by the Congress, and you don't know if it will receive funding. But then we see the following in an energy trade journal article dated January 23:

"To get a commercial plant in operation, United [Airlines] and its partners plan to tap into the $510 million investment that the departments of Agriculture and Energy, as well as the U.S. Navy, dedicated to advanced drop-in biofuels last August."

As much as you might point to fine print in your press releases to justify its legality, it appears that people out there think this is real and funded. Aren't you simply misleading the private sector, and possibly leading them to make financially damaging decisions based on a government program that might not exist?

I know that some good people are working hard in your office to prevent this kind of thing and be more responsible, but I do hope that the Department is working from the top down on being more judicious and transparent.

Dr. Kelly. We appreciate your concern about the timing of the announcement and regret that a misunderstanding was created about the availability of funding. No guarantee of funds being available was implied in our announcement. The private sector is positioning itself to take advantage of this initiative through announcements such as you have cited. However, the process to compete and secure funding from this initiative will be completely open, transparent, and based solely on the merits of the technologies instead of any press announcement.

INNOVATIVE MANUFACTURING INITIATIVE

Chairman Frelinghuysen. Dr. Kelly, the Advanced Manufacturing is a center point of your budget request this year, and within that program, the Innovative Manufacturing Initiative (IMI) appears to be the major increase and the core program aimed at giving American manufacturing a competitive edge.

What specifically does the IMI aim to do?

Dr. Kelly. As part of a broader Department of Energy effort to advance the clean energy economy, the Innovative Manufacturing Initiative (IMI) aims to: 1) increase industrial and manufacturing energy efficiency, 2) deliver breakthroughs in technology that significantly reduce energy and carbon intensity throughout the economy, 3) revitalize existing manufacturing industries and 4) support the development of new products in emerging industries. To achieve these goals, the IMI funds cost-shared research and development of transformational manufacturing processes and materials technologies. The scope of projects addressed in the IMI Funding Opportunity Announcement includes four subtopics under Manufacturing and three under Materials. The technology readiness level (TRL) of IMI projects could be from 2 (Applied Research) to 6 (Prototype) to advance the engineering and development of transformational manufacturing process and materials technologies that significantly improve the competitive position of U.S. industry.

Chairman Frelinghuysen. What types of organizations will be eligible to participate? Will it be exclusively companies, or will universities and national labs somehow be involved as well?

Dr. Kelly. The Innovative Manufacturing Initiative (IMI) Funding Opportunity Announcement was open to the following applicants: (1) institutions of higher education; (2) National Laboratories; (3) nonprofit and for-profit private entities; and (4) State and local governments. Other non-DOE Federally Funded Research and Development Centers (FFDCs) and laboratories were also eligible to apply. Teaming arrangement and industrial collaboration were strongly recommended. Of the 259 final applications received for this funding opportunity, there were 59 universities, 55 large businesses, 89 small businesses, 41 FFRDCs and government laboratories, and 15 non-profit organizations.

Chairman Frelinghuysen. The budget calls for $100 million for the IMI. I was a bit surprised to find out that half of this is to pay mortgages on awards first made with fiscal year 2011 funds. Was the IMI a new program in fiscal year 2011?

Dr. Kelly. The Innovative Manufacturing Initiative (IMI) solicitation is a continuation of previously funded efforts within the Industrial Technologies Program (now the Advanced Manufacturing Office); specifically Energy-Intensive Processes, Industrial Materials, and other elements of Industries of the Future (Crosscutting). Because the last Industrial Technologies Program solicitation for research and development projects was conducted in 2009, and most of the previously funded projects are now nearing completion, AMO saw a need for this new solicitation to address the most pressing research needs of the manufacturing industry. The IMI solicitation was developed in May/June 2011 and was issued on June 24, 2011. Due to the large initial response to the solicitation (over 1400 letters of intent to submit an application), the schedule was extended to add a concept paper review phase with full applications due to the Department of Energy on December 7, 2011. As a result, awards in FY11 were no longer possible and funding planned for this solicitation was carried over into FY12 to support selected projects. 259 applications were ultimately received and a comprehensive technical review was conducted. The review completed in mid-February, with results compiled later that month. A selection decision is pending.

SHALE OIL

Chairman Frelinghuysen. Secretary McConnell, the U.S. holds much more recoverable shale oil (500 billion-1.1 trillion barrels equivalent) than Saudi Arabia has proven oil reserves (less than 300 billion barrels). At this point, recovery efforts are challenged by efficiency and environmental concerns. However, if an efficient and environmentally acceptable way could be found to recover this oil, it would meet U.S. demand for over 100 years.

In 2005, a RAND Corporation analysis found that "it does not make sense that oil shale is missing from the Department of Energy's R&D portfolio." Yet I do not see it in your budget request. Am I missing it?

While our country is reducing our oil consumption, there is no doubt that we will remain reliant on it for our vehicles for decades to come. EIA estimates that by 2035 more than 99% of our transportation fuels will still come from fossil fuel resources. Can you give me a convincing argument why the Department of Energy should not be investing in improving our ability to recover shale oil?

Secretary McConnell. The Department recognizes the rapid development of shale oil, especially in the Eagle Ford Shale in South Texas, where production grew by more than 200 percent last year, and the Bakken formation of North Dakota and Montana, where output has increased tenfold in the last five years. These new oil supplies are adding both jobs and significant oil production to improve energy security.

The U.S. also holds abundant oil shale resources, which is rock that is usually mined and heated by a process to produce a liquid, which can be used as a substitute for conventional oil. However, domestic oil shale is not currently produced commercially in the U.S. due to environmental and safety considerations.

Chairman Frelinghuysen. The private sector is investing in electric vehicles as well, yet EERE is asking for more than $200 million this year alone to support electric vehicles. Do you have any other reason?

Dr. Kellyl. The Vehicle Technologies Program (VTP) fiscal year 2013 budget request supports a portfolio of technologies that can reduce

dependence on petroleum, including advanced combustion, materials, fuels technologies, and alternative fuels, as well as electric drive. Vehicle electrification is a primary pathway to breaking our dependence on petroleum, and as such, the VTP request seeks to support a robust R&D activity for not only advanced batteries but also power electronics and electric machines. The Program works closely with industry – through a variety of means including cost-shared projects and cooperative research partnerships – to prevent duplication of effort and ensure Federally-funded work focuses on critical barriers that industry cannot overcome on its own.

As an example, current state-of-the-art lithium-ion batteries are adequate for initial product launches, but for electric-drive vehicles to move from early adopter niche markets to mainstream consumers, continued R&D is needed to further improve battery performance and reduce cost. In addition, global competition in advanced battery development is intense, and battery technology is evolving rapidly. Strong support for R&D is needed to ensure that the U.S. maintains technology leadership, and the Federal government plays an important role.

The VTP budget request would support accelerated R&D on advanced battery technology with a major focus on advanced battery design optimization and battery manufacturing to significantly improve performance and reduce cost. R&D would also focus on the development of high performance and low cost power electronics, improved drive motor technologies that require reduced or no rare earth materials, and the development of advanced charging technology that would allow electric-drive vehicles to conveniently and efficiently charge from the grid. All of this is needed for electric-drive vehicles to be widely accessible to the full spectrum of consumers and enable the market penetration needed to fully realize the energy, economic, and environmental benefits of electric drive.

ADDRESSING RISING GAS PRICES

Chairman Frelinghuysen. Gas prices are once again sky-high — a phrase that has been said too many years in a row in this very room. With the price of gasoline hovering around $4 per gallon, the activities in the Department of Energy and other federal agencies clearly take on a new sense of urgency.

Dr. Kelly, only about 34 percent of the budget request for your program focuses on areas related to gas prices. What's more, while your request proposes to increase those areas by 21 percent, it proposes to increase the other programs that are not related to gas prices by far more — 32 percent. Is your budget request putting the emphasis on the wrong areas?

What is your program doing to focus on lowering gas prices, and how is that reflected in your budget request?

Mr. McConnell, your office focuses specifically on fossil energy sources, including oil and natural gas. Putting the Strategic Petroleum Reserve aside for a moment, what is your office doing in its research and development portfolio to lower gas prices?

Secretary McConnell. The Department's priority is to reduce the Nation's dependence on oil by diversifying our supply of energy for transportation needs and increasing the efficiency of our vehicles. This will also reduce our Nation's economic vulnerability to high and unstable energy prices.

The Office of Fossil Energy focuses its research on the safe and environmentally sustainable development of our unconventional oil and natural gas resources.

CHINESE COMPANIES UNDERCUTTING SOLAR PRICES

Chairman Frelinghuysen. Dr. Kelly, the American solar industry is experiencing somewhat of a shakeout due to, in part, the pressure of Chinese solar products undercutting our prices. Just last week, the Department of Commerce announced new tariffs to address subsidies in China that are lowering their prices below a fair level. I suspect, however, that these tariffs will not close the book on this story.

What is your assessment of American solar industry, and how we are competing with other countries like China?

Dr. Kelly. America is unequivocally competitive in solar manufacturing, but not universally across the supply chain. The low cost solar panels from China are almost exclusively made from either single crystalline or polycrystalline Silicon. A significant amount of the IP on Silicon solar panels has been developed in the US and has left the country. However, the US still has strength in the supply chain that enables the manufacturing of solar cells and modules. For example, companies such as Applied Materials, Dow, MEMC, REC, Hemlock, DuPont, and 3M export a significant amount of equipment and materials that support the global silicon industry. But domestic manufacturing of silicon cells and modules has proven much more difficult in light of intense competition overseas, and the fact that the majority of modules today are deployed overseas. Competition in what has become a commodity market for solar panels will be very challenging in the US when other regions of the world compete with supply side incentives that the US has not been able to match. Current pricing levels for PV modules will put more pressure on US based manufacturers with further consolidation likely in the industry. Our companies with some of the best technology in the world need to sell at or below manufacturing costs to compete against imports.

The US has a very strong innovation engine led by our research universities, national labs, and corporate research labs. DOE funded research is responsible for more than half of the world record solar cell performance records from 1977 to 2011. The challenge is to translate the leadership at the innovation stage to leadership in manufacturing. This has proved very difficult in the US in other industries besides solar manufacturing. With the resources available to the Solar Program, we have created a funding program called SUNPATH (Scaling Up Nascent Photovoltaics AT Home). The

SUNPATH program is focused on increasing domestic manufacturing through investments that have sustainable, competitive cost and performance advantages. SUNPATH will help companies with pilot-scale commercial production scale up their manufacturing capabilities, enabling them to overcome a funding gap that often curtails domestic business at the critical stage of initial pilot scale production. By bridging this gap, SUNPATH will help ensure that innovative, low-cost solar technologies are manufactured in the United States.

Chairman Frelinghuysen. How are your programs working to address these issues, and to ensure that research into solar technologies lead to manufacturing jobs here at home instead of overseas?

Dr. Kelly. Historically, it has been the trend that many of the innovations in solar and in other technologies, such as semiconductor microelectronics, have been developed in the U.S. and then manufactured abroad to a significant degree. The Solar program at DOE has done very well in terms of evolving patents and know-how from the research in a lab into the early stage of product development through a high successful incubator program. As a direct consequence, start-up companies that were funded by DOE through various programs are leaving the shores of the U.S. to find cheap capital in other countries such as China, thus directly leading to the loss of intellectual property. As a result, DOE has developed what it is calling its SUNPATH program. SUNPATH, which stands for Scaling Up Nascent PV At Home, targets companies as they scale at the critical stage of 50-100MW, which is often when technologies go off-shore seeking cheap capital.

SUNPATH has supported companies such as PrimeStar, which was recently acquired by a large U.S. corporation. In fact, $60 million in federal funding for the incubator program since 2007 has leveraged more than $1.6 billion in private funds. However, transitioning to a full-fledged product development company involves significant capital investment (in the case of solar manufacturing, it is approximately $1M/MW). This has proven to be expensive and problematic within the US, due to the increasing cost of capital which contrasts with the willingness of foreign financial institutions to shoulder the risk associated with scaling new technologies provided that manufacturing occurs within their respective countries.

MEMORANDUM FOR THE POWER MARKETING ADMINISTRATORS

Chairman Frelinghuysen. Secretary Hoffman and Dr. Kelly, Secretary Chu recently announced plans to use the four Power Marketing Administrations to further the Administration's goals with respect to transforming the nation's electric sector, including in areas that would seem to intersect with the goals of your offices. What can you tell us about this plan for the PMAs?

To what extent, if any, will your offices be involved in these planned activities? Is the intent to take research your offices conduct and deploy it through the PMAs rather than the private sector? Will this affect any aspects of your offices' budget requests?

Secretary Hoffman and Dr. Kelly. The Department of Energy's (DOE) Power Marketing Administrations (PMAs) play a vital role in providing an electricity system that supports our Nation's economic competitiveness, security and prosperity. On March 16, 2012, DOE Secretary Chu sent a memorandum to the Administrators of the four PMAs, requesting their assistance in facilitating the transition to a more resilient and flexible grid while ensuring customers continue to receive value-added products and services at the lowest possible costs consistent with sound business principles. As highlighted in testimony DOE submitted on April 26, 2012, to the House Natural Resources Committee (copy attached), the Memo outlines broad concepts for achieving these goals in a manner that will be customized to reflect the unique attributes of each PMA. DOE intends to move sequentially and will assess our approach to the other PMAs in light of our experience with WAPA.

DOE has begun its review with the Western Area Power Administration (WAPA). Embracing this challenge, staff from the Western Area Power Administration (Western) and DOE formed a Joint Outreach Team (JOT) to gather information from Western's customers, tribes, and stakeholders through a structured public outreach process, which included workshops, listening sessions, and opportunities to submit written comments on the effort. The robust interaction generated from the public process has resulted in a set of draft recommendations that will be made available for review and comment via the Federal Register on Tuesday, November 20, 2012.

In response to input received during the stakeholder process, the JOT developed a set of principles that were used to help guide the development of the recommendations. The principles include:

- consider the unique attributes of Western's regions
- coordinate with Federal generating agencies (U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and International Boundary and Water Commission)
- ensure that the beneficiary pays
- consider the existing efforts within Western
- ensure that Western stays within the limits of its authority

To continue meeting its statutorily defined mission, Western must also adapt and respond to additional obligations imposed by Congress, the Federal Energy Regulatory Commission (FERC), and the North American Electric Reliability Corporation (NERC) as a result of changing technologies and societal needs. For instance, Western is responsible for meeting new obligations and requirements for open access transmission service, reliable operations, and transmission development when its facilities are used to deliver the full spectrum of energy and energy-related products, including renewables, as well as transmission-related products and services to meet its customer's needs. Indeed, as our Nation's electricity system evolves, new opportunities arise for Western to continue to meet its core mission. Opportunities include a constructive role in addressing issues around cyber security, integrating and/or interconnecting new generating technologies into the Federal transmission system, and remaining fully compliant with the applicable mandatory reliability standards, among others.

After the comment period on the draft recommendations closes, the JOT will finalize the recommendations and submit recommendations to the Secretary of Energy.

Chairman Frelinghuysen. Secretary Hoffman, the memorandum specifically refers to the PMAs as being "uniquely positioned to serve as test beds for innovative cyber-security technologies." Can you tell us what this might involve?

Secretary Hoffman. DOE is working with the PMA's to ensure they are appropriately responding to cybersecurity challenges. DOE is installing

an e-mail filtering product at all of its facilities, including the PMAs. This product has already proven its worth. DOE's is also working with all of its facilities, including the PMA's, to implement the Cybersecurity Maturity Model. As DOE works with industry to develop new technologies and protocols, DOE will ensure the PMAs along with DOE's other facilities are using the latest protections and responses to cyber challenges.

QUESTIONS FROM MR. SIMPSON OF IDAHO

QUESTION FOR PATRICIA HOFFMAN, ASSISTANT SECRETARY FOR THE OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY

Mr. Simpson. Last year I wrote a letter asking the Department of Energy to designate the wireless test bed at the Idaho National Laboratory as a wireless user facility, and you responded in a letter to me dated November 18, 2011, that you had tasked INL to submit a report to you by the end of the fiscal year to develop an operational framework for a wireless user facility at INL. How do you plan to proceed with this report? Are you going to implement their recommendations?

Secretary Hoffman. In 2012, DOE tasked the Idaho National Laboratory (INL) to develop a national strategy, operations framework, and a business model to create a national scientific user facility for its wireless test bed. The strategy should describe how it will develop a cooperative research partner and investment strategy, leveraging relationships with government, industry, and academia.

After INL has completed its strategy and plan, DOE will review and determine if it is in the best interest of DOE and the Nation to pursue the strategy. While there appears to be a need and interest in creating a national wireless test bed by leveraging existing resources at INL, INL must lay the groundwork and build the necessary partnerships to clearly illustrate such a user facility is viable and sustainable.

QUESTIONS FOR HENRY KELLY, ACTING ASSISTANT SECRETARY FOR EERE

Mr. Simpson. Dr. Kelly, I think you would agree with me that with increasingly tight budgets, we have to find ways to better maximize investments that have already been made to execute DOE's various missions. Over the years DOE has invested considerably in Idaho at the Idaho National Lab. Most people think of nuclear when they think of Idaho, but there have also been substantial investments made at INL to test electric vehicle batteries and to develop feedstocks for biomass. Can you please tell me what you plan to do to better leverage these investments at INL and at other national laboratories?

Dr. Kelly. The Office of Energy Efficiency and Renewable Energy (EERE) recognizes the core capabilities of our national laboratories, and has established an RD&D portfolio that integrates these capabilities with academic and industry efforts to develop and demonstrate technologies for achieving DOE strategic goals. Two examples of EERE working with national labs include RD&D for biomass feedstocks and electric vehicle batteries.

Biomass Feedstocks:

INL is heavily incorporated into the Bioenergy Technologies Office in several important ways. INL is providing core capabilities for feedstock logistics, including applied and fundamental research, which is essential to developing the pipeline needed for program advancements. INL has developed a feedstock resource library which provides feedstock quality information and is working closely with other national laboratories to develop comprehensive design cases and states of technology under analytical efforts working with other DOE national laboratories. INL now has a Biomass Feedstock Process Demonstration Unit (PDU) which can prepare and evaluate feedstocks that can be utilized by PDUs at other conversion-focused national laboratories. Working in tandem, the national laboratories can provide the Bioenergy Technologies Office protocols to develop, test, and produce bioenergy fuels in an interactive process at a scale larger than bench scale (nominally one dry ton per day).

DOE-EERE has made significant investments in biomass feedstock capabilities and infrastructure at INL, including applied and fundamental

research, which is essential to developing the pipeline needed for meeting program objectives. The biomass feedstock Process Demonstration Unit (PDU) built and operated by INL provides state-of-the art capability and user access to biomass feedstock development equipment and capabilities. Further, the Biomass Library at INL provides unprecedented access to fully characterized reference biomass samples and feedstock quality information for broad support of biofuel conversion development. These capabilities are leveraged through collaborations and compliment a number of our other national laboratory facilities and capabilities in biomass resources assessment, analysis, and conversion technology development. The Funding Opportunity Announcement on feedstock logistics recently issued from the Biomass Technologies Office also encouraged participants to leverage these investments at INL.

Vehicle Batteries:

In support of the EV Everywhere Grand Challenge to enable affordable plug-in electric drive vehicles within 10 years, DOE-EERE has invested in a significant expansion of the INL Battery Testing Center facilities associated with the new INL Energy Systems Laboratory. EERE relies on this industry-recognized state-of-the-art capability to support its work in the areas of battery cell and system testing, test and analysis procedures, and advanced diagnostic testing capabilities for performance and life characterization. The INL Battery Testing Center provides valuable testing and analysis expertise to accurately characterize and validate the performance and life of emerging energy storage materials under development and validate the performance of DOE projects against technical performance goals. INL capabilities are leveraged through collaborations and compliment the efforts of a number of other national laboratory facilities, including: materials, fabrication, testing, and diagnostic capabilities at Argonne National Laboratory (ANL); facilities for abuse testing at Sandia National Laboratory (SNL); and facilities for system thermal characterization at the National Renewable Energy Laboratory (NREL).

Additionally, in support of DOE's goal of petroleum reduction and energy security, INL leads the light-duty Advanced Vehicle Testing Activity (AVTA), which provides benchmarked field-based vehicle performance and system efficiency data, and performs detailed analysis to provide DOE-EERE, industry, and other stakeholders information regarding the effectiveness of advanced vehicle technologies. This effort is made possible

by INL's secure data management infrastructure established as part of its legacy as a nuclear facility. DOE-EERE plans to continue to leverage INL's expertise in the secure transmittal, storage, archival, analysis, and dissemination of vehicle data to validate and quantify the real-world petroleum reduction benefits of the advanced automotive technologies in our portfolio.

Mr. Simpson. The Department is planning to fund R&D centers in advanced manufacturing and an "electrical systems hub" - can you explain to us how our capabilities at the various National Labs will be best leveraged to make these a success?

Dr. Kelly. The national labs are encouraged to apply to future Funding Opportunity Announcements either as a lead organization or in partnership with other interested parties. Each application will be evaluated to determine if their technical approach, dedicated staff, and facilities meet DOE's goals established for future centers and merit selection for award.

QUESTION ADDRESSED TO EERE, FE, AND OE

Mr. Simpson. Every year the Department of Energy invests billions in research to discover new and innovative energy technologies, but this research is too stove-piped, meaning our nuclear, renewable and fossil energy programs don't collaborate and find innovative ways to improve our nation's energy systems, which should be DOE's primary mission. In Idaho we're actually doing a fair amount of research looking into how these different energy systems might be integrated to find greater efficiencies and benefits as opposed to our traditional approach to energy production, but I don't see the Department investing anything towards these new "hybrid" energy systems. Can you tell me what the Department is doing to advance research on integrating energy systems and would you support a defined program whose sole purpose is to research the benefits of integrating multiple energy systems?

Dr. Kelly, Secretary McConnell, and Secretary Hoffman. The Department fully recognizes that systems integration is extremely important for improving the efficiency and performance of energy technologies. Although DOE's energy technology offices are organized along specific lines -- nuclear, fossil, grid, and renewables/efficiency – the Department has recently been paying increasing attention to the question of system integration. For instance, the Office of Electricity Delivery and Energy Reliability (OE) and the Office of Energy Efficiency and Renewable Energy (EERE) have conducted several studies on the integration of variable renewable generation (wind and solar) into the existing power grid. The Office of Fossil Energy (FE) has studied hybrid fuel cell/gas turbine power generation configurations, which leverage complementary technical capabilities of these systems. And DOE is supporting the construction of the new Energy Systems Integration Facility (ESIF) at NREL, which will directly address topics such as power and thermal systems integration. However, because this topic is so important, the Department would be open to discussions on how to structure a defined program to research the integration of multiple energy systems.

QUESTION FOR CHARLES MCCONNELL, ACTING ASSISTANT SECRETARY FOR FE

Mr. Simpson. The Energy Policy Act of 2005 stated that unconventional fuels, including oil shale "are strategically important resources that should be developed to reduce the growing dependence of the United States on politically and economically unstable sources of foreign oil imports". The Department is responsible for implementing a portion of this law (Section 369(h)). However, in this budget, the budget line for Unconventional Fossil Technology was zeroed out. Can you tell me why this budget line has no funding support from the administration and how it proposes to implement the Energy Policy Act of 2005 without funds for unconventional fossil development?

Secretary McConnell. EPAct Section 369(h) required the Secretary of Energy to establish a task force on this topic, as well as meet other requirements. These requirements have been met.

Mr. Simpson. This budget proposes $45 million between EPA, USGS, and DOE to study the impacts of hydraulic "fracking" of shale gas. How is DOE going to ensure there is no duplication between agencies and what is DOE's responsibility in this initiative? How will the National Labs be involved with this effort?

Secretary McConnell. This will be a collaborative research program. The three agencies will create a Steering Committee to coordinate the agencies' activities for unconventional oil and gas research. The Steering Committee will provide leadership, coordinate the activities of the three participating agencies, and reach out to other relevant federal, state and local organizations. . Each agency will bring their own core competencies to the research efforts. DOE will focus on its core technical and scientific competencies.

TUESDAY, MARCH 20, 2012.

OFFICE OF SCIENCE, U.S. DEPARTMENT OF ENERGY

WITNESS

WILLIAM F. BRINKMAN, UNDER SECRETARY FOR SCIENCE (ACTING), DEPARTMENT OF ENERGY, OFFICE OF SCIENCE

Mr. FRELINGHUYSEN. Good afternoon, everybody. The ranking and I want to apologize for the late start of the meeting. We had a vote and we may be interrupted by some further votes during the hearing process, but we want to acknowledge the fact that all of you were here on time even if we were absent.

We have before us today Dr. Bill Brinkman, Director of the Office of Science, to discuss the Department's Fiscal Year 2013 request. Dr. Brinkman, welcome once again to our subcommittee.

Dr. Brinkman, although most of our constituents may not be aware that the Department of Energy is one of the major government supporters of basic science, we are all well aware, acutely aware of the importance of your mission. The scientists and technicians under your direction are responsible for world leading advances in technology, science, and intellectual property, and I thank you and all your colleagues for their important work.

Last year our Subcommittee fought hard, given the limited funds we had available, to ensure that your office was fully supported. The final act provided $4.9 billion, a $46 million increase, no small change when every dollar is carefully allocated among competing priorities. That $4.9 billion, however, was $500 million below the President's request last year. I know the request was based on a desire to double funding for basic science research across the government, but that plan was simply not achievable under current budget restraints.

Your Fiscal Year 2013 budget request seems to begin to recognize this reality. At $5 billion, it is a $103 million increase over last year, and you make some hard choices within that request. We likely will not agree with every choice you have made, and we will be exploring these during our discussions today, but we appreciate that you are now making them.

Unfortunately, even though your budget request is more reasonable, it still includes investments which were only supportable under the doubling path, not under a more realistic flat-funding outlook. We need to understand how the administration is going to shift its longer-term planning, which is why in the conference agreement last year we directed you to provide the committee with a flat budget scenario by February 10th. This report has not been submitted, and you can be sure we will ask why.

Dr. Brinkman, 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 4 weeks from the time you receive them. Members who have additional questions for the record will have until the close of business tomorrow to provide them to the subcommittee office.

[The information follows:]

OPENING STATEMENT

The Honorable Rodney Frelinghuysen

Chairman

Energy and Water Development Subcommittee

House Committee on Appropriations

Office of Science

Fiscal Year 2013 Budget Request

March 20, 2012

Good morning, everyone. I'd like to call this hearing to order. We have before us today Dr. Bill Brinkman, Director of the Office of Science, to discuss the Department's fiscal year 2013 request. Dr. Brinkman, welcome to the subcommittee.

Dr. Brinkman, although most of our constituents may not be aware that the Department of Energy is one of the major governmental supporters of basic science, I'm well aware of the importance of your work. The scientists and technicians under your direction are responsible for world-leading advances in technology, science, and intellectual property, and I thank you and all of them for your work.

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At this point, I'll turn to Mr. Visclosky for any comments he may have.

Mr. FRELINGHUYSEN. At this point I will turn to my ranking member, Mr. Visclosky, for any comments he may have.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Sorry for being here late. Dr. Brinkman, welcome.

The Secretary of Energy, Dr. Chu, has said that he regards his two principal challenges to be energy independence and climate change. In the long term I believe that much of the inspiration to overcome both of these challenges will come from the Office of Science. I appreciate that the administration continues its support for basic science by requesting a 2 percent increase in the Department's budget, this is not the boost in funding that many advocates had hoped for; yet in a constrained fiscal environment it is significant.

In many areas of science and technology, American researchers arguably remain 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 certain areas we have fallen behind. Given the constrained environment we face, it is particularly important that we strategically plan each program to ensure that we are proceeding in a deliberate and thoughtful manner, increasing or maintaining our lead in areas where we can, and limiting our investment where we cannot.

U.S. leadership in many areas of science and technology depends in part on the continued availability of the most advanced scientific facilities. However, I remain very concerned that many of the infrastructure plans of the Department were developed with a far more optimistic funding profile than the current reality will support. We have also ensured that any redundancy is eliminated in order to maximize the scientific and technological advances within tight fiscal constraints. It is an issue I am very concerned about. I hope to hear from you today how the Office of Science has begun to reevaluate the strategic plans of major program areas.

While the committee has been supportive of the Office of Science and other related programs, such as ARPA–E, we also continue to have concerns regarding the duplication and interaction of several recent organizational initiatives. The Energy Innovation Hubs, ARPA–E, and the Energy Frontier Research Centers are just a few examples. While the subcommittee will examine the performance of ARPA–E separately, the justification for this program in part was that different organizational models were necessary because the Department's existing programs were not sufficient agents for transformational or disruptive technological advances.

While I appreciate that some of the early reviews of these new models have been positive, I would like to hear what you and the Office of Science are doing to ensure that this new culture is, in fact, being integrated into other science programs.

With that, Mr. Chairman, I would yield back my time.

Mr. FRELINGHUYSEN. Thank you very much, Mr. Visclosky.

[The information follows:]

Visclosky Opening Statement at Hearing on FY13 Budget for Office of Science

March 20th, 2012

Subcommittee Ranking Member Rep. Peter Visclosky

Good afternoon, Dr. Brinkman. It is good to have you here today.

The Secretary of Energy, Dr. Chu, has said that he regards his two principal challenges to be energy independence and climate change. In the long term, I believe that much of the inspiration to overcome both of these challenges will come from the Office of Science.

I appreciate that the Administration continues its support for basic science by requesting a two percent increase from FY 2012 for the Department of Energy's Science program. This is not the boost in funding that many advocates had hoped for, yet in our constrained fiscal environment it is significant.

In many areas of science and technology, American researchers arguably remain 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 certain areas we have clearly fallen behind. Given the constrained fiscal environment, it is particularly important that we strategically plan each major program area to ensure we are proceeding in a deliberate and thoughtful manner, increasing or maintaining our lead in the areas where we can and limiting our investment where we cannot.

U.S. leadership in many areas of science and technology depends, in part, on the continued availability of the most advanced scientific facilities for our researchers. However, I remain concerned that many of the infrastructure plans of the Department were developed with a far more optimistic funding profile than the current reality will support. We must also ensure that any redundancy is eliminated, in order to maximize the scientific and technological advances within tight fiscal constraints. I hope to hear from you today how the Office of Science has begun to reevaluate the strategic plans of major program areas.

While this Committee has been supportive of the Office of Science and other related programs, such as ARPA-E, we continue to have concerns regarding the duplication and interaction of several recent organizational initiatives; the Energy

Innovation Hubs, ARPA-E, and the Energy Frontier Research Centers are just a few examples. While the Subcommittee will examine the performance of ARPA-E separately, the justification for this program, in part, was that different organizational models were necessary because the Department's existing programs were not sufficiently effective agents of "transformational" or "disruptive" technological advancements. While I appreciate that some of the early reviews of these new models have been positive, I would like to hear what you are doing to ensure that this "new" culture is being integrated into the other Science programs.

Additionally, I will be interested in hearing your perspective on where we should be investing in science and how it fits into the Administration's "all-of-the-above strategy for the 21st century that develops every source of American-made energy."

Thank you, Mr. Chairman for the time.

Mr. FRELINGHUYSEN. Dr. Brinkman, the floor is yours.

Mr. BRINKMAN. Thank you very much, Chairman Frelinghuysen and Ranking Member Visclosky and members of the committee. I am pleased to come before you today——

Mr. FRELINGHUYSEN. You may need to move that mic a little closer to make sure we can hear you.

Mr. BRINKMAN. Is it on?

Mr. FRELINGHUYSEN. It is on.

Mr. BRINKMAN. Okay. I want to thank the committee for its continuing strong support for our office. Even in this challenging fiscal environment, the Office of Science is the largest source of funding of basic physical sciences in the United States, and the research facilities funded by the office are critical to enhancing U.S. competitiveness and maintaining U.S. leadership in science and technology.

In his State of the Union address, President Obama emphasized the importance of basic research and urged Congress to support the same kind of research and innovation that led to the computer chip and the Internet, to American jobs, and to American industries.

The President's fiscal year 2013 budget request for the Office of Science is $5 billion, representing a 2.4 percent increase from 2012. Within the President's request for the overall flat discretionary funding, this increase to the Office of Science demonstrates the President's commitment to basic science, which is vital to producing the discovery and innovation that will strengthen our competitiveness and economic leadership.

The Office of Science is doing its part to ensure that the United States is a global leader in clean energy science and technology. Our three Bioenergy Research Centers are taking complementary paths toward producing next-generation biofuels. We support 46 Energy Frontier Research Centers across the country, which conduct research in an array of material science and engineering issues related to the solving of various energy problems.

The Fuels from Sunlight Hub is ramping up operations while already producing scientific output and publications. I would like to thank the committee for its support of the second Energy Innovation Hub on batteries and electrical storage, which will accelerate development of energy storage solutions for both transportation and grid sectors. The Basic Energy Science program is on schedule to make a selection for that hub by the end of the summer.

The ten national laboratories in the Office of Science routinely produce cutting-edge science and technology and operate a set of user facilities that are the envy of the world. We have created the world's first x-ray laser which unlocks new areas of research in multiple fields. Our synchrotron light sources regularly make key contributions to our understanding of protein structure and materials, our scientific computing facilities enable ground-breaking research and development to produce exascale computing, and we will deliver a strategic plan on exascale to you soon.

In the biological and environmental research division, the Environmental Molecular Sciences Laboratory integrates computational and experimental capabilities as well as fosters collaboration among disciplines to characterize biological organisms and molecules. The Atmospheric Radiation Measurement facility, or ARM

as it is called, makes critical measurements of clouds and aerosols to aid in our understanding of the atmosphere and climate. There are many examples of industry making use of these facilities, and we have illustrated this, a few of these in the handouts here.

While the President's budget prioritizes clean energy research, we continue to be the primary funding agency for an array of basic sciences. That has meant making difficult choices and trade-offs in several program areas while focusing on areas where we can make the strongest impact. High Energy Physics continues its transition into the intensity frontier and will deliver a report on the scientific opportunities in the intensity frontier later this year.

This month our Daya Bay experiment, in collaboration with China, measured one of the important characteristics of neutrinos, the ubiquitous particle that is so poorly understood. We continue to participate in the Large Hadron Collider and the search for the Higgs particle now appears to be bearing fruit.

Despite a challenging budget environment for nuclear physics, the President's request includes $22 million for the Facility for Rare Isotopes Beam at Michigan State University and will allow the project to move forward. In Fusion Energy Sciences the administration is committed to the ITER project, an international fusion experiment involving six nations and the European Union, and the culmination of decades of research in fusion. ITER will produce the world's first burning plasma, producing net energy from sustained thermonuclear reactions. I want to emphasize that although U.S. contributions to ITER call for us to build and deliver hardware to the project in France, 80 percent of the ITER funding is spent in the United States, and if you include the support of American scientists working overseas in France, that number rises to 90 percent. Although the focus of critical energy research in the President's 2013 budget has resulted in difficult decisions across the Office of Science, these decisions were made with extreme care, and the resulting trade-offs remain robust, maintain robust research programs in high-impact areas in both use-inspired and discovery science.

I look forward to working with you, Mr. Chairman, and the rest of the committee on the Office of Science budget request. Thank you.

Mr. FRELINGHUYSEN. Thank you, Dr. Brinkman.

[The information follows:]

Statement of Director of the Office of Science, William F. Brinkman

U.S. Department of Energy

Subcommittee on Energy & Water Appropriations

U.S. House of Representatives

FY 2013 Budget Hearing

March 20, 2012

Introduction

Thank you, Chairman Frelinghuysen, Ranking Member Visclosky, and members of the committee. I am pleased to come before you today to present the President's Fiscal Year 2013 budget request for the Office of Science at the Department of Energy. I want to thank the committee for its strong support for the Office of the Science, even in this challenging fiscal environment. The Office of Science is the largest source of funding for basic physical science in the United States, and the research and facilities funded by the Office of Science are critical to enhancing U.S. competitiveness and maintaining U.S. leadership in science and technology.

In his State of the Union address in January, President Obama emphasized the importance of basic research and urged Congress to "support the same kind of research and innovation that led to the computer chip and the Internet; to new American jobs and new American industries." The President's FY 2013 budget request for the Office of Science is $5.0 billion, representing an increase of 2.4% over the FY 2012 appropriation. Within the President's request for overall flat discretionary funding, this increase in the Office of Science demonstrates the President's commitment to research and basic science, which is vital to producing the discovery and innovation that will strengthen our competiveness and our scientific leadership.

The Office of Science is doing its part to ensure that the United States is the global leader in clean energy science and technology. Our three Biofuel Research Centers have taken different and complementary paths toward producing the next generation of biofuels. The results speak for themselves: engineering a strain of bacteria that could produce drop-in fuel replacements, developing new crops that are more easily convertible into fuels, and conducting research into sustainable biofuel agricultural practices. Each biofuel center underwent an intense peer review process in November and December of last year, and all received extremely positive scores and comments at the end of this process.

We support 46 Energy Frontier Research Centers (EFRC) across the country, which conduct research into a wide array of materials science and engineering issues related to solving various energy problems. For example, a DOE-funded EFRC has synthesized silicon nanowire solar cells that are able to convert 90% of the photons they absorb into electrons. The cell contains only 2% silicon, and remaining 98% is polymer, reducing the potential cost of solar cells. This is the kind of breakthrough technology we are looking for that can be picked up by industry through ARPA-E

or the applied energy programs. We continue to rigorously evaluate each EFRC's performance and scientific output as renewal decisions on the EFRCs will be made in FY 2014.

Our first Energy Innovation Hub, the Fuels from Sunlight Hub, is ramping up operations: hiring staff and acquiring space while already producing scientific output and publications. This hub will work on directly converting sunlight to fuels, such as developing new, more efficient methods of directly using sunlight to produce hydrogen from water.

I would like to thank the committee for its support of the Office of Science's second Energy Innovation Hub, on Batteries and Energy Storage and was funded by the FY 2012 Appropriations Bill. We anticipate a vigorous competition, and the Basic Energy Sciences (BES) program aims to make a selection decision by the end of the summer.

The 10 national laboratories in the Office of Science routinely produce cutting edge science and technology and have a set of user facilities that have benefited U.S. industry. These facilities, our synchrotrons, high performance computers, nanoscience centers and our neutron scattering centers, offer opportunities for even stronger interactions with industry; and we are looking at ways to enhance this activity. There are many examples of industry making use of our facilities, and we have illustrated a few of these in the handouts here.

Our scientific user facilities continue to be the envy of the world. We have demonstrated an x-ray laser for the first time and have made considerable improvements in its performance already. Our synchrotron light sources regularly make key contributions to our understanding of protein structure and materials. Protein crystallography at the Advanced Photon Source has enabled a potential new drug to combat Alzheimer's disease. Our scientific computing facilities enable groundbreaking science including the simulation of the large scale structure of the universe and the design of more fuel efficient car and jet engines. We continue to support research and development to achieve exascale computing, and will deliver a strategic plan on exascale to you soon.

In the Biological and Environmental Research program, the Environmental Molecular Sciences Laboratory integrates computational and experimental capabilities as well as fosters collaboration among disciplines to characterize biological organisms and molecules. The Atmospheric Radiation Measurement facilities, or ARMs, make critical measurements that inform our understanding of the atmosphere and the earth's climate.

While the President's budget has rightfully prioritized research toward clean energy and the environment, we also continue to be the primary funding agency for an array of basic physical sciences that the Office of Science has long supported. The FY 2013 Budget submission reflects a careful prioritization process across several program areas to ensure effective and efficient allocation of resources.

In the High Energy Physics program, operations at the Tevatron collider at Fermilab were completed last fall. In addition, the High Energy Physics (HEP) recently held a workshop to explore domestic opportunities for experiments at the Intensity Frontier. Also, note that we recently measured one of the important characteristics of neutrinos at the Daya Bay experiment. HEP continues to contribute to the energy frontier with experiments at the Large Hadron Collider and the search for the Higgs Boson. In the Cosmic Frontier, Saul Perlmutter's work toward the

discovery of the accelerating universe is the latest Office of Science research to be honored with a Nobel Prize – and HEP continues to support research and experiments to reveal the nature of dark energy.

Nuclear Physics budget continues to support the development of next generation facilities. Even in these tight budget times, the President made the Facility for Rare Isotope Beams (FRIB) a priority for funding and has requested $22 million in FY 2013 to keep the project moving forward. The Administration is hopeful that Congress will fund FRIB this year. The FY 2013 budget also continues to support the 12 GeV upgrade to the Continuous Electron Beam Accelerator Facility at Thomas Jefferson National Laboratory.

In Fusion Energy Sciences, the budget includes support for the ITER project, an international fusion experiment involving six nations and the European Union. The U.S. remains committed to the scientific mission of ITER, while maintaining a balanced research portfolio, and will work with ITER partners to accomplish this goal. ITER aims to produce the world's first "burning plasma," which will result in net energy production from sustained thermonuclear reactions. This is the culmination of decades of research in fusion.

I want to emphasize that eighty percent of our ITER funding is spent in the United States, with U.S. designed and constructed components sent to the project site located in France. If you include the support of American scientists working overseas, that share of ITER funds used to support American workers rises to ninety percent. ITER will engage U.S. industry and our national labs in design and construction work for the project. In order to support an increase in ITER funding, we had to make several difficult decisions in the rest of the U.S. fusion program, including an early closure of the Alcator C-Mod tokamak at MIT. Even so the proposed budget for FY13 is not sufficient to keep the project on track and we are discussing with our partners how we might mitigate its effects.

The difficult decisions in Fusion and other areas were not made lightly, and reflect the choices necessary to ensure a strong American infrastructure for innovation. I look forward to working with you, Mr. Chairman, and the rest of the Committee to fully fund the Office of Science budget request. The material that follows will explain, in greater detail, the scientific program that will be supported by this budget request.

Research toward a Clean Energy Future

President Obama noted in his State of the Union address in January, "Nowhere is the promise of innovation greater than in American-made energy." The Office of Science is committed to advancing our scientific understanding of biosystems, advanced materials, and modeling and simulation to enable next-generation energy technologies that will move us away from fossil fuels toward cleaner, more advanced, and more efficient sources of energy.

The Office of Science believes there are several themes upon which we should build our research program to address barriers to new energy technologies.

- **Materials and chemistry by design.** Building on past success in modeling materials, we aim to simulate and possibly even create custom nanoscale and mesoscale structures for scientific advances and manufacturing innovations in solar energy conversion; clean-energy electricity generation; battery and vehicle transportation; and carbon capture, use, and sequestration.
- **Biosystems by design.** Using accumulated knowledge of biology, genetics, sequencing, and microbes, we can now target the development of synthetic biology tools and technologies and integrative analysis of experimental genomic science datasets to design and construct improved biofuels and bioproducts.
- **Modeling and simulation**. Our Leadership Computing Facilities and production computing facilities advance materials and chemistry by design and broadly address energy technology challenges. This continues a long standing practice of the Office of Science to provide the scientific community access to supercomputing expertise and equipment.

The Office of Science's clean energy research builds upon decades of core program funding in BES and the Biological and Environmental Research (BER) program. The rapid deployment and success of the EFRCs and BRCs are directly attributable to the historic strength of their core science program that produced a powerful knowledge base which enables DOE-funded scientists to tackle today's clean energy challenges.

Energy Frontier Research Centers

The EFRCs bring together the skills and talents of a team of investigators to perform energy-relevant, basic research with a scope and complexity beyond that found in standard single-investigator or small-group awards. To help ensure their success, BES provides proactive oversight through regular and frequent interactions with the EFRCs, including meetings with the EFRC Directors as a group, monthly teleconferences, and formal reviews, highlighted by an early management peer review in 2010 and the ongoing mid-term scientific peer reviews in FY 2012. In May 2011, BES brought the EFRC researchers together for a major research meeting,

the Energy Frontier Research Centers Summit and Forum, to share progress and build collaborations To ensure communication of scientific research advances, technology needs, and program directions (to avoid duplication), management of the EFRC research includes coordination with other BES research activities and with the DOE technology offices.

Individual EFRCs perform a wide breadth of research in materials science and engineering that are focused on the design, discovery, synthesis, and characterization of novel, solid-state materials that improve the conversion of solar energy and heat into electricity and fuels; improving the conversion of electricity to light; improving electrical energy storage; enhancing materials resistance to corrosion, decay, or failure in extreme conditions of temperature, pressure, radiation, or chemical exposures; taking advantage of emergent phenomena, such as superconductivity, to improve energy transmission; optimizing energy flow to improve energy efficiency; and tailoring materials and processes at the atomic level to maximize catalytic activity. Efforts to bridge disciplines, generate new avenues of inquiry, and accelerate research within the broader community include periodic all-hands meetings, joint symposia and workshops, summer schools, tool development, and principal investigator meetings.

As an example of the innovative research occurring in the EFRCs, Professor Harry Atwater at the California Institute of Technology and his coworkers at the Light-Material Interactions for Energy Conversion EFRC have grown new crystalline silicon nanowires that can be used to make solar cells that convert 90% of the photons they absorb into electrons. Each cell is only 2% silicon, and remaining 98% is polymer, reducing the potential cost of solar cells that could be made from them, possibly manufactured in a roll-to-roll process.

Energy Innovation Hubs

Energy Innovation Hubs are composed of a large, multidisciplinary team of investigators whose research integrates basic to applied research and focuses on a single critical national energy need. They are funded as five-year, potentially renewable projects.

The Batteries and Energy Storage Hub will focus on understanding the fundamental performance limitations of electrochemical energy storage to enable the next generation of electrochemical energy storage technologies. Advanced energy storage solutions have become increasingly critical to the Nation with the expanded deployment of renewable energy sources coupled with growth in the numbers of hybrid and electric vehicles. For the electrical grid, new approaches to electrochemical energy storage can enable inherently intermittent renewable energy sources to meet continuous electricity demand. For vehicles, new batteries with improved lifetimes and storage capacities are needed to expand the range of electric vehicles for a single charge while simultaneously decreasing the manufacturing cost and weight. Today's electrical energy storage approaches suffer from limited energy and power capacities, lower-than-desired rates of charge and discharge, cycle life limitations, low abuse tolerance, high cost, and poor performance at high or low temperatures.

The Batteries and Energy Storage Hub will accelerate the development of energy storage solutions that are well beyond current capabilities and approach theoretical limits. This development will be enabled by cross-disciplinary R&D focused on the barriers to transforming electrochemical energy storage, including the exploration of new materials, devices, systems,

and novel approaches for transportation and utility-scale storage. Outside of the Hub, battery research is typically focused on one particular problem or research challenge and thus lacks the resources and the diverse breadth of talent to consider holistic solutions. The Hub will provide an integrated team directed at research to overcome the current technical limits for electrochemical energy storage, bring them to the point where the risk level will be low enough for industry to further develop the innovations discovered by the Hub, and deploy these new technologies into the marketplace.

The Hub's goal is to deliver revolutionary research that will result in new technologies and approaches, rather than to focus on a single technology or on incremental improvements to current technologies. The Hub's ultimate technological impact should go well beyond current research and development activities. While advancing the current understanding of the science that underpins energy storage, the Hub will include the development of working bench-top prototype devices that demonstrate radically new approaches for electrochemical storage and are scalable. These should have the potential to be produced at low manufacturing cost from earth-abundant materials and possess greatly improved properties compared to present commercially available energy storage technologies.

Established in September 2010, the Fuels from Sunlight Hub is designed to bring together a multi-disciplinary, multi-investigator, multi-institutional team to create transformative advances in the development of artificial photosynthetic systems that convert sunlight, water, and carbon dioxide into a range of commercially useful fuels. This Hub, the Joint Center for Artificial Photosynthesis (JCAP), is led by the California Institute of Technology (Caltech) in primary partnership with Lawrence Berkeley National Laboratory. Partners include the SLAC National Accelerator Laboratory and several University of California institutions.

JCAP is composed of internationally-renowned scientists and engineers that seek to integrate decades of community effort in light harvesting and conversion, homogeneous and heterogeneous catalysis, interfacing, membrane and mesoscale assembly, and computational modeling and simulation, with more current research efforts using powerful new tools to examine, understand, and manipulate matter at the nanoscale. By studying the science of scale-up and benchmarking both components (catalysts) and systems (device prototypes), JCAP seeks to accelerate the transition from laboratory discovery to industrial use. As there is currently no direct solar-to-fuels industry in the world, JCAP has the potential for profound environmental and economic impact—establishing U.S. global leadership in renewable energy, reducing our dependence on imported oil, decreasing greenhouse gas emissions, and providing new jobs in an emerging energy technology.

Recently, JCAP scientists developed a new solution to the problem of creating hydrogen directly from sunlight. One challenge in producing hydrogen from water in this manner is the creation of gas bubbles in the water. So, JCAP created a proton exchange membrane (PEM) electrolyzer that generates hydrogen and oxygen from water vapor instead of liquid water. Since water vapor is already a gas, this eliminates the problem of bubble formation in the liquid. The fundamental insights gained from this discovery may lead to an entirely new approach to photoelectrolysis that, in turn, could alter the strategy for building a commercially viable solar-fuels generation system.

Bioenergy Research Centers

The three Bioenergy Research Centers (BRCs) have achieved significant research progress and have received overwhelmingly positive annual evaluations from teams of outside peer reviewers. In four years of operations, BRC researchers have produced 741 peer-reviewed publications and 293 patent disclosures or applications.

There have been several important research achievements, among many other developments, at the BRCs. The Joint BioEnergy Institute (JBEI), at Lawrence Berkeley National Lab, engineered the bacterium E. coli to produce hydrocarbon fuels directly from switchgrass, allowing for the production of "green" gasoline, diesel, and a chemical precursor to jet fuel. At the BioEnergy Science Center at Oak Ridge National Lab, they developed a new genetic strain of switchgrass that increases fuel yields with greatly reduced enzyme loads. The Great Lakes Bioenergy Research Center in Wisconsin produced a key study showing that perennial biofuel crops such as switchgrass can be sustainably grown on Conservation Reserve Program lands while reducing net carbon dioxide emissions.

As BRC researchers move to develop techniques to help scale-up conversion technologies, they will be able to make use of the newly constructed Advanced Biofuels Process Demonstration Unit at Lawrence Berkeley National Laboratory supported by DOE's Office of Energy Efficiency and Renewable Energy.

Multiple centers were necessary to tackle this extremely broad and diverse set of scientific challenges. In supporting three BRCs, the Department sought to bring maximum scientific resources to bear on this national priority. Over time, the three BRCs have come to occupy complementary areas and, through a combination of cooperation and competition, have accelerated the pace of discovery.

In November and December of 2011, BER conducted on-site reviews that evaluated the renewal proposals from each BRC. They were each evaluated by separate external peer review panels of seven to nine reviewers, with one reviewer serving on all three panels. The renewal review teams provided strongly favorable appraisals of the performance of all three BRCs, and were impressed with the productivity and progress of all the centers to date. The review teams strongly recommend renewal of all three BRCs, and BER has accepted that recommendation. The Office of Science proposes renewing all three BRCs in the FY 2013 budget, subject to continued progress and funding.

Investments in Foundational Science

The United States today has significant needs in developing clean energy, and the Office of Science will play a significant role in developing new sources of energy. In addition, this budget request continues our strong commitment to foundational, basic research for innovation and discovery in condensed matter and material physics, chemistry, biology, climate and environmental sciences, applied mathematics, computational and computer science, high energy physics, nuclear physics, plasma physics, and fusion energy sciences. The Office of Science supports over 25,000 investigators from more than 300 academic institutions and all of the DOE laboratories.

Core research funding in the Basic Energy Sciences program is directed to new research efforts to design materials with targeted properties and tailored chemical processes through theory, computation, and modeling, as validated by precise experimental characterization. Discovery of new materials and chemical assemblies with new properties and accurate predictions of their interactions with the environment are crucial to advances in energy technologies, as well as to virtually all industries that use materials in their products and manufacturing. The ultimate goal is to provide the nation with a science-based computational tool set to rationally predict and design materials and chemical processes to gain a global competitive edge in scientific discovery and innovation.

As a direct result of DOE investments over the past decade, the U.S. currently holds clear leadership in high performance computational science and engineering. To continue U.S. leadership in this area, we must address two significant challenges: advancing the Department's science and engineering missions by effectively utilizing our existing hardware and software and supporting research to extend these capabilities and take on even more complex challenges. In the course of our regular assessment of the needs of the scientific community, it is clear that in several areas DOE's simulation and data analysis needs exceed petascale capabilities. This is driving the Office of Science towards exascale computing.

However, there are several critical technology challenges on the path to exascale. There are three critical research challenges that must be overcome in order to achieve exascale computing: reducing power consumption; enabling users to fully utilize an extremely parallel system containing billions of processors; and improving the system's fault tolerance. Hardware R&D efforts in FY 2013 will be focused on early-stage research aimed at reducing the technical risk of some of the most critical technologies necessary for exascale.

In addition, new algorithms will be required that optimize management of data movement. The FY 2013 budget request increases investments across the research portfolio with a focus on the challenges that link data-intensive science and high performance computing, including exascale. These investments will reach across hardware and applications. They will advance critical technologies, mathematical methods, software, tools, middleware, and science applications.

Climate and Environmental Systems research is enhanced by a new focus on increasing the resolution of climate models as well as validation and verification. The funding continues support for the Arctic Next Generation Ecosystem Experiment to improve the representation of the major carbon sinks associated with changes in Arctic permafrost ecosystems in Earth system and regional climate models. In addition, a Next Generation Ecosystem Experiment will be initiated to address poorly understood ecosystem processes that govern biogenic aerosol emissions to the atmosphere, focusing on one of the most climatically-sensitive tropical regions, the Amazon.

The Office of Science coordinates with other agencies that perform climate research through the U.S. Global Change Research Program (USGCRP). This program integrates and coordinates Federal research and applications to assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change. USGCRP recently developed a decadal strategic plan that was used to inform the development of the FY 2013 Budget request. The USGCRP also ensures coordination, avoids overlap and redundancy, and enables communication of each agency's unique resources to each other. The Office of

Science has unique capabilities such as our national labs, expertise in computing and modeling inter-comparison, and the Atmospheric Radiation Measurement (ARM) facility. These assets make DOE a vital contributor toward enhancing our scientific understanding of the earth's climate.

Stewardship of High Energy Physics, Nuclear Physics, and Fusion Science

The President's FY 2013 budget emphasizes use-inspired energy research and foundational research that will lead to new energy and manufacturing technologies for a competitive innovation economy. At the same time, the Budget continues to support research in the areas of high energy physics, nuclear physics, and fusion energy sciences. The Budget seeks to prioritize resources toward research aimed at our most pressing challenges, while maintaining our unique role as national stewards of these research areas.

Fusion Energy Sciences

The Fusion Energy Sciences program request reflects the continued U.S. commitment to the scientific mission of ITER, while maintaining a balanced research portfolio across the program. The ITER experiment aims to produce the world's first "burning plasma," in which thermonuclear reactions will produce net energy for the first time (with a projected amplification factor of ten).

The funding increase of $45 million for the U.S. contributions to the ITER Project bring the FY 2013 request to $150 million and will enable the U.S. to make long-lead procurements as the project enters its construction period. Eighty percent of U.S. ITER funding is spent in the United States. The majority of our ITER obligations are "in-kind," with components designed and built in the U.S. before being shipped to France for final assembly into the ITER apparatus.

The continued long-term success of the U.S. fusion science efforts also depends on maintaining a healthy domestic fusion program. The FY 2013 budget seeks to balance these competing priorities in the context of constrained budgets. Domestic research in most areas is reduced, while program balance is retained. The FY 2013 budget request ceases operations at the Alcator C-Mod tokamak facility at the Massachusetts Institute of Technology. Remaining investments still enable support for a broad program in fusion and plasma science research that will be highly impactful and maintain a vibrant U.S. workforce through, among other means, international partnerships.

Nuclear Physics

The Nuclear Physics program is an important part of the Energy Department's overall scientific research and development program and the FY 2013 budget request supports a portfolio of facility construction and upgrades in addition to core research. This includes $22 million for the Facility for Rare Isotope Beams (FRIB) at Michigan State University (MSU), as well as support for the 12 GeV upgrade at the Continuous Electron Beam Accelerator Facility at Thomas Jefferson National Accelerator Facility. The Office of Science request for FRIB reflects the priority the President places on this very important and worthy project, even in these tight budget times. The proposed funding will keep the project moving forward and allow MSU to continue

engineering and planning work. These funds will keep the project moving forward and allow MSU to continue the work necessary to reach critical project milestones.

High Energy Physics

The proposed FY 2013 budget maintains our commitment to support transformational research at all three frontiers of high energy physics. At the Energy Frontier, powerful particle accelerators are used to create new particles, reveal their interactions, and investigate fundamental forces. High priority efforts in FY 2013 include the analysis of legacy Tevatron data and continued support for U.S. participation in research at the Large Hadron Collider at CERN, which includes the support of U.S. based researchers and data centers.

At the intensity frontier, researchers investigate fundamental forces and particle interactions by studying events that rarely occur in nature. The U.S. is uniquely positioned to make advances at the Intensity Frontier. The Office of Science held the *Fundamental Physics at the Intensity Frontier* workshop in December 2011. The workshop identified a number of compelling research questions at the Intensity Frontier that would significantly add to our understanding of the fundamental questions of spaee, time, energy, and matter.

The FY 2013 budget continues support for Intensity Frontier neutrino research and the planned Muon to Electron Conversion Experiment at Fermilab. It also supports minimal sustaining de-watering efforts at the Homestake Mine in South Dakota.

Earlier this month, the Daya Bay Reactor Neutrino Experiment—a multinational collaboration operating in China and led, on the U.S. side, by the Office of Science—recorded and analyzed the largest set of neutrino reactor data ever collected. The analysis provided unprecedented understanding of the nature of neutrinos and could help explain why the universe is composed mostly of matter rather than anti-matter. Still under construction, the Daya Bay experiment is already the most sensitive experiment in the world for this type of physics and promises to reveal many more insights into the fundamental nature of our Universe.

At the Cosmic Frontier, measurements are made to reveal new insights and information about the nature of dark matter and dark energy to understand fundamental particle properties and discover new phenomena. Saul Perlmutter, Professor of Physics at the University of California, Berkeley, and senior scientist at Lawrence Berkeley National Laboratory, was awarded the 2011 Nobel Prize in Physics, which he shared with Adam G. Riess of Johns Hopkins University and Brian Schmidt of the Australian National University's Mount Stromlo and Siding Spring Observatories. Perlmutter led the Supernova Cosmology Project that, in 1998, was one of the teams that discovered that galaxies are receding from one another faster now than they were billions of years ago—a phenomenon thought to be driven by dark energy. The FY 2013 budget request builds on these successes with a ramp up for engineering and design efforts for the camera of the Large Synoptic Survey Telescope—a National Science Foundation (NSF) project that aims to chart objects in the sky that change or move and trace billions of remote galaxies, providing multiple probes of the mysterious dark matter and dark energy..

Cosmic Frontier experiments may be getting closer to identifying the long-sought dark matter through the observation of high-energy particles. The Fermi Large Area Telescope (LAT), a joint NASA-DOE project assembled at SLAC, observes high-energy electrons, positrons & gamma

rays, and can distinguish positrons from electrons through clever use of the Earth's magnetic field. Recent Fermi-LAT measurements extend and confirm earlier intriguing observation of an excess of high-energy positrons that may be a signal for dark matter. Further studies are underway to improve the precision of this result.

The FY 2013 request also supports collaborations with the NSF on research and technology development and experiments designed to directly detect dark matter particles using ultra-sensitive detectors located underground.

Workforce Development
While our largest contribution to STEM education and training is through the support for undergraduates, graduate students, and postdocs included in competitive research grants at universities and DOE national laboratories; the Office of Science's Workforce Development for Teachers and Scientists (WDTS) program helps ensure that DOE and the Nation have a sustained pipeline of highly skilled and diverse science, technology, engineering, and mathematics (STEM) workers.

The FY 2013 request supports several targeted programs that include undergraduate research internships at the DOE laboratories and competitions such as the National Science Bowl.

The Importance of Scientific User Facilities

The Office of Science User Facilities provide the Nation's researchers with the most advanced tools of modern science including accelerators, colliders, supercomputers, light sources, and neutron sources, as well as facilities for studying the nanoworld, the environment, and the atmosphere. About 26,500 researchers from universities, national laboratories, industry, and international partners are expected to use the Office of Science scientific user facilities in FY 2013. Maintaining this domestic infrastructure is critical to the advancement of our innovation economy.

The new BES facilities that are currently under construction—the National Synchrotron Light Source-II (NSLS-II) and the Linac Coherent Light Source-II (LCLS-II)—continue the tradition of BES and the Office of Science providing the most advanced scientific user facilities for the Nation's research community in the most cost effective way. All BES construction projects are conceived and planned with the broad user community and, during construction, are executed on schedule and within cost.

In addition to providing unique facilities for conducting world-leading, breakthrough science, the light sources, neutron sources, electron imaging facilities, and nano-science centers supported by the Basic Energy Sciences program also support R&D at dozens of Fortune 500 companies. Companies in industries as diverse as pharmaceuticals and semi-conductors support their own beamlines at DOE facilities to conduct R&D leading to new products.

The Linac Coherent Light Source (LCLS) (the world's first x-ray free electron laser) provides capabilities that are revolutionizing our ability to image matter at the atomic scale. The intensity and ultrashort duration of LCLS x-ray pulses allow researchers to develop a new approach for determining the three dimensional structures of proteins. The laser's brilliant pulses of x-ray light pull structural data from tiny protein nanocrystals, avoiding the need to use large protein crystals

that can be difficult or impossible to prepare. This technique will accelerate the structural analysis of some proteins by several years and will allow scientists to decipher tens of thousands of other macromolecules that are out of reach today, including many involved in energy technologies and biopharmaceutical applications.

Much like the light sources in BES, the computational facilities and programming expertise in ASCR support a wide array of scientific research, as well as directly benefitting U.S. industry. Companies from a wide variety of industries, such as in wind energy and automobiles, have used ASCR facilities for simulation and modeling that lead to product improvement. In at least one case, this research prompted a company to purchase its own supercomputer.

This budget request continues support for upgrades and new facility planning and construction as well as operations at existing facilities. Priority investments include the Linac Coherent Light Source-II project to provide a second, independently controlled laser to the LCLS facility, the Advanced Photon Source Upgrade, and operations of planned 10 petaflop upgrades to the Leadership Computing Facilities at Argonne and Oak Ridge National Laboratories.

Program Direction

Throughout FY 2011, the Office of Science reduced expenses for travel, support services, and other related costs, and operated under a hiring freeze, resulting in sufficient carryover funding to sustain essential operations in the current fiscal year. The overall requested increase for FY 2013 will maintain essential research operations at the FY 2011 level with backfill hiring of essential positions, controlled retention strategies, and targeted recruitment efforts. Backfilled positions include scientific positions at headquarters for science program oversight, personnel to handle nuclear safety and other safety positions, and contract specialists to ensure efficient expenditure of funds.

Science Laboratories Infrastructure

Infrastructure modernization efforts are slowed somewhat due to budget constraints but still intact. The FY 2013 request supports two new project starts—the Utilities Upgrade project at Fermi National Accelerator Laboratory and the Utility Infrastructure Modernization project at Thomas Jefferson National Accelerator Facility. It also supports all four continuing line item construction projects.

Mr. FRELINGHUYSEN. We all know you are faced with making some tough trade-offs this year. With limited funds, your request almost unavoidably had to make some tough decisions by cutting funding from some programs that this Subcommittee has historically been very supportive of, but on top of that tough reality your request adds $92 million for new Basic Energy Science research. Why has the Department made it more difficult for a number of major programs, which we have supported, and made it more difficult for some of your existing laboratories and other facilities by proposing to add new initiatives when those programs are worthy of support on a historical basis, those types of adjustments?

Mr. BRINKMAN. I agree with you that those programs are worthy of support on a historical basis, but at the same time, the administration's high priority is clean energy, and we regard it as a very high priority to try to improve on our ability to make clean energy without CO_2, and the additions that we put to BES are designed to do that. They are focused exactly on that subject.

Mr. FRELINGHUYSEN. So you defend your decision for new spending, based on the administration's priorities?

Mr. BRINKMAN. Right. It is based on the administration's priorities, that is the way it was worked out. We believe that we want to support this idea, this program, towards directing of the Department to work on clean energy and to try every technique we can think of to push that forward because of the importance of the program, so we added——

Mr. FRELINGHUYSEN. So we are pushing some new initiatives forward, and what are we doing with the historical commitment? You mentioned some, you mentioned within nuclear physics the request delays by a year the start of the Facility for the Rare Isotope Beams facility in Michigan, cuts in half the operating time for the RHIC at Brookhaven.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. What does that mean to our overall mission and the direction we are going if we are putting those on the back burner here?

Mr. BRINKMAN. Clearly the budget for nuclear physics is not sufficient to keep everything going, and within the next year will we have to look at it very carefully and figure out what to do.

Mr. FRELINGHUYSEN. Well, why don't we look at it right now?

Mr. BRINKMAN. Well, we are.

Mr. FRELINGHUYSEN. But I mean there are some layoffs at the Fermilab in Illinois.

Mr. BRINKMAN. There will be some layoffs in Fermilab coming up this year.

Mr. FRELINGHUYSEN. Well, let me just focus, as you might anticipate, on fusion. You are quite familiar with fusion, with all of your Princeton connections.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. I think we all understand that budgets are tight, and we have a responsibility to make tough budgetary choices. But I would like to take a moment just so there is a focus on, shall we say, the fusion accounts. The President's budget request's funding for domestic fusion is cut by $49 million, and ITER is cut by $50 million from its planned level, while it increases fund-

ing for other science programs. I would say fusion comes out as a loser here. Why is that?

Mr. BRINKMAN. Well, it is the same thing I said earlier.

Mr. FRELINGHUYSEN. Because this is one area, as are the other areas, I assume, where only government would have perhaps the resources to make this type of——

Mr. BRINKMAN. Yes, fusion is definitely in the government domain, and we have not gotten as much money as we would like, and we are trying to keep both these things alive. We had to make some very hard decisions in the fusion program as to what we would do and would not do in the coming years.

Mr. FRELINGHUYSEN. So what is literally going to happen to those who are involved in these kinds—I can certainly cite Princeton, but MIT, General Atomics, I mean there are a lot of players in here that are involved.

Mr. BRINKMAN. Yes. It was a very hard decision that needed to be made among those three: the General Atomics, the DIII–D machine; and the Princeton NSTX machine; and Alcator C-MOD. And our folks who run that program took a lot of time to think hard about which one they felt was least beneficial to the future.

Mr. FRELINGHUYSEN. So the people who thought hard about it were not the people in those facilities? It was people under you?

Mr. BRINKMAN. Well, of course the community also had its own views of that, but mostly the people——

Mr. FRELINGHUYSEN. Not people over in OMB, I hope?

Mr. BRINKMAN. No, no. That particular issue was not people at OMB.

Mr. FRELINGHUYSEN. But there is a domestic component here.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. Because you made the point yourself that a lot of the money that is spent here goes out—80 percent I think was the figure you mentioned, right, goes back to our economy?

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. What about our international obligations? To ITER?

Mr. BRINKMAN. Oh, the insufficient funds you mean?

Mr. FRELINGHUYSEN. Yes.

Mr. BRINKMAN. That is a problem that we are working right now. We have been talking with our partners.

Mr. FRELINGHUYSEN. You made it more difficult by putting more money into other accounts here.

Mr. BRINKMAN. Yes, that is true.

Mr. FRELINGHUYSEN. And so what will become of the ITER, if you will pardon the expression, maybe because I had oversight of NASA, but it is like the international space station in many ways.

Mr. BRINKMAN. I hope it is not quite that bad.

Mr. FRELINGHUYSEN. Well, it is a huge asset, and ITER will be, too. You have a lot of contributing nations here.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. What does it mean to us that we are not fulfilling our obligations when I assume other countries are doing it?

Mr. BRINKMAN. We intend to fulfill our obligations. We may not have enough money this year, but we certainly intend to fulfill our

obligations to ITER, and the administration has stated very clearly that they support, will support ITER, and so we intend to make those commitments. Now, we were short this year, but we will try to figure out how to compensate for that, and we are working at trying to do that and figuring out the best way to do that. You know, ITER is a very different problem than the space station, the way it is set up.

Mr. FRELINGHUYSEN. Maybe it was an unfortunate analogy, but there are a lot of contributors, it is an international project.

Mr. BRINKMAN. There are a lot of contributors. I think the big difference——

Mr. FRELINGHUYSEN. And our reputation to some extent is on the line here.

Mr. BRINKMAN. Yes, I agree with that. I agree with that. We do not want to fail. We do not want ITER to fail because of the United States; let's put it that way.

Mr. FRELINGHUYSEN. And this does impact people on the ground here in a variety of laboratories and in the private sector as well?

Mr. BRINKMAN. It does, yes.

Mr. FRELINGHUYSEN. And the committee has had a keen interest in making sure that wherever we are making these investments, there is some commensurate area where in fact we either protect or increase employment rather than reduce employment.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. You could be doing some things here in a way that would impact, you know, the future probability of success in some of these areas.

Mr. BRINKMAN. Oh, yes, I think we are definitely doing that.

Mr. FRELINGHUYSEN. I mean, the nuclear physics——

Mr. BRINKMAN. We are taking some risks here.

Mr. FRELINGHUYSEN. There are some risks, so you feel comfortable with your recommendations here?

Mr. BRINKMAN. I feel as good as I can.

Mr. FRELINGHUYSEN. Well, we hope that you will have some by the end of this hearing, we will convince you perhaps of some other things. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Dr. Brinkman, the administration has highlighted that American manufacturing is a major theme in this year's energy budget, and it would seem to be particularly relevant to the Department's applied research programs. Can you give us a couple of specific examples of how the Office of Science is going to specifically and discretely support manufacturing?

Mr. BRINKMAN. Yes. In the last 10, 15 years, there has been a very major change.

Mr. FRELINGHUYSEN. Doctor, you have got to move that microphone right in front of your mouth so we can hear you, please.

Mr. BRINKMAN. A major change in our national laboratories in the sense that we used to simply do research experiments at the laboratories with university people involved, but we have now created over the last 15, 20 years a whole set of facilities that are unique and that no company is really willing to build, going to build. A synchrotron is not something a single company is likely to build, and our high-speed computing is not something a company,

unless they are Intel, will build. And so what has happened is we have had a lot more interaction with U.S. industry. In fact, this little brochure which we brought along has a whole host of examples of how we have coupled and helped industry with our facilities, and you can look on the back side here, just this whole list of companies that have benefited greatly from the facilities we——

Mr. VISCLOSKY. I see the list of companies. But the Secretary in a conversation he had with me is saying that this is a particular initiative in this year's budget 2013. What examples can you give me in the 2013 budget that you have that is going to provide assistance to maintaining and increasing manufacturing in the United States of America because of the Office of Science? We are talking about the 2013 budget.

Mr. BRINKMAN. I understand, but I think what he was talking about is the applied energy programs when he was talking. I don't know that he was talking about us.

Mr. VISCLOSKY. So you have no discrete programs in the office at this time?

Mr. BRINKMAN. We have a lot, but we don't have a special program that addresses that issue specifically. There is a hub that we are going to put together.

Mr. VISCLOSKY. We have five hubs now.

Mr. BRINKMAN. Oh, there are five hubs, but there is one hub that is on critical materials, which is very closely working with the industry. Our biofuels centers are very closely coupled to industry, so we are working to transfer the patents and know-how to industry through them. Our synchrotrons are cranking out protein structures one after another these days.

Mr. VISCLOSKY. But you are doing that today. The Secretary emphasized there are going to be discrete new initiatives because of the loss of manufacturing. What companies——

Mr. BRINKMAN. But I think that that is——

Mr. VISCLOSKY. What specific companies are we trading patents and trademarks with that are going to keep manufacturing in the United States?

Mr. BRINKMAN. As far as I know what he is talking about there is some of the things that he has got going in the applied programs.

Mr. VISCLOSKY. Okay. If I could ask another question. On your budget request for the Office of Science, there would appear to be between fiscal year 2012 and 2013 some discrete decisions made as far as priorities. For example, and the chairman has touched on it, there is a cut of $15 million in the recommendation for high-energy physics. On the other hand, there is a request for $105 million more for basic science, which would lead me to believe somebody really made a discrete value judgment, whether we agree with it or not.

In looking at the composition of the Basic Energy Science programs, and I will give you a couple examples here, in fundamental interactions research we have chemical physics research increased by $3 million and atomic molecular and optical science increased by a million. There is a differential there obviously of a factor of 2. When we get to chemical transformation research, catalystic science is $4 million, separations and analysis is $2 million, heavy

elements chemistry is $2 million, geosciences research is $2 million. When we get to photochemistry and biochemistry research, photosynthetic systems is $2 million, physical biosciences is $2 million, solar photochemistry is $2 million. And when we get to nanoscale science research centers, the Center for Nanoscale Materials is $2.2 million, Center for Functional Nanomaterials is $2.7 million, molecular foundry is $2.2 million, the Center for Nanophase Materials Science is $2.2 million, and the Center for Integrated Nanotechnologies is $1.7 million. Those are almost all exactly the same number, and I don't have a sense anybody made a discrete decision as to which had more value between molecular foundry or the Center for Nanophase Materials Science or physical biosciences. Everybody got $2 million more.

Mr. BRINKMAN. There is a whole group.

Mr. VISCLOSKY. They all have exactly $2 million more value?

Mr. BRINKMAN. You are talking about a whole group of sciences in chemistry and materials that really are the core part of this whole clean energy activity, and so we have tried to increase them some. It is true that it is rather spread around, that is a fact, it may be spread around more than you like, but it is important for us to get in this clean energy initiative, to get all these different areas healthy and keep them going.

Mr. VISCLOSKY. Well, if I—with the chairman's——

Mr. FRELINGHUYSEN. I just want to make sure we get Mr. Olver and Mr. Womack in here.

Mr. VISCLOSKY. I am sorry.

Mr. FRELINGHUYSEN. But, no, I think that Mr. Visclosky needs an answer.

Mr. VISCLOSKY. Mr. Olver is here in case he cannot—I will defer, we are coming back.

Mr. FRELINGHUYSEN. Mr. Womack, do you want to get your oar in the water here, or Mr. Olver? I am not sure we want to have two scientists go at it here. But we are prepared. Mr. Womack, do you want to get in?

Mr. WOMACK. Not at this stage. I certainly hope that you are not inferring that I am a scientist at all, because I am far from it.

Mr. FRELINGHUYSEN. Okay, Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman, thank you very much. I was getting very interested in where my ranking member was going with that discussion of what sounded like very small differences. Of course, I don't know what the total was for each of those eight or ten items that he mentioned, all of which went up $2 million essentially over the year.

Dr. Brinkman, in your testimony you point out that the infrastructure modernization has been slowed somewhat due to the budget constraints, but is still intact. You point out that the budget does support four continuing line-item construction projects. But I don't know, unless the chairman has already mentioned a couple of them by name, what are those four construction projects and what amount of money goes into those?

Mr. BRINKMAN. Let's see. Those are SLI construction projects. These are modernization projects.

Mr. FRELINGHUYSEN. Just to break down the acronym a little bit for the record here.

Mr. BRINKMAN. I have forgotten what SLI stands for. They are a laboratory improvement program. It is a special laboratory improvement program.

Mr. OLVER. Of the U.S. science laboratories?

Mr. BRINKMAN. Right, at the U.S. science laboratories.

Mr. OLVER. National laboratories.

Mr. BRINKMAN. And so there are things like——

Mr. OLVER. Which are the four that are the ones that also supports all four continuing line-item construction projects? Which ones are those, for how many dollars? Maybe somebody has an answer.

Mr. BRINKMAN. There are four that we have going here. There is one at the Jefferson Lab.

Mr. FRELINGHUYSEN. Put that microphone a little closer.

Mr. BRINKMAN. One at the Jefferson Lab, there is one at Fermilab.

Mr. OLVER. Those are the two that are new?

Mr. BRINKMAN. Those are new ones, but the old one is a science building at SLAC.

Mr. OLVER. SLAC, where is that?

Mr. BRINKMAN. I am sorry. At Stanford, linear accelerator facility at Stanford. There is the energy science building at Argonne National Laboratory, and there is a renovated science lab phase II at Brookhaven.

Mr. OLVER. Brookhaven?

Mr. BRINKMAN. Yeah.

Mr. OLVER. What is the fourth one?

Mr. BRINKMAN. They are all infrastructure.

Mr. OLVER. What is the fourth one?

Mr. BRINKMAN. Brookhaven. It is a renovated science lab.

Mr. OLVER. I have Stanford, Oregon, Brookhaven. What is the fourth one?

Mr. BRINKMAN. Not Oregon. Stanford, Argonne National Laboratory.

Mr. OLVER. Argonne.

Mr. BRINKMAN. Brookhaven, and—well, there are two at SLAC, two at Stanford. There is a research and user support building.

Mr. OLVER. So two of the four are at Stanford, one at Brookhaven, and one at Argonne.

Mr. BRINKMAN. Those are the ones that——

Mr. OLVER. What is the total amount of money involved in the construction budget for the continuation of those, our continuing line-item construction projects?

Mr. BRINKMAN. Yes, the highest one is $36 million, the lowest one is 14.

Mr. OLVER. What is the sum total?

Mr. BRINKMAN. The sum total is $109 million.

Mr. OLVER. One hundred nine million dollars is the amount that is in this budget for those four?

Mr. BRINKMAN. Right. All of them, including the new ones.

Mr. OLVER. Oh, including the new ones?

Mr. BRINKMAN. Right.

Mr. OLVER. How much are the two new ones?

Mr. BRINKMAN. Well, they are not much, $5 million.

Mr. OLVER. There are the two that you mentioned in your testimony at Fermi, one at Fermi and one at Thomas Jefferson. Where is the Thomas Jefferson?

Mr. BRINKMAN. Down in Newport, Virginia.

Mr. OLVER. I figured it was in Virginia, but I did not realize there was a national lab sitting in—you do learn something around here.

Mr. BRINKMAN. Right.

Mr. OLVER. Those two are $5 million each?

Mr. BRINKMAN. Two-and-a-half actually. They are just starting, it is just the design phase.

Mr. OLVER. All right. So then it would sound as if there is over $100 million for continuation of the four. Are those four going to be complete with that $109 million or are those going to have a continuing budget next year as well?

Mr. BRINKMAN. Let's see. I do not have those numbers. I do not know those numbers. I think they are finished in 2014. Is that right? That is not here.

Mr. OLVER. Well, okay, I am——

Mr. FRELINGHUYSEN. Will the gentleman yield?

Mr. OLVER. Surely.

Mr. FRELINGHUYSEN. You have some bigger projects in the offing here, right?

Mr. BRINKMAN. Oh, yes.

Mr. FRELINGHUYSEN. Some major construction ones.

Mr. BRINKMAN. This is a program. Let me try to make sure that you understand. This is a program of around $110, $115 million which is meant to be for modernization of the infrastructure at the laboratories. There have been lots of complaints about the fact that the laboratories have really gotten old and they need new buildings, and——

Mr. OLVER. We have a lot of them. It would be hard to keep them all up to snuff at maintenance levels. You do have facilities that will degrade over a period of time, there is no question.

The reason I asked that is that I also understand that, I think you were here at that time, you asked for the two new ones that are there in the 2011 budget. They were not funded in the 2011 budget.

Mr. BRINKMAN. That is right.

Mr. OLVER. You did not ask for them in the 2012 budget, but now even though you are saying you are on constrained time, you are asking for the start of these two new ones. I am not sure whether the old ones will be complete.

Mr. BRINKMAN. The old ones will be——

Mr. OLVER. I am not sure you indicated clearly whether the old ones will be completed in this budget.

Mr. BRINKMAN. Can I just say one thing? We have a budget of around $115 million, plus or minus, for this program. We try to keep it at that level, and so we are phasing these projects in and out to keep the total constant. That is our plan, to spend about that much money every year on infrastructure.

Mr. FRELINGHUYSEN. Will the gentleman yield? This is relative to modernization and renovation——

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. So a variety of labs, bring them up to speed.

Mr. OLVER. So the implication of what you have just said is that if any of the four old ongoing ones are completed——

Mr. BRINKMAN. Others will come in.

Mr. OLVER [continuing]. And is no longer there, then in the next year you are going to have others that will come along on a list of priorities.

Mr. BRINKMAN. And we have a long list.

Mr. OLVER. Keeping the whole of this at $100 to $115 million total.

Mr. BRINKMAN. Right.

Mr. OLVER. For all the facilities that need upgrading.

Mr. BRINKMAN. That is right. I can tell you, we have a very long list of things that the various laboratories would like for us to do, so we are just kind of working our way through this thing very gradually.

Mr. OLVER. Okay. I will try to digest that.

Mr. FRELINGHUYSEN. Mr. Olver, we better let Mr. Womack jump in here.

Mr. WOMACK. The role in maintaining U.S. Leadership in high-performance computing is a key to American innovation, economic growth. The Office of Science, through its operation of the National Energy Research Scientific Computing Center at Berkeley and the leadership class facilities at Argonne and Oak Ridge, has played a central role in keeping America in a leadership position. Unfortunately, because of a proposed nearly 5 percent decrease for high-performance computing and an apparent lack of urgency on exascale planning, the Office of Science's commitment does not seem to reflect the importance of the issue. So the fiscal year 2012 enacted appropriations directed the Department to report to the committee by February its plans for moving forward on the exascale computing initiative, a report which to this day I do not think has been submitted.

Mr. BRINKMAN. It is essentially ready.

Mr. WOMACK. Give us an update.

Mr. BRINKMAN. Pardon? It is there. The report will be to you shortly. Look, we very much believe in working on exascale, but we at the same time want to keep our computer centers that we have at the cutting edge. And as you know, recently Japan and China sort of beat us at this game, and we would not like to let that continue. And so we are working on that and we are working on exascale at the same time.

In the exascale world, there are some very fundamental issues that need to be solved in order for us to do exascale, and when there are kind of research-type questions, you do not throw a lot of money at them. You get good research people to work on them, and then when you figure out what you can do, then you spend the money. So we are a little bit slower than we might be on exascale, but we think we are doing well on it, and so we think we will be pushing forward at a good, fast clip, but there are just some very hard technical problems that have to be solved.

Mr. WOMACK. Is there a timeline?

Mr. BRINKMAN. There is a timeline. We are shooting at 2020.

Mr. WOMACK. 2020, okay.

Mr. FRELINGHUYSEN. If the gentleman would yield, we are upgrading our existing capacity in a variety of sites around the country, right?

Mr. BRINKMAN. Yes. The Office of Science has two upgrades that are coming: one at Oak Ridge, which is a major upgrade of that facility; and there is another one, there is a Blue Gene/Q IBM machine that will be installed at Argonne National Laboratory.

Mr. FRELINGHUYSEN. So it is Argonne and Oak Ridge. But the report you allude to is our jump over that.

Mr. BRINKMAN. That is a jump over.

Mr. FRELINGHUYSEN. A technological jump over that.

Mr. BRINKMAN. Exascale is a technological jump over that.

Mr. FRELINGHUYSEN. So the report is, what, being vetted? Where is this report?

Mr. BRINKMAN. It is somewhat near its concurrence.

Mr. FRELINGHUYSEN. Describe to me what "concurrence" means for the record.

Mr. BRINKMAN. It means various people have to approve it before it goes out the door.

Mr. FRELINGHUYSEN. So is it variably good news? Where are we going to be relative to the Japanese and Chinese?

Mr. BRINKMAN. No, no.

Mr. FRELINGHUYSEN. What?

Mr. BRINKMAN. We are going to take care of that issue.

Mr. FRELINGHUYSEN. Oh, we are?

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. Mr. Visclosky.

Mr. VISCLOSKY. The plan is brought forth, and you mentioned 2020, and I understand it ranges 2019 to 2022. Will you have discrete benchmarks for each of the fiscal years, so that as we proceed the committee can review progress or lack thereof?

Mr. BRINKMAN. As I said earlier, we will, but we have to get to a point where we have a path to get there. And that is one of the issues right now is we have to get to a point where we understand how to get there, and you cannot go running on a path when you do not know what the right path is. So we are spending money now to try to define the path.

We have these teams of people that are looking at this problem trying to understand how we go forward with it. And for instance even yesterday, there was a meeting looking at the hardware part of this problem, trying to understand what we could do to solve the energy-use problem that is a very, very big important aspect of this problem. So we are doing those kinds of things, but we have got to solve this problem first.

Mr. FRELINGHUYSEN. Allow me to use this opportunity, we have two votes, so we are going to be absent from this room for maybe half an hour.

Mr. BRINKMAN. Okay, we will be waiting.

Mr. FRELINGHUYSEN. Good, I am so happy to hear that. We will be back. Thank you. We stand adjourned.

[Recess.]

Mr. FRELINGHUYSEN. I am happy to resume our hearing, and thank you for your forbearance, your patience. I just want to follow

up. I asked about exascale, and you were not dismissing me, but I have some legitimate concerns about what the Chinese and Japanese are doing.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. And how would you characterize where they are? I see it on the defense side. Both Mr. Visclosky and I serve on the Defense Subcommittee, and people often say, you know, that the Chinese will never measure up with aircraft and submarines in their defense posture.

Mr. BRINKMAN. Right, until they do.

Mr. FRELINGHUYSEN. Until they do. And things are always, if you will pardon the expression, accelerated. And I assume in the world of supercomputers this is, if you will pardon the expression, our great leap forward. And where do we stack up in that area?

Mr. BRINKMAN. Well, at the moment they have this machine that is, I think, second in the world. The Japanese actually have the first in the world machine, but they built that one with American parts. The Chinese are going ahead very rapidly now to try to build their own microprocessors and build a machine that is completely Chinese, and I have every reason to believe that they will succeed. They are very dedicated and looking to do that.

Now, we have our own plans which, you know, involve Cray and IBM and Intel and Nvidia and these various companies, all of which are working with us very closely to try to see to it that we stay ahead, and get back in the lead; we are very much hoping to be able to do that in the next year or two.

Mr. FRELINGHUYSEN. So the report you referenced will—what will that report indicate?

Mr. BRINKMAN. Well, that report will only talk about exascale, which is a longer-term thing, which is not the immediate competition that is going on for the next couple years, and so——

Mr. FRELINGHUYSEN. But the exascale is, in fact, to assure in the future our superiority.

Mr. BRINKMAN. Right. At the moment we are only going a factor of 10 from the petascale machine, 10 to 20, we are moving up that much in the new machines, but exascale is a factor of a thousand from the peta, so that is a very big step forward. The current estimate is it would take a power plant next to your computer to run it, that is not what is going to get built, and so we have to figure out some ways. For instance, a conference we had yesterday——

Mr. FRELINGHUYSEN. Are you suggesting we do not have the ability to build a power plant? I know we have difficulty building nuclear power plants and oil refineries, but——

Mr. BRINKMAN. I think I suggested that I would not have the budget to run a power plant.

Mr. FRELINGHUYSEN. Well, at the rate you are going—no.

I want to get back, if I could, in all seriousness, to follow up where the ranking member was going in terms of scientific research leading to something here in the U.S.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. To actual manufacturing. And the ranking can state it, but he comes from Gary, Indiana, and whether you come from Gary, Indiana, or you come from the pharmaceutical capital of the world, which also includes parts of the former Bell

Laboratories system in New Jersey. We are keenly interested in things that are inherently of value to the United States of America.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. And so I want to get into what you are doing to assure the type of investments we are making, and we understand there are some tough decisions here, whether there is a real focus here on American jobs and technology, our industrial base. So give us some level of assurance.

Mr. BRINKMAN. Well, let me just say one of the things I forgot to mention is that we have proposed as part of this whole chemistry materials work a mesoscale physics initiative, and we believe that that initiative is very much oriented towards manufacturing. We want to make a strong emphasis, especially for you from a pharmaceutical State, we have very strong interactions with a whole host of pharmaceutical companies; it is very interesting. Eli Lilly, the company, has actually its own beamline at Argonne National Laboratory, and they have their research facility in San Diego. They send proteins to Argonne to have the structure determined, and then come back and they use it. It is an integral part of their drug development today, and so they very much use our facility.

Mr. FRELINGHUYSEN. Well, Sandia has a little piece of the action, too.

Mr. BRINKMAN. Sandia?

Mr. FRELINGHUYSEN. It actually does have some sort of pharmaceutical connection.

Mr. BRINKMAN. Oh, yeah, that is a different kind of thing completely.

Mr. FRELINGHUYSEN. Yes.

Mr. BRINKMAN. I mean, there are other things, like General Electric has used Brookhaven National Laboratory a lot to look at their development work on sodium sulfur batteries. A sodium sulfur battery is a big round thing and it has got sodium on the outside in a membrane and then sulfur on the inside, and you need to understand all the various interfaces between those materials, and you can do that with x-rays at our synchrotrons. They regularly come and image the battery, look at the battery, and see what the battery is doing.

Mr. FRELINGHUYSEN. Our question to Dr. Chu, and this is my view of where we were going when he testified before us, is that we are involved in all these things. You are providing invaluable assistance in terms of these types of developments, but how do we actually keep the essential intellectual property here? Dr. Chu gave us the impression that there is no way we could stop the migration of some of these discoveries, and it gets back to what we would like to do to resurrect our manufacturing base and better own the waterfront.

Mr. BRINKMAN. Look, I am certainly not an expert in international patent law, but certainly many of these things are being patented. My impression is that we have a lot of conflict over patent law with China, but I do not know anything about that.

Mr. FRELINGHUYSEN. But you have under your jurisdiction a lot of centers.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. Mr. Olver pointed out some. And then there is, what, 82 frontier centers, and——

Mr. BRINKMAN. Forty-six.

Mr. FRELINGHUYSEN. You have these hubs and everybody has a degree of excitement about ARPA–E, we have got all sorts of——

Mr. BRINKMAN. They all have very strong patent and intellectual property programs, and we try to patent as much as we can. Every laboratory has a patent office that works to do that. As you know, we have things like CRADAs and this new thing we call Act, which is a new way for a company to approach a laboratory, which is a little faster and maybe a little simpler for smaller companies. So we have worked hard to try to find new ways to do this.

For our user facilities it is a rather easy process because we are not trying to claim their intellectual property. They have to pay full cost recovery if they want to use the facility for company private things, but if they are going to simply publish the data, we do not charge them. And so we have very specific processes to try to protect our intellectual property, we have worked very hard at that.

One of the things we have done over the last few years is we very much elevated the intellectual property technology transfer organization in the Department. It now reports directly to the Secretary, and so we have worked hard at improving this situation.

Mr. FRELINGHUYSEN. Mr. Visclosky. Thank you for your patience.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Doctor, just to catch up to where we were right before we left, we were talking about exascale computing, and you mentioned that you do not have milestones yet, because you have not defined the path which will be in the final report.

Mr. BRINKMAN. Let's see. It is not defining the path, it is determining the path.

Mr. VISCLOSKY. Okay, when you determine the path.

Mr. BRINKMAN. Yeah, we have to figure that out.

Mr. VISCLOSKY. That path will be delineated in the report that will be submitted?

Mr. BRINKMAN. Oh, no, no, no. The report you are going to get is the next few weeks, and the path that we are talking about here is a technology path that we have to figure out.

Mr. VISCLOSKY. Right.

Mr. BRINKMAN. In that report we will talk about how we are going to use, to work on the technology to get there, but that is not a complete path.

Mr. VISCLOSKY. Let me ask you this, then: In the report, will you with any specificity be able to tell the Subcommittee when we are sitting here next year what you anticipate will be accomplished between now and next year, so that we can see if you are making progress or not?

Mr. BRINKMAN. Yes, there are several things that we are working on that we need to understand. One of them I already mentioned, this issue of the amount of power such a machine would take. We cannot——

Mr. VISCLOSKY. Right, but my time—because I have other questions, but there will be discrete——

Mr. BRINKMAN. There are these discrete things that we are——

Mr. VISCLOSKY [continuing]. Milestones that you will be able to——

Mr. BRINKMAN [continuing]. Working on to try to understand how to go forward.

Mr. VISCLOSKY. Okay. If I could get back to my original line of questioning. Why did everybody just get $2 million more? No, I am serious.

Mr. BRINKMAN. No, no, I understand that. And the answer is that this distribution was notional. We will be competing proposals across those various subfields, and however that competition comes out, the money will be redistributed. So that was a sort of notional effort about how much each one of those little fields will get in that competition, but we will have a competition.

Mr. VISCLOSKY. When you say "notional", you are essentially saying everybody gets the same, we will see where the grants come in, and then we will move money around.

Mr. BRINKMAN. And then we will move money around.

Mr. VISCLOSKY. Before the Department solicits for grants, there is no anticipation as to what types of work, what types of research, or what types of different proposals——

Mr. BRINKMAN. No, no, no, no, no.

Mr. VISCLOSKY. There is a Department of Energy.

Mr. BRINKMAN. I am sorry. Don't get the idea that we just let any grants come in. We have a thing called FOA, it is Funding Opportunity Announcements, that we announce what areas we would accept grants in.

And so we put out these Funding Opportunity Announcements and specify what we are looking for, and they tend to be fairly broad so that they can be used, you know, within that subfield that we are talking about there.

Mr. VISCLOSKY. In your mind, looking ahead a year, the Department doesn't come to some conclusion that separations and analysis under the chemical transformation might put more funds in there and it creates more applications because there is more need there?

Mr. BRINKMAN. If we get better applications then somewhere else, we will put the funds over there. That is what it is saying, within the confines of the larger program.

Mr. VISCLOSKY. Why do you break it down by accounts if you just wait to see what you get in? Why even bother?

Mr. BRINKMAN. Well, we could. But we put a notional number there. We try to——

Mr. VISCLOSKY. I know. Why did you even bother? Why don't we just have transformation research?

Mr. BRINKMAN. It is a good question. We could have done without it. We could have done without it. We thought it would be helpful.

Mr. VISCLOSKY. I find the answer very unsatisfactory.

Mr. BRINKMAN. Sorry.

Mr. VISCLOSKY. The next question I have is the budget request for fiscal year 2012 asks for $97 million within basic energy sciences for major items of equipment. The final conference report passed by the United States Congress in December, signed into law by the President of the United States, provides $97 million, explic-

itly providing funds for each of the six major items of equipment projects at the levels in the budget request. Doctor, how much money did the Department allocate for these purchases for fiscal year '12?

Mr. BRINKMAN. For MIEs?

Mr. VISCLOSKY. Yes.

Mr. BRINKMAN. I don't know if we know that number off the top of my head.

Mr. VISCLOSKY. $73.5 million, okay.

So in spite of Congress' direction for $97 million to go to these projects, the Office of Science went in a different direction. In fact, your 2013 budget request formally—and I might add incorrectly—states that the lower $73.5 million was appropriated in fiscal year 2012, and it begs the obvious question as to where the money went. Of the six projects in the request and that Congress funded, what did you cut to get to your number?

Mr. BRINKMAN. Let's see. We probably cancelled something in there. What was it? Team II and PUP? We cancelled one of the projects is what happened.

Mr. VISCLOSKY. The other one was the SNS power upgrade project for $5.4 million.

Mr. BRINKMAN. Yes, SNS, yes. That one was cancelled, right? That was cancelled.

Mr. VISCLOSKY. And you never communicated that to this Subcommittee or to the Senate Subcommittee, as I understand it.

Mr. BRINKMAN. Oh, I am sorry.

Mr. VISCLOSKY. After the fact, after the fact.

Mr. BRINKMAN. Yes. We felt that we had to do that because we wanted to put more emphasis on the Synchrotron.

Mr. VISCLOSKY. I have got to tell you, Doctor, when people cut down trees and put ink on a piece of paper in a sign into law, I would expect that the administration comes back and consults with the United States Congress, a coequal branch, before they start moving around $23 million.

And my other question, and it is rhetorical, is out of a basic energy science budget of $1.7 billion, of which $1.5 billion is research, that the Department couldn't find $11 million?

Mr. BRINKMAN. I don't know the answer to this. Can I get back to you on this?

Mr. VISCLOSKY. It is a rhetorical question.

Mr. BRINKMAN. Because I just don't know the details of this. Okay, I will get back to you on this.

Mr. FRELINGHUYSEN. Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman.

You know, I have to wander back and forth around these papers that I have in front of me in order to find what I want to do, but, Mr. Secretary, you at several points have emphasized that your priorities have been for clean energy and that you, wherever there was change, you were giving priority to clean energy.

Well, it seems to me that—I am now going into talking about the fusion sciences. It seems to me that the high-energy physicists and the fusion scientists and the plasma scientists, wherever they happen to be—and this is similar to their talking about inertial or

magnetic containment—that they think that that is the Holy Grail, truly the Holy Grail of clean energy.

Mr. BRINKMAN. Yes, I agree.

Mr. OLVER. All right. But what we are seeing here is a substantial change in the budgets. The budget for—and realizing that inertial containment is in a different NNSA program—the magnetic is all within your area, within the Office of Science. And the Office of Science for fusion sciences is flat-funded for this coming year.

Now, the chairman has already pointed out that there had been at an earlier time a commitment for a higher number for here than is actually provided, a number that was up in the $200 million range for this year, and that is down, but a sizeable amount up $50 million from what it was last year.

Mr. BRINKMAN. Right.

Mr. OLVER. And the number of dollars for the domestic programs, the various domestic programs, which include at the science labs, at some of the universities which do theoretical work around the country, and at the place that had experimental facilities, mainly General Atomics and MIT and Princeton, in the major scientific experimental equipment, that the sum total for them is down by $50 million; and I think the chairman, without driving it home, is questioning where we are headed.

If our commitment to ITER—and you are saying our commitment has got to be whole—my impression is that ITER has gone through some benchmark changes or goalpost movements or something so that the timeframe has moved somewhat along, and it has become considerably more expensive over a period of time than was the case in the early years, 8 or 10 years ago, that the total amount of dollars intended for that has gone up.

But in the coming years, in 2014, we go 1 more year and they are talking about a $250 million commitment to ITER and a $300 million a year commitment in the next couple of years even going higher than that. And if we are going to end up with a flat budget, then the domestic programs are going to really be affected. At the moment, while the budget seems to really take it, it puts the wood to the program at MIT, which was one of our two functioning—well, I shouldn't say this. Maybe there are more than two functioning tokamak laboratories right now.

I understood that Princeton is waiting for an upgrade, an important upgrade that has to be done to get them back on track. And when they come back on track, they will be in better shape. They will be at higher capacity than others.

Mr. BRINKMAN. They will be back on track. They will be in better shape.

Mr. FRELINGHUYSEN. Obviously, if we move ahead.

Mr. OLVER. Right. But will we have any money left in there? How are we going to get this kind of money with ITER? ITER was going to eat our whole domestic program essentially in the program with the numbers that are involved here.

Mr. BRINKMAN. Look, obviously, that can't happen.

Mr. OLVER. Obviously, that can't happen. Tell me how.

Mr. BRINKMAN. You can't take ITER up to $250 million a year and take another $100 million out of the bill of domestic programs.

There won't be a domestic program if you do that, right? We cannot do that. We are going to have to find another way to fund ITER.

Mr. OLVER. Well, why isn't that obvious right now?

Mr. BRINKMAN. Well, it is obvious; and we are going to work that over the next year to make sure we get it right.

Mr. OLVER. Yes. Well, but it is kind of like a gun to the head the way this is playing out. It is a gun to the head. Anybody that is in any of the others—by the way, each—no two of these tokamak programs, the magnetic programs, looks exactly alike.

Mr. BRINKMAN. No. That is true.

Mr. OLVER. Our biggest one that is operable at the moment I think is the General Atomics facility.

Mr. BRINKMAN. That is right.

Mr. OLVER. And there are others in other countries, some of them larger; and all of them have different shapes, different characteristics, different measures. All of them have done work, and every one of them has done work that is ending up as the baseline for ITER to do its work. Because ITER is just basically an upgrade in size, in capacity, and power and so forth——

Mr. BRINKMAN. Right.

Mr. OLVER [continuing]. To get us to something that, if they can sustainably burn, which they hope to get to test by 15 years or so from now, sustainability to burn——

Mr. BRINKMAN. Yes, look, what has happened in this field of magnetic fusion, over a period of something like 50 years there has been a gradual building of larger and larger machines that did more and more and got closer and closer to a burning plasma. The last two of that sequence, one was JET in England and the other was GFTR at Princeton, we got to that point and then it became clear that the next machine, in order to really demonstrate a burning freezer, was a very large machine, right? That is when things went into this international fit and took all this time to get going.

When I came on the scene, in 2009, ITER was frankly in quite a mess because it didn't have the proper management. It didn't have a whole bunch of things in the right place. We have straightened out a lot of that now. I believe that the program is now running much, much better than it was 3 years ago. Through all of that, there are all these estimates of what it was going to cost, and, frankly, they were often made almost as guesses rather than real designs.

And now we have really real designs. We know exactly. We had a really—working at detailed designs. We are trying to find ways to save money on those designs and building them. So we are doing a heck of a lot of work to try to understand how to keep the cost under control and the project moving forward. It is a very, very intense period right now for the ITER project.

Mr. OLVER. We don't even yet know whether the Holy Grail is going to be through the inertial or the magnetic mechanism, exactly.

Mr. BRINKMAN. That is true.

Mr. OLVER. Yes, that is true. Maybe they both will work.

Mr. FRELINGHUYSEN. If the gentleman will yield, but if you reduce the funding by $150 million, I mean, that is a shocker.

Mr. BRINKMAN. Peace.

Mr. FRELINGHUYSEN. No. You must have come to some rationale for that decision, and I would like you to——

Mr. BRINKMAN. The rationale of the administration is that we need to push harder on clean energy, that that fusion is not likely to occur for more than 50 years, all right, 2050, maybe, and so, from an administrative point of view, it had less priority than the other clean energy programs. That was——

Mr. OLVER. Okay, well, it is whatever provides for clean energy now. Although many of the other things that we are doing on clean energy are not going to happen immediately or commercialize within 10 years in many cases.

Mr. BRINKMAN. Oh, no, no, no. No, no, no, no, no. Look, nothing happens in a few years. The kinds of things we are doing take 10 years. For instance, you can't introduce a new type of battery in less than 10 years by the time you do all the safety things.

Lithium burns, so you can't—you have to worry about all of the safety issues, et cetera. So typically 10 years for a new product.

Mr. FRELINGHUYSEN. I want to get Mr. Womack in here.

Mr. OLVER. Yes, fine. I will come back.

Mr. FRELINGHUYSEN. Please do.

Mr. Womack.

Mr. WOMACK. I want to come back to computing again, and I know some of this discussion maybe has already transpired right after the votes and before I was able to make it back in. But help kind of a lay citizen like myself understand, in this next generation of computing, what is your vision for what this type of speed, if you will, or this type of data processing can actually do that we can't do now?

And then I have a follow-up question. I know you had a military partner in this initiative with the NNSA, and I realize there maybe are some futuristic things that could be of some classified nature, but what does it do for our military?

Mr. BRINKMAN. Well, let's see. Let me take first the science part, and then I will talk about the military parts.

In the science world, there are just many, many problems for which we still cannot model these problems and simulate the problems on our current computers. Various examples include combustion and an engine inside of this. It is a very, very difficult problem.

There are hundreds of different molecules that get created in the process of that combustion, and a turbulence inside the cylinder has to be modeled, and we just can't, even with petaflop machines, we can't model that completely.

In a materials world we can model perfect crystals today, but we want to be able to model materials with small grains and see how the small grains of crystals interact and make better and better materials, and that is part of the whole nanoscience initiative to be able to do that kind of thing. We are seeing results from that today.

Still we could go a lot further in those things. Fusion is the classic example of something that needs a much higher level to simulation before we really completely understand it. So there are lots of problems. I am not worried about finding problems to work on.

On the industrial side, we have worked with Boeing, for instance, and did simulations of their wings for the 787. They went out and bought their own petaflop machine because it was so important to them to be able to get that simulation.

One of our favorite examples is this smart truck thing where we used our petaflop machine to simulate the flow of air around 18 wheelers, trailers. You know, the big problem with the trucks is they have a very flat back, so they essentially create a kind of vacuum behind them. Well, guess what? That vacuum sucks on the back of the truck trying to pull it backwards, right? So, we invented a small part that they can slap underneath the trailer, which greatly reduces that vacuum and, we increase the efficiency of those trucks by 12 percent. This is a truck that gets 6 miles a gallon. So you save one heck of a lot of gasoline with that.

So these kinds of simulations, even that simulation is not as detailed as eventually you might like it to be. So I think there is no question that we will be able to do that.

In the military, there was a big emphasis at the Livermore laboratory which has been the simulation of nuclear weapons. That is another very big problem because of the amount of materials and the types of chemistry that goes on and that nuclear reaction that goes on, and that is something that is very hard to simulate.

So these problems are very hard to attack, and I think a bigger and bigger machine will allow us to do that.

Mr. WOMACK. Before the vote, we talked a little bit about the facilities piece and the investment that is being made in this exascale initiative, and I know you mentioned China and Japan specifically, and I think there was even some discussion before I came back. But what about Europe? Where is Europe in this race, if you will?

Mr. BRINKMAN. Well, I don't know where they are as far as where they stand on this famous Linpack scale, but they certainly are trying as well.

We have to remember also that there is this whole international business, and IBM and Cray are trying to sell the machines that we helped work with them to develop. They are out there on the market right now trying to sell these things. And that is all fine, right? That is what it should be. That is good American industry, making money. And so that is happening as well. You have to recognize that, as it is going on.

Mr. WOMACK. And if I heard you correctly before we ended my last round of questions referencing China and Japan, upon implementation, you are pretty confident that the United States is going to be looked at as, shall we say, a leader in this field.

Mr. BRINKMAN. Yes. Yes. I feel confident that we will maintain our leadership in this field. We have a set of companies behind us and very good people at our national laboratories, and I think we can maintain our place in the field. I think you take Intel, you take Cray, you take NVIDIA and IBM, these companies are very strong in this field, and we can work with them to keep us ahead.

Mr. WOMACK. Thank you, Dr. Brinkman.

Mr. FRELINGHUYSEN. Thank you, Mr. Womack.

Just for the record, where are we doing the truck simulation?

Mr. BRINKMAN. That is at Oak Ridge.

Mr. FRELINGHUYSEN. And we are also taking a look at tires as well? I don't want to get into where they are manufactured, but I——

Mr. BRINKMAN. The tires work was done at Sandia, and it has been going on for quite a long time with Goodyear. That simulation apparently——

Mr. FRELINGHUYSEN. That is worthy of simulation as well.

Mr. BRINKMAN. Oh, yes.

Mr. FRELINGHUYSEN. We hope that some of those tires might be domestically produced.

Mr. BRINKMAN. Well, that is a different question.

Mr. FRELINGHUYSEN. I want to get back to some of the issues I raised in my opening remarks.

Dr. Brinkman, this year is similar to the last two in that additional funding for any program is going to be exceedingly hard to come by. The budget for the Office of Science is particularly difficult because of the existing commitments, some of which we have talked about, to several large projects. Those budgets are scheduled to grow this year, not all, but some of them are.

But this committee must live within its means, and that means making extremely difficult decisions. It is very likely that we cannot count on having an additional $100 million for you to add to the Office of Science in your budget request. This will be based on the debate in Congress probably over the next couple of weeks but certainly over the past year.

We look to you and the Department to help in prioritizing as we make these decisions. To that end, the Fiscal Year 2012 appropriations conference report, which has been referenced earlier, directed your office to provide us with what I would call a flat budget scenario. That is, if you receive funding at the 2012 level, how would you prioritize your budget? When are we going to get that report, and would you outline for the committee what you do with flat funding? Because there is a strong probability it may be flat funding.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. I wish it wasn't, but, in reality, that may be where we are going.

Mr. BRINKMAN. The answer to that, I think, is a little tricky. Because if we——

Mr. FRELINGHUYSEN. The report, though, where is the report? That isn't tricky.

Mr. BRINKMAN. It is tricky. That has not gone through. We do not have a report ready for you at this stage, and we need to work on that.

What I was going to say is——

Mr. FRELINGHUYSEN. Let me just say, I think it is important to accelerate that. I mean, there is a strong probability we may be put in a position——

Mr. BRINKMAN. The problem with publishing a report of what you do over 5 years with constant level budget is that in that report, you are going to propose closing down a bunch of things.

Mr. FRELINGHUYSEN. Well, you already proposed that in your budget.

Mr. BRINKMAN. For this year.

Mr. FRELINGHUYSEN. No, but let's lay it out. To some extent——

Mr. BRINKMAN. I am going to lay out more.

Mr. FRELINGHUYSEN [continuing]. You have already signed a warrant for certain actions, haven't you?

Mr. BRINKMAN. Yes, sir.

Mr. FRELINGHUYSEN. And that is going to ripple across the public and private sector.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. But I just think somebody over in your operation ought to be taking a look at——

Mr. BRINKMAN. Well, we certainly are doing that. The question is whether we can show whether we can release those.

Mr. FRELINGHUYSEN. The worst-case scenarios—I know we turn to our military people, and we ask what happens when you reduce the Army by 80,000 and the Marines by 20,000 and you have ships under 285 and you have a reduced number of submarines? I can't imagine we couldn't take a look at growth, the broad spectrum of all of your centers and programs.

Mr. BRINKMAN. We do that. We do that.

Mr. FRELINGHUYSEN. Well, we have asked for something.

Mr. BRINKMAN. Well, we will try to work that out, okay?

Mr. FRELINGHUYSEN. On another issue, there was considerable buzz last year in the science community and the general public about a tentative of funding at the CERN, the Europeans' physics center, showing that neutrinos actually move faster than light. You want to talk about that? I saw something actually in the Wall Street Journal and the New York Times. What is going on?

Mr. BRINKMAN. What happened there is that the group that was doing that discovered——

Mr. FRELINGHUYSEN. And give us an overview of what CERN is doing.

Mr. BRINKMAN. Well, what CERN is doing there is they take their accelerators and smash muons into a target and the muons decay and give you neutrinos. You can time very accurately when those neutrinos are created at that point, and then you can time it very accurately when the neutrinos are detected at the cave in Italy.

So what you are doing, you are timing the neutrinos between those two points, but you also have to make sure you coordinate the timing of those two points by light and up through the GPS satellites. What happened is that there was a connector from the sensor that captured the signal from the GPS to put it into an optical fiber, and that connecter being loose turns out it puts a delay in the time light takes to get from CERN to Gran Sasso cave. So, because of this connector, not because the speed of light was anything different, because this connector had a delay in it, it looked like light was taking longer than the neutrino. And that is where this thing came——

Mr. FRELINGHUYSEN. So do we have any labs that are doing similar type research, and knowing you have Princeton roots and this is all about Einstein, isn't it?

Mr. BRINKMAN. Yes. This is all about Einstein. That is for sure.

Mr. FRELINGHUYSEN. And so what are we doing here at home and where do you put Einstein on this question?

Mr. BRINKMAN. My own belief is that is what is going to happen here.

I think, first of all, this answer that they have, the group that originally published this thing, is saying this is at the speed of light. The speed of neutrinos is the same as the speed of light. My view is, I don't think we have got to go check that again, frankly, but we are.

Mr. FRELINGHUYSEN. So are we doing anything that relates to it here and where are we doing it?

Mr. BRINKMAN. Yes, at Fermilab. At Fermilab.

Mr. FRELINGHUYSEN. Mr. Visclosky.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Doctor, the long baseline neutrino experiment would focus obviously on neutrino research. The possible total construction costs of the project as proposed at Fermilab could range in excess of a billion to $2 billion. There have been hurdles in arriving at the current design. In particular, the National Science Foundation was slated to build and maintain the detector facility, but they announced in late 2010 that they were pulling all funding. This year's budget for your Department instead provides funding to continue research while it evaluates the proposed plan.

Do you know when the Department is going to be making a decision as to whether they are going to proceed with this proposal or not, given the fact that there is also now a new budget proposal in the House that cuts discretionary spending by another $19 billion?

Mr. BRINKMAN. Yes. Let me tell you where we are on this, and what our thinking is.

All through summer and fall of this past year we have asked Fermilab and the high energy physics community to figure out and settle and come up with a real design, down select the various options from the various options and give us a real plan for what this thing would look like.

They have done all of that and they have done a really good job. They really went at it in detail and came back to us. But the problem is they came back with a very high price. So, with constant level of funding, I don't see us being able to do that specific experiment.

But we have a couple of smaller experiments that we are doing in the Homestake Mine out in South Dakota. For $11 million we can keep the pumps running and do these smaller experiments.

One of them is a dark energy experiment, and the other one is called a Miranda experiment, it is basically a neutrino—decay. These are two interesting experiments that will keep us with that mine. South Dakota and their benefactor out there have put almost a hundred million dollars into that mine at this stage, and so we are trying to help them keep that open and do some science.

But I think we are going to be looking for other ways. The fact of the matter is that one of the very important parameters of neutrinos has just been measured at Daya Bay in China where we are a collaborator with the Chinese on an experiment which looks at neutrinos coming from reactors.

Mr. VISCLOSKY. But for budgetary purposes it is not being built into the administration's budget in the outyears.

Mr. BRINKMAN. Not at this stage.

Mr. VISCLOSKY. The next question I would have is the budget proposal before us has $20 million for the Energy Frontier Research Centers, and I have been a proponent of those centers. There are 46 of them.

Mr. BRINKMAN. No, no, no, no.

Oh, yeah, yeah. You are right. I am sorry. Yes, sir. You are right.

Mr. VISCLOSKY. I stand to be corrected. All you have to do is look at my pocket and know I am a goofball.

Mr. BRINKMAN. Now I know what you are talking about.

Mr. VISCLOSKY. Has the Department made a decision as to how they will distribute that $20 million between the 46 centers?

Mr. BRINKMAN. I don't think they have gotten that far. That $20 million is meant to try to help to couple those centers into projects in EERE. That is the thought behind it, and we will see how it works out. We haven't worked that out yet.

Mr. FRELINGHUYSEN. What do you mean "couple?" Could you expand? What does that mean? I think we know what it means, but maybe you could explain it.

Mr. BRINKMAN. The Energy Frontier Research Centers are creating a lot of really interesting new ideas for gadgets and devices, and those things need to be taken further towards development and then into development and manufacturing. That is really EERE's job. So we want to try to enhance these things in ways that makes that easier.

Mr. FRELINGHUYSEN. Excuse me.

Mr. VISCLOSKY. If I could have one more question, Mr. Chairman.

The budget request reduces funding for the RHIC facility at Brookhaven National Laboratory, and it is my understanding that this would reduce operating time in fiscal year 2013 to 9 weeks. The facility received $156.6 million in the request, and I am led to believe that for an additional $3 million they could run up to 15 weeks, enough to conduct a run in 2013. Why not include the additional $3 million?

Mr. BRINKMAN. I would have to go back and look at the exact numbers, how long they can run. I know that their budget, the budget we gave them, did not allow them to run anywhere near the full capacity, and that is very unfortunate, but that reflects back on the total budget of the nuclear physics program.

Mr. VISCLOSKY. Yes, if you could, for the record, what the tradeoff was and why they didn't get to three.

Mr. BRINKMAN. Well, it involves the nuclear physics program having a reduced budget in the proposed '13 budget. So between trying to fund FRIB and RHIC and the Thomas Jefferson laboratory, something had to give.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Before going to Mr. Olver, both Mr. Olver and I mentioned the work at MIT. Does this basically shut down their operation, or is there money in there to shut it down——

Mr. BRINKMAN. There is money in there to see to it that we handle the graduate students and let some of them finish; it is a gradual shutdown.

Mr. FRELINGHUYSEN. A major blow, in any case.

Mr. Olver.

Mr. OLVER. Okay, since you raised that one, Mr. Chairman, thank you. Do any of the university programs in plasma science, or fusion sciences have more graduate students than MIT?

Mr. BRINKMAN. Well, I am not absolutely sure, but there is a large number. It is something like 300 graduate students outside of MIT in the program.

Mr. OLVER. In programs around, but I was just asking if any one has as many as they have. I think they are in the 50 or 60 level themselves.

Mr. BRINKMAN. Well, Wisconsin is probably the next competitor. MIT has a fairly large——

Mr. OLVER. Very large.

Mr. BRINKMAN. Yes, but these kinds of considerations were all thought about in trying to come up——

Mr. OLVER. Okay. All right. I understand that things are not easy.

But let me follow a little line in these numbers. Over a 5–year period, the budget has gone up and down. The proportion of the budget 5 years ago for the national labs and the programs in other institutions around the country was somewhat larger than it is now. And it is now—for the first time, it is coming down about $5 million.

As a side question, is the amount of money spent at Oak Ridge as the leader of our ITER program, is that attributed to ITER, as a contribution to ITER? That portion goes——

Mr. BRINKMAN. No, no, no, no. That whole portion is attributed to ITER and not at all to the base program.

Mr. OLVER. Okay. Then the three major ones, the major individual programs which were General Atomics and Princeton and MIT, those represent about a third of the budget, as it looks like for now.

Mr. BRINKMAN. Right, that sounds about right.

Mr. OLVER. And then ITER has been growing, and it is the one that is just going up, up, up, if we are going to make those commitments.

Now my intention would be that if we wish ITER to be successful, then we have to have a successful group of these major institutions that are continuing to function. Because each one of them puts in things. What ITER is doing is simply upscaling whatever works. And to terminate anybody at this point in this game is a dangerous thing to do, not only for the success of ITER but, of course, for the success of our own domestic program as well.

I am repeating, I think, that every one of these components has had some inputs into the development of the ITER program.

Mr. BRINKMAN. I agree with you that all three have had inputs into the ITER program, all three of the national facilities. However, if you asked me which has been the most productive from the point of view of preparing for ITER, it has clearly been DIIID. They have done a series of experiments.

Mr. OLVER. And it has grown relative to the others in the last few years, no question.

Mr. BRINKMAN. No question. And it has just done very well. In fact, there is an annual, international plasma physics meeting, run

by IAEA, the International Atomic Energy Commission, and 4 out of the last 5 years experiments at DIIID have won the best paper at the meeting. So they have done very, very, very well.

And the other thing, I don't want to belittle MIT's effort, either. They have done some very nice work in particular on tungsten walls and tungsten diverter walls in the bottom part of the machine. But I have to say that is also being done at JET in England. And so this is all the kinds of things that we took into consideration.

Mr. OLVER. One needs whatever it is that JET is doing in England and whatever there are others doing in Japan or South Korea.

Mr. BRINKMAN. You want to take those into account.

Mr. OLVER. All those need to be part of this or else this Holy Grail is going to be made hard.

Mr. BRINKMAN. Right.

Mr. OLVER. One last short question. I started asking, shortly after we started creating hubs, was there any expectation that some of the research, frontier research centers, which must be pretty close to hubs that are being created——

Mr. BRINKMAN. Yeah.

Mr. OLVER. Are any of them to be subsumed into the hubs as reviews go forward?

Mr. BRINKMAN. Now, I would say it is very possible that that would happen. For instance, right now, the hub that is just getting started——

Mr. OLVER. You only have one hub going at the moment.

Mr. BRINKMAN. Right. They have the Fuels from Sunlight Hub.

Mr. FRELINGHUYSEN. If the gentleman would yield, I think we are looking for some information on the hubs. I think we are still missing an update as to what they are doing.

Mr. BRINKMAN. I could answer his question. I mean, the answer is that in the Fuels from Sunlight Hub, the scout tech group, that head set actually was part of an EFRC. So, to some extent, the technology with the EFRCs has been consumed into the hub. In fact, Nate Lewis, who was a professor at Cal Tech, is using a whole set of EFRCs to feed new catalyst into the hub.

Mr. OLVER. But that should also happen with ones like the battery science or the solar science one, the two hubs that are functional out of Erie.

Mr. BRINKMAN. We are just getting the proposals to start the battery hub.

Mr. OLVER. That is right.

Mr. BRINKMAN. But here again is a situation, but I don't know who is going to win this. But let me take Argonne National Laboratory for a minute. We have an EFRC on batteries there, and in that EFRC they have some people who invented some of the new cathode materials that are being introduced into batteries today, into Volt and things like that. I am sure they are going to apply for a hub. If they win the hub, that EFRC will be part of it.

Mr. OLVER. They will be an applicant in it. But we will still leave the other frontier science centers sitting where they are.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. The shades will be closed, but they are not quite closed on this hearing.

Mr. BRINKMAN. I can see that.

Mr. FRELINGHUYSEN. I don't know how you withstood it. You could have winked at us or something, and we would have put the shades down for you. We like—you know, we like transparency and openness.

I want to just focus for a few minutes on the bioresearch centers. You are plugging in a $375 million investment again for the next 5 years; is that correct?

Mr. BRINKMAN. We are hoping to, yes.

Mr. FRELINGHUYSEN. Yes, can you tell us how you evaluate each of these centers?

Mr. BRINKMAN. Yes. Well——

Mr. FRELINGHUYSEN. How do you actually evaluate their performance and how do you match that relative to their original goals? Each of them had a whole set of goals.

Mr. BRINKMAN. Well, we have very elaborate review processes that we use. First of all, we have these places write a report. We bring in outside scientists. Then they come—they either go to the laboratory——

Mr. FRELINGHUYSEN. They are independent peer reviewed.

Mr. BRINKMAN. It is totally independent peer reviewed. They will spend at least a day either at the site or at a review here in Washington, go through the whole process of reviewing them.

We then asked each of those reviewers to write us reports on what their views of the centers are, and a few of the reviewers actually sit on review committees for more than one center, so we get into some intercomparison among the centers.

And that process was just finished this fall, and then that is why——

Mr. FRELINGHUYSEN. And so do each of the centers have specific goals?

Mr. BRINKMAN. Each of the centers have specific goals.

Mr. FRELINGHUYSEN. And can you assure us they have been met or is this still——

Mr. BRINKMAN. I can get you the specific examples.

Mr. FRELINGHUYSEN. Give us an example.

Mr. BRINKMAN. Well, let's see, the simplest example is one that was done at JBEI at Berkeley where they took an E. coli, these microbes that everybody gets sick on every now and then, but they took them, modified the DNA and the E. coli so that the E. coli would act as an agent for taking cellulose and making it into—I think disabalene was the name of the molecule, which is a drop in a substitute fuel for gasoline. So they are making that kind of progress of finding new ways to make fuels, and we are hoping that——

Mr. FRELINGHUYSEN. So one has a particular focus on cellulose, right, and what we might describe as next-generation biofuels?

Mr. BRINKMAN. The one in Oak Ridge, for instance, has a very strong focus on breaking down ligon. One of the crazy things about plants is the plant generally are coated with ligon, and that is what makes the plant so strong. And in order to get to cellulose to sugars you have to break down this ligon, and it is not easy. So they have done the modification of plants, of DNA so that the plant actually grows with a ligon that is not so strong.

Mr. FRELINGHUYSEN. And are you focusing on plants that are not involved with the food chain and food supply?

Mr. BRINKMAN. Absolutely.

Mr. FRELINGHUYSEN. So that is passe, is that right?

Mr. BRINKMAN. We are surely not trying to use corn.

Mr. FRELINGHUYSEN. Good, glad to hear that.

So have you uncovered any specific concerns about any of these three centers in terms of where they are going and what they might likely be doing in the next 5-year cycle?

Mr. BRINKMAN. We believe that they are heading in quite different directions, two I talked about. The third one is actually heading and trying to understand what kinds of soils and what kind of terrain you can grow these kind of plants that are not food plants but would be good for fuel. And so they have taken that tack, which means, all three have sort of found their own direction to move, and I think it has been very good.

Mr. FRELINGHUYSEN. Does this program compare notes to similar programs that might be——

Mr. BRINKMAN. Yes, they go to all the conferences and that kind of stuff, so they definitely are in the field and know what is going on.

Mr. FRELINGHUYSEN. Okay. Mr. Visclosky, any further questions?

Mr. VISCLOSKY. I have got more, if you wouldn't mind, Mr. Chairman.

On the fusion budget, there is a request for about a $3.8 million reduction for fiscal year '13, but I understand that there are reports that the Office of Science is exploring having American fusion scientists do work overseas. Is that true?

Mr. BRINKMAN. Well, what is going on there is the following: we have not built any. The newer machines that are being built are all being built with superducting magnets, and also there tend to be stellarators, and we are not building any machine like that. So we believe that in order for us to be able to use and learn from those kinds of machines we are going to have to work on some of the international machines.

There is a machine in Germany which is a stellarator, a super ducting stellarator, which we would very much like to do experiments on. With the kinds of budgets we haven't had the kind of money to build those kinds of machines here.

Mr. VISCLOSKY. Another question I would have is, my understanding as far as the Department's commitment for research grants—and I certainly understand multiyear funding for these grants, that science just doesn't start and stop on a 12-month basis—but that the rotation right now would allow for about 6.5 percent of fiscal year '12s monies to go to new grants because of the multiyear funding. And I am wondering, has the office looked at that to provide a greater window for new opportunities as research is taking place, a new idea has come so that there is more than 10 percent available in new grants?

Mr. BRINKMAN. We worry about this. We worry about the ratio of the number of renewals. Our typical grants are 3 years. So you would say, well, there is a third will be coming up every year. But you don't just want to renew that third. You want to give a lot of

opportunities for new things. So you tend to take some 10, 20 percent of those older ones and not fund them and put on new things.

Mr. VISCLOSKY. So are most for 3-year periods, Doctor?

Mr. BRINKMAN. Most of our grants are 3 years, right?

Mr. VISCLOSKY. And if I could just bring in ARPA–E in for a second, my understanding of ARPA–E is that at the beginning you have got 3 years and don't come back to us for this particular idea.

Mr. BRINKMAN. Yes.

Mr. VISCLOSKY. Has the office looked at that to free up money?

Mr. BRINKMAN. I don't know that—I would not have said that—My understanding of ARPA–E——

Mr. VISCLOSKY. I understand I might not be correct on it, but——

Mr. BRINKMAN. My understanding of ARPA–E, the way they are set up is they are saying, hey, we are not trying to fund long-term research. We are trying to fund things that are very close to development. And so we are asking you to march down a development path, and if you can't get down that path we are going to cut you off.

That is the thing, that is the way they work.

But I think we are somewhat different. We are trying to fund somewhat longer-term research, and so we have to be a little more careful about cutting people off because——

Mr. FRELINGHUYSEN. Longer-term research, some of which we have been discussing, and we might be cutting a few off, right?

Mr. BRINKMAN. Yes.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Mr. Olver, I just have one question. I want to get a little focus here. In the area of basic energy sciences, you have $42 million for mesoscale science to apply nanoscience. Tell us a little bit about this initiative.

Mr. BRINKMAN. I described a little bit of this earlier.

Mr. FRELINGHUYSEN. I am aware of the NanoValley and a lot of people are working in this area.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. What are you doing specifically?

Mr. BRINKMAN. Well, we, of course, have had these five nanoscience centers that we have had for some time now; and these, I think, have been very successful in doing new things like, for example——

Mr. FRELINGHUYSEN. You have got to move the mike closer, please.

Mr. BRINKMAN. These nanoscience centers that we have, I think, been quite successful. One example, for instance, is that we found that you can make palladium and platinum catalysts much more effective if you make a very tiny, say, gold particle and then coat the particle with platinum or palladium. That gives a much better catalyst, a much more effective catalyst. This is the kind of nanoscience that we think is tremendously important, and so we are very interested in doing that.

But we also believe we can make all kinds of new things that reach up into the mesoscale. The mesoscale is at the micron level and the size of cells and things like that, but also we think that these kinds of materials where you use the nanoscale size things to put them together in complex ways will make for more—for in-

stance, a very high-strength steel or very high, composite materials that are much, much stronger than what we have today. Those are the kinds of things we are thinking about.

Mr. FRELINGHUYSEN. You are doing it. Are others doing it as well?

Mr. BRINKMAN. Oh, yeah.

Mr. FRELINGHUYSEN. There is quite a lot of our industrial complex that is focusing on this.

Mr. BRINKMAN. Yes.

Mr. FRELINGHUYSEN. I am just hoping the twains are meeting in terms of our support in a variety of different budget areas, that these scientists are talking and collaborating where appropriate.

Mr. BRINKMAN. Yes, and you know the NSF also has a nanoscience program, a fairly sizeable one, in which we talk to each other.

Mr. OLVER. Mr. Chairman.

Mr. FRELINGHUYSEN. Mr. Olver, you are batting cleanup standing between our votes.

Mr. OLVER. Oh, are we about to vote? Oh, okay.

You are talking about mesoscale and nanoscale. I was going to ask you, but you then answered that meso is micro. I was wondering, what was this? Were we going in the other direction? Are you involved in nano? No. Okay.

But you are doing the science, and once the science is done under you, under your office, then that will end up in the critical materials hub——

Mr. BRINKMAN. We would hope so. Yes, that is what we have planned.

Mr. OLVER [continuing]. Over here.

Mr. BRINKMAN. Right, but you have to be careful, right? The critical materials hub is going to look at critical materials, right? So we don't always invent new things that only use critical materials or alternative critical materials. We will be inventing things that will not just necessarily go to that hub.

Mr. OLVER. But you are going to be making the basic materials.

Mr. BRINKMAN. We will be making things that they use in various places.

Mr. OLVER. And then they are going to be figuring out how to commercialize them.

Mr. BRINKMAN. Right.

Mr. OLVER. How to make them function much more economically.

Mr. BRINKMAN. Right.

Mr. FRELINGHUYSEN. Thank you, Dr. Brinkman. Thank you for being here.

We stand adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

DEPARTMENT OF ENERGY OFFICE OF SCIENCE
FISCAL YEAR 2013 BUDGET HEARING

MARCH 20, 2012

STRATEGIC AND PROGRAM MANAGEMENT

BENEFITS TO MANUFACTURING AND JOBS

Subcommittee. Dr. Brinkman, the Administration has highlighted American manufacturing as a major theme in its budget this year—an area this subcommittee has been concerned with for a number of years. This is particularly relevant to the Department's applied research programs, but it is also very relevant to the basic science activities under your purview.

How are the choices in the budget request targeted to keep America competitive in the innovation marketplace?

Dr. Brinkman. Within the overall flat federal discretionary funding request, the increase in the Office of Science demonstrates the President's commitment to research and basic science to ensure that the United States is the global leader in clean energy science and technology and that the U.S. invests in advanced manufacturing. Three high priority areas—materials and chemistry by design, biosystems by design, and modeling and simulation—are chosen for their direct and vital linkages to enabling discovery and innovation that will strengthen our Nation's scientific leadership while having the highest potential to impact the technology sector.

Subcommittee. Can you give us some obvious examples of how the Science programs support American manufacturing, and perhaps one or two less obvious examples?

Dr. Brinkman. The long term support for basic materials and chemistry research by the Science programs has provided the broad knowledge foundation from which technology innovations in manufacturing are often spawned. One example is research on materials development through nanoscale alloy design funded by the Basic Energy Sciences (BES) program. Researchers invented a new family of aluminum alloys by using atomic scale imaging that led to the optimization of the strengthening and aging resistance of the alloys. The new aluminum alloys have been cast by the Ford Motor Company into brake rotors that replace much heavier cast-iron rotors to improve the fuel economy of its cars; the same class of alloys may also be used to replace titanium in elevated temperature applications, such as heat shields by Boeing.

As another example of the innovative research impacting manufacturing, researchers at a BES supported Energy Frontier Research Center have grown new crystalline silicon nanowires that are able to convert 90 percent of the photons they absorb into electrons. Each device contains only 2 percent silicon, with the remaining 98 percent a polymer, potentially making solar cells inexpensive to produce from this material—possibly by a roll-to-roll manufacturing process. In addition to direct research support, the suite of user facilities supported by the Office of Science can also contribute to American manufacturing.

In another example, a group of General Electric (GE) researchers used sophisticated scientific capabilities at the Advanced Photon Source at Argonne National Laboratory and the National Synchrotron Light Source at Brookhaven National Laboratory, both of which are supported by Office of Science, to understand in detail the internal chemistry of an actual commercial battery charging and discharging in real time. Additional studies of battery cross-sections helped GE engineers to further understand the system to achieve breakthroughs in energy density, charging power, and long cycle life. The insights have led directly to the development of the commercial Durathon sodium metal halide battery and the associated creation of American manufacturing jobs.

CHOOSING AREAS FOR AMERICAN SCIENCE LEADERSHIP

Subcommittee. Dr. Brinkman, the United States has a long history of leadership in science research. A key part of that leadership comes from building and hosting the world's leading science experiments and facilities. In past years, the Office of Science has run the world's largest particle accelerator, the most cutting-edge fusion experiments, and the fastest supercomputers, to name a few examples.

But building these facilities requires considerable funding. And with the need to reduce overall federal spending, we face difficult choices over where to put our limited investments. We have to ask ourselves: If we cannot lead in every area of science, then in what areas should we focus?

In what areas of science should we look host the leading infrastructure in the coming decade, and how is that prioritization reflected in the budget request?

Dr. Brinkman. It is vital that we invest wisely to be among the global leaders in most fields. The areas of focus for the Office of Science are those that are emphasized in the FY 2013 request: Basic Energy Sciences (BES), Biological and Environmental Research (BER), and Advanced Scientific Computing Research (ASCR). The BES request supports the construction of the National Synchrotron Light Source-II (NSLS-II) and its first instrument suite, and upgrades to the Linac Coherent Light Source (LCLS) and Advanced Photon Source (APS). The BER request includes support for new capabilities for the Atmospheric Radiation Measurement (ARM) Climate Research Facility that extend ground-breaking measurements in arctic and tropical climatic regions. The request for ASCR continues investments in significant upgrades to the Argonne and Oak Ridge leadership class computing facilities. Operations at existing ASCR, BER, and BES facilities are supported at near optimal levels.

Although the requests for Nuclear Physics (NP), High Energy Physics (HEP), and Fusion Energy Sciences (FES) include difficult trade-offs, each also makes strong investments in sustaining U.S. leadership. The NP request provides sufficient funds for continued planning of the Facility for Rare Isotope Beams (FRIB) project and support to keep the 12 GeV upgrade to the Continuous Electron Beam Accelerator Facility (CEBAF) on track. The FES request reflects our continued commitment to the scientific mission of

ITER, while maintaining a balanced research portfolio. The HEP request includes minimal sustaining dewatering activities in the Homestake mine while completing existing experiments and completes construction of the Neutrino Appearance (NOvA) experiment.

THE CHALLENGE OF CONSTRUCTION BUDGETS IN THIS YEAR'S BUDGET

Subcommittee. Dr. Brinkman, your budget this year is particularly challenging because a number of infrastructure projects were previously started or planned when a much higher future budget was envisioned for the Office of Science. We all know the tight budgets that we now face, and we need to adjust our plans to live within our means.

Can you address some of the main planned construction, procurement and infrastructure projects that present budgetary challenges this year?

Dr. Brinkman. All of the Office of Science planned construction, procurement and infrastructure projects presented challenges given the current fiscal climate and constrained budget environment for Fiscal Year 2013. In Fusion Energy Sciences, the ITER project increases $45.0 million to $150.0 million in FY 2013, primarily for U.S. fabrication of components for the facility. In Nuclear Physics, the Facility for Rare Isotope Beams has design funding held flat at $22.0 million. In Basic Energy Sciences, the Linac Coherent Light Source-II project increases from $30.0 million to $63.5 million, offset by a ramp down at the National Synchrotron Light Source-II. In Science Laboratories Infrastructure, the construction budget is up only $4.6 million to $109.6 million for a collection of smaller projects, of which three will be completed in FY 2013 and two new projects are initiated at a combined total of $5.0 million.

Subcommittee. What choices did you make regarding these projects in the fiscal year 2013 budget request?

Dr. Brinkman. The Administration's guiding principle while developing the FY 2013 budget for the Office of Science was to strike a balance between the goals of ensuring our Nation's future energy and economic security and preparing a strong foundation for future energy research and development activities and discovery science across all of the fields that we support.

In High Energy Physics, no additional design funding was requested for the Long Baseline Neutrino Experiment. This decision is not a judgment about the importance of the science, but rather it is a recognition that the peak cost of the project as currently proposed cannot be accommodated in the current

budget climate or that projected for the next decade given the discretionary funding caps in the Budget Control Act. To ensure that the U.S. continues its leadership in advancing this field while keeping our Nation on a sustainable financial path, DOE requested that Fermilab lead the community in the development of an affordable and phased approach that will enhance scientific understanding in this important field at each phase. Within NP we have kept the 12 GeV upgrade to Continuous Electron Beam Accelerator Facility (CEBAF) remains on track and also ensured that the Facility for Rare Isotope Beams (FRIB) has sufficient funding to progress.

Subcommittee. Do your choices regarding construction projects in this year's request tee us up to fit within tight budgetary limits in future years? Or if we fund the construction projects in the request, will we be putting the Office of Science on the hook for growing budgetary commitments in the next several years?

Dr. Brinkman. We believe that the fiscal climate will be constrained for the foreseeable future and development of future budgets for the Office of Science will continue to be a challenge. We are currently in the process of developing a plan for future Office of Science facilities as one of the Department's High Priority Performance Goals.

HARD DECISIONS, OR "SPLITTING THE BABY"

Subcommittee. Dr. Brinkman, we've said this many times today and we'll say it many more times: we've got some tough decisions to make this year. To fit within our tight budgets, some projects and programs must be cut. Your budget request proposes one way to go about this.

I can think of two approaches: first, you can focus all of the cuts on a small number of projects or programs while preserving the others. Or, you can spread the cuts across many areas.

It seems that your budget request does the latter. For example, in the fusion program, it makes a substantial cut to the domestic program, while also significantly reducing ITER funding. Likewise in Nuclear Physics, you delay FRIB construction , cut RHIC operations in half, and fail to give the Thomas Jefferson Lab project enough funding to complete construction.

Are you failing to make even more difficult decisions — and in doing so, are you "splitting the proverbial baby"?

Dr. Brinkman. A balance between new project investment and research support is required if the U.S. is to retain leadership capability in these sciences. The choices made are strategic. The balance chosen between new project investments and on-going research will enable significant progress in these projects while promoting research activities required to stay at the forefront in these fields. In combination, they will enable reaping the scientific returns that will be generated by these projects.

TRANSFERRING INNOVATION TO THE MARKET

Subcommittee. Dr. Brinkman, America's private sector economy has been the world's premier innovation engine for much of the last century — and it's often referred to as the "innovation ecosystem," in investment circles. I've heard it said that most universities and other basic research institutions do not readily have access to the nation's private sector "innovation ecosystem." The National Science Foundation is implementing its "Innovation Corps" program to help to give basic science researchers access to U.S. industry, and vice versa, through public/private partnerships.

Does the Office of Science have a similar problem with transferring innovations to the private sector?

Dr. Brinkman. The Office of Science recognizes the issues inherent in transferring scientific discoveries to the marketplace, due to the nascent nature of the technologies that arise from basic research. It is often challenging to attract private sector investment for early-stage technologies that have considerable risk and require considerable additional investment to mature. The DOE applied technology offices play an important role in supporting applied research and development to advance promising technologies and to reduce the technology risk to the point where the private sector can make informed decisions about commercial investment.

Subcommittee. What is the Office of Science doing to address this problem?

Dr. Brinkman. The Department of Energy, including the Office of Science, is actively engaged in reducing barriers for the private sector, including small companies and entrepreneurs, to access and adopt the scientific discoveries arising from and resources available at the laboratories.

The Office of Science has played a pivotal role in supporting the DOE in efforts to streamline how the laboratories are able to engage with industry, thereby accelerating technology development and deployment and more quickly reducing some of the uncertainties that give rise to the risks of early stage technology commercialization.

The Energy Frontier Research Centers (EFRCs) are active in efforts that have 'use-inspired' applications, and those entities are encouraged to engage with industry when interests are aligned with the mission of the DOE. The

Office of Science currently supports several Hubs and BioEnergy Research Centers, all of which have a large number of industry partners.

The Office of Science has held two of four planned workshops to bring together representatives from the Department, the laboratories, and industry to focus on and support collaborations in four strategic areas: Materials for Energy Research, Modeling and Simulations, Cyber Security, and Batteries. These topics were selected with industry as areas in which there is the greatest synergy between the Department's research agenda and the interests of the private sector.

The Office of Science is also planning to make greater use of its Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs to assist with technology transfer. Beginning in FY2013, topics for SBIR/STTR solicitations will include technology transfer opportunities. Small businesses will have the opportunity to apply for SBIR/STTR grants that include options to license technology developed at DOE laboratories.

IMPORTANCE OF USER FACILITIES

Subcommittee. The construction and operation of the Office of Science's user facilities are extremely expensive, but they are — to use an overused phrase that truly fits here — an engine of innovation for our nation.

How many investigators or groups use the Office of Science's facilities each year?

Dr. Brinkman. Approximately 26,500 researchers from universities, national laboratories, industry, and international partners are expected to use the Office of Science scientific user facilities in FY 2013.

Subcommittee. I understand that we're not only talking about university researchers, but companies across the country rely upon these facilities as well. What is the mix of universities, industry users, and other types of groups that are supported by your facilities?

Dr. Brinkman. In FY 2013 the Office of Science estimates that approximately 53 percent of facility users will be from universities, 4 percent will come from industry, and 43 percent will come from DOE and other U.S. Government laboratories and foreign nations.

Subcommittee. What types of industries use these facilities? What are some highlights and examples?

Dr. Brinkman. Industrial users of Office of Science scientific user facilities come from all sectors of industry.

Examples of recent highlights and results of these activities include:

- A project initiated by the California Institute of Technology that developed a new solar cell design employing advanced optics and nanotechnology to maximize performance and minimize cost. This project moved from the laboratory bench to the early stages of commercialization within one year.

- General Electric has constructed a plant in Schenectady, NY that GE estimates will create 350 jobs and will produce a new advanced line of heavy duty batteries that GE plans to sell to telecommunications

firms, utilities, data centers, and other industrial and transportation customers worldwide. To help achieve these breakthroughs, GE researchers relied on two of the Nation's most advanced and sophisticated scientific user facilities, the National Synchrotron Light Source (NSLS) at the Brookhaven National Laboratory on Long Island and the Advanced Photon Source (APS) at the Argonne National Laboratory outside Chicago.

- A team of researchers at the DOE's Joint BioEnergy Institute (JBEI), a research center led by the Lawrence Berkeley National Laboratory, has demonstrated that introducing a maize (corn) gene into switchgrass, a highly touted potential feedstock for advanced biofuels, more than doubles (250 percent) the amount of starch in the plant's cell walls and makes it much easier to extract polysaccharides and convert them into fermentable sugars. JBEI researchers, working with researchers at the U.S. Department of Agriculture's Agricultural Research Service (ARS) conducted this research.

- At Washington University, in St. Louis's Photosynthetic Antenna Research Center (PARC), scientists are exploring biological photosystems, to build both hybrids that combine natural and synthetic parts as well as fully synthetic versions of natural systems. The PARC team has succeeded in making a crucial photosystem component—a light-harvesting antenna—from scratch. The new antenna is modeled on the chlorosome, or biological antenna, found in green photosynthetic bacteria. PARC is one of 46 Energy Frontier Research Centers (EFRCs) established by the Office of Science in 2009 at universities, national laboratories, and other institutions around the Nation to accelerate advanced basic research related to energy.

A more complete description of the capabilities, accomplishments and procedures for accessing SC user facilities can be found at http://science.energy.gov/stories-of-discovery-and-innovation and http://science.energy.gov/user-facilities.

Subcommittee. Could companies build their own facilities like these?

Dr. Brinkman. In most cases, both the capital cost and the annual maintenance and operations cost of these facilities make it prohibitive for companies to undertake ownership of a major facility.

NEW AWARDS VERSUS MORTGAGES

Subcommittee. Last year, we began to discuss the issue of the Department's financial mortgages — that is, awards the Department makes which commit future-year funds. The practice of giving this type of award meant, for example, that only 6.5 percent of the 2012 budget request for the Basic Energy Sciences program was available for new grants — and that was with a $300 million proposed increase for the program.

This presents two serious problems. First, very little of your budget each year is available to steer towards new opportunities. Second, when future appropriation levels are uncertain, you are essentially promising money to grantees that you don't know you'll have. These are both problematic, and the fiscal year 2012 conference report made it clear that the Department is to transition away from committing future-year funds.

How is the Office of Science progressing in making that transition?

Dr. Brinkman. The Department has not yet made a formal determination on how to proceed with the transition away from mortgages, though we are reviewing implementation options.

Subcommittee. For comparison to last year, what percent of this year's budget request for Basic Energy Sciences is for new awards?

Dr. Brinkman. BES reviews approximately 460 ongoing research projects annually, utilizing external experts to provide over 2,000 individual reviews of performance. The turnover of research projects and areas is accelerated by the tremendous proposal pressure of new ideas that are received continuously. Success rates vary year to year, but of the approximately 90–95 percent of eligible grantees who submit renewal proposals, 10–20 percent of all BES research projects submitted for renewal are terminated. The termination of work that has reached its conclusion, is past its fruition, or has underperformed frees up funding for research based on fresh ideas. The success rate for new proposals varies significantly from year to year based on the availability of appropriations and can range from only 5% to as high at 40% in some cases, even while excluding one-time funding such as ARRA.

INFRASTRUCTURE

BALANCE BETWEEN RESEARCH AND NEW FACILITIES

Subcommittee. Each science program funds ongoing research and operations, as well as investments in future cutting-edge experiments and facilities. Much of the research relies heavily on past years' investments in facilities and equipment, while new investment in facilities enable tomorrow's research. Each year's budget must therefore be a careful balance between ongoing research and new facility investment. The budget request for Science proposes that 14% of its budget be spent on future facilities.

Is this percentage up or down from last year, Dr. Brinkman?

Dr. Brinkman. The percentage is below the FY 2012 percentage of about 15.

Subcommittee. Do you believe that 14% of the total budget is the right level of investment in future facilities?

Dr. Brinkman. There is no fixed portion of the Office of Science budget that should be invested in future facilities research and development. Future allocations of investments in research and research facility development must be evaluated within the contexts of the current fiscal and budgetary climates and competing national priorities across the broad spectrum of Federal program and policy requirements.

For the FY 2013 budget request, I do believe the Administration's request has struck a good balance among the support for our researchers, our existing scientific user facilities, and upgrades and new facilities to ensure our continuing scientific leadership.

UTILITY UPGRADE PROJECTS

Subcommittee. The budget request includes funding for two new utility upgrade projects under Science Laboratories Infrastructure, one at Fermilab and one at the Jefferson Lab. Strangely enough, these two projects were in the fiscal year 2011 budget, then omitted in the fiscal year 2012 request, and now they are again included in this year's request.

Why is now the time for each of these utility upgrades?

Dr. Brinkman. Two projects requested to start in FY 2011 had to be postponed due to the lack of an appropriation—the Utilities Upgrade project at FNAL and the Utility Infrastructure Modernization project at TJNAF. As the budget declined, the program could only support one new project start in FY 2012—the Science and User Support Building project at SLAC. The two utilities projects were not included in the FY 2012 Congressional Request because of budgetary constraints and the emergence of the higher priority project at SLAC.

FUSION ENERGY SCIENCES

REDUCTION TO PLANNED ITER FUNDING

Subcommittee. Fiscal year 2013 was scheduled to mark a large planned increase to the Department of Energy's contribution to ITER, the international fusion experiment. The plan was to increase funding from $105 million in fiscal year 2012 to $200 million in fiscal year 2013. The budget request proposes just $150 million, a $50 million reduction to our contribution. This marks a significant reduction to our contribution, while the other partner countries have been taking pains to meet their commitments.

Dr. Brinkman, does this proposed reduction to ITER funding represent a slowdown in funding for ITER, or a reduction to our overall contribution?

Dr. Brinkman. The FY 2013 request represents a $45M increase from FY 2012. The request level supports our commitment to the scientific mission of ITER, while maintaining a balanced research portfolio. We are working with our partners to accomplish this goal.

Subcommittee. Given this proposed reduction, in what fiscal years can we expect to see the highest funding contribution to ITER? Previous plans put funding in fiscal years 2014 through 2017 at nearly $300 million per year. Has that changed?

Dr. Brinkman. At Critical Decision-2 (CD-2), we will finalize the total cost, including the profile by year, technical scope, and schedule for the U.S. project commitments. Prior to CD-2, I would not want to speculate on outyear funding profiles.

Subcommittee. What impact will this reduction to ITER funding have on the United States' timeline for meeting its ITER commitments?

Dr. Brinkman. We are working with our partners to accomplish the scientific mission of ITER, and discussions are underway with the ITER Organization and our ITER partners to develop an approach that minimizes the schedule impact.

Subcommittee. Has the Department of Energy discussed this reduction to ITER funding with the ITER organization and partner countries prior to releasing the budget request?

Dr. Brinkman. Prior to the release of the FY 2013 budget request, the U.S. discussed with some partners the possibility that fiscal constraints may impact U.S. contributions to ITER; however, specific funding levels were not discussed. The ITER Organization itself did not participate in these discussions.

Subcommittee. Are the ITER organization and our partner nations concerned?

Dr. Brinkman. ITER Members and the ITER Organization expressed concern about the project's cost and schedule, including the implications of the US budget proposal. Analysis by the U.S. ITER Project Office, the ITER Organization, and the other Members indicates that this budget proposal will support the schedule for ITER construction.

Subcommittee. Do you see any evidence that any of ITER's partner countries will not meet their expected financial commitments?

Dr. Brinkman. The partner countries are in a diverse set of circumstances. While, to our knowledge, all partners have secured funding ITER funding for the next year, several nations do not yet have budgets in place beyond 2014. We expect that, like the U.S., our partners are committed to the scientific mission of ITER and that their ability to meet financial commitments will remain subject to political or economic changes.

REDUCTION TO DOMESTIC FUSION ENERGY PROGRAM

Subcommittee. The budget request reduces funding for our domestic fusion energy program by about $49 million — a major cut. ITER, the international fusion experiment , obviously represents a large investment and leap forward, but the United States' domestic fusion energy program has played—and continues to play—a critical role in progress towards using fusion as an energy source. It is important that we continue to invest in our domestic program to ensure that our experiments and scientists support progress towards fusion energy, and to ensure that our scientists and engineers continue to be the world's best.

How do our domestic magnetic fusion experiments and assets compare to fusion experiments in operation or construction in other countries?

Dr. Brinkman. The U.S. has three major domestic fusion facilities. They enable U.S. leadership in many aspects of magnetic confinement fusion research.

The DIII-D facility at General Atomics is the largest tokamak fusion research experiment in the U.S. and arguably one of the most significant magnetic confinement experiments in the world, enabling U.S. world leadership in the fusion energy sciences. DIII-D has considerable experimental flexibility and also extensive world-class diagnostic instrumentation to measure the properties of high-temperature plasmas. Characteristics of the facility include a highly flexible field-shaping coil system to produce a wide variety of plasma shapes, all-carbon plasma-facing material, coil sets both inside and outside the vacuum vessel that are used to correct error fields and study the plasma response to perturbing magnetic fields, a broad range of auxiliary heating and current drive systems, over 50 state-of-the-art diagnostic systems to examine plasma parameters, and an advanced digital control system for feedback control of plasma. Its program has substantial reach domestically and internationally, with participation of over 300 researchers from 100 institutions in 22 countries. The American Physical Society (APS) has given four Awards for Excellence in Plasma Physics for work conducted on DIII-D, and 43 scientists who conduct DIII-D research have been elected Fellows of the APS. The DIII-D program is the leading choice of the ITER Organization when it comes to answering scientific and technical questions for the project.

The National Spherical Torus Experiment (NSTX) at Princeton Plasma Physics Laboratory is a national scientific user facility designed to explore the physics of plasmas confined in the spherical torus (ST) configuration. It makes unique contributions to the scientific understanding of magnetic confinement in the areas of electron energy transport, liquid metal plasma-material interfaces, and energetic particle confinement for burning plasmas. Its program is also highly collaborative, with over 250 researchers from 40 institutions in 9 countries. NSTX is the world leader in the study of very compact, low-aspect-ratio tokamaks, which are a strong candidate as a future compact source of fusion neutrons for fusion materials research. After the upgrade currently in progress, NSTX will be the world's defining experiment to assess whether this geometry is viable as a volumetric neutron source.

The Alcator C-Mod facility at the Massachusetts Institute of Technology is unique in the U.S. (and world) because it is specifically designed to operate at very high magnetic field strengths. With its compact size, this means that C-Mod has the highest-in-the-world heat fluxes to plasma-facing components, which allows it to explore this physics. C-Mod also is a major contributor to radiofrequency heating of plasmas, and it has metallic (rather than graphite) first-wall materials.

In the last 15 years, the other six ITER Members have been investing in major new magnetic-confinement fusion facilities, even as they also invest in ITER. These new facilities have the potential to surpass the capabilities of U.S. facilities in certain respects over the next decade and beyond. Therefore, it is advantageous for the U.S. to increase its engagement in international facilities, especially those where we have been invited to participate. This requires that the U.S. continue to have a strong domestic program with which to develop its research themes and its scientific expertise.

The United Kingdom (U.K.) is home to the largest tokamak in the world, the Joint European Torus (JET), which is operated as a pan-European experiment. JET is the only existing tokamak that can operate with the deuterium-tritium fuel that ITER will use. The U.K. also has an experiment, named Mega Amp Spherical Tokamak (MAST), at Culham Laboratory, which is comparable in scope and complementary in capability to the NSTX facility at Princeton.

Superconducting magnet technology provides a tool through which important leading frontiers in magnetic fusion will be confronted. Most notable is the challenge to extend fusion plasma duration to thousands of seconds and beyond. The U.S. does not have a facility with this capability, although advanced designs were developed and proposed for construction by the U.S. in the 1990's. However, the world has two new facilities with this superconducting magnet technology, the Korea Superconducting Tokamak Advanced Research (KSTAR) facility in Korea and the Experimental Advanced Superconducting Tokamak (EAST) facility in China. Two more are being built (three if ITER is included): in Germany, a billion-dollar-class superconducting stellarator called Wendelstein 7-X (W7-X) is nearing completion, and Japan, even amidst the tremendous upheaval that accompanied their recent natural calamities, remains on track to complete the construction this decade of a multibillion-dollar superconducting tokamak (JT-60SA), which will be second only to ITER in its scientific capabilities.

These will join a non-superconducting German tokamak, called the Axially Symmetric Divertor Experiment-Upgrade (ASDEX-U), which is comparable in scale to the DIII-D facility in the U.S., although it has different plasma-facing materials and is somewhat less flexible. Also in the EU, there is a superconducting tokamak in France, Tore Supra, which is a leader in the challenging arena of fusion plasma materials. Japan already has a billion-dollar-class stellarator, named the Large Helical Device (LHD). The Russian Federation has indicated that it has the funding for a new magnetic confinement facility in its fusion program, which will develop the operating scenarios of a fusion neutron source. Finally, India has constructed a superconducting tokamak.

Subcommittee. Do you believe the domestic fusion program is provided sufficient funding in the budget request to maintain its position as a global leader?

Dr. Brinkman. The proposed budget was developed with a long-term vision for the non-ITER part of the Fusion Energy Sciences program. It positions the program to maximize the scientific return of our investment in ITER; address gaps in materials science required for harnessing fusion energy; and continues to steward the broader plasma sciences, taking advantage of cross-agency synergies. It also provides opportunities for U.S. scientists to do research on new billion-dollar-class international

superconducting facilities. The proposed budget will allow the U.S. to continue to have a dynamic domestic fusion program with high impact.

Subcommittee. The request proposes to terminate support for the Alcator C-MOD facility at MIT. What was your reasoning for terminating that facility and continuing the others?

Dr. Brinkman. The decision to terminate one of the largest three U.S. facilities—the Alcator C-Mod facility at MIT, the DIII-D facility at General Atomics, or the NSTX facility at Princeton Plasma Physics Laboratory—was in part driven by the obligation of the Office of Science to preserve the breadth of the Fusion Energy Sciences program in this challenging budget. Nurturing the plasma sciences that both includes and reaches beyond magnetic fusion is a recommendation urged by the National Academies. Although the FY 2013 Budget Request proposes to terminate support for the Alcator C-Mod facility at MIT, this choice preserves approximately 40 smaller university programs in the plasma sciences in FY 2013.

Regarding the choice among the three large facilities, the judgment was made in part based on the potential for world leadership by the remaining two facilities as a synergistic pair given our long-range goals, including the potential for advancing the U.S. program not only in ITER research but also in fusion nuclear science, a gap identified by the Fusion Energy Sciences Advisory Committee where the U.S. can assert world leadership. To be sure, the Alcator C-Mod closure will present technical losses on the national and world stage. However, the factors mentioned above in the context of preserving program breadth as well as overall Science portfolio balance contributed to our judgment in making this difficult decision. Continuing operation of the DIII-D and NSTX facilities will maintain and establish U.S. leadership in the areas of advanced tokamak and spherical torus physics as a scientifically powerful tandem that will be highly relevant to both ITER and to the design and mission choice for a future fusion nuclear science facility.

Subcommittee. What, if any, benefit would there be to continuing this project?

Dr. Brinkman. One of the major issues for ITER and any future fusion facility is the ability to handle high power loading on all-metal wall materials. Alcator C-Mod is unique in the U.S. in its operation with all-metal walls and complements the capabilities of some international research

endeavors in this arena, and would distinguish itself in very high-temperature wall operation if the program were continued. The scientific questions that would be explored under these conditions are relevant to ITER. Beyond this and other scientific questions to which the MIT program contributes, the MIT program joins other university programs in student education and training in the fusion and plasma sciences. At present, it sponsors 29 graduate students out of the more than 400 students (about 260 full-time equivalents) who are supported in the national Fusion Energy Sciences program.

Subcommittee. What is the level of funding that would be necessary, and are there upgrades that would be necessary to get the full benefit the C-MOD facility?

Dr. Brinkman. Total annual program funding of approximately $29 million (similar to the FY 2012 level) would be required to continue the C-MOD facility program. The necessary upgrades (including a tungsten divertor to enable the class of research mentioned above) are included in this funding level.

Subcommittee. Princeton began a significant upgrade to their fusion facility in fiscal year 2012. When the upgrade is complete, how will that facility stack up against facilities around the world?

Dr. Brinkman. When it is complete, the NSTX-Upgrade (NSTX-U) will be the leading spherical torus in the world, in terms of heating power, flexibility, control capability, and diagnostic instrumentation. The resultant physics studies that will be enabled will put NSTX-U in a class by itself for a facility of this configuration, as it will permit study of plasma conditions relevant to a possible future fusion nuclear science facility. At the conclusion of the upgrade construction, NSTX-U and DIII-D will form a world-leading, powerful scientific tandem by virtue of their well-chosen complementary capabilities, which can be exploited in ITER-relevant research. Compared to other spherical torus experiments in the world, NSTX-U will be second to none. At its inception, NSTX was designed to be complementary in many ways to the MAST facility in the U.K., the only other large spherical torus in the world. For example, NSTX has explored different start-up methods, different techniques for sustaining the electrical current in the plasma, and different configurations and materials for handling the power exhaust from the plasma. With the upgrade of NSTX, these

complementary studies will be even more effective. By collaborating closely with MAST, the NSTX team will be able to thoroughly evaluate the long-term potential of the spherical torus configuration.

Subcommittee. How will Princeton's facility contribute to the ITER effort?

Dr. Brinkman. By the time NSTX-U resumes operation, all of the ITER design decisions will likely have been made and consequently the focus will be on developing operating scenarios and research plans. NSTX-U will be able to contribute to these endeavors in several ways. NSTX-U will have an advanced control system and will be able to evaluate advanced operating scenarios for ITER. It will also be able to evaluate techniques for disruption mitigation and edge localized mode control. Because of its low magnetic field, it can also study a type of instability driven by fast particles in the plasma—in NSTX-U the fast particles will be injected from the outside by neutral beams, whereas in ITER the fast particles will be the so-called alpha particles produced by the internal fusion reactions. During the past several years, NSTX has typically participated in about half of the projects of the International Tokamak Physics Activity (ITPA), which conducts joint research in support of ITER design and operation.

SENDING AMERICAN FUSION SCIENTISTS OVERSEAS

Subcommittee. Dr. Brinkman, the budget request puts a substantial crunch on our domestic fusion program, which your request reduces by $49 million — a 16 percent cut. All of the increases in the fusion program are for ITER, an international project hosted in France. At the same time, we've heard reports that you've explored shipping American fusion scientists overseas to do their work at facilities in Korea and other nations.

Dr. Brinkman, how can our nation's fusion program survive — much less thrive as a global leader — when we're considering not only reducing funding, but shuttering our own facilities and sending our scientists overseas?

Dr. Brinkman. The scale of the cost of fusion facilities has reached the point where collaboration is essential. We can remain globally competitive by making sure that we maintain core competencies in key areas and that our scientists have access to the best facilities in the world. Around the globe, several nations have invested in billion-dollar-class facilities using superconducting magnet technologies. Such experiments have not been constructed in the U.S. It is essential that U.S. scientists have access to these programs so as to be engaged as the programs mature and present new scientific opportunities only available overseas at such facilities. The potential payoff from modest investment is great, and any international efforts will lever U.S. capability in a manner that amplifies U.S. leadership in areas of worldwide interest. The recent Fusion Energy Sciences Advisory Committee Report *International Collaboration in Fusion Energy Sciences Research: Opportunities and Modes* suggested that an effective mode of international collaboration would be to explore operating limits and control techniques in the flexible and well-diagnosed U.S. facilities and collaborate in extending the promising modes of operation to long-pulse superconducting facilities abroad.

DIFFERENTIATING ITER FROM EXISTING FUSION EXPERIMENTS

Subcommittee. ITER, the international fusion project, represents a massive international financial commitment to a single fusion project that we hope will move the prospect for fusion energy forward significantly.

I understand that the estimated cost for ITER, including contributions from 6 countries and the European Union, is around $21 billion. Dr. Brinkman, can you articulate how this project is worth the price tag? In other words, what makes it so different than the ongoing magnetic fusion experiments in the United States?

Dr. Brinkman. ITER, with its unique set of operating parameters, represents the capstone of over two generations of magnetic fusion research, and will enable the first-ever studies of the science of burning plasmas; plasmas in which the energy released from fusion exceeds the energy required to initially heat and control the plasma itself. The 2004 NRC study, *Burning Plasmas: Bringing a Star to Earth*[1], underscored the readiness and opportunities for the U.S. to participate in a magnetically confined burning plasma experiment such as ITER.

The fusion research community works together to minimize facility duplication among international facilities. ITER was a result of a widespread consensus that a machine of ITER's capability would enable the next steps on fusion research.

Subcommittee. If ITER comes online and operates as we hope near the end of the decade, what will differentiate ITER from a full-fledged fusion energy power plant? In other words, what scientific and technical hurdles lie beyond ITER, and how long do you speculate it will take to overcome them?

Dr. Brinkman. ITER aims to provide scientific information on burning plasma behavior that is necessary to design a magnetically confined fusion energy facility. There will still, however, be significant challenges that must be addressed for fusion to make a viable energy source. The most significant of these challenges include developing the materials that can withstand the harsh environment inside the fusion chamber on the timescales required to be viable commercially and advancing the science that will

[1] Available at http://www.nap.edu/catalog.php?record_id=10816.

enable harnessing fusion power and closing the fuel cycle. This challenge was identified in a recent Fusion Energy Sciences Advisory Committee report as a significant gap in the Fusion Energy Sciences program. Starting in FY 2012 and continuing with the FY 2013 request, the Fusion Energy Sciences program has begun a modest initiative to begin to address that challenge. How quickly these questions can be resolved will depend in part on the level of investment and the technical risk that the U.S. and other national programs are prepared to assume and on any hurdles that research efforts might uncover.

TECHNICAL STATUS OF ITER PROJECT

Subcommittee. ITER, the international collaboration to develop a large-scale fusion energy test reactor in southern France, has had significant funding and management challenges but appears to making some significant progress in the last year or two.

Where are we in the timeline towards the completion of the project? What work is currently being done towards design and construction?

Dr. Brinkman. Construction at the ITER site is underway. The main tokamak building foundation has been poured and seismic isolation work has been completed. The large poloidal field coil assembly building is complete. The headquarters building should be complete by the end of the year. The U.S. and the other ITER Members have placed a number of early procurements and will begin placing mid phase procurements over the next couple of years. To support our commitments to the scientific mission of ITER, while maintaining a balanced portfolio, we are developing a project schedule and will work with our partners to achieve this goal. Currently in the U.S., work is underway to assemble the Central Solenoid magnets, the toroidal field conductor, and the cooling water system for ITER.

Subcommittee. Dr. Brinkman, what do you think are the most difficult and risky hurdles between now and taking ITER online?

Dr. Brinkman. Like any major construction project, ITER will face challenges in all project areas—technical scope/design, cost, schedule, and management. The Office of Science has well-established protocols for reviewing construction projects against its baselines, and we will closely watch all of these issues with ITER.

Subcommittee. Have there been any unexpected "hiccups" as the United States begins its contracted work to build the central solenoid and other parts?

Dr. Brinkman. There have been "hiccups" with the Central Solenoid (CS), which is a critical component in ITER to control the plasma and maintain its stability. Given its important role, the CS coils must perform reliably. There has been extensive testing of the superconductor that was specified by the ITER Organization to determine whether it will meet the

full specified duty cycle during operations. After several rounds of testing a number of different superconductor samples, there remains some question as to whether the superconductor will meet this duty cycle. The issue is being addressed by high-level technical teams, and we expect the issue to be resolved in time for CS coil fabrication.

Subcommittee. How would the Administration's proposed funding level of $150 million in fiscal year 2013 affect procurement plans for the United States' components?

Dr. Brinkman. The FY 2013 requested funding level of $150 million is sufficient to support U.S. commitments to ITER.

Subcommittee. The estimated total cost for ITER has exploded significantly since its original estimates. In the past, we've seen that large Science construction projects keep to their budget by reducing the scope of the project. With the assumption that the ITER partner countries simply cannot bear more cost increases, do you see a risk that the scope of the ITER project could be scaled back significantly?

Dr. Brinkman. The cost of the U.S. Contributions to ITER project has increased, but the DOE and the U.S. ITER Project Office are working to keep those costs under control, while maintaining the scientific mission of the facility. Some of the efforts to date include value engineering, working with component manufacturers to drive down costs, and examining potential scope deferrals.

CONTRIBUTION TO ITER GOES PRIMARILY TO AMERICAN JOBS

Subcommittee. The United States is slated to contribute a total of nearly $2 billion to ITER. With such a large cost for an experiment that will located overseas, it seems prudent to take a moment to discuss where that funding will go.

Dr. Brinkman, can you describe where exactly most of our contribution to ITER is going?

Dr. Brinkman. We estimate that 80% of the U.S. ITER funding will be spent in the U.S. This includes the costs of the U.S. in-kind commitments, research, development and design efforts, and the cost of U.S. ITER Project Office personnel. In addition, other ITER Members are providing funding to U.S. industry, as well as DOE laboratories, to support their in-kind commitments. For example, the European Union (EU) has let a contract to Oxford Instruments (New Jersey) for superconducting strand ($58 million), and Luvata (Connecticut) is supplying toroidal field magnet coil strand to the EU ($28 million).

Subcommittee. Given that the lion's share of our contribution will be given by providing various components critical to the ITER project, can you describe exactly who is making those components? Is the Department of Energy using American labs? American companies? Foreign companies?

Dr. Brinkman. Of the dollars obligated to date in procurement actions for hardware, R&D, and services, 98% have been spent in the U.S. at laboratories and universities and in private industry. The hardware procurements placed so far are all with U.S. companies and include toroidal field conductor strand (being produced by Oxford Superconductor, with the cabling to be done by New England Wire Technologies); ITER cooling water system drain tanks (being procured through AREVA-U.S. with various subcontractors around the U.S.); and design tooling, and fabrication of the central solenoid (awarded to General Atomics). Other hardware contracts are still in process; we expect that the bulk of future orders will also be placed with U.S. performers.

Subcommittee. Have ITER procurement orders within the United States impacted American industry, or provided additional manufacturing opportunities beyond the U.S. contribution to ITER?

Dr. Brinkman. Yes, we are aware of two superconducting strand procurements placed in the U.S. by other ITER Members. Also, Princeton Plasma Physics Laboratory and Savannah River National Laboratory are doing work for the ITER Organization under Work for Others (WFO) arrangements. In addition, U.S. laboratories and companies have received work from the ITER Organization and the European ITER Domestic Agency valued at more than $75 million.

STATUS UPDATE ON INERTIAL FUSION ENERGY

Subcommittee. More than a year ago and a half ago, the Department commissioned the National Academies to study the viability of inertial fusion as an energy source, and to map out possible paths forward for a Departmental research program. Though the study is not yet complete, an interim report was issued earlier this month with some indication of the National Academies' recommendations.

Dr. Brinkman, I believe this interim report recommended that the NNSA's National Ignition Facility be used in part to investigate fusion energy. What was your takeaway from this interim report about the viability of an inertial fusion energy program, what facilities it would use, and who should manage it?

Dr. Brinkman. The interim report from the National Academies of Science (NAS) recognized that despite significant advances in inertial confinement fusion, it is still too early to choose a particular driver approach for inertial fusion energy. However, the current National Ignition Facility (NIF) laser, while not specifically designed for inertial fusion energy (IFE) study, still provides an important tool for exploring inertial fusion ignition science. Other facilities, operated by both NNSA and Office of Science, could be utilized by an IFE program to address the full range of IFE science and technology research issues. The current High Energy Density Laboratory Plasma (HEDLP) program within the Fusion Energy Sciences program is positioned to address the fundamental scientific issues necessary for the realization of IFE, and to continue to support the broader community of high energy density science.

Subcommittee. In his testimony in front of this Committee earlier this month, Tom D'Agostino of the National Nuclear Security Administration indicated that, even in the event that ignition is not achieved, the National Ignition Facility can provide very useful data for the upkeep of our nuclear weapons. Is that the same case for inertial fusion energy, or are we out luck if we can't demonstrate ignition?

Dr. Brinkman. Regardless of achieving ignition on this machine in the initial proposed time frame, the NIF is currently reaching conditions never-before-attained in a laboratory inertial fusion facility. Experiments exploring the ignition regime are providing valuable information relevant to

evaluating the prospects for an IFE program. In the absence of ignition, NIF and supporting research nationally can explore those scientific issues that have surprised researchers, and this in itself has value.

Subcommittee. Beyond the difficulties in achieving ignition at the National Ignition Facility — which we as a Subcommittee covered more in depth when we discussion the nuclear weapons budget — what are the main challenges involved with using inertial fusion for energy production?

Dr. Brinkman. At present the additional challenges facing the use of inertial fusion for energy production are many, including driver type and efficiency, routine and cost-effective target production, chamber design, energy capture, tritium breeding, facility lifecycle, and radiation resistant materials. There is opportunity to address some of these uncertainties through leveraging investments made in magnetic fusion materials and technologies. However, although these challenges will eventually be critical to establishing a viable IFE program, the challenge of understanding the fundamental high energy density science that underpins IFE should be the near-term focus.

RETAINING FUSION EXPERTISE THAT DOESN'T FIT DOE MOLD

Subcommittee. Dr. Brinkman, we've put some attention in the past several years on the holes in DOE's fusion programs. The NNSA conducts research into inertial confinement fusion for weapons purposes, and the Office of Science supports research for magnetic confinement fusion. There are other avenues and hybrid approaches, however, that have traditionally not had a stable home at the Department, and yet other approaches that have not had a home while the Department mulls over whether to pursue an inertial fusion energy program.

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?

Dr. Brinkman. The Department of Energy will provide opportunity for groups, including the Naval Research Laboratory (NRL), to continue their research by issuing competitive, peer-reviewed funding opportunity announcements to which they are eligible to apply. It is through rigorous peer review that we will maintain and ensure that the highest quality science is supported by the Department. A solicitation for applications in high energy density laboratory plasma science was held in FY 2012, for which researchers from NRL were eligible, and another is planned for FY 2013.

Subcommittee. What other hybrid or alternative approaches are out there that the Department is supporting, and what ideas are you not supporting?

Dr. Brinkman. Fundamental research into hybrid and alternative approaches to inertial fusion supported by the Department, such as heavy-ion fusion, magnetized-target-fusion, and high-gain advanced designs like fast-ignition, are being reviewed through competitive solicitations in FY 2012 and FY 2013. Although the Department does not have the resources required to support research into every hybrid or alternative approach to inertial fusion, the Department has not down-selected against any particular approach. Funding decisions will be informed by the conclusions and recommendations from the NAS Committee on Inertial Fusion Energy.

BASIC ENERGY SCIENCES

INCREASES FOR MESOSCALE AND MATERIALS BY DESIGN

Subcommittee. The budget request proposes $62 million for two new Basic Energy Science initiatives: $42 million for so-called "Mesoscale science," and $20 million for "Materials and Chemistry by Design."

Since most of us on the subcommittee are not chemists, biologists, or physicists, can you explain these two new initiatives?

Dr. Brinkman. These two new activities are both aiming at enhancing the role of science in supporting a clean energy agenda. The $42 million request for nanoscale to mesoscale sciences for clean energy will develop a deeper understanding of structure and properties across many scales: from atomic and molecular scales, through the nanoscale, and into the mesoscale.

The mesoscale, the size regime of hundreds of nanometers, is a region of transition, where the quantum and nanoscale regions give way to the classical macroscale region. We have quantum mechanics to understand the atomic and nanoscale and classical physics to understand the macroscale, but the mesoscale remains relatively unexplored. The mesoscale science opportunity embraces and exploits the enormous foundation of nanoscience understanding and expertise that the community has laid over the last decade. While science and engineering at the nanoscale has enabled us to develop materials with new properties, the next step is to understand and manipulate how these materials behave at the next largest scale—the mesoscale—to lay the foundation for creating the next generation of devices and processes.

Uniquely mesoscale phenomena are pervasive in the materials world; understanding their occurrence, operation, and potential would be a powerful step forward for science and technology. Beyond opening a new area of science, the opportunity for new, cheaper, and more efficient technologies and solutions to societal problems is significant and timely. The mesoscale is also the critical length scale linking nanoscale innovations to macroscale processes—imagine applying atom-by-atom precision and control to manufacturing processes for tailored functionalities. In the realm of energy, this means science-based innovations in direct conversion of solar energy to fuels, in effective storage and transmission of electrical energy, in carbon capture and sequestration, and in the efficient use of energy. For example,

the development of nanomaterials that are porous on the mesoscale will improve the power density, efficiency, and throughput of next generation energy storage and conversion materials, and thus it has game changing potential. Another unique aspect of mesoscale science is the opportunity to create new multi-component 3-dimensional composites based on nanoscale building blocks. The new class of materials that exhibits emerging functionalities and properties—electronic, mechanical, optical, catalytic, and magnetic—can impact many application fields.

The $20 million request for "Materials and Chemistry by Design" was primarily motivated by the fact that the discovery of new materials has been an engine driving science frontiers and fueling technology innovations. The core of the activities is to provide the Nation with a science-based computational tool set to rationally predict and design materials and chemical processes to gain a global competitive edge in scientific discovery and innovation. Specific emphasis will be on new software tools and data standards to catalyze a fully integrated approach from material discovery to applications.

Subcommittee. Are these two initiatives a step more applied than the other research that already exists in the Basic Energy Sciences program?

Dr. Brinkman. Both of these basic research activities will have a strong use-inspired science component that aims at contributing to the clean energy agenda. These efforts further enhance the existing BES research activities, which maintain a balance of grand challenge science, discovery science, and use-inspired science as defined by the series of strategic planning activities under the auspices of the BES Advisory Committee (http://science.energy.gov/bes/news-and-resources/reports/basic-research-needs/). Use-inspired science is not applied research, but describes basic research seeking fundamental understanding that is motivated or inspired by considerations of practical use.

Subcommittee. What are some potential applications of these proposed research areas?

Dr. Brinkman. Both activities will likely have a broad impact on energy production, storage, and use. For example, the research may result in better ways of tapping sunlight, storing electricity, or making fuel from splitting water or the chemical reduction of carbon dioxide. Addressing the

mesoscale science challenges will also contribute to innovations in manufacturing science

Subcommittee. Last year's budget request included $40 million for a new multi-agency effort in Basic Energy Sciences called "computational Materials and Chemistry by Design." How was that proposal different that the proposal this year? Or is it the same initiative?

Dr. Brinkman. The two proposed activities shared the common goal of launching a new era of predictive modeling for rational materials and chemistry by design. The request in FY 2013 is lower in funding level and is more narrowly targeted towards new software tools and data standards to catalyze a fully integrated approach from material discovery to applications.

DISREGARDING CONGRESSIONAL DIRECTION

Subcommittee. The budget request for fiscal year 2012 asked for $97 million within Basic Energy Sciences for Major Items of Equipment — or "MIEs". The final conference report passed by the Congress in December provided $97 million, explicitly providing funding for each of the six MIE projects at the levels in your budget request.

Dr. Brinkman, how much is the Department allocating to these Major Items of Equipment in fiscal year 2012?

Dr. Brinkman. The Basic Energy Sciences program allocated $73.5 million for major item of equipment projects in FY 2012.

Subcommittee. So in spite of the Congress' direction for $97 million to go to these projects, the Office of Science went a different direction and provided only $73.5 million. In fact, your 2013 budget request formally—and incorrectly—states that the lower $73.5 million was appropriated in fiscal year 2012. It begs the obvious question of where the rest of the money went, and why your office changes this amount. Of the six projects in the request and that the Congress funded, what did you cut to get to your number?

Dr. Brinkman. Four of the six MIE projects were fully funded in FY 2012. Two of the MIE projects—the Spallation Neutron Source Power Upgrade Project (PUP) and the Transmission Electron Aberration-corrected Microscope II (TEAM II) projects—were not funded. The decision not to proceed with the two projects was based primarily on unfavorable reviews of the technical merits, scope, and funding requirements of the projects. The extensive technical and cost reviews on the PUP and TEAM II projects clearly indicated that neither project was suitable for funding, and hence they were deemed low priorities in the overall BES portfolio. BES plans to use the funding provided for these two MIE projects to substantially increase the utilization of the suite of scientific user facilities in FY 2012.

Subcommittee. Your office's explanation for this shift of funding is, and I quote, "Without this funding, the SNS operations and user support would have been significantly reduced." Out of a Basic Energy Sciences budget of $1.7 billion, of which $1.5 billion is research, how could you not

find $11 million for the operation in these two areas, but instead ignore congressional direction to solve the problem?

Dr. Brinkman. The DOE decision to not continue the SNS PUP and TEAM II was made solely on the lower-than-expected technical merits and soundness of the two MIE projects. The use of the $23.5 million to alleviate the shortage of operating funding in FY 2012 for the SNS and the other BES user facilities—balanced amid competing priorities for all activities in the BES program—represents the best use of these appropriations for taxpayers in keeping with the broad objectives of the MIEs for which the funds were requested.

Subcommittee. Dr. Brinkman, it is deeply concerning that within this program's research budget of $1.542 billion, you could not follow the only direction the Congress provided — direction that simply reiterates your request. It is even more of a concern that this may be a symptom of a broader problem. Can I have your assurance that you will ensure that all explicit congressional direction is followed?

Dr. Brinkman. I sincerely apologize for the gap in timely communications and will work to ensure we do better in the future. Should deviation from congressional direction be considered in the future, for programmatic or technical considerations, we will consult with Congress in a timely manner.

ADDING PROGRAMS WITHOUT CONFRONTING TRADEOFFS

Subcommittee. Dr. Brinkman, throughout the last several budget requests, the Department has proposed a number of new initiatives. But rather than proposing to end some programs to pay for these new ones, the Department usually proposes to simply add the new initiative on top of the existing Science programs. This has been a point of frustration for thus Committee, since we do not have the luxury of adding more and more funding to your overall budget.

We see this again in the fiscal year 2013 budget, specifically with the $92 million in new Basic Energy Sciences research activities that I mentioned before. Rather than shifting focus from lower-priority areas within Basic Energy Sciences to these new areas, you propose to add them on top of existing research. Aren't you avoiding real tradeoffs when you do this?

Dr. Brinkman. The research increases in the Basic Energy Sciences (BES) program support the President's goals for the advancement of clean energy technologies, which also includes proposed FY 2013 DOE increases in the Office of Energy Efficiency and Renewable Energy and the Advanced Research Projects Agency-Energy. These proposed funding increases for clean energy technologies are part of a limited set of government-wide initiatives in FY 2013 that target scarce federal resources to areas critical for growing the economy and restoring middle-class security.

The President has proposed these increases on top of existing programs that have proven track records of accomplishments for the highest potential payoff. The tradeoffs for the President's top new priorities have been considered government-wide within an overall flat discretionary budget, and the Department of Energy and Office of Science have contributed to the offsetting reductions.

LIGHT SOURCES

Subcommittee. Dr. Brinkman, the "light sources" are particular kind of user facility hosted by the Office of Science, and our inventory includes major light sources at the Argonne National Lab and SLAC at Stanford.

What, scientifically, do the light sources let us do?

Dr. Brinkman. X-rays are an essential tool for studying the structure of matter and have long been used to peer into material through which visible light cannot penetrate. The hallmark of modern synchrotron light sources is their breadth of impact across a broad spectrum of science areas including biology, chemistry, environmental sciences, geosciences, health science, materials science, and physics. For example, light sources make it possible to understand the chemical and physical properties of advanced materials which in turn enable the design of new materials for use in energy technologies such as batteries, catalysts, and photovoltaic cells. The novel insights obtained on the structure of complex biological molecules through the use of ultra-bright light sources allow us to engineer new pharmaceuticals to combat disease and enhance our quality of life. The suite of synchrotron light sources operated by Basic Energy Sciences provides these unique research tools to all innovators in the U.S. science and technology enterprise, including industry, national laboratories, and universities. From the global competitiveness perspective, the prevailing and far-reaching impacts of light sources have indeed made them one of the most popular modern tools of science and technology with international competition to maintain world leadership in light source capabilities.

Subcommittee. What does the new generation of light sources allow us to do that we could never do before?

Dr. Brinkman. The new generation of light sources will provide extreme brightness together with unprecedented energy, spatial, and temporal resolutions to unlock new avenues of research. The Linac Coherent Light Source at the SLAC National Accelerator Laboratory offers an entirely new type of light source—an x-ray free electron laser, which delivers revolutionary new capabilities to determine 3-dimenstional structures and open the door to new structural studies of reactions by taking consecutive ultra-fast snapshots of the atomic structure with light pulses lasting only a few quadrillionths (10^{-15}) of a second.

In the case of the National Synchrotron Light Source-II, under construction at the Brookhaven National Laboratory, this state-of-the-art, medium-energy (3 billion electron-volt) electron storage ring source is designed to deliver world-leading intensity and brightness, which will be combined with cutting-edge beamline optics and detectors to push energy and spatial resolution to new limits. The future nano-probe beamline aims to enable x-ray experiments with an ultimate goal of about 1 nanometer spatial resolution for probing the nanoscale interfacial structures critical in determining properties and functionalities of material and biological systems.

Collectively, these new capabilities will significantly advance our knowledge across the diverse disciplines light sources serve and fuel future innovations in a wide range of technologies and applications. For example, ultrafast X-ray pulses with high repetition rates will help reveal the chemical dynamics of charge distribution across molecules and reactions associated with changing incident solar flux on a material. This knowledge could help identify optimal pathways for efficiently converting sunlight to electricity and fuels in artificial systems. For catalysis research, the new generation of light source will offer coherent imaging capabilities to follow changes in the structure of catalytic sites during catalytic conversion. This insight could facilitate the discovery of novel reaction pathways to make more selective and more efficient catalysts.

Subcommittee. What's down the road? What will the next generation of light sources let us do that we can't do now?

Dr. Brinkman. Future light sources will enhance both the quality and quantity of the light beams to provide precise control of light-matter interactions at the quantum level and on timescales never before possible. They will provide fully coherent light beams akin to those available in conventional lasers but with wavelengths that are four or five orders of magnitude shorter to be able to peer inside individual atoms and pulse lengths that are two or three orders of magnitude shorter to simultaneously freeze the motion of individual atoms. The quality and the intensity of the beams will allow us to image a single biological molecule with one light pulse; a complete discovery science experiment done in less than a quadrillionth of a second. We will be able to knit together a series of precise snapshots to generate flipbook-style movies of the folding of complex biological proteins or the evolution of a phase transition in a high

temperature superconductor and thereby expand our understanding beyond the just the structure of atoms to now include dynamics and function. With the ability to probe both the ultra-small and the ultrafast worlds, we will design, fabricate, and control advanced materials and chemical processes with designer functionalities. These new light sources, which will include free electron lasers together with ring-based sources, will themselves be examples of the best that science and technology can offer.

ADVANCED PHOTO SOURCE UPGRADE

Subcommittee. The budget request includes funding for the second year of an upgrade project at the Advanced Photon Source. This is a $390 million upgrade that is just getting underway.

What will we get for this upgrade? What benefits will the science community and industry see, and will we have to wait until the upgrade is complete in 2020?

Dr. Brinkman. The Advanced Photon Source Upgrade (APS-U) project will provide significant technical enhancements in the hard x-ray range, particularly above 20 keV. More than a dozen new or upgraded beamlines will be built in areas such as high energy diffraction, in situ studies of materials synthesis, phase contrast imaging, and ultrafast diffraction and spectroscopy, providing the ability to image inside materials with spatial resolution down to the nanometer range, and observe processes with time resolution down to the picoseconds regime. The combination of these traits will propel APS as a world-leading machine for many years to come.

The APS upgrade will advance the science made possible with hard x-rays further into the ultrafast and ultrasmall and advance the state of the art for large scale user facilities and advanced instrumentation. Areas of emphasis will be the use of penetrating, high energy x-rays for atomic-scale studies of real materials in real time under real conditions, the imaging of hierarchical structures on length scales from millimeters to nanometers, and ultrafast studies of chemical and physical processes on time scales down to picoseconds. The science enabled by the APS upgrade will advance the development of synthesis of new materials with outstanding properties and probe the dynamics of energy conversion systems.

The upgrade is urgently needed to assist the U.S. in developing the science and technology necessary to remain globally competitive in key areas such as the new materials for energy applications, life sciences, and understanding of the environment lest the U.S. fall behind international competition. The APS-U project is designed in a modular fashion with components of the accelerator and instruments being upgraded in a time-phased fashion. Benefits to the user community may be realized prior to the final completion date of the project, currently scheduled for FY 2020.

Subcommittee. When was this facility first built, and has it been upgraded since?

Dr. Brinkman. APS construction started in 1986, and the facility was first commissioned in 1996. Many of the APS components—both accelerator and instruments—were designed in the early 1990s and are not optimized for today's needs. Incremental improvements to the reliability of the accelerator and the number of available beamlines have been carried out since that time. No major upgrade has been done prior to the APS-U project, which will provide real time, spatial, energy, and temporal resolution far better than the APS can deliver today.

NEW CONSTRUCTION OPTION FOR LCLS II X-RAY FACILITY AT SLAC

Subcommittee. Dr. Brinkman, last year's budget request included $30 million to expand the capabilities of the Linac Coherent Light Source II — I'll just refer to it as the LCLS-II.

First, can you remind us what this cutting edge and relatively new facility, as it exists already, allows scientists and engineers to do?

Dr. Brinkman. The Linac Coherent Light Source (LCLS)—the world's first x-ray free electron laser—provides capabilities that are revolutionizing our ability to image matter at the atomic scale. The intensity and ultrashort duration of LCLS x-ray pulses allow researchers to develop a new approach for determining the three dimensional structures of materials and chemical assemblies. The laser's brilliant pulses of x-ray light pull structural data from tiny nanocrystals, avoiding the need to use large samples that can sometimes be difficult or impossible to prepare. This technique will accelerate the analysis and allow scientists to decipher tens of thousands of samples that are out of reach today, including many involved in energy technologies and biopharmaceutical applications.

In August, the Department indicated that it now wishes to revise its plan to expand the LCLS-II experiment into a second x-ray beam tunnel, rather than fitting more equipment into the existing tunnel as originally envisioned. Because this new approach would involve more construction and potentially raise the total cost significantly, the Congress funded design and engineering in fiscal year 2012 and held approval of construction for fiscal year 2013.

Subcommittee. Dr. Brinkman, what is your latest estimate on how much the total project will cost?

Dr. Brinkman. The preliminary cost range for LCLS-II as established at the Critical Deicision-1 technical review was $350–500 million with a point estimate of the total project cost at $405 million.

Subcommittee. Do the benefits of this new "two-tunnel" option warrant the increase?

Dr. Brinkman. The success and high demand of the LCLS capabilities prompted a re-evaluation of the original one-tunnel strategy. In addition, since the inception of the LCLS-II concept in April 2010, significant progress has been achieved in technical capability. As proposed in the FY 2013 Budget, the LCLS-II Project will provide two x-ray beams (soft and hard) and experimental space for four new instruments. LCLS-II extends the spectral range of LCLS (500–9,000 eV), providing independent soft x-ray (250–2,000 eV) and hard x-ray (2,000–13,000 eV) beams to a new experimental hall for increased capacity. The extension in photon energy will, at the low energy end, allow studies of chemical reactions involving carbon (requires 285 eV), chemically one of the most important elements and, at the high energy end, will aid structure determinations of proteins by providing access to selenium (requires 12,600 eV), which serves as a "marker atom" to facilitate structure determination. LCLS-II therefore extends both the capacity and capability of LCLS. At project completion, the LCLS/LCLS-II facilities will operate two independent electron linacs and three independent x-ray sources. The increased capacity LCLS-II will offer will help build the user community and result in more science delivered at a lower cost per experiment and an increased opportunity to learn how to further exploit the FEL capabilities. The two-tunnel option supplants the preliminary plan because it also allows simultaneous operations of instruments and minimizes interference with ongoing user operations of the LCLS. Overall, we believe the benefits of the two-tunnel option justify the total project cost, and the future LCLS-II will provide a much superior user facility for the Nation.

ENERGY FRONTIER RESEARCH CENTERS

Subcommittee. The 46 Energy Frontier Research Centers (EFRCs) established in 2009 are in their 4th year of funding, and fiscal year 2013 represents their fifth and last planned year. It seems prudent to understand the effectiveness of this relatively new research model.

Dr. Brinkman, last year this subcommittee asked the Department how well these 46 EFRCs are performing. The response was, in a nutshell, that basic science does "not lend itself well to...specific performance benchmarks." Now, this subcommittee has supported these centers, but when taxpayers are putting $100 million per year into them — and when that funding could go to other research or to reducing the deficit — it seems prudent to put some more rigor to our oversight.

The Department had planned a review of each EFRC for fiscal year 2012, to focus on scientific progress and overall impact. Dr. Brinkman, where are you in this review process?

Dr. Brinkman. The midterm peer reviews for the EFRCs began on January 9, 2012. Each of the EFRCs prepared a review document summarizing their progress to date and plans for future research. In addition, each EFRC will have a full day, in-person review by a panel of external experts in their research area. Following the in-person review, each of the reviewers on the panel provides an independent assessment of the EFRC following the guidance in 10 Code of Federal Regulations, Part 600.13(2). BES assesses this input and provides both the anonymous peer reviews and BES guidance to each of the EFRCs, including specific actions and recommendations. The EFRCs are given 30 days to respond to the reviews, recommendations, and action items.

The panel reviews will be completed for all EFRCs in early April 2012. Decisions will be made as to funding impact (positive and negative) on FY 2012 continuation funding (the fourth year of funding) after all of the EFRCs have responded to BES guidance.

Subcommittee. How many EFRCs are receiving favorable reviews, and how many are falling short of their expectations for scientific progress?

Dr. Brinkman. It is too early to make conclusions about the outcome of the peer reviews, as the process is not completed. Based on ongoing management of the EFRCs, the scientific impact of the EFRCs has been demonstrated by the publication of over 1,000 papers to date. In addition, the EFRCs are having technological impact as indicated by over 40 patents applications and approximately 50 additional patent/invention disclosures by 28 of the EFRCs. Small businesses are being launched, and both small and large companies are taking advantage of the advances from the EFRCs. In addition, many of the EFRCs are developing experimental techniques and advances in theory and modeling that are having a broad impact for their community's research activities.

Subcommittee. As of now, how would you rate the overall performance of the EFRC research model? Please keep in mind, I'm not asking whether it's "good" or "bad" — instead, I'm asking how well it stacks up to the many other ways that funding could be used in the Office of Science.

Dr. Brinkman. The EFRCs have performed very well to date as indicated by the number and quality of scientific papers, patents, and business interests mentioned in the previous response. Unlike smaller research awards, the EFRCs also typically have multi-institutional teams, bringing together some of the best researchers in diverse fields to work together on complex, used-inspired research challenges. We believe the synergies within these larger teams of researchers are providing unique contributions to some of the difficult challenges for energy technologies.

That said, the EFRCs are very complementary to the other types of research supported in the Office of Science. Single-investigator and small-group research projects, which are effective sources of new scientific discoveries in a single discipline, are less capable of tackling the multi-disciplinary research challenges addressed by the EFRCs due to the narrower range of expertise of the smaller number of scientists involved. In addition, the EFRCs and single-investigator/small group research are now collaborating effectively with the Fuels from Sunlight Energy Innovation Hub as it seeks to accelerate progress toward a viable solar fuels system by incorporating the latest scientific discoveries across the full spectrum of research supported by the Office of Science.

Subcommittee. What is the Department's plan for the EFRCs after the first five years of the EFRCs? Will the Department propose to renew all 46 centers, to renew some of them, or to consider them all complete and move on to either new EFRCs, or other unrelated grants?

Dr. Brinkman. The 46 Energy Frontier Research Centers (EFRCs) were established in late FY 2009 for an initial 5-year award period, and any re-competition/renewal process would not be implemented until FY 2014. The EFRC mid-term peer reviews are scheduled to be completed in the third quarter of FY 2012, after which the Department will issue a report to Congress as requested by House Report 112-331. The report to Congress will provide the Department's assessment of the EFRCs and their progress toward meeting their initial five-year goals. The Department will use the results of the EFRC reviews to assess what the best path forward is with respect to the EFRC program.

PROPOSAL TO ADD $20 MILLION TO ENERGY FRONTIER RESEARCH CENTERS

Subcommittee. The budget request proposes to add $20 million to the Energy Frontier Research Centers (EFRC's) to encourage cooperative work with applied research funded by the Office of Energy Efficiency and Renewable Energy. The Department's goal is to transition some of the science work into energy applications.

There are 46 EFRCs. Will each EFRC get additional funding? Half of them? Or only a few?

Dr. Brinkman. The Office of Science FY 2013 budget request includes a $20 million increase, leveraging the $100 million annual SC investment in EFRCs, for R&D jointly funded with the Office of Energy Efficiency and Renewable Energy (EERE) program to accelerate discoveries and innovations for clean energy technologies. The increase will fully fund supplemental activities jointly with EERE and not incur mortgages into FY 2014. We anticipate that all EFRCs will be eligible to compete for the joint R&D funding with EERE; however, the number of EFRCs that will receive funding will be determined following a solicitation to be issued after the funds have been appropriated.

Subcommittee. How do you see this program being implemented? Talk us through a single EFRC, and how this funding will lead to joint applied work and ultimately to energy innovations.

Dr. Brinkman. The EFRCs are vibrant research environments for bringing together the skills and talents of teams of investigators to perform energy-relevant, basic research with a scope and complexity beyond that found in standard single-investigator or small-group research efforts. The Funding Opportunity Announcement (FOA) for the joint R&D with EERE will challenge the EFRCs to propose research that will integrate basic and applied research for tackling tough scientific hurdles to foster and accelerate basic research for building a new clean energy economy. The multi-investigator, multi-disciplinary EFRCs will be asked to form partnerships with applied researchers funded by EERE—who will be responding to the EERE research needs described in the FOA—in order to jointly bring their ideas to fruition. The research directions for the EFRCs in the FOA will be broadly stated to allow the EFRCs to propose innovative ideas that integrate

well to the research needs identified in the EERE portion of the FOA, to help advance new concepts and overcome fundamental challenges for energy innovation. Proposals will be jointly reviewed by SC and EERE.

Co-funding and co-siting of research by the BES program and the Department's technology programs has proven to be a valuable approach to facilitate close integration of basic and applied research. Such teams of researchers benefit by sharing of resources, expertise, and knowledge of research breakthroughs and program needs. Existing efforts within the Department's national laboratories and EFRCs play a particularly important role in successfully fostering these new jointly funded research efforts within the Department.

FOCUS ON NEAR-TERM ENERGY TECHNOLOGIES

Subcommittee. Dr. Brinkman, the budget request for the Office of Science clearly points to the fact that the Department is giving top priorities to research that can enable near-term advances in energy technologies. With this focus on basic science research with near-term applications — use-inspired research, I believe is the term — it seems that you should be able to indicate which energy technology or technologies each grant is geared towards.

How much funding in the budget request for Basic Energy Sciences is for each major energy technology, such as solar power and batteries?

Dr. Brinkman. The Basic Energy Sciences (BES) research program supports basic research that is not focused on near-term applications, which are the purview of the DOE technology programs that fund R&D toward specific near-to-mid-term needs. The BES organization and budget are structured according to scientific disciplines (e.g., experimental condensed matter physics; atomic, molecular, and optical sciences; and materials chemistry), rather than by end-use energy technology areas. The cross-cutting nature of basic research—defined by the Office of Management and Budget (OMB) as "systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind"—does not permit the reliable binning of funding for scientific disciplines into technology areas. For example, an objective of the BES research in catalysis science is to develop mechanistic understandings of the promotion of chemical reactions. As a result of this research, fundamental advances are being made in inorganic, organometallic, porous, and nanomaterial synthesis; surface and physical chemistry; and organic chemistry. Results from research in catalysis sciences provide new knowledge for our Nation's energy security by having relevance to numerous energy technology efforts, such as reactions that model petroleum or coal processing, hydrogen production and storage, fuel cells, specialty chemical synthesis, polymer synthesis, nanomaterials synthesis, environmental remediation, and pollution prevention.

As you note, the BES research portfolio does contains some research that we describe as use-inspired. The OMB definition also states that "basic research may include activities with broad applications in mind." This particularly

applies to the BES program, which is housed in the mission-driven Department of Energy. However, use-inspired basic research does not mean applied research. BES identifies use-inspired basic research by sponsoring Basic Research Needs Workshops in areas of energy technological importance such as solar energy utilization; superconductivity; solid state lighting; advanced nuclear energy systems; combustion of 21st Century transportation fuels; electrical-energy storage; geosciences as it relates to the storage of energy wastes (the long-term storage of both nuclear waste and CO_2); the hydrogen economy; materials under extreme environments; and catalysis for energy applications. These workshops are informed by involvement from the DOE technology programs and industry representatives and include participation from scientists from universities and DOE laboratories.

The product of these workshops are reports that identify priority research directions—"use-inspired" basic research— in areas spanning from the most fundamental questions of how nature works to research that addresses scientific show-stoppers in the R&D programs supported by the DOE technology offices. An example of such a showstopper is understanding and eliminating photochemical, electrical, and mechanical degradation of photovoltaics under realistic solar and thermal conditions to develop options for cost-effective solar cells with long lifetimes.

Solving these problems requires breakthrough advances with new understanding, new materials, and new phenomena that will come from fundamental science. The BES program portfolio has been reassessed and restructured to reflect the results of these workshops. In addition, the basic research directions described in such workshops form the basis for the science supporting a clean energy agenda as proposed in the FY 2013 budget.

STATUS OF ENERGY INNOVATION HUBS

Subcommittee. The Department of Energy owes the Committee, by mid-April, a detailed report on the status of its Energy Innovation Hubs. In the meantime, I'd like to get your take on how these research "experiments" are going.

In fiscal year 2010, the Department began three Hubs, one of which – the Fuels from Sunlight hub — is in the Office of Science. Fiscal year 2013 would be the 4th year of funding out of this Hub's initial five-year term. Can you describe, first, the hub's goal; and second, how the hub is doing, in a broad sense, according to its interim goals and schedule milestones?

Dr. Brinkman. Following a rigorous merit review and selection process in 2010, the Hub award was negotiated as a cooperative agreement with the lead institution, the California Institute of Technology (Caltech, which also funds the University of California partners as subcontractors), and as part of the management and operating contracts with the Lawrence Berkeley National Laboratory (LBNL) and SLAC National Laboratory (SLAC) partners. The JCAP award was initiated on September 29, 2010, which marked the start of the first project year for JCAP, funded through the FY 2010 appropriation. JCAP is currently in its second project year, which is supported with FY 2011 funds.

The Hub is fully operational in temporary laboratory space on the Caltech campus and in a leased laboratory near the Berkeley campus. Renovation of the permanent space for JCAP in the Jorgensen Laboratory at Caltech is on schedule and will be completed by May 2012. JCAP has successfully acquired all equipment on schedule, including instrumentation for unique capabilities in high-throughput screening and prototype manufacturing. Staffing is on target, with approximately 60 senior staff, postdoctoral associates, and graduate students now participating in JCAP activities on a daily basis.

The Hub has successfully competed for access to several DOE user facilities, including the Advanced Light Source and the National Energy Research Scientific Computing Center at LBNL. The development of the ambient pressure beamline for catalyst studies at the Stanford Synchrotron Radiation Lightsource (SSRL) at SLAC, which was part of the project plan, is proceeding as planned. JCAP has established collaborations involving

exchange of materials and personnel with more than a dozen Energy Frontier Research Centers.

R&D progress has been made steadily since the start of JCAP operations. Approximately 10 papers have been published in or submitted to peer-reviewed scientific publications and JCAP researchers have presented more than 60 technical talks to the scientific community. JCAP's mission is to develop a viable solar fuels generation system that can convert sunlight, water, and carbon dioxide to a broad range of fuels. Splitting water with sunlight is a critical first step in solar fuel production. Therefore, early JCAP results have focused on improved solar water splitting, a new approach to electrochemical water splitting that uses water vapor rather than liquid; the synthesis of a new catalyst for hydrogen generation from water; and a new method for the large-scale growth of semiconductor nanowires for solar hydrogen production. In keeping with JCAP's emphasis on generation of intellectual property, five invention disclosures and one provisional patent have been filed to date.

JCAP capabilities are rapidly coming online. The high-throughput screening technology is up and starting to screen light absorbers and catalysts, and prototype manufacturing using state-of-the-art computer aided design and manufacturing techniques is also operational.

Subcommittee. In the fiscal year 2012 appropriations bill, the Congress funded two additional hubs, one of which — the Batteries and Energy Storage hub—is in the Office of Science. Where are these two hubs in the process of selecting a recipient and beginning research?

Dr. Brinkman. The Department will utilize a process for competitive award of the Batteries and Energy Storage Hub similar to that used for the three Hubs established in FY 2010. The funding opportunity announcement was issued on February 1, 2012, with letters of intent due on March 1. We are currently awaiting full applications, which are due on May 31, and we will select an award recipient after merit review. . Research can begin following processing of the award.

Subcommittee. Rigorously measuring performance of all programs — especially new ones — is a priority for this Committee, and that theme was emphasized in the fiscal year 2012 bill and conference report. Have you established specific, measurable goals for these two new hubs?

Dr. Brinkman. The overarching objective of the Batteries and Energy Storage Hub will be to deliver research leading to revolutionary new electrochemical energy storage technologies. The ultimate goal will be to surpass the current technical limits for electrochemical energy storage. In addition to fundamental science and engineering research, the Hub will support bench-scale prototypes to further evaluate scientific and engineering discoveries from the Hub. One goal is to reduce the risk level to the point that industry will further develop the innovations discovered by the Hub and deploy these new technologies into the marketplace. Success for the Hub will be measured by both scientific advances (which may be partially measured by publications, patents, etc.) and the use of these advances by industry. The funding opportunity announcement for the Batteries and Energy Storage Hub requires measurable deliverables and benchmarks be included as part of the application. The Department does not predetermine specific deliverables and milestones but requires that these be fully described in each Hub application, and the proposed milestones are considered as part of the peer review and selection process. Following the award, DOE will continually measure progress against these milestones through a process that will include annual, independent peer reviews.

The funding opportunity announcement for the Critical Materials Hub is under development by the Office of Energy Efficiency and Renewable Energy and will follow a parallel process for establishing deliverables and milestones for the Hub.

STATUS OF NEW BATTERIES AND ENERGY STORAGE ENERGY INNOVATION HUB

Subcommittee. The fiscal year 2012 appropriation provided the first $20 million in funding to establish an Energy Innovation Hub in Batteries and Energy Storage.

Where is the Department in the process of establishing the Hub? When can we expect a site to be selected?

Dr. Brinkman. We have received letters of intent and are currently awaiting full applications, which are due on May 31. The award recipient selection will determine the site.

Subcommittee. There are a number of energy storage programs across the Department. Can you add any clarify on what exact areas the Hub will focus, and how it will not be redundant with the other batteries research?

Dr. Brinkman. The funding opportunity announcement (FOA) for the Batteries and Energy Storage Hub was developed with input from other offices across the Department with energy storage programs to ensure that it complemented existing efforts. The interdisciplinary research and development in the Hub will advance next generation electrochemical energy storage technologies that can be used to improve the reliability and the efficiency of the electrical grid; to better integrate clean, renewable energy technologies as part of the electrical system; and to improve the range of electric and hybrid vehicles. The Hub will not focus on a single technology or incremental improvements to current technologies as do programs in OE and EERE nor will it focus solely on fundamental science as does research in BES. Instead, the Hub will deliver revolutionary, multidisciplinary research by assembling a broad and unified team to advance both scientific and engineering understanding of electrochemical storage that will be applicable to many battery technologies and will provide the foundation for the next generation of new technologies and approaches.

Regarding exact areas for the Hub and delineation from current research in the Department, the FOA provides the following guidance: "The Hub's research vision should go beyond current technology with a proposed research plan that leverages DOE's current programs and provides avenues

for interactions and information flow. The Hub's research should not be duplicative of or otherwise indistinguishable from current DOE funded research. For reference, the current DOE research portfolio is described in a number of on-line resources that are listed in Section IX of this FOA. Also, as background information, the current status of technologies and goals for transportation and grid storage are summarized below." To further clarify the roles of each of the DOE offices for batteries and energy storage research, DOE held a public Batteries and Energy Storage Information meeting to provide overviews of the Department's Energy Storage activities (cross-cutting basic research and technology research for vehicles and for the grid) including the proposed Hub.

To further ensure continued delineation of the Hub and other research programs across DOE, the research plans, goals, and priorities for batteries and energy storage research and development are coordinated through technology teams that comprise DOE staff from the Offices involved in energy storage research.

Subcommittee. What are the specific goals and milestones for the proposed batteries hub?

Dr. Brinkman. The primary objective of the Batteries and Energy Storage Hub will be to deliver research leading to revolutionary new electrochemical energy storage technologies. The applications for the Hub must include measurable deliverables and benchmarks that surpass the current technical limits for electrochemical energy storage. In addition to fundamental science and engineering research to provide foundational science that will be applicable to many electrochemical storage technologies, the Hub will use bench-scale prototypes to further evaluate scientific discoveries and reduce the risk level to the point that industry will further develop the innovations discovered by the Hub and deploy these new technologies into the marketplace. The funding opportunity announcement for the Batteries and Energy Storage Hub will not predetermine specific deliverables and milestones, but requires that these be fully described and finalized during the award process. To succeed, the Hub must have deliverables or benchmarks to focus the research on short, intermediate, and long term goals. DOE will continually measure progress against these milestones including the annual, independent peer reviews of the successful applicant.

Subcommittee. The Department is due to deliver a report on the Hub's milestones and performance criteria by the end of April; are you on track for delivering it by then?

Dr. Brinkman. The Department is assembling the detailed information requested in House Report 112-331 and compiling it into a unified report on all the Hubs. While this process is underway, delivery of this report may be delayed.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

WHAT SUPERCOMPUTERS MAKE POSSIBLE

Subcommittee. The Department's fastest computing systems are what you'd refer to as "petaflop systems," that can perform one-thousand trillion calculations per second. These systems are many, many times faster than the world's fastest just a few years ago. And I'd imagine that they enable science inquiry and innovation that was never before possible.

What has current petaflop computers let us do we could never before?

Dr. Brinkman. Petaflop computers have been used to perform the most advanced earthquake simulation of a Southern California quake to develop predictive models of earthquake processes; improve our understanding of the atomistic mechanisms of stress corrosion cracking of nickel-based alloys and silica glass, which are essential for advanced nuclear reactors and nuclear-waste management; couple simulation data with experimental data from the Advanced Light Source at Berkeley to illuminate how DNA replication continues past a damaged site so a lesion can be later repaired; and to complete the first simulation of abrupt climate change. More examples of the phenomena that scientists are exploring with current petaflop computers are available in the INCITE In Review report at http://www.olcf.ornl.gov/wp-content/uploads/2010/03/INCITE_IR_FINAL_7-19-11.pdf.

Subcommittee. What would exascale, the next generation of systems one thousand times faster, let us do that we can't do now?

Dr. Brinkman. If exascale capabilities are coupled with fast-prototyping techniques, materials scientists may be able to cut development time in half for photovoltaics, batteries, magnets, cement, catalysts, and much more. This will be made possible through accelerating predictions of materials properties and simulations of their use in realistic environments.

Combustion researchers will be better able to model the complexities of diesel combustion, which involves a much more complex fuel burning at much higher pressure than can be simulated today. Exascale will enable high fidelity simulations of nuclear fuel and reactor systems, such as the flow of coolant, that may help accelerate the development of advanced nuclear energy technologies. Computational biologists will be able to look at

individual processes within our complex systems and study system dynamics and natural variations. Climate researchers will develop global atmospheric models at a one kilometer scale, allowing them to more accurately study destructive phenomena like hurricanes.

These and other advances we have not even imagined yet are within reach at the exascale.

EXASCALE COMPUTING — PROGRESS TOWARDS GOALS

Subcommittee. Dr. Brinkman, in last year's budget request, the Department emphasized a push for exascale computing — in essence, it set a goal of developing a system 1,000 times faster than today's fastest systems.

Can you take a moment to explain how far we've gotten towards that exascale goal?

Dr. Brinkman. Some of the exascale relevant research has been underway for a few years. These investments include core computer research efforts, uncertainty quantification research, and the start of three co-design centers to ensure scientific computing challenges are informing architecture designs while critical DOE applications also stay informed with regard to hardware developments. These long lead-time efforts have hinted at some options and tradeoffs but much work remains to be done. ASCR supports several significant steps toward exascale in FY 2012, including the start of investments in critical technologies and the installation of our first hybrid computing system at the Oak Ridge Leadership Computing Facility.

EXASCALE COMPUTING — PLAN DUE TO COMMITTEE

Subcommittee. When last year's budget request included $90 million for the exascale initiative, it became clear that we needed a plan, including a target year for getting to exascale, and a roadmap and cost estimate for getting there. Last year's House bill, and subsequently the fiscal year 2012 conference report, directed the Department to provide such a plan by early February. To date, the Department has still not delivered on that plan. I understand it may be working its way through concurrence — but frankly, the Department should have been started working on this plan more than a year ago.

Dr. Brinkman, when will you get us that plan, and will it have a target date and total cost estimate?

Dr. Brinkman. While we have of course had long term plans for the implementation of our exascale strategy since before last year, we are working to translate that broad strategy to an implementation plan.

Subcommittee. The Department requests $68 million for the exascale initiative, considerably less than the $90 million requested last year. I should point out that this reinforces the problem with having no exascale roadmap — we don't know if this sudden drop in exascale funding is planned, or a change to the plan due to other forces. What changed that led to this 32 percent drop in the request?

Dr. Brinkman. The FY 2012 appropriation level provided $72 million in the ASCR budget for exascale R&D. The FY 2013 exascale request is also supported by a new $21 million proposal for data-intensive science, $4 million of which is for a data-intensive co-design center that is part of the $68 million exascale request, while the remaining $17 million is not specifically in support of exascale. Results from the data-intensive science proposal will ensure that the Department can fully realize the benefits of the exascale investments. The data-intensive sciences funding will support several exascale relevant projects including a data-intensive science co-design effort that is very much needed going forward. As with other high risk research investments, any shortfalls in funding increase the risk of not meeting goals or timelines. However, judicious management of funds and risks is part of the Department's strategy for exascale.

Subcommittee. The European Commission recently announced a doubling of its funding for their exascale initiative. China likewise has an ambitious plan for developing an exascale system, with an equally ambitious target year of 2020 publicly announced.

How does our initiative compare to their programs in approach, speed, and funding?

Dr. Brinkman. The European Union (EU) has announced a doubling of their investments in exascale computing to 1.2 billion euros per year. However, these funds are across the EU and include hardware and infrastructure acquisitions and support, ongoing efforts as well as those dedicated to exascale goals. China plans to invest 4 billion yuan over a five year period from 2011 to 2015. These funds also support several petascale computing facilities and at least one machine in the 50–100 petaflop range. Neither has announced detailed enough information to discern how much is dedicated to research on the significant power, resilience, and software challenges posed by exascale computing. The Department's exascale numbers do not include hardware acquisition or petascale-focused efforts and therefore cannot be compared to the announced plans from overseas.

DATA-INTENSIVE SCIENCE INITIATIVE

Subcommittee. In this year's request, the Department emphasizes a new $21 million initiative to focus on "Data-Intensive Science". As your budget request describes it, this initiative is to ensure our computing systems can deal with the massive amounts of data our science experiments and simulations do and will require.

Can you start by explaining, in simple terms, what the data problem is here that you're trying to solve?

Dr. Brinkman. The President's Council of Advisors on Science and Technology's recent report, "Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology", identified the urgent challenges of data intensive science and recognized that "effective use of data will be critical to meeting every one of this report's technical priorities." This report is the primary driver of Administration-wide investments in this area. The Department's investments are focused on two mission-critical areas of data-intensive science.

First, our suite of scientific user facilities generates massive quantities of data each day. Planned upgrades are expected to increase data rates by up to a factor of 1,000. To ensure these expensive facilities deliver on their scientific potential for the Nation, we must invest in new tools, technologies, and software to get every drop of scientific insight out of that very high throughput data. These efforts must be coupled to specific facility designs and community needs.

Second, there are challenges to the scientific user facilities and other areas of data intensive science due to the changing hardware on the path to exascale. In supercomputing generations up to the current petascale, the primary concern has been achieving enough computational cycles and on-chip data management was not a concern. In the exascale regime, we will have to worry about how data is moved across chips. The sharp increase in the number of cores on a chip and the introduction of hybrid boards with specialized accelerators requires the facilities to address their detector and other data taking software, which was not written to take advantage of these new designs and will not function well on them. These challenges are the same or very similar to the challenges of the science applications at our scientific computing facilities and thus there is a strong connection between

this aspect of data-intensive science initiative and our exascale research initiative.

Subcommittee. Last year, the budget focused on the exascale initiative. What precipitated this new initiative? Was this something you didn't see coming last year?

Dr. Brinkman. The Office of Science has been focused on the connected challenges of exascale and data-intensive science for several years now. Many workshops have already been held to more fully understand the specific challenges to critical DOE applications and scientific user facilities. Both initiatives are urgently needed and the Office of Science has made investments in data management, visualization, software and mathematics to address the needs of DOE facilities and large-scale collaborations in FY 2011 and FY 2012. The PCAST report underscored the importance and urgency of data-intensive science investments and led to the Administration-wide initiative within which DOE is focusing on its mission needs in this area.

Subcommittee. A focus on data could mean many things. It could mean the ability to store data; to transport it across the country; to perform computing on large amounts of data. Which will be the focus of this initiative, since your budget doesn't spell it out?

Dr. Brinkman. The Office of Science user facilities require us to address all of those aspects as they face significant challenges in capturing, storing, and delivering the data; and the researchers we support need to be able to analyze, visualize, and extract meaning from the data. There are investments across the ASCR research portfolio that span those challenges. Applied Mathematics is developing techniques for understanding and extracting meaning from massive amounts of scientific data of all sorts including noisy, heterogeneous datasets. Computer Science is developing new technologies for storing, analyzing and visualizing massive quantities of high throughput data produced by both facilities and simulations. Next Generation Networking for Science is developing the means to transport it across the Nation to share it or to analyze it remotely to avoid the need to transfer it to multiple sites. Computational Partnerships will support partnerships with the other programs to address the specific needs of their facilities with an emphasis on how they capture the data. Computational Partnerships also supports a Scientific Data, Analysis and Visualization

Institute to help the partner's computational applications manage and extract meaning from their data. Finally Computational Partnerships has proposed starting a data-intensive science co-design center to look at hardware issues and plan for and influence the most significant changes in computing hardware from the point of view of the scientific user facilities.

Subcommittee. How will this play out? Will each lab and program be asked to devote some funding to "data challenges", broadly conceived, or will you have a more deliberate approach?

Dr. Brinkman. Each activity with the Advanced Scientific Computing Research (ASCR) program is devoting some funding to the aspect of the data challenge where they can best have an impact. A single ASCR Funding Opportunity Announcement (FOA) is planned for FY 2013 with funding from each activity in recognition of the fact that teams of experts might best address the challenges by cutting across the activities. The FOA will be open to all laboratories and universities and multi-institutional teams will be encouraged. The FOA will highlight the specific challenges of the Office of Science that we need the research community to address.

Subcommittee. Some in the computing community think that you're working out of order on this, and we first need to tackle the computing challenge of getting to exascale speeds before we tackle the data problem. How would you respond to that perspective?

Dr. Brinkman. These challenges are so tightly coupled that it is almost impossible to work on exascale without impacting data-intensive science. In addition, the Office of Science manages some of the Nation's most advanced scientific user facilities and these facilities generate tremendous amounts of data today. These facilities are already facing challenges beyond the design scope of their computing systems and planned upgrades, and new facilities have much more significant challenges that will need to be addressed in the design phase to avoid costly mistakes. With a leadership role in developing and delivering high performance computing and in providing the Nation with a suite of state-of-the-art scientific user facilities, the Office of Science cannot afford to decouple or delay these efforts.

PLAN FOR LEADERSHIP COMPUTING FACILITIES

Subcommittee. The Office of Science has a history of building supercomputing systems that dominate the global rankings of the fastest unclassified computing systems. These systems, including the Leadership Computing Facilities at Argonne and Oak Ridge, as well as the computing center at Berkeley, provide irreplaceable computational capabilities to scientists across the country.

As you well know, global competition in the high performance computing area has been heating up lately, and we've got some stiff competition at the top of the rankings. As of November, China and Japan have four of the world's five fastest systems. But I understand that we have major system upgrades in the works.

Dr. Brinkman, given current funding levels and the budget request, what is the current upgrade plan for the Office of Science's supercomputing facilities?

Dr. Brinkman. Within current funding levels, we will complete upgrades to the Leadership Computing Facilities to take each facility to at least 10 petaflops by FY 2013. We have additional options in the Cray contract to take the Oak Ridge facility to 20 petaflops. This hybrid machine will be critical for our researchers working on exascale technologies. Both machines will provide new capabilities to the research community, including industry, to deliver new science and engineering insights.

Subcommittee. Where do you expect those upgrades will put the Department of Energy's systems in the global rankings?

Dr. Brinkman. First let me be clear that our place on the Top 500 list is not nearly as important as the scientific results that these machines deliver. This is why we invest significant effort and focus on our early science program to ensure the machines are fully engaged in delivering sustained performance on scientific and engineering codes important to the Department and address national challenges such as developing new clean energy options. However, we expect both of the Science machines to be in the top 10 and expect the NNSA machine to top the list in FY 2013.

Subcommittee. How important do you feel it is to keep us at the top of the global rankings?

Dr. Brinkman. It is important for the United States to be competitive in global rankings and for our vendors to offer hardware capable of topping the list. For the Department, what is most important is the mission critical science and engineering that the computing facilities deliver. Our missions compel us to push the state-of-the-art in a number of areas of science and engineering–materials, chemistry, earth science, nuclear physics and engineering, etc. The computing facilities play a vital role in accomplishing this.

INCITE PROGRAM FOR INDUSTRY USE OF COMPUTING SIMULATIONS

Subcommittee. The Office of Science gives time on its high performance computers to external groups, ranging from universities to companies. There are some very interesting examples of American industry using the Department's computers to develop some groundbreaking innovations.

How much of your office's computing time goes to industry?

Dr. Brinkman. Industry use accounts for approximately 72 million processor hours or 2% of the total time available across the Office of Science's high performance computing facilities, which include the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory, the Argonne Leadership Computing Facility (ALCF) at Argonne National Laboratory and the Oak Ridge Leadership Computing Facility (OLCF) at Oak Ridge National Laboratory. The break out of industry use per facility is as follows: NERSC, 0.2% or 1.4 million processor hours; ALCF, 4% or 49 million processor hours; and OLCF, 1.4% or 22 million processor hours.

Subcommittee. What types of private sector products is this supporting? What are some examples of recent successes?

Dr. Brinkman. The private sector is using the Office of Science's high performance and leadership computing facilities to design quieter and more energy efficient automotive and jet engines, commercial airplanes, wind turbines and turbines for power plants. In addition, industry has also used our facilities to design better fire-fighting foams and cleaning products, fuel cells, semiconductors, and add-on parts to increase the aerodynamics and fuel efficiency of long haul trucks.

We have had several recent successes I would like to tell you about.

General Electric (GE) determined the effects of unsteady flow interactions between blade rows on the efficiency of turbines, which provided engineers with the analytical tools to extract greater design efficiency and fuel savings. GE researchers also used the results to provide a substantial return on

investment justification to persuade management to purchase its own Cray supercomputer.

Ramgen used computational fluid dynamics with shock compression to expedite design-cycle analysis. This research accelerated the development of a CO_2 compressor allowing Ramgen to go from computer design and testing to cutting a titanium prototype in 2 months.

Boeing demonstrated the effectiveness and accuracy of computational fluid dynamics simulation tools and used them in designing their next generation of aircraft, significantly reducing the need for prototyping and wind tunnel testing.

General Motors accelerated materials research by at least a year to help meet fuel economy and emissions standards. The resulting prototype thermoelectric generator in a Chevy Suburban generated up to 5% improvements in fuel economy.

United Technologies studies of nickel and platinum are demonstrating that the less expensive nickel can be used as a catalyst to produce hydrogen.

General Electric Global Research simulated the complex turbulent flows that generate noise from wind turbine airfoils and jet exhaust nozzles to validate the accuracy of a large eddy simulation solver. The simulations are considered by GE to be critical for developing next-generation, "green" low-noise wind turbines and jet engines.

Procter and Gamble (P&G) researchers investigated the molecular mechanisms of bubble formation in foams, performing computer simulations at an unprecedented scale on the dissolving of soap and foaming of suds. An understanding of how suds form and break down is critical in the development of many consumer goods, foods, and fire control materials. Through this research, P&G developed a new approach to evaluate materials and made the case to senior management for investing in high-performance computers for in-house proprietary work.

Pratt and Whitney used virtual testing to accelerate improvements in jet engine design, dramatically decreasing problem-solution turnaround times in development of their PurePower™ engine. The new-generation engine improves fuel burn efficiency by 12–15%, with a potential savings to airlines of nearly $1 million per aircraft per year. It also cuts carbon

emissions by 3,000 tons per aircraft per year while reducing other emissions 50%.

Smart Truck Brands went from concept to design to manufacture of add-on parts in 18 months. These add-on parts, which were made available in 2011, demonstrated fuel mileage improvements of 7–12%, which exceeds California Air Resource Board's requirements.

Subcommittee. Do our top systems support only U.S. companies?

Dr. Brinkman. Yes, in addition to providing time to scientists and researchers at universities and laboratories, the Leadership Computing Facilities support U.S. companies. Computer time on the Leadership Computing Facilities is not available to foreign companies.

Subcommittee. When should a company buy their own supercomputer, and when is it an appropriate use of taxpayer dollars for the Department to give time to industrial partners?

Dr. Brinkman. Companies normally buy their own supercomputers or large clusters when their engineers have demonstrated the need for advanced capabilities for their proprietary work or it is to the company's competitive advantage (shortened time to market) to purchase and maintain their own supercomputers and support infrastructure. Industry is normally awarded time on Office of Science supercomputers as a result of a successfully peer-reviewed proposal and typically companies receiving these awards agree to share their results with the open research community through presentations or publications. If, however, a company wants to perform proprietary research they must pay the full cost of their use of the facility.

In the past, industry has used our facilities to tackle strategic, competitively important problems that are too complex to address with in-house computing resources; scale internally developed software; investigate government and university codes that already scale; test pathways to build an internal return on investment (ROI) case for additional systems and software; grow their expertise in modeling, simulation, and large-scale data analysis with high-performance computing (HPC); achieve breakthrough insights, understanding, and discoveries or advance to the "next level" in their ability to use HPC to solve more difficult problems.

FUTURE COMPUTING BREAKTHROUGHS

Subcommittee. Dr. Brinkman, much of the attention in your request is on the next decade, leading up to exascale computing systems. What's next after that? Where do you believe computing is going after that, and how do you think the Office of Science's computing program will need to look next?

Your program focuses to a large extent on incremental improvements to computing. Are you putting any investments into truly future-generation breakthroughs in computing science and technology, such as quantum computing or other advanced concepts? If not, why not?

Dr. Brinkman. The challenges of exascale are so significant and the Department's goals are so ambitious that I feel this is the appropriate focus for the Advanced Scientific Computing Research program. Beyond exascale, I think we are looking at something other than silicon and there are investments in nanoelectronics and new materials within the Office of Basic Energy Sciences that are coordinated with the computing experts. The Department has not invested significantly in quantum computing because these machines have been shown to be most useful for factoring large numbers and for identifying primes; these capabilities are not important to the Department's missions, which require machines that are useful for such things as optimization, numerical simulations, computational fluid dynamics, molecular dynamics, particle-in-cell, adaptive meshing, and linear algebra.

HIGH ENERGY PHYSICS

ACCELERATOR SCIENCE AND SOCIETY

Subcommittee. Particle accelerators play a central role in many programs in the Office of Science. These experiment, which accelerate small particles of matter to extremely high velocities and then analyze the resulting collisions, are known widely as part of basic science research, as in the case of the Large Hadron Collider in Europe.

Dr. Brinkman, do you see basic science research as the primary benefit of particle accelerators, or are there other more applied benefits?

Dr. Brinkman. While discovery science research is one of the primary benefactors, there are many applied benefits from particle accelerators beyond this. A 2009 workshop on this topic looked at the substantial benefits to industry, energy and environment, medicine, and defense and security, in addition to those in discovery science. To enhance the availability and benefits of accelerator applications in other fields, we are working on a strategic plan for stewardship of accelerator R&D across the broad spectrum of users.

Subcommittee. How widely are accelerator technologies used today in the private sector?

Dr. Brinkman. Worldwide, products that are processed, treated, or inspected by particle beams have an annual value exceeding $500 billion. The magnetic resonance imaging market in North America alone is about $2.3 billion annually. Accelerators are ubiquitous in our society and contribute heavily to U.S. economic competitiveness. It is estimated that more than 18,000 accelerators are in operation worldwide, the bulk of which are used for ion implantation (for example, in the semiconductor industry) and electron beam materials processing (such as tire manufacturing and food sterilization).

Subcommittee. What are some examples of innovations that originated in the development of particle accelerators?

Dr. Brinkman. The magnetic resonance imaging industry was, in part, an outgrowth of superconducting magnet development for accelerators.

Isotope production for medical imaging and proton cancer therapy facilities are other examples. Electron accelerators are now being used for food and water purification.

LONG BASELINE NEUTRINO EXPERIMENT

Subcommittee. The Long Baseline Neutrino Experiment, or LBNE, would focus on keeping the United States at the forefront of neutrino research, a wing of physics that helps to fill out our model of the fundamental particles that make up everything around us. I understand that this project would send a beam of high-speed particles from Illinois into an underground mine hundreds of miles away. The total construction cost for this project, proposed for construction at Fermilab, is considerable – somewhere from $1 to $2 billion.

Dr. Brinkman, can you begin by explaining to us why such an investment in neutrino research performed at the LBNE would be important?

Dr. Brinkman. After the photon, the neutrino is the most common particle in the universe—yet it is amongst the most poorly understood. Trillions pass through your thumb every second, yet they almost never interact with normal matter. Only in the last 20 years have studies of atmospheric and solar neutrinos conclusively shown that neutrinos (which come in at least three varieties) can change between these different varieties, indicating that they have mass. That neutrinos have mass is the only direct experimental evidence of beyond-the-Standard Model physics. The Standard Model predicts that neutrinos are strictly massless—so at least in this area the Standard Model is incomplete and needs to be modified. There is also the possibility that a deeper understanding of neutrino interactions will help explain the preponderance of matter over anti-matter in the observable universe. A better understanding of the neutrino sector will help us pursue these questions. The LHC or a lepton collider are not sufficient instruments for these studies, because they very small interaction probabilities for neutrinos. Rather, experiments designed to answer some of the outstanding questions about neutrinos will require an intense source.

Subcommittee. There have been significant hurdles in arriving at the current design for the LBNE. In particular, the National Science Foundation (NSF) was slated to build and maintain the detector facility deep within an abandoned mine in South Dakota. The NSF announced in late 2010 that it was pulling all funding. The Department has not proposed to begin construction in the budget request, but instead provides funding to continue research while it evaluates the proposed plan. Where is the Department in

the evaluation process? In addition to overall budget considerations, what are the remaining hang-ups?

Dr. Brinkman. DOE considered both LBNE's scientific opportunities and its cost and schedule estimates in the context of planning for the overall Office of Science program. Based on these considerations, the Department determined it could not support the LBNE project as it was configured. This decision was not a judgment about the importance of the science, but rather a recognition that the peak cost of the project as proposed could not be accommodated in the current budget climate or that projected for the next decade given the discretionary funding caps in the Budget Control Act. In March, DOE requested that Fermilab lead the community in the development of a phased approach that could enhance scientific understanding at each phase.

Subcommittee. How would a proposal for the Department of Energy to take over and develop the mine allowed the project to continue without "breaking the bank" for a program that is highly unlikely to see an overall funding increase?

Dr. Brinkman. The FY 2013 budget contains funding to support minimal sustaining operations at Homestake in support of two existing experiments: a dark matter search and a demonstration project to establish the technology needed to search for very rare nuclear processes. These experiments are scheduled to be installed in the mine in the next few weeks and will utilize facilities and space developed by the state of South Dakota.

Any development and/or expansion of the mine facilities beyond those currently available would only take place to enable specific approved future projects. This targeted approach is in sharp contrast to the multi-purpose science facility that had been planned by the National Science Foundation's Physics Division. Our approach is consistent with anticipated funding levels and with Office of Science mission and goals.

Subcommittee. The underground facility will require ongoing operations and maintenance funding, a responsibility that would fall to the Department of Energy now that the NSF has pulled out. How much annual funding do you expect this will require once the facility is completed and operational? And do you think the program of High Energy Physics and the

Office of Science as a whole will be able to carry the financial burden of operating yet another facility?

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SEARCH FOR THE HIGGS BOSON

Subcommittee. There has been a lot of attention in recent years on the search for the so-called Higgs Boson, a fundamental particle we've never seen but physicists theorize is in some way responsible for explaining why things have mass.

I understand that there have been some strides towards a possibly discovery of this particle. Where is the science community in that process?

Dr. Brinkman. The search for the Higgs boson has been at the forefront of particle physics at the energy frontier for the past decade and has become the most coveted prize in particle physics. The four experimental collaborations (two from the Tevatron and two from the Large Hadron Collider) are close to reaching fundamental and complementary results which will allow the community to finally pinpoint this elusive particle. All four collaborations presented their most recent results at the annual winter conferences at the beginning of March, showing increasing but not yet conclusive evidence of the Higgs boson's existence. These results are consistent with a Standard Model Higgs Boson with a mass around 125 GeV. Their results have been published in peer-reviewed journals as well.

Subcommittee. Most of the attention has been on the Large Hadron Collider in Europe, since it opened in a couple of years ago. How are our scientists involved in that effort, and how has our own Tevatron at Fermilab, which was shut down last year, contributed to the Higgs search?

Dr. Brinkman. The Tevatron was, for a long time, the highest energy frontier machine in the world and U.S. scientists and international collaborators have made numerous key measurements in particle physics using its data, including the recent Higgs searches. New analyses based on Tevatron data conducted by scientists from the CDF and DZero collaborations at Fermilab find excesses in their data that can be interpreted as coming from a Higgs boson with a mass in the region of 115 to 135 GeV. These analyses are still in agreement with and offer similar confidence levels as the LHC results at the lower end of the search range.

U.S. participation in the CERN experiments has also been crucial to the LHC program. Approximately 1,200 physicists from U.S. institutions conduct research as collaborators in ATLAS and CMS, supported by the

DOE High Energy Physics and NSF research programs, and the contribution of U.S. scientists is substantial in several key analyses aimed at the Higgs discovery. Given the broad experience gained during the Tevatron run, U.S. physicists are in a unique position to contribute to LHC analyses with high impact. Two major DOE laboratories also act as hosts for the U.S. collaborations: The U.S. ATLAS program is hosted by Brookhaven National Laboratory, and the U.S. CMS program is hosted by Fermi National Accelerator Laboratory. At these sites large computing centers receive and distribute data from CERN, which are used by collaborators from U.S. universities and laboratories.

LARGE HADRON COLLIDER

Subcommittee. The Large Hadron Collider has received. Though it is located in Europe, the United States has contributed significantly to the experiment.

What fraction of the total construction cost did the United States contribute to the LHC – did we play a substantial role?

Dr. Brinkman. The U.S. part of the LHC construction project consisted of a DOE contribution ($200 million) to the LHC machine (the U.S. LHC Accelerator Project) and contributions by DOE ($250 million) and NSF ($81 million) to two detectors—ATLAS and CMS. These contributions correspond to just over 20% of the total cost of the detectors. The sum of U.S. contributions to the LHC was congressionally-capped at $531 million. The U.S. contributions to the detectors were the largest single contributions to those projects, clearly a very significant role. The U.S. role in the accelerator project was relatively smaller but nevertheless contributed world-leading technology in high-field accelerator magnets that was developed in the U.S.

Subcommittee. How much do we contribute annually to ongoing research and operations of the LHC?

Dr. Brinkman. The LHC operations program supports the maintenance and operations of the CMS and ATLAS detector components built in the U.S. and the computing needed to deliver reconstructed data to the U.S. physicists doing research. Many U.S. technical personnel are located at CERN to efficiently operate and maintain the U.S.-built components. In addition, the U.S. contributes to common operating costs. The DOE contributes in total about $130 million for operations ($60 million) and research ($70 million) at the LHC.

Subcommittee. We obviously have a tension between contributing to this large international experiment, and funding our own programs. How long will we continue contributing to the LHC, and can our domestic high energy physics program thrive while we do so?

Dr. Brinkman. U.S. scientists are contributing significantly to LHC scientific investigations, and this participation is contributing to a vibrant

U.S. high energy physics community. In 1997 CERN and the U.S. signed a cooperation agreement that established a framework for U.S. involvement in the LHC project. Elements of this agreement covering participation in the experiments remain in effect until 2017. The DOE and NSF, in coordination with OSTP, have developed a U.S. position with regard to future interactions with CERN. The U.S. position is to continue communicating and collaborating on roadmap priorities and projects for which the U.S. and CERN share an interest and to maintain the current U.S. status, at least through the termination of the LHC protocol in 2017. This scientific collaboration is not a one-way street; DOE SC national scientific user facilities are open to interested users nationally and internationally, and access is granted based on a proposal and merit review process. Participation by international scientists at the DOE high energy physics user facilities is an integral part of the ongoing and productive collaborations with U.S. scientists.

Going forward, as new initiatives of mutual interest are considered, a stakeholder approach on a project-by-project basis appears to be a good basis for collaboration. In 2008, the High Energy Physics Advisory Panel identified continued U.S. participation in the LHC physics program as the highest priority for the U.S. HEP program. Our domestic high energy physics program will only be strengthened if we can actively participate in all three frontiers with our international partners.

DARK MATTER AND DARK ENERGY

Subcommittee. While the focus in the High Energy Physics program has turned to neutrino physics—the so-called "Intensity Frontier" —a significant portion of the program focuses on dark matter, dark energy, and other cosmological questions.

What are these areas, and why are they important to science and innovation?

Dr. Brinkman. Scientists believe that so-called Dark Energy is responsible for the observed acceleration of the expansion of the universe that was discovered in 1999. It is estimated to comprise approximately 70 percent of the matter-energy content of the universe, but what it is made of is a complete mystery. The Nobel Prize in Physics for 2011 was awarded for the discovery of cosmic acceleration, and its implications for the existence of Dark Energy.

Similarly, so-called Dark Matter is estimated to comprise approximately 25 percent of the matter-energy content of the universe. Crucial to understanding the importance of dark matter is the fact that the Standard Model of particle physics has no place for dark matter particles. Therefore discovering the nature of dark matter will have an enormous impact on our understanding of particle physics and the laws of nature.

Any discoveries in these areas would profoundly alter the fields of physics and astronomy. The technology used to take these measurements involves innovation in the design of new, state-of-the-art instrumentation that one day may have wider applications.

Subcommittee. What are some of the large upcoming initiatives in these areas budgeted for in the request?

Dr. Brinkman. DOE is participating in a partnership with NSF on the ground-based Large Synoptic Survey Telescope (LSST) and has requested a funding start in FY 2013 for its contribution to the proposed project, a state-of-the-art 3.2 billion-pixel CCD optical camera. The LSST was identified as the highest priority for a large, ground-based initiative for astronomy and astrophysics in 2011–2020 by the National Academies' Astronomy and Astrophysics Decadal Survey, *New Worlds, New Horizons*. LSST is a multi-purpose observatory. By increasing its sensitivity by an order of magnitude

compared to current wide-field telescopes, we hope to substantially improve our understanding of the nature of Dark Energy. The agencies have coordinated the project schedule and funding plan and are jointly overseeing it.

A "second-generation" set of Dark Matter experiments is also being planned for the near future. Beginning in FY 2013, research and development (R&D) will be supported for a number of promising dark matter detection technologies, selected by competitive review, that will increase sensitivity to dark matter particles by over an order of magnitude compared to current experiments. Following one year of R&D, the best technologies will be selected to receive project funding beginning in FY 2014.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

EXTENSION OF BIOENERGY RESEARCH CENTERS FOR ANOTHER FIVE YEARS

Subcommittee. The three Bioenergy Research Centers were established with five-year terms in mind, and the budget request proposes to continue these centers for another five years. While these centers have produced considerable scientific advances towards energy self-sufficiency, renewing them for a second five years entails $375 million in federal investment. This is *not* something to be taken likely.

Dr. Brinkman, can you describe to the Subcommittee the evaluation and reviews that your office has conducted leading up to your recommendation for renewal of the centers?

Dr. Brinkman. Evaluation of BRC performance has been rigorous, with researchers working against stated milestones and the centers subject to thorough annual peer review by groups of outside experts.

At the outset of the BRC program, in September 2007, the DOE Office of Science developed a detailed "DOE Management Plan for the DOE Bioenergy Research Centers (BRCs) Program." The Management Plan delineated roles and responsibilities for the BRCs and for all DOE offices that would be involved in the program and provided a blueprint for DOE management of the three centers. At the heart of the Management Plan was a statement of goals for the program. The Management Plan text was provided to all three BRCs so that DOE's goals and the terms by which each BRC was evaluated would be explicit and clear to all concerned.

The DOE program management staff closely monitors scientific progress, tracks safety practices, and ensures that the BRCs are being effectively managed. In addition to coordinating annual progress reviews, the DOE program staff maintains constant communication with leadership at the BRCs throughout the year to discuss current research status, be aware of upcoming publications or other BRC products, and facilitate opportunities for coordination of activities between the centers and with other DOE facilities such as the Joint Genome Institute.

The external peer review committees have provided impartial feedback and advice on BRC research progress and plans to achieve future objectives, and

they have submitted favorable appraisals of all three BRCs' performance during every annual review. The DOE Management Plan goals provided the framework for the external reviews. As a result, each BRC has been evaluated annually on progress toward and effectiveness in achieving these goals.

DOE program staff took these external reviews into consideration in evaluating the BRCs for renewal.

DOE program staff also evaluated the centers in light of the goals set forth in the original funding opportunity announcement (DE-PS02-06ER64304) and the more detailed white paper (DOE/SC-0097) that accompanied it. They found that the centers have achieved significant research progress and demonstrated impressive responsiveness and flexibility in taking on new directions as needs have evolved both for DOE and the biofuels industry over the intervening period.

Subcommittee. Who is conducting the reviews? Is an outside panel conducting a full, independent peer review of the centers?

Dr. Brinkman. Annual reviews are administered by DOE program staff within the Office of Biological and Environmental Research, using external peer review teams. The external review teams assembled for the annual progress reviews are composed of internationally recognized scientists from academic and international research institutions, DOE national laboratories, and industry. Reviewers for each panel were selected to bring a breadth of expertise across systems biology, microbial physiology and genetics, plant biology and genetics, genomic database management and informatics, and chemical engineering.

Subcommittee. According to the evaluations, how did each center do in meeting its original goals? If you would, please also articulate what the goals were for each center's first term.

Dr. Brinkman. Now in their fifth year of operation, the three BRCs have performed well in four external peer reviews. Peer reviewers had access to extensive documentation, including the detailed research and scientific milestones submitted annually by each BRC, against which to measure progress. In evaluating the BRCs and in considering options for their renewal and continuation, DOE program staff relied significantly on the impartial evaluation of these outside reviewers. The peer reviewers'

positive evaluations have corroborated and reinforced the evaluation by DOE program staff that the BRCs have matched or exceeded DOE's original goals for the BRC program. In the process they have produced numerous significant discoveries that have advanced the broader field of bioenergy research and developed an impressive volume of licensable intellectual property.

Annual external review panels have consistently determined that each BRC is making significant scientific and technical advancements toward the realization of cellulosic biofuels. These determinations are made by critically evaluating the scientific and technical output of each center and critically assessing progress towards the original goals.

The BRCs are guided by three overarching science goals: develop next-generation bioenergy crops; improve biomass deconstruction, including discovery and design of enzymes and microbes with novel biomass-degrading capabilities; and advance biofuel synthesis through development of transformational microbe-mediated strategies. Each overarching science goal is addressed in different but complementary ways by each center.

The BioEnergy Science Center (BESC) is focusing on the central problem of recalcitrance—the resistance of cellulosic biomass to enzymatic breakdown into sugars. Developing modified biomass feedstocks that are more susceptible to breakdown and improved biological systems for deconstruction of biomass will enable improved production of a broad range of biofuels and other commodity products, of which ethanol will likely be the first to be commercialized. BESC's targeted focus on recalcitrance is singular among the Bioenergy Research Centers. BESC is concentrating on the bioenergy crops of switchgrass and poplar and on the engineering of microbes for converting plant material directly into biofuel in a single step (consolidated bioprocessing) to decrease costs and improve overall process efficiency.

Great Lakes Bioenergy Research Center (GLBRC) researchers aim to increase the energy density of grasses and other nontraditional oil crops by understanding and manipulating the metabolic and genetic circuits that control accumulation of oils in plant tissues. GLBRC biomass-processing researchers are also searching for and improving natural cellulose-degrading enzymes extracted from diverse environments, and developing a new high-throughput system for screening such enzymes. GLBRC fuels synthesis research is using a combination of directed evolution, systems biology, and

computational modeling to improve biofuel producing microbes. Unique among the BRCs, GLBRC also has a major research emphasis on sustainability issues surrounding the development of a biofuels economy.

Joint BioEnergy Institute (JBEI) researchers are applying synthetic biology approaches to engineer microorganisms to convert sugars into advanced biofuels, such as alkanes and other high energy-content hydrocarbons that would be drop-in replacements for petroleum-based gasoline, diesel, and jet fuel. JBEI is also experimenting with a fundamentally new method of pretreatment using ionic liquids that shows promise of vastly shortening processing times. JBEI is targeting knowledge gaps in plant cell wall synthesis, using well characterized model plants to establish fundamental principles that can be subsequently explored in bioenergy feedstock plants.

Subcommittee. Did the evaluations uncover any specific concerns about any of these three centers, or recommendations for moving forward? What were they?

Dr. Brinkman. External review teams noted that DOE should continue to press the centers on several fronts: center-wide integration among researchers within each center should be improved, additional collaborative activities among the three centers should be explored to try and more effectively leverage resources or allow comparative analysis of results, and communication and outreach activities with the larger research community and biofuels industry should be improved.

Subcommittee. For each center, what specifically research needs justify their extension? What are the specific goals for the second five years?

Dr. Brinkman. DOE strongly believes that the centers' programs are closely aligned with Department mission goals and that all three centers are well on the path to achieving the program's important national objectives. The plans for future research presented by the three BRCs are consistent with DOE goals in fundamental bioenergy research and national needs for development of sustainable and economically competitive biofuels. Taken together, the three plans present a highly complementary set of research approaches and scientific objectives that will address key barriers in development of dedicated biomass feedstocks, improved approaches for enzymatic breakdown of cellulosic biomass, and engineering of biological systems for the synthesis of next generation biofuels. For all three centers,

the research plans build on successful lines of research, but also present new objectives (new lines of work focusing on conversion of lignin, greater emphasis on post-ethanol biofuels, etc.) in response to new priorities that have emerged since the founding of the centers four years ago. The plans appropriately maintain a strong emphasis on fundamental biofuels research, but demonstrate a necessary awareness of the evolving landscape of the nascent biofuels industry and the need to quickly advance fundamental science discoveries along the path toward commercial deployment.

Significant research challenges remain in developing a fundamental understanding of biofuels produced from cellulosic biomass and methods to economize the growth, processing, and conversion of bioenergy crops to produce the next generation biofuels. Each center will focus on specific aspects of biofuel production.

BESC will complete a coordinated research effort, initiated during the first five years of operations, to modify plant cell walls to reduce their recalcitrance, develop and optimize microorganisms capable of one-step fermentation of lignocellulose without added enzymes (consolidated bioprocessing, or CBP), and evaluate opportunities for less severe biomass pretreatments tuned to the properties of new feedstocks and biocatalysts.

GLBRC will place increasing emphasis on producing and deploying perennial, productive crops that have improved processing traits and on developing improved processes for converting both crop residues and perennial crops into biofuels. Research will increase emphasis on laboratory-scale production of advanced biofuels (beyond bioethanol) and modifying deconstruction and conversion technologies to maximize the efficiency of lignocellulosic biomass processing.

JBEI will continue to target key gaps in understanding in the mechanism of plant cell wall assembly, composition, and regulation, in order to develop effective methods to deconstruct biomass and novel biological tools to engineer and optimize pathways in microbes to produce advanced biofuels and fuel precursors.

Subcommittee. If funded, would this be the final five-year term for these centers?

Dr. Brinkman. Bioenergy research is expected to remain a Biological and Environmental Research priority. The Department will continue to assess the best mechanism for achieving our goals in this area.

BREAKTHROUGHS AT THE BIOENERGY RESEARCH CENTERS

Subcommittee. Dr. Brinkman, I've periodically seen reports of breakthroughs at the Department's three Bioenergy Research Centers towards developing economical biofuels that do not compete with food crops.

What are some examples of major breakthroughs made at these centers?

Dr. Brinkman. An expanded list of major accomplishments made at each center is available on the publically-accessible websites for each BRC. Provided below are a few examples for each center that are major scientific breakthroughs:

BESC Accomplishments

Creation of a high-throughput platform to handle tens of thousands of feedstock samples, both from transgenic and natural variants to determine the chemical, structural, and genetic features that make cellulosic biomass recalcitrant. The BESC Multichamber Pretreatment Reactor for High Throughput Screening of Biomass has been licensed and is commercially available.

Genetic engineering of the cellulose-degrading microbe *Clostridium cellulolyticum* to produce isobutanol directly from cellulose, the first demonstration of consolidated bioprocessing for production next generation biofuels.

More accomplishments are available at: http://bioenergycenter.org/

GLBRC Accomplishments

Development of new computational modeling approaches that more accurately predict the effects of genetic manipulations of metabolic flux in biofuel-producing microbes, enabling more effective metabolic engineering strategies for improved synthesis.

More accomplishments are available at: http://greatlakesbioenergy.org/

JBEI Accomplishments

Developed an advanced biomass pretreatment process using room temperature ionic liquids that completely solubilize the plant cell walls of switchgrass, corn stover, and other plants, resulting in up to 5-fold improvement in efficiency of subsequent enzymatic breakdown of biomass to fermentable sugars.

Used metagenomic driven bioprospecting to discover highly efficient new cellulase enzymes from microbial communities from environments with high biomass degradation rates (green compost, tropical forest soils, etc.)

Developed and licensed the j5 Scar-less Automated DNA Assembly Design Software to automate and optimize the design of rapid DNA assembly for metabolic pathway engineering in biofuel producing microbes. Using this software and automated robotics technologies, researchers are able to reduce the labor and materials required for large scale DNA construction projects.

More accomplishments are available at: http://www.jbei.org/

UPDATE ON NEXT-GENERATION BIOFUELS

Subcommittee. I've read several accounts over the last year on how cellulosic and other next-generation biofuels have been more challenging to develop than we anticipated. What is the current state of our pursuit of developing economical next-generation biofuels derived from sources that do not compete with our food supply?

Dr. Brinkman. Plants are remarkably complex organisms that have evolved over many millions of years to capture the energy of the sun and store it in complex polymers and cellular components that are highly resistant to degradation. It should not be surprising if undoing what Nature has taken so long to perfect may take longer than expected. That said, the BRCs have made significant advances in the fundamental understanding of bioenergy plant metabolism, cellulose degradation, and microbial conversion of plant derived sugars to biofuels and biofuel precursor compounds. These developments are leading to the design of new dedicated bioenergy crops with improved biofuel properties, new pretreatment processes to isolate and break down cellulose to its component sugars, and new microbial processes to convert cellulosic sugars to a wide variety of biofuel products. These developments are taking place with significant involvement of industrial partners to capitalize on and incorporate these discoveries into potentially commercially viable biofuel production processes. This translation of basic science to commercial application does take time, but the BRCs and their growing list of industry partners are making rapid progress towards developing the basis for a new cellulosic biofuel industry.

While the EERE Office of Biomass Program (OBP) has no formal role in working with the BRCs and their industrial partners to accelerate the transition of new BRC-developed feedstock and processes into commercial applications, coordination and knowledge and technology transfer is a priority for all parties. The Office of Science has recurring coordination meetings with OBP to provide updates and briefings about the BRCs, and there have been numerous meetings and workshops sponsored by both Science and OBP involving BRC participants. Many of the industrial partners and industrial advisory committee members for the BRCs are OBP performers. The BRCs were instrumental in the design of the OBP Recovery Act-funded Advanced Biofuels Process Development Unit that provides a transitional capability from lab-scale to pilot-scale testing of biofuel-relevant processes.

OBP is on track to demonstrate and validate multiple integrated systems for the conversion of biomass to cellulosic ethanol. Laboratory-scale processes have been developed that could enable cellulosic ethanol to be cost-competitive if successfully scaled-up and produced at commercial scale. During FY 2013 and beyond, OBP is planning to shift its R&D efforts to advanced "drop-in" hydrocarbon biofuels.

FUKUSHIMA RADIATION RESEARCH

Subcommittee. The conference report for fiscal year 2012 included funding for research into the effects of radiation from the events in Fukushima, Japan last March. Our hearts go out to the folks affected in Japan, and it behooves us to learn as much as we can from that terrible tragedy.

Where are you in performing that research, and what outcomes can we expect to see when it is completed?

Dr. Brinkman. The health effects of low dose radiation are subtle and very difficult to experimentally discern. Very large sample sizes are needed to lend sufficient statistical power to the analysis of the experimental observations. In FY 2012, DOE is fully funding a large epidemiological study evaluating data collected and available from over a million radiation workers. Analysis of the results will provide the necessary statistical power to draw conclusions and make recommendations on the health effects of low dose radiation applicable to the events in Fukushima Japan.

Subcommittee. The budget request does not include any additional funding for research. Was the funding provided in fiscal year 2012 sufficient to fully complete the research?

Dr. Brinkman. Yes, the FY 2012 funding will complete this epidemiological study on the health effects of low dose radiation exposure.

MEDICAL RESEARCH

Subcommittee. Dr. Brinkman, the Department of Energy has a history of making significant contributions to diagnostic medicine through its work in nuclear medicine. While this research takes advantage of some of the science research expertise at the Department of Energy laboratories, it is increasingly important to cut activities that do not directly relate to the Department's energy-focused missions. At the same time, the National Institutes of Health, for example, provides roughly $30 billion for medical research.

Dr. Brinkman, what discussions have you had with the NIH or other agencies about taking over funding and oversight responsibilities for this and other medicine-focused programs?

Dr. Brinkman. DOE has a history of coordination and collaboration with NIH in the fundamental science underpinning nuclear medicine, including holding joint scientific workshops and ensuring participation in advisory meetings and review panels. We have been engaged in preliminary discussions with our colleagues at the National Institutes of Health regarding the radiochemistry and imaging activities within Biological and Environmental Research and will continue to do so. We expect to follow-up on progress on this matter in more detail in an upcoming report to Congress later this year.

LONG-STANDING CENTERS IN BIOLOGICAL AND ENVIRONMENTAL RESEARCH

Subcommittee. Several research centers have been funded for many years through the Biological and Environmental Research program — the Joint Genome Institute, and the Environmental Molecular Sciences Laboratory are two examples, totaling about $115 million in federal investment per year.

What do these centers contribute to the Department's energy-focused mission?

Dr. Brinkman. The Joint Genome Institute (JGI) and the Environmental Molecular Sciences Laboratory (EMSL) are DOE National Scientific User Facilities providing unique capabilities to scientific users within DOE and the larger scientific community.

JGI is the only federally-funded high-throughput genome sequencing and analysis facility dedicated to genomes of non-medical microbes, microbial communities, plants, fungi and other targets relevant to DOE missions in energy, climate, and environment. JGI provides collaborators around the world with access to massive-scale DNA sequencing to underpin modern systems biology research and provides fundamental data on key genes that may link to biological functions, including microbial metabolic pathways and enzymes that are used to generate fuel molecules, affect plant biomass formation, degrade contaminants, or capture CO_2. The information can then be used to optimize organisms for biofuels production and other DOE missions.

EMSL provides a broad range of premier instruments for experimental research and a High Performance Computing facility for modeling and simulation to enable multi-disciplinary research on the complex physical, chemical and biological interfaces, interactions, and mechanisms that contribute to earth's climate and environmental cycles and processes as well as other DOE missions. EMSL houses more than 75 premier instruments for experimental studies.

Subcommittee. Other centers that the Department established recently are not meant to be perpetually funded, but instead are intended as limited engagements to make specific breakthroughs. The Joint Genome Institute

and the Environmental Molecular Sciences Laboratory appear to be perpetually funded, with no mention of time limitations. Why are they different? What do they do, and what about them justifies apparent permanence?

Dr. Brinkman. JGI and EMSL are part of a broad suite of Office of Science National User Facilities. The Office of Science User Facilities are a unique resource for the Nation's researchers. In 2011 over 26,500 researchers from academia, industry, and government laboratories, spanning all fifty states and the District of Columbia, utilized the Office of Science's unique facilities to perform new science. The Office of Science continues to build on its long legacy of excellence in creating world-class large-scale scientific tools.

JGI and EMSL each provide co-located instrumentation to allow a rapid production of transformational science, in support of broad community scientific goals. Both of the facilities are highly adaptable to new scientific priorities.

JGI provides scientific users with massive-scale DNA sequencing and genome analysis capabilities for non-medical microbes, microbial communities, plants, fungi and other organisms of relevance to DOE missions in energy, climate, and the environment. These capabilities underpin DOE's systems biology research leading to a better understanding of key genes, gene function, metabolic pathways and enzymes that could be used to generate fuel molecules, affect plant biomass formation, degrade contaminants, or capture CO_2. This information can then be used to optimize organisms for biofuels production and other DOE missions. As genome sequencing technologies continue to make rapid advances, JGI is evolving to incorporate more functional information and bioinformatics capabilities to bring added value to the interpretation of genome sequences.

EMSL provides a broad range of premier instruments for experimental research and a High Performance Computing (HPC) facility for modeling and simulation to enable multi-disciplinary research on the complex physical, chemical and biological interfaces, interactions, and mechanisms that contribute to Earth's climate and environmental cycles and processes as well as other DOE missions. EMSL houses more than 75 premier instruments for experimental studies. EMSL science has led to transformative catalytic exhaust aftertreatment systems, improved diesel treatment systems,

improved mass spectrometer capabilities, and a refined methodology to rapidly describe aerosol physical, chemical, and optical properties. A full description of EMSL and its success stories may be found at: http://www.emsl.pnl.gov/emslweb/. EMSL's strategy is to be rapidly adaptive to emerging scientific challenges. For example, the suite of instrumentation at EMSL shifted to a focus on science that requires a combination of the most powerful magnets, mass spectrometry, microfabrication, and distributed high performance computing. EMSL's strategy is revisited annually, so that instrumentation that has little value on the science is replaced with next generation or other types of technologies that guarantee the highest scientific return on investment.

ATMOSPHERIC RADIATION MEASUREMENT CLIMATE FACILITIES

Subcommittee. The request includes $70.6 million for the Atmospheric Radiation Measurement Climate Research Facilities, or ARM facilities for short.

I understand that these facilities are relevant to climate modeling. What is the purpose of these facilities, and why are they necessary when NOAA and other federal agencies are the experts in the measurement of weather and climate?

Dr. Brinkman. The ARM facility sites are designed to provide a comprehensive set of continuously-observed very high resolution three dimensional data bases of aerosols, clouds, and precipitation fields, for use by the climate research community. The sites are located at the most climate-sensitive geographic regions, and databases contain both in situ point observations as well as spatially resolved information obtained by scanning radars and lidar systems. Spatial resolution is of order of 10 meters, over a domain of 10 kilometers or more. The value of the ARM capabilities is critical to the climate prediction community, insofar that climate model uncertainties are dominated by an inadequate representation of clouds and aerosols in climate models. There are no equivalent measurement capabilities at NOAA, NASA, or any other Federal agency. Today, weather and climate researchers at numerous academic and Federal laboratory institutions (including NOAA) use data from the ARM sites.

Subcommittee. How many ARM facilities does this support, and where are located?

Dr. Brinkman. There are four permanent ARM facility sites, each located in unique climate-sensitive geographic regions that require long-term measurements, to advance regional and global climate predictability. The sites are located in central Oklahoma; Barrow, Alaska; the western tropical Pacific; and the Azores Islands in the Atlantic. In addition, there are three mobile units, deployed to climate sensitive regions as part of shorter term intensive campaigns for durations of 6 to 12 months. Two of the mobile units are on deployment to India and the Maldives; the third facility is currently being installed at Oliktok, Alaska.

Subcommittee. Does the budget include the addition of any new ARM facilities?

Dr. Brinkman. The FY 2013 budget does not include the addition of new facilities.

Subcommittee. Is there an anticipated lifetime to these facilities and this program?

Dr. Brinkman. The ARM sites will be needed by the community for at least one more decade, in part to improve certainty of higher resolution climate predictions and also to validate systematic improvements in climate model. Much progress had been made during the past decades in cloud and aerosol science using ARM facility databases, but those advances were until recently based on in situ local measurements to parameterize cloud and aerosol processes for use in macroscale climate models of order of 150 kilometer spatial resolution. During the past few years, advances in climate modeling toward higher spatial resolutions of order of 15 to 25 kilometers, with embedded information on extreme events, have resulted in more stringent requirements for cloud and aerosol research. Unlike past ARM strategies to collect only local point measurements, these new requirements now focus on extending the scientific understanding to capture the continuously observed three-dimensional evolution of cloud, aerosol, and precipitation systems on scales of tens of meters, over a spatial domain of order of 10 to 15 kilometers. Based on Recovery Act investments in FY 2011 and FY 2012, ARM sites each now have three dimensional scanning radars and lidars, which complement their in-situ meteorological observations. However, the uncertainty of climate model predictions is still traced to inadequate representations of cloud and aerosol processes, so we anticipate that the ARM sites will be needed by the community for at least one more decade, in part to improve certainty of higher resolution climate predictions and also to validate systematic improvements in climate model.

INCREASE FOR ECOSYSTEM SCIENCE

Subcommittee. The request includes an increase of $29 million for Terrestrial Ecosystem Science, to expand research relating to arctic permafrost and tropical regions.

What is the importance of these areas to warrant such an increase — the largest increase in the Biological and Environmental Research program?

Dr. Brinkman. The Arctic and tropical regions contain significant subsurface carbon, that if released could have significant warming potential. Little is known of the dynamics governing ecological change in these regions, yet changes in these regions can be so significant that there will likely be larger scale climate change patterns in temperature, precipitation, and extreme events that will emerge even in the mid-latitudes, including the United States. In climate prediction modeling, most efforts during recent decades have focused on advancing atmospheric and oceanic dynamics, but much less effort has been placed on terrestrial land use responses. It is now well-accepted by the scientific community that regions that are already undergoing rapid change (e.g., the Arctic) or are vulnerable to significant change (the tropics and savannah ecosystems) have been relatively under-studied; these terrestrial systems are either weakly represented or absent from most climate modeling programs. During recent years, Arctic permafrost regions in Alaska, northern Canada, and Russia are well-documented with rapid climate warming, permafrost thaw, and ecological migration. Similarly, the tropics are beginning to experience significant climate shifts, associated with various combinations of changing monsoon circulations, changes in adjacent coastal ocean circulations, and changes in land use activity.

Subcommittee. This research involves teams actually deployed abroad. Will these be grants to universities to conduct the field research, or conducted by national labs?

Dr. Brinkman. Research will be based on a combination of national laboratory and university-based research. National laboratories will be responsible for much of the basic measurement infrastructure, database management and archival systems, and climate model interfaces. Universities will be responsible for process-level understanding of unique

yet important components of ecological systems experiencing climate change.

Subcommittee. Is this research proposed for a finite number of years?

Dr. Brinkman. Yes, the long term field studies are designed to be for 10 years.

Subcommittee. What did you cut to make room for these increases?

Dr. Brinkman. The subsurface biogeochemical research activity was reduced to provide for this opportunity.

NUCLEAR PHYSICS

FACILITY FOR RARE ISOTOPE BEAMS (FRIB)

Subcommittee. The President's budget request does not provide funding to begin construction of the Facility for Rare Isotope Beams (F-RIB), a planned user facility in Michigan, but instead provides just enough funding to continue research for the project. I understand the Department had to make tough choices in its budget request, and I'd like to better understand this one.

What would this facility let us do that we can't do already?

Dr. Brinkman. FRIB will provide intense beams of rare isotopes; that is, short-lived nuclei not normally found on Earth. This will enable scientists to make discoveries about the properties of these rare isotopes in order to better understand the physics of nuclei, nuclear astrophysics, fundamental interactions, and applications for society. FRIB will increase the number of isotopes with known properties from about 2,000 observed over the last century to about 5,000 and will provide world-leading research capabilities. The fields of nuclear structure and astrophysics that will be studied at FRIB provide the link between our understanding of the fundamental constituents of nature and the understanding of the matter of which we, the Earth, and stars are made. Expertise in these areas is also central to applied fields such as energy, security, and medicine.

Subcommittee. Did the Department have specific concerns about the F-RIB project?

Dr. Brinkman. No, the Administration supports the Facility for Rare Isotope Beams at Michigan State University. In the President's FY 2013 Budget, the Administration proposes funding for the Facility for Rare Isotope Beams equal to the FY 2012 enacted level of $22 million. This request will keep this important and worthy project moving forward and reflects the priority the President places on FRIB, even in these tight budget times.

Subcommittee. What is the Department's plan for F-RIB moving forward? Are you proposing to terminate the project, or simply delaying it by a year?

Dr. Brinkman. The $22 million proposed investment included in the FY 2013 budget for this project reflects the Department's commitment to seeing it move forward

REDUCTION TO RHIC OPERATING TIME

Subcommittee. The budget request trims funding for the RHIC facility at Brookhaven National Laboratory, reducing its operating time in fiscal year 2013 to only 9 weeks — which I understand is not enough time to do a full run in 2013. The facility receives $156.6 million in the request, and my understanding is that an additional $3 million would get the runtime up to 15 weeks, enough to conduct a run in 2013. When considered "in a vacuum," it seems that this small percentage increase in cost would have significant marginal benefits. But I understand that you've got some extremely difficult tradeoffs to consider within Nuclear Physics, RHIC's parent program.

What was your reasoning when deciding to trim the RHIC budget just enough to reduce its runtime so drastically? In other words, can you explain the tradeoffs, and how the budget was so tight that $3 million was not available?

Dr. Brinkman. The Nuclear Physics program is supporting two high priority capabilities for the future of the field—the 12 GeV Continuous Electron Beam Accelerator Facility Upgrade at Jefferson Lab and the Facility for Rare Isotope Beams at Michigan State University—within the overall context of a budget situation that is very different than it was a few years ago. With federal funds as tight as they are, difficult budget choices had to be made within the Nuclear Physics program. Research across the program was reduced, and funding for operations of facilities was constrained, including for the Relativistic Heavy Ion Collider at Brookhaven National Laboratory.

Subcommittee. Is this a 1-year problem because of special circumstances this year, or can we expect an ongoing challenge with RHIC and the Nuclear Physics program?

Dr. Brinkman. We believe that developing future budgets for all Office of Science programs will be a challenge for the foreseeable future. The Office of Science has used the Nuclear Science Advisory Committee to provide regular reviews of Nuclear Physics programs and priorities, most recently in 2007 and 2002. This year DOE, along with the National Science Foundation, has asked NSAC to examine existing nuclear physics research capabilities and scientific efforts, assess their role and potential for scientific

advancements, and provide advice regarding the time and resources needed to achieve the planned programs.

LITHIUM-7 ISOTOPE PRODUCTION

Subcommittee. As you know, the Department of Energy is an important supplier of isotopes for research, medical, and industrial needs not only in the United States, but around the world.

With advances in isotope production being made in Canada and France, what is the Department doing to ensure it can continue to provide a reliable, domestic supply of isotopes for research, medical and industrial uses to meet growing demand in the United States?

Dr. Brinkman. The Office of Science Isotope Program is making significant advances in isotope production. Emphasis has been placed on making investments in developing new production techniques for high priority isotopes to increase their availability. Examples include R&D for re-establishing a domestic production capability for stable isotopes, whose national inventory is being depleted. Another example is alpha-emitter production, most notably that of actinium-225, a promising new cancer-treatment agent. Production of californium-252, an isotope of strategic importance to oil and gas exploration, was restarted under the management of the Office of Science. In the past few months, the program has embarked on a new initiative to extract americium-241, used in oil and gas exploration and in smoke detectors, from plutonium waste streams at Los Alamos National Laboratory from NNSA feedstock. The program is establishing new production capabilities outside the suite of NP Isotope Program facilities, including university facilities. The program is also strengthening communication with stakeholders to better forecast isotope demand and mitigate potential shortages. In January of 2012, the Office of Science and NNSA jointly sponsored a Federal Workshop on Isotope Demand and Supply in which over twenty different Federal entities participated.

Subcommittee. Russia and China are currently the only major sources of Lithium-7, which is important to some nuclear power reactor operations. As more nuclear power plants are constructed throughout the world, the demand for Lithium-7 will likely increase. How is the Department positioning itself to respond to a potential future shortage of Lithium-7 and/or other isotopes?

Dr. Brinkman. The Department has taken many steps to better understand isotope demand in order to prepare for and possibly mitigate

potential shortages. Most recently in January 2012, at the Federal Workshop on Isotope Demand and Supply, Federal entities identified isotopes that were critically needed in order to meet their mission, including outyear projections and estimates of quantities needed. In August 2011, the Office of Science participated in a Stable Isotope Workshop sponsored by DOE in which the status of nuclear energy-related critical isotopes (lithium-7, boron-10, and depleted zinc) was assessed. Near- and long-term supply and demand projections and production technologies were discussed. The Office of Science is currently engaged with federal entities including the Department's Office of Nuclear Energy, industrial stakeholders, and others to understand demand, any potential supply challenges, and whether there is an appropriate Federal role in mitigating any potential lithium-7 shortage.

The DOE recognizes the importance of these critical isotopes to U.S. energy production and the need to assure a reliable supply for the Nation.

MOLYBDENUM-99 PRODUCTION OPTIONS

Subcommittee. Molybdenum-99, known as "molly-99", is an important radioactive isotope for diagnostic medicine, but we've had significant supply challenges in the last several years. There are also proliferation issues involved, since the isotope's production depends on the use of highly enriched uranium in nuclear reactors.

Since the Department's isotope production programs have been consolidated under your purview, Dr. Brinkman, can you update us on the current state of moly-99 supply in the United States?

Dr. Brinkman. The United States does not currently produce the medical isotope molybdenum-99 (Mo-99) and must import 100 percent of its supply from foreign producers, most of which use proliferation-sensitive highly enriched uranium (HEU) in their production processes. NNSA's Global Threat Reduction Initiative (GTRI) has the responsibility for accelerating the establishment of a reliable supply of Mo-99 produced without HEU.

To accomplish this objective, NNSA works with existing Mo-99 producers to assist in the conversion from HEU targets to LEU targets, and has partnered with four U.S. commercial entities to accelerate the development of technical pathways that do not use HEU to produce Mo-99 in the United States.

International Projects: The four international producers that use HEU targets are Belgium, Canada, the Netherlands, and South Africa (South Africa is partially converted to LEU production). Through the assistance provided by NNSA, the Mo-99 producer in South Africa has successfully produced large-scale supplies of Mo-99 with LEU targets and has received regulatory approval for the distribution and use of LEU-produced Mo-99 in the United States. At the March 2012 Nuclear Security Summit, Belgium and the Netherlands announced commitments to convert their respective commercial production to LEU targets by 2015, subject to technical and regulatory challenges. The Canadian government has stated that the National Research Universal (NRU) reactor that produces Mo-99 will no longer produce isotopes after 2016, thereby no longer producing Mo-99 with HEU.

U.S. Domestic Projects: NNSA has entered into cooperative agreements with four U.S. commercial partners to develop non-HEU-based technology

for Mo-99 production including Babcock and Wilcox (B&W)—LEU solution reactor technology, General Electric-Hitachi (GE-Hitachi)—neutron capture technology, NorthStar Medical Radioisotopes—accelerator technology, and Morgridge Institute for Research—accelerator with LEU fission technology. NNSA support to these projects is implemented under a 50–50 cost-share cooperative agreement.

Currently, all of the projects are in Phase 1 cooperative agreements. The Phase 1 cooperative agreements provide funding for a limited scope of activities that are categorically excluded from the National Environmental Policy Act (NEPA) requirements. Categorically excluded activities include work such as conceptual and preliminary design for the projects. Once NNSA meets its NEPA obligations, the evaluation of which is currently underway, additional support for Phase 2 of each of the projects may commence. Funding provided under Phase 2 cooperative agreements will support the final design, construction, and production phases of the projects.

Subcommittee. In 2010, General Electric came up with a way to produce moly-99 in reactors that use low-enriched uranium. But GE has since decided that it's not currently economical to retrofit a reactor to produce moly-99 this way, because an aging Canadian reactor is still cheaply producing the isotope. Is this a market failure that is going to hurt us in several years when the Canadian reactor shuts down, or is the current and future supply of moly-99 secure?

Dr. Brinkman. Significant historical shortages of Mo-99 resulted from reliance on aging reactors. The historical subsidies provided by governments with the current production facilities has rendered the cost of Mo-99 artificially low, thus preventing new producers from entering the market and making it difficult for current international producers to convert from HEU targets to LEU targets. In order to develop a secure and reliable Mo-99 market, the use of subsidies must end and the market must move toward full cost recovery.

NNSA entered into a cooperative agreement with General Electric-Hitachi (GEH) in September 2009 to accelerate the domestic production of non-HEU-based Mo-99 through the implementation of a neutron capture technology to produce Mo-99. Despite significant technical progress, GEH decided to suspend work on this project following the successful completion of their Phase 1 cooperative agreement. While both GEH and NNSA are

confident that large quantities of Mo-99 can be produced using this technology, GEH made a business decision to not move forward at this time based upon their evaluation of the current status of the market and the continued availability of subsidized Mo-99 from some of the foreign producers.

NNSA is continuing to work with three other domestic commercial entities to accelerate the production of non-HEU-based Mo-99 in the United States through multiple technology pathways to ensure that a diverse, reliable supply of non-HEU-based Mo-99 is available for the medical community. However, if the Mo-99 market does not transition to full cost recovery, it significantly put at risk the business viability of these emerging projects that are intended to replace the current aging infrastructure, most significantly from the Canadian NRU reactor.

WORKFORCE DEVELOPMENT

REALIGNMENT OF WORFORCE DEVELOPMENT PROGRAM

Subcommittee. Dr. Brinkman, I understand that you and your staff have put considerable effort into evaluating and improving the Workforce Development for Teachers and Scientists program. Can you explain what realignments have been made, what programs are discontinued in the request, and what further changes are to come?

Dr. Brinkman. The Deputy Director for Science Programs commissioned a Committee of Visitors (COV) Review of the Workforce Development for Teachers and Scientists program in 2010 under the auspices of the Basic Energy Sciences Advisory Committee (BESAC). The COV report together with an internal examination of the activities in the WDTS program by the Deputy Director for Science Programs, who has served as the Acting Director of WDTS since May 2011, resulted in a number of realignments. Activities that reviewed well and were strongly supportive of the WDTS mission received increase funding; other activities were terminated, most of these in the FY 2012 budget. The activities that received the strongest endorsements include the three programs that bring students and faculty to the DOE laboratories for extended periods during the year (the Science Undergraduate Laboratory Internship, the Community College Internship, and the Visiting Faculty Program); the National Science Bowl; the Albert Einstein Distinguished Educator Fellowship; and the DOE Office of Science Graduate Fellowship. Other activities that were outside of the WDTS mission (e.g., teacher training and curriculum development) or that were not impactful were terminated. No funds are requested for the DOE Office of Science Graduate Fellowship in FY 2013, because the Administration is evaluating the role of mission agencies in support of graduate fellowships. This role is discussed in our forthcoming report requested by Congress.

Further reviews of the WDTS program are planned, including an external peer review of the laboratory management of their activities and a second COV review of the Federal management of the entire WDTS program. Additional changes, which we expect to be significantly less dramatic than those that took place over the past two years, will be informed by these two reviews.

QUESTIONS FROM CHAIRMAN FRELINGHUYSEN OF NEW JERSEY

PROPOSED INCREASES WITH SHARP CUTS IN OTHER AREAS

Chairman Frelinghuysen. Dr. Brinkman, you were faced with making some tough tradeoffs this year. With limited funds, your request almost unavoidably had to make some tough decisions by cutting funding from some programs. But on top of that tough reality, your request adds $92 million for new Basic Energy Science research.

Why has the Department made it even worse for a number of major programs, labs, and facilities by proposing to add funding for several new initiatives?

Dr. Brinkman. The $4.99 billion dollar FY 2013 request for the Office of Science represents a strong commitment by the Administration to maintain our Nation's investments in science and innovation. In composing the request, the Administration made many difficult decisions while maintaining substantial investments in each of the six core research programs. Despite a challenging budget environment for Nuclear Physics with significant reductions across the program, the President's request includes $22 million for the Facility for Rare Isotope Beams at Michigan State University. This will allow the project to continue to move forward in project engineering and design. In Fusion Energy Sciences, while maintaining a balanced portfolio, the Administration is committed to the scientific goals of ITER, an international fusion experiment involving six nations and the European Union. ITER will produce the world's first "burning plasma," a self-sustained positive net-energy thermonuclear reaction.

- The $106 million increase requested in the Basic Energy Sciences (BES) program reflects the Administration's judgment that there is exceptional potential for science to seed new breakthroughs in clean energy. The BES increase is specifically targeted in the following areas:

  A joint research and development effort with the Office of Energy Efficiency and Renewable Energy aimed at accelerating the transition

of novel scientific discoveries into innovative prototype clean energy technologies leveraging the existing investments in clean energy sciences at Energy Frontier Research Centers and at the BES user facilities ($35 million).

- New core fundamental scientific research efforts that will contribute to science-based chemical and materials design and manufacturing by increasing our understanding of the correlations between material structure, chemistry, and function for clean energy applications ($42 million)

- New core fundamental scientific research efforts in the areas of Materials and Chemistry by Design, with the specific goal to provide the Nation with a science-based computational tool set to rationally predict and design materials and chemical processes to gain a global competitive edge in scientific discovery and innovation ($20 million)

Chairman Frelinghuysen. Was it responsible to propose these increases when there is so much pain elsewhere in the Science programs — including layoffs, facility shutdowns, and failure to international commitments?

Dr. Brinkman. The Administration believes that is essential to pursue new opportunities with the greatest potential benefit even in austere fiscal times. The Nation cannot afford to defer renewing investments in our highest priority research areas.

ADMINISTRATION'S LOW PRIORITY FOR FUSION ENERGY

Chairman Frelinghuysen. I understand as well as anyone that budgets are tight, and that it's our responsibility to make tough budgetary choices. But I'd like to take a moment to better understand why the Administration has made the choices it has made.

The President's budget request funding for the domestic Fusion Energy program by $49 million and cuts ITER by $50 million from its planned level, while it increases funding for other Science programs. In choosing winners and losers, it seems that the Department of Energy has chosen Fusion Energy Sciences as a loser.

Fusion is an example where government has a proper role — that is, if government doesn't fund it, no one will fund this research area with the potential to create a long-term solution to our nation's energy needs. Aren't we being shortsighted, and shortchanging future generations by not making a strong long-term investment now?

Dr. Brinkman. With the proposed budget request, the U.S. continues to have a strong investment in fusion research. The U.S. is a partner in the ITER Project, which is designed to be the first magnetic fusion facility to achieve self-sustaining ("burning") plasmas and which will open a new era in fusion energy science. The proposed budget will sustain a domestic U.S. program that continues to make significant contributions to resolving vital issues in fusion research and thereby contribute to building the scientific foundation of fusion energy.

Chairman Frelinghuysen. How would the funding levels in the budget request affect America's fusion science community and industry? Can we retain a world-leading fusion program and fulfill our ITER commitments at the levels in the request?

Dr. Brinkman. The proposed budget was developed with a long-term vision for the non-ITER part of the Fusion Energy Sciences program. It positions the program to maximize the scientific return of our investment in ITER; address gaps in materials science, required for harnessing fusion energy; and continue to invest in the broader plasma sciences, taking advantage of cross-agency synergies. It also provides opportunities for U.S. scientists to do research on a billion-dollar-class of new international

superconducting facilities. The proposed budget will allow the U.S. to continue to have a dynamic fusion program that leads in critical areas.

Chairman Frelinghuysen. And how would the reduction to planned ITER funding impact our manufacturers and scientists here in the United States, since 90 percent of our ITER contributions go to American companies and scientists?

Dr. Brinkman. The $45 million increase in ITER funding for FY 2013 will provide for increased procurements with U.S. industry. The funding request for FY 2013 maintains our commitment to the scientific mission of ITER while maintaining a balanced research portfolio.

SCIENCE RESEARCH LEADING TO MANUFACTURING HERE... OR ABROAD

Chairman Frelinghuysen. I'd like to bring up an area of concern that we've posed to other Department officials this month, because I don't believe we've heard a compelling answer yet. The Office of Science is a key component of the Department's efforts to drive American innovation. But innovation is not the end point — converting that innovation into American manufacturing and industry jobs is a critical next step.

How does the Department ensure that science discoveries and innovations supported by the Office of Science lead to industry jobs here at home, rather than abroad?

Dr. Brinkman. The Department of Energy understands and is working on the challenges in growing the U.S. manufacturing base. The objective is to retain manufacturing jobs arising from our technological innovations here in the U.S. whenever feasible. Secretary Chu has recently created the Office of Advance Manufacturing, previously the Office of Industrial Technologies, to support U.S. manufacturing of DOE funded technologies.

In terms of DOE licensing operations our Laboratories exclusive or partially exclusive licensing agreements have a 'U.S. Manufacturing' preference clause that typically provides: "*All LICENSED PRODUCTS for use or sale under any LICENSED PATENTS will be substantially manufactured in the U.S.*" Any company that cannot agree to this statement must request a waiver showing net benefit back to the U.S. economy if it cannot agree to manufacture in the U.S. The considerations for net benefit back to the U.S. economy include direct or indirect investment in U.S.-based plant and equipment, creation of new and/or higher-quality U.S.-based jobs, enhancement of the domestic skills base, further domestic development of the technology, significant reinvestment of profits in the domestic economy, and other such factors. The Department has seen only one to two waivers a year during recent years. For research funded at a university, a similar clause is required by the Bayh-Dole legislation.

Additional language and background for U.S. manufacturing.

The waiver considers factors that make domestic manufacturing commercially infeasible, including the strategic implementation to find a

U.S. manufacturer, the significance of the technology, the possible delay to market entry, the relative costs of U.S. and foreign manufacturing, and any other circumstances that make foreign manufacturing necessary.

U.S. Manufacturing Preference

The Act restricts foreign manufacturing of federally-funded inventions. More specifically, if a university grants a company an exclusive license to use a federally-funded invention, the Act requires that such invention, or products that incorporate such invention, be manufactured substantially in the United States.

FLAT BUDGET SCENARIO

Chairman Frelinghuysen. Dr. Brinkman, this year is similar to the last two, in that additional funding for any program is going to be exceedingly hard to come by. The budget for the Office of Science is particularly difficult because of existing commitments to several large projects whose budgets were scheduled to grow this year. But this Committee must live within our means, and that means making extremely difficult decisions — it is very likely that we cannot count on having the additional $100 million you add to the Office of Science in the budget request.

We look to you and the Department to help in prioritizing as we make those decisions. To that end, the fiscal year 2012 appropriations conference report directed your office to provide us with a flag budget scenario — that is, if you received funding at the 2012 level, how would you prioritize your budget?

This budget scenario was due at the beginning of February, but unfortunately we are still waiting for it. Dr. Brinkman, when will you get us this report?

Dr. Brinkman. The FY 2013 budget submitted to Congress presents the funding level proposed by the President for the Office of Science and reflects the Administration's priorities.

GLOBAL COMPETITION FOR SUPERCOMPUTERS

Chairman Frelinghuysen. In the last several years, China and then Japan began operating supercomputing systems that are faster than our best unclassified systems. I understand that when China took the lead of the global rankings at the end of 2010, its computing system primarily used American processors. But that won't be the case for long. In short, we have serious competition out there.

How do you see the competitive landscape evolving over the next five years?

Dr. Brinkman. The world is clearly in agreement that high performance computing is important for many reasons including industrial competitiveness. China, Japan, Europe, and India have announced significant new investments in high performance computing with the intent of fostering competitive domestic computing vendors. The United States has been the leader in this area for some time but leadership in such a fast paced field requires significant sustained investments. Even in the commercial sector, I believe that the United States needs to remain among the leaders in this area. This may be difficult, as many of these other governments invest directly in their domestic industries for strategic purposes.

The Department is focused on addressing our mission needs, which demand greater computing capabilities. We are focused on our mission. Some of the toughest next-generation challenges for our energy, environment, and national security mission will require more computing capability with significantly lower power requirements. We need our critical applications to run well on rapidly changing hardware in order to deliver scientific and engineering results. We need to be able to understand and trust these results. I believe that these are challenging requirements that will drive U.S. industry to innovative and competitive solutions.

FASTER-THAN-LIGHT PARTICLES?

Chairman Frelinghuysen. Dr. Brinkman, there was considerable buzz last year in the science community and the general public about a tentative finding at CERN, the European physics center, showing that neutrinos — a small, elusive particle — actually move faster than light.

Most of the members of this subcommittee, I dare say, are not scientists. For our benefit, can you explain in a nutshell what the CERN experiment found, and why it would be significant if confirmed?

Dr. Brinkman. In September 2011, the CERN experiment announced they had measured faster-than-light neutrinos. The neutrinos in the experiment were created in a beam at CERN, then largely passed through the earth as they only interact very weakly with normal matter, and some of them were detected by a large underground detector located in the Italian Alps. The distance the neutrinos traveled was known to very high accuracy. The timing of the passage was done using a Global Positioning System (GPS). By dividing the distance by the time, they found that the neutrinos traveled from CERN to the detector 60 nanoseconds faster than light would! The implications, if confirmed, would be far reaching. Einstein's theory of relativity has survived challenges for a century.

Chairman Frelinghuysen. I understand that CERN announced two potential issues in their experiment that may have biased the results. What is the current status of their finding?

Dr. Brinkman. The CERN collaboration has identified two possible effects that could have an influence on its neutrino timing measurement. These both require further tests with a short pulsed beam. The potential extent of these two effects is being studied by the collaboration. New measurements with short pulsed beams are scheduled for May.

Chairman Frelinghuysen. Do you think CERN's finding will be verified, or that the finding will prove to be incorrect?

Dr. Brinkman. The likelihood for faster-than-light neutrinos being verified seems slim. A different neutrino physics experiment recently announced a new measurement, using last year's short pulsed beam from

CERN, which indicated that the neutrinos do not exceed the speed of light on their journey between the two laboratories.

Chairman Frelinghuysen. Do we have any similar experiments here in the United States? What are the Department's lab's doing to help confirm or reject this finding?

Dr. Brinkman. The Main Injector Neutrino Oscillation Search (MINOS) Experiment, with a neutrino beam from Fermilab in Batavia, IL and a far detector in Soudan Mine, Minnesota (735km away), has recently procured new GPS receivers and associated hardware. Data will be taken in the spring of 2012 with initial results expected later this year that will either verify or refute the original CERN results.

Chairman Frelinghuysen. As I mentioned before, what do you think this says about the state of basic science research, and the public's attitude towards it?

Dr. Brinkman. The press release made by the original CERN experiment garnered international media attention, and sparked quite a great deal of interest among the general public and from students. Scientists were asked questions on topics ranging from the basic "what is a neutrino?" to the advanced "could this explain dark energy?" I think this reflects well on the public's excitement about basic science and its ability to answer very fundamental questions. The fact that these results can be independently verified or refuted also provided the public with an excellent lesson on how science is done.

QUESTION FROM MR. SIMPSON OF IDAHO

Mr. Simpson. Mr. Undersecretary, as you may or may not be aware, I have a company in my district called International Isotopes that makes Cobalt 60 in INL's Advanced Test Reactor. International Isotopes in fact is the only U.S. based supplier of this important isotope (which is used in cancer treatment shipping container inspections).

For 15 years, International Isotopes has contracted directly with INL for cobalt "irradiation services" – a partnership which has worked very well for both parties.

Earlier this year, however the Office of Science's Isotope Business Office took over control of the contract.

Since the IBO took over, International Isotopes has experienced significant delays in work under the new contract –delays that have resulted in an alarming decrease in cobalt production.

Frankly, I am concerned that these delays will begin impacting cancer patients and other critical users of medical and industrial isotopes.

Are you aware of this situation?

Dr. Brinkman. We are aware of the facts of this situation and Isotope Business Office (IBO) and Idaho National Laboratory (INL) are working diligently to ensure that cobalt-60 has been shipped to International Isotopes as ordered. Presently, INL reports no delays in work or decrease in cobalt-60 production relative to plans. All cobalt-60 targets in the reactor have continued to be irradiated and all shipments have been made expeditiously upon receipt of orders from International Isotopes. There is a potential for delays in the future as International Isotopes did not properly label some cobalt-60 targets as such, which will make their identification challenging when they need to be removed for relocation in the reactor.

Work performance is independent of the contracting mechanism. In fact, provision of cobalt-60 is enhanced under IBO management as the irradiation targets have been given higher priority for space in the reactor since the IBO moved under the authority of the Office of Science.

Mr. Simpson. Will you work with me to ensure that International Isotopes has the ability to work directly with INL to resolve it?

Dr. Brinkman. The Department of Energy is committed to working with International Isotopes to optimize cobalt-60 production and mitigate any potential delays.

QUESTIONS FROM MR. REHBERG OF MONTANA

ITER

Mr. Rehberg. The administration has stated that it is "committed to ITER". At the same time, the FY2013 budget proposes severe cuts for the domestic fusion program. Without a strong domestic program, the commitment to ITER is hollow and ultimately useless. Is the administration truly committed to fusion energy?

Dr. Brinkman. The FY 2013 Budget proposes a program that will help establish the scientific basis for fusion energy through both its research program and through partnership in the ITER project. The choices made reflect a prioritization of burning plasma science, which is the one of the most significant hurdles to demonstrating fusion's scientific and technical feasibility, while continuing to invest in a broader plasma sciences research portfolio. In this budget, choices were made to preserve a level of effort across the board, including the areas of major facility research in magnetic fusion, theory and computation, university-class research in magnetic fusion and in general plasma sciences, and in high energy density laboratory plasma physics at universities as well as national laboratories. The Office of Science will lever our investments in fusion energy sciences through national and international partnerships. Modest initiatives are proposed in areas that have been identified as gaps critical to fusion's success, most notably fusion materials science.

Mr. Rehberg. How will you pay for ITER and still have a strong Fusion Energy Sciences domestic program, capable of reaping the benefits of U.S. investments?

Dr. Brinkman. The FY 2013 Budget reflects the Administrations ongoing commitment to the scientific mission of ITER, while maintaining a balanced research portfolio. We are working with our ITER partners to accomplish this goal.

Mr. Rehberg. The 2013 budget proposal includes broad and deep cuts to the domestic fusion program, including the shutdown of the only University-based major facility. How will the next generation of scientists in this field be trained?

Dr. Brinkman. Maintaining scientific breadth is important for the health of the fusion and plasma sciences, and this budget accomplishes that goal. Regarding impacts to universities specifically, we note that this budget proposal will support about 400 individual students in the fusion and plasma sciences nationally.

As you may or may not be aware, I have a company in my district called International Isotopes that makes Cobalt 60 in INL's Advanced Test Reactor. International Isotopes in fact is the only U.S. based supplier of this important isotope (which is used in cancer treatment shipping container inspections).

For 15 years, International Isotopes has contracted directly with INL for cobalt "irradiation services" – a partnership which has worked very well for both parties.

Earlier this year, however the Office of Science's Isotope Business Office took over control of the contract.

WEDNESDAY, MARCH 28, 2012.

DEPARTMENT OF ENERGY, ARPA–E AND LOAN GUARANTEE PROGRAM

WITNESSES

DR. ARUN MAJUMDAR, DIRECTOR, ARPA–E

DAVID FRANTZ, DIRECTOR, LOAN GUARANTEE PROGRAM

Mr. FRELINGHUYSEN. Good afternoon. I would like to call the meeting to order, and I apologize to everyone for the delay in getting going. Our hearing today is for Fiscal Year 2013 budget request for the Department of Energy's Loan Guarantee Programs, and for the Advanced Research Programs Agency—Energy, ARPA–E. Dr. Majumdar, thank you for being here. Mr. Frantz welcome to the committee.

We asked the two of you to appear together because of the unique nature of your programs. Although you were authorized before 2008, you both formed the backbone of some of this administration's most visible initiatives. Now that we are into the fourth year of the administration, you have enough of a track record that we can have a more informed discussion about the successes you have had, and some of your challenges.

Mr. Majumdar, this budget request for $375 million for ARPA–E activities is a $75 million increase for the Fiscal Year 2012 appropriation. This is a 27 percent increase, matched only by the 28 percent increase requested for energy efficiency and renewable energy. At the same time, the request cuts funding for fossil energy, and nuclear energy research and development. While I would like to believe that the present support for all of the above energy strategy is for an all-of-the above engineer strategy, the facts indicate that this budget request, in some ways, is more ideological than practical.

Yet, the ARPA–E program has identified an important niche for itself by supporting high-risk, high-reward projects, and given all of the political pressures surrounding your program, you have made some tough decisions, including the termination of projects which were not achieving their goals. And I think that is commendable. I would encourage other parts of the Department to learn lessons from the way you have done business.

The Loan Guarantee Program, on the other hand, has been the center of some controversy, starting with the Solyndra bankruptcy, and now extending into questions about other companies. Apparently, even the President no longer wants to take responsibility for this program, according to remarks he made last week.

Mr. Frantz, you are not asking for any new loan guarantee authority, but given the billions of dollars that your programs are overseeing, you will have some hard questions. We will have some

hard questions for you to answer today. We look forward to your answers.

And may I say, parenthetically, I generally support loan guarantees, but I do think, to some extent, and it is unfortunate, that the water has sort of been poisoned here because I think they have been a valuable resource. But we are going to move on.

Please ensure that the hearing record, questions for the record, and any supporting information requested by the subcommittee are delivered in final form to us no later than 4 weeks from the time you receive them. Members who have additional questions for the record will have until the close of business tomorrow to provide them to the subcommittee office. With that, I turn to Mr. Visclosky for any opening comments he cares to make.

[The information follows:]

OPENING STATEMENT
The Honorable Rodney Frelinghuysen
Chairman, Energy and Water Development Subcommittee

House Committee on Appropriations
Hearing on the Fiscal Year 2013 Budget Request for
Loan Guarantee Programs and the
Advanced Research Programs Agency—Energy
March 28, 2012

I would like to call this hearing to order. Good afternoon, everyone. Our hearing today is on the Fiscal Year 2013 budget request for the Department of Energy's loan guarantee programs and the Advanced Research Programs Agency -- Energy. Dr. Majumdar and Mr. Frantz, welcome to the subcommittee.

We ask the two of you to appear together because of the unique nature of your programs. Although you were authorized before 2008, you both form the backbone of some of this Administration's most visible initiatives. Now that we're into the fourth year of the Administration, you have enough of a track record that we can have a more informed discussion about the successes you've had and your challenges.

Dr. Majumdar, this budget requests $375 million for ARPA-E's activities, a $75 million increase from the fiscal year 2012 appropriation. This is a 27 percent increase, matched only by the 28 percent increase requested for Energy Efficiency and Renewable Energy. At the same time, the request cuts funding for fossil energy and nuclear energy research and development. While I'd like to believe the President's support for an "all of the above" energy strategy, the facts indicate that this budget request is more ideological than practical.

Yet the ARPA-E program has identified an important niche for itself by supporting high-risk, high reward projects. And given all the political pressures surrounding your program, you've made some tough decisions, including the termination of projects which were not achieving their goals. I'd encourage other parts of the Department to learn lessons from the way you're doing business.

The Loan Guarantee Program, on the other hand, has been the center of some controversy, starting with the Solyndra bankruptcy and now extending into questions about other companies. Apparently, even the President no longer wants to take responsibility for this program, according to remarks he made last week.[1] Mr. Frantz, you are not asking for any new loan guarantee authority, but given the billions of dollars that your programs are overseeing, you will have some hard questions to answer today. I look forward to your answers.

Please ensure that the hearing record, questions for the record, and any supporting information requested by the subcommittee are delivered in final form to us 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.

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[1] *"Obviously, we wish Solyndra hadn't gone bankrupt. Part of the reason they did was because the Chinese were subsidizing their solar industry and flooding the market in ways that Solyndra couldn't compete. But understand: This was not our program, per se. Congress — Democrats and Republicans — put together a loan guarantee program because they understood historically that when you get new industries, it's easy to raise money for startups, but if you want to take them to scale, oftentimes there's a lot of risk involved, and what the loan guarantee program was designed to do was to help startup companies get to scale."*

— President Obama, interview with American Public Media's "Marketplace," March 21, 2012

With that, I will turn to Mr. Visclosky for his opening comments.

Mr. VISCLOSKY. Thank you, Mr. Chairman. Doctor, it is good to see you again, and Mr. Frantz thank you for taking the time to be with us. Dr. Majumdar, I will be interested to hear what progress is being made at ARPA–E. As you know, despite my appreciation for the innovation and streamline project model you use, I have repeatedly shared my concerns regarding the programs's potential overlap with other areas of DOE. Many of the activities pursued by ARPA–E are in the areas where either DOE has applied programs or the Office of Science is also endeavoring to make progress. I believe that there is a place for competition within the Department, but in an era of scarce funding, redundancies must be kept to a minimum, if not eliminated.

I am interested in hearing your approach to coordinating between programs at the Department, to ensure that overlap is minimized, and how also you are working in your position to spread, if you would, your new culture. While the subcommittee was initially a reluctant supporter of the program, I believe that given many positive reviews, we should pursue the ARPA–E model long enough to determine if we can get a return that justifies the investment.

Mr. Frantz, the Allison Report recently requested by the White House found that the Federal Credit Reform Act methodology the Loan Guarantee Program office uses was appropriate. Further, using that measure, the report estimated a potential budget impact of the outstanding loans is less than DOE's current estimates, and below the loan loss reserve provided by Congress.

Your own reestimate, as I understand it, confirms this, showing that the total credit subsidy cost of the portfolio went down from 22.5 percent to 13.2 percent driven by primarily by the success of the Ford and Nissan loan guarantees. To be fair, the statistics are dated.

After looking at the details of the reestimate, there is a particular area of concern that I hope you will address today, loans that have no link to a utility and are primarily projects related to manufacturing. I also am keenly interested in the actions the Department is taking both through its own initiative and also in response to the recommendations made by the report.

With that, gentlemen, thank you very much. Thank you, Mr. Chairman.

[The information follows:]

Visclosky Opening Statement at FY13 Budget Hearing for ARPA-E

March 28th, 2012

Subcommittee Ranking Member Rep. Peter Visclosky

Good afternoon. Dr. Majumdar, it is good to see you again. Mr. Frantz, thank you for taking the time with us today.

Dr. Majumdar, I will be interested to hear what progress is being made at ARPA-E. As you know, despite my appreciation for the innovative and streamlined project model used by ARPA-E, I have repeatedly shared my concerns regarding your program's potential overlap with other areas of DOE. Many of the activities pursued by ARPA-E are in areas where either DOE's applied programs or the Office of Science are also endeavoring to make progress. I believe that there is a place for competition within the Department, but in an era of scarce funding redundancies must be kept to a minimum. Doctor, I am interested in hearing your approach to coordinating between programs at the Department to ensure that overlap is minimized.

While the Subcommittee was initially a reluctant supporter of the program, I believe that, given many positive reviews, we should pursue the ARPA-E model long enough to determine if we can get a return that justifies our investment. I genuinely appreciate that, despite still being in its infancy, ARPA-E has terminated under-performing activities and returned the funding to the treasury; I only hope that its diligence is adopted by other programs. Additionally, it would be well if ARPA-E's culture of urgency could be inculcated across the Department.

Mr. Frantz, the 'Allison Report' recently requested by the White House found that the Federal Credit Reform Act methodology the Department Loan Guarantee Program Office uses was appropriate. Further, using that measure the report estimates that the potential budget impact of the outstanding loans is less than DOE's current estimate and below the loan loss reserve provided by Congress. Your own reestimate confirms this, showing that the total credit subsidy cost of the portfolio went down from 22.5 percent to 13.2 percent, driven primarily by the success of the Ford and Nissan loan guarantees. After looking at the details of the reestimate, there is a particular area of concern that I hope you will address today, loans that have no link to a utility and are primarily projects related to manufacturing. I also am keenly interested in the actions the Department is taking,

both through its own initiative and also in response to the recommendations made by the Allison Report.

Thank you, Mr. Chairman for the time.

Mr. FRELINGHUYSEN. Dr. Majumdar, please, the floor is yours. We have a full house here today. There is a high interest in the work that both of you are committed to.

Dr. MAJUMDAR. I would like to extend my thanks to the Chairman, to the Ranking Member and the esteemed members of the Subcommittee for inviting me to present the Department of Energy Fiscal Year 2013 budget request for the Advanced Research Projects Agency—Energy, or ARPA–E. As I said before to many of you, I consider you all to be my board of directors. I am here to report to you what we have done in the past, and what we plan to do in the future. ARPA–E is focused on research to create breakthroughs in energy technologies.

Let me explain what I mean by using an example. Until the 1970s, we used to use punch cards like this to enter data into computers, and in only 30 years, we went from punch cards to this, smartphones. Most of the innovations that allowed information revolution—transistors, integrated circuits, wireless communication, and the Internet—were created first in the United States, and then used globally. We didn't make better and better punch cards. We invented the future using technology innovations based on a strong foundation in science and engineering. The U.S. has been doing this all throughout the last century, from the Wright brothers and the airplane, Jonas Salk and the polio vaccine, to Nikola Tesla and Westinghouse creating the first AC electric grid.

These and many of the innovations by our parents and grandparents created a better and more secure life for all of us. ARPA–E's goal is to catalyze similar innovations in the energy sector so that our children and grandchildren have a better future than we do. ARPA–E's statutory goal is to invest in research to rapidly translate science into breakthrough energy technologies that are too risky for the private sector, but ones that would ensure U.S. global competitiveness and security. ARPA–E does not fund incremental improvements in existing technologies, but rather quantum leaps in energy technologies.

Let me give you a few examples of what I believe are early ARPA–E successes.

Last month, an ARPA–E awardee, Envia, announced the world record in energy density at 400 watt-hours per kilogram for a rechargeable lithium ion battery, which is double that of today's batteries. What does this mean? If we were to travel from Washington to New Jersey, it would cost about $40 for gasoline in a conventional car, whereas in an electric car the electricity cost would be about $6; more than six times cheaper. But the challenge in electric cars is that the battery pack would cost about $30,000. Now Envia's battery is not yet ready for prime time, but if you were to use Envia's batteries today, it would cut the battery cost in half, and they are trying to reduce the cost even further. ARPA–E's goal is to reduce the cost of batteries so that electric cars can have comparable range and cost as gasoline-based cars so that they can be sold without subsidies and reduce our dependence on imported petroleum.

We all know that algae can produce oil, but those oil-producing algae don't grow very fast. We have a team at Berkeley that is taking the set of genes that produce oil in algae, and inserting those

genes in a plant like tobacco that grows fast and in bad soil. If this works, you would simply squeeze the leaves of tobacco, and produce oil. I really hope that research is widely successful because it could put our tobacco farmers back to work and reduce our dependence on imported petroleum by creating a renewable fuel. That is a win/win/win proposition.

Our grid is an aging infrastructure.

Here is an example. The average age of a transformer in the United States is 42 years, 2 years beyond its projected life span. A typical 1 megawatt transformer in a distribution substation weighs about 8,000 pounds and is manufactured by foreign companies. An ARPA–E awardee, Cree, based in North Carolina, is creating a quantum leap in electric power technology. They are developing a 1 megawatt transistor—in fact, here it is. This is a 1 megawatt electrical power transistor that can handle 1 megawatt, that is 200 homes using a single transistor made of silicon carbide, the size of a fingernail. If they are successful, the 1 megawatt transistor could shrink from 8,000 pounds to 100 pounds and greatly reduce the cost and increase reliability. Now, here is the kicker. Because the United States is the world-leading manufacturer of silicon carbide, the Cree project could transform future electrical power technologies, and create a large export market.

These are only a few chapters of the ARPA–E story, and the ARPA–E story is an American story. These pioneers are the Wright brothers, the Salks, the Edisons, and Teslas of the 21st Century. They will compete and sometimes fail, but they will get back up and try again. The future prosperity and security for our Nation depends on them. ARPA–E will continue to find these crown jewels of our Nation and invest in them.

Last month we organized the third annual ARPA–E Energy Innovation Summit which was attended by about 2,500 innovators, entrepreneurs, investors, Federal and State agencies, Members and staffers of Congress, and the White House. We showcased ARPA–E funded technologies and also showcased technologies that ARPA–E could not fund. We want them to win as well.

We had the pleasure of having Congressmen Womack and Fattah of this Subcommittee speak at the summit and I hope you all get a chance to attend the summit next year and meet the pioneers and innovators from your own districts.

Let me report what we are going with Fiscal Year 2012 appropriations.

Last year, I promised that we would focus on the use of natural gas in transportation. In February, we have announced a new program to fund research on breakthroughs that would make it cheaper to own and operate natural gas vehicles than a gasoline-based one, and one you could refuel at home.

I also promised that we would create a joint program with the Department of Defense to invent dual use technologies that address our National security needs and also a civilian economy. We are in the process of issuing a new funding opportunity for improving the safety, reliability, and performance of energy-stored systems.

ARPA–E is unique for issuing an open funding opportunity to all of our Nation's innovators, to propose any new idea on energy. This openness is important because innovators can integrate across tra-

ditional silos, and create something new; ones that we could not imagine.

ARPA–E projects involve risk that the private sector is unwilling to take. Because this is research, some may fail. Managing the risk on behalf of the taxpayers through active program management is part of ARPA–E's DNA. We have discontinued several projects where the idea simply did not work. This is a promise I made last year, and one that we can have now carried out.

ARPA–E will continue to proactively seek out, white spaces, where it can fill a vital gap in early-stage research in coordination with the Office of Science and Applied Energy Offices. In Fiscal Year 2013, we plan to have an increased emphasis on transportation, but with adequate attention to stationary power systems.

I thank you for the opportunity to testify before you and I look forward to answering your question. Thank you.

Mr. FRELINGHUYSEN. Thank you, Doctor.

[The information follows:]

Statement of the Director of ARPA-E, Arun Majumdar
Department of Energy
Subcommittee on Energy and Water Development, & Related Agencies
U.S. House Appropriations Committee
FY2013 Budget Hearing
March 28, 2012

ARPA-E
Catalyzing Energy Breakthroughs to Secure America's Future

Chairman Frelinghuysen, Ranking Member Visclosky, 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 its Fiscal Year (FY) 2013 budget request of $350 million. I want to first thank the committee for all of your support for ARPA-E. I also want to report to you the state of ARPA-E and its plans for the future.

Mission:
ARPA-E is focused on innovations in energy technologies. Let me explain what I mean by using an example from information technology. Until the 1970s, we used to use punch cards to enter data into computers. In only 30 years, we went from punch cards to smart phones. Today, punch cards have become not just obsolete, but forgotten. Most of the innovations that allowed the information revolution - transistors, integrated circuits, wireless communication, and the internet - were created first in the U.S., and then used globally. We didn't make better and better punch cards. We invented our way into the future using technology innovations based on our strong foundations in science and engineering. The U.S. has been doing this all throughout the last century - from the Wright brothers and the airplane, Jonas Salk and the polio vaccine, to Nikola Tesla and Westinghouse creating the first AC electric grid. These and many other innovations created the foundations for new industries that led to U.S. economic growth and also enabled the rest of the world. ARPA-E's goal is to catalyze similar innovations in the energy sector.

ARPA-E's statutory goal is to invest in research to rapidly translate science into breakthrough energy technologies that would enhance U.S. global competitiveness as well as our national, economic, and environmental security. ARPA-E projects create quantum leaps in energy technologies, are ones that are too risky for the private sector, but those that have the potential to be transformative and make large societal impact in the next 10-20 years. ARPA-E does not fund incremental improvements in existing technologies, but rather funds research that would create new technologies, which do not exist today, but if they did, they would make today's technologies obsolete.

Early Signs of Success

ARPA-E's goal is to identify and invest in very innovative research projects that last 2-3 years, but can have transformative impact measured by our technological leadership, economic prosperity, and national energy and environmental security 10-15 years from now. Awardees have cited ARPA-E's initial funding and active program management as critical factors in their

overcoming key technical barriers ahead of schedule which helped spur follow-on funding. To date, the Agency has awarded over $520 million to 180 projects, which range from new approaches to making biofuels to new technologies that enable a smarter grid. While the Agency is still in its infant stage, the total amount of follow-on private sector investments will soon exceed the total ARPA-E investment. Furthermore, eleven of the first set of projects two and a half years ago that received $40 million from ARPA-E produced breakthroughs that generated more than $200 million in private sector investment.

Here is a small sample of some of our awardees:

- Batteries for EVs/PHEVs: ARPA-E's advanced battery program is working to develop a variety of rechargeable battery technologies that would reduce the cost of ownership of an EV or PHEV to that of a conventional automobile without subsidy. One ARPA-E awardee, Envia, announced at the 2012 ARPA-E Summit that they have doubled the energy density for a rechargeable lithium-ion battery to 400 Whr/kg, an innovation that will cut the cost of the battery pack in half. Other companies are targeting 600 Whr/kg. Our goal is to reduce the cost of rechargeable batteries to 20-25% of today's cost.[1] Achievements such as this drive key aspects of the EV Grand Challenge.

- Transportation Fuels: ARPA-E's Electrofuels program is focused on genetically engineering non-photosynthetic microbes to transform carbon dioxide and water into oil. This approach, powered by hydrogen or domestically produced electricity may be able to achieve 10 times more efficient biofuel production than plant-based photosynthesis. One of our awardees, OPX Biotechnologies of Boulder, Colorado has engineered microbes to use hydrogen and carbon dioxide to make liquid transportation fuel. If they can successfully scale their experiments in cost and volume, they could create the foundation for an entirely new industry to convert our domestic resources of natural gas into liquid transportation fuels through a process that results in less net emissions, including reduced greenhouse gas emissions, than from the oil-based fuel it displaces.

- Electrical Power Technologies: Cree, an ARPA-E awardee based in North Carolina, is creating a quantum leap in electrical power technology by developing a 1 MW transistor made of silicon carbide the size of your fingernail. Cree's goal is to have this transistor switch electrical power of 20,000 Volts at 50,000 Hz, as opposed to 60 Hz in today's transformers. With this transistor, a 1 MW transformer could shrink to 100 lbs from the current 8000 lbs with greatly reduced cost and increased reliability. Because the U.S. is the world's leading manufacturer of silicon carbide, the Cree project could transform future electrical power technologies and create a large export market.

- Grid-Scale Electrical Storage: The cost of renewable electricity from solar and wind continues to decline and could be competitive with that from natural gas (about 5-6 cents per

[1] If we achieve this goal, the cost of an EV with a range 50% greater than today's EVs could be priced at $20,000-25,000 without subsidy. A PHEV would be comparably priced. An American family that drives 12,000 miles per year will be spared a gasoline bill of $1,440/year, assuming today's gasoline prices and a car that averages 30 MPG. The cost of electricity: about $300/year, thus saving about $100/month for American families.

kilowatt hour) within a decade. In order to better integrate these intermittent renewable sources on the grid, we will need a combination of improved transmission and distribution system and increased energy storage. Today, the lowest cost energy storage in the GigaWatt-hour scale is pumped-hydro or compressed air. While these forms of energy storage cost less than $100/kWh, they are geographically limited. ARPA-E challenged the scientific community to invent new technologies that could achieve Gigawatts-hour scale storage. One awardee – a partnership between MIT and 24M – is using the chemistry of lithium-ion batteries in a new flow battery architecture that creates a hybrid between a battery and a fuel cell, with the goal to reduce battery grid storage to $60/kWh.

- Carbon Capture: Today, the cost of capturing carbon dioxide from a coal-fired power plant is estimated to be about $80/t$CO_2$, whereas the delivery price for CO_2 paid by oil companies for Enhanced Oil Recovery (EOR) is in the range of $20 - $35/t$CO_2$. ARPA-E funds 15 projects all aimed at lowering the capture cost to $25/t$CO_2$, which will greatly increase the business opportunity for CO_2 in EOR and will greatly reduce the cost of Carbon Capture, *Utilization* and Storage (CCUS). Codexis, one of the program's awardees, is using directed genetic evolution to create a more robust and efficient biological enzyme, carbonic anhydrase. If this enzyme can be made to function in the exhaust stack of a coal plant, it will greatly increase the CO_2 capture rate, decrease the energy penalty, and dramatically lower the cost of carbon capture.

These projects are a small slice of the exciting technologies funded by ARPA-E. The complete list of the projects funded by ARPA-E, and links to fact sheets for each project, is available at: http://arpa-e.energy.gov/ProgramsProjects/ViewAllProjects.aspx.

Programs from Fiscal Year 2011 Budget

This past year, on April 20, 2011, ARPA-E put out a solicitation to develop five new programs that could spark critical breakthrough technologies and secure America's energy future, and on September 29, 2011, ARPA-E announced 60 cutting-edge research projects. Totaling $156 million, the new ARPA-E selections focused on accelerating innovations in energy technology while increasing America's competitiveness in rare earth alternatives and breakthroughs in biofuels, thermal storage, grid controls, and solar power electronics.

The projects selected are located in 25 states, with 50% of projects led by universities, 23% by small businesses, 12% by large businesses, 13% by national labs, and 2% by non-profits.

The new programs announced and selected in FY2011 are:

- **PETRO: Plants Engineered To Replace Oil**
  ARPA-E is funding breakthrough technologies that optimize the biochemical processes of energy capture and conversion to develop robust, farm-ready crops that deliver more energy per acre with less processing prior to the pump. If successful, PETRO will create biofuels from domestic sources such as tobacco and pine trees for half their current cost, making them cost-competitive with fuels derived from oil.

- **REACT: Rare Earth Alternatives in Critical Technologies**
  Rare earths are naturally-occurring minerals with unique properties that are used in many existing and emerging energy technologies. Rising rare earth prices have already escalated costs for some energy technologies and may jeopardize the availability and widespread adoption of many critical energy solutions by U.S. manufacturers. ARPA-E is funding early-stage technology alternatives that reduce or eliminate the dependence on rare earth materials by developing substitutes in two key areas: electric vehicle motors and wind generators.

- **HEATS: High Energy Advanced Thermal Storage**
  More than 90% of the energy used in the U.S. involves the transport and conversion of thermal energy. Therefore, advancements in thermal energy storage – both hot and cold – would dramatically improve performance for a variety of critical energy applications. ARPA-E is helping develop revolutionary cost-effective, thermal energy storage technologies.

- **GENI: Green Electricity Network Integration**
  ARPA-E is funding innovative control software and high-voltage hardware to reliably control the grid network, specifically: 1) cost-optimizing controls able to manage sporadically available sources, such as wind and solar, alongside coal and nuclear; and 2) resilient power flow control hardware – or the energy equivalent of an internet router – to enable automated, real-time control of grid components. If successful, these technologies will enable utilities and operators to optimally control the flow of power.

- **Solar ADEPT: Solar Agile Delivery of Electrical Power Technology**
  The SunShot Initiative leverages the unique strengths across DOE to reduce the total cost of utility-scale solar power systems by 75 percent by the end of the decade. If successful, this would enable solar electricity to scale without subsidies and make the U.S. globally competitive in solar technology. ARPA-E's portion of the collaboration is the Solar ADEPT program, which focuses on integrating advanced power electronics into solar panels and solar farms to extract and deliver energy more efficiently. This program could reduce power electronics costs by up to 50 percent for utilities and 80 percent for homeowners.

Programs from Fiscal Year 2012 Budget

The last time I was before you, we spoke of ARPA-E's plans for 2012. Specifically, we spoke of natural gas for transportation, the option for an open funding opportunity, as we did in 2009, and our partnership with the Department of Defense. I am happy to report progress to you on all three of these areas.

Methane Opportunities for Vehicular Energy (MOVE)
This program was launched on February 23, 2012 and seeks to fund the development of transformational technologies that reduce the system-level cost of natural gas use in vehicles. Of particular interest are technologies that enable at-home refueling and low-cost on-board storage

for natural gas vehicles. This $30 million funding announcement aims to engage our country's brightest scientists, engineers and entrepreneurs to find ways to harness our abundant supplies of domestic natural gas for vehicles and builds on an Administration-wide commitment to reducing our dependence on oil by encouraging greater use of natural gas in transportation,

Open Funding Opportunity Announcement
Just as ARPA-E did in its very first Funding Opportunity Announcement back in 2009, this open program, announced March 2, 2012, seeks to address the challenges imposed by the rapidly evolving global energy market. The $150 million program will look at many areas including, but not limited to, electricity generation by both renewable and non-renewable means, electricity transmission, storage, and distribution; energy efficiency for buildings, manufacturing and commerce, and personal use; and all aspects of transportation, including the production and distribution of both renewable and non-renewable fuels, and electrification.

Advanced Management and Protection of Energy-storage Devices (AMPED)
In 2011, U.S. Secretary of the Navy, Ray Mabus, announced at the 2nd annual ARPA-E Energy Innovation Summit a new partnership between ARPA-E and the Department of Defense to jointly develop energy technologies that will be used to make our nation and our armed forces secure. As a part of this partnership, I am happy to report that ARPA-E plans to issue a new Funding Opportunity Announcement (FOA) early next month entitled "Advanced Management and Protection of Energy-storage Devices" (AMPED).

The objective of the AMPED FOA will be to identify and support novel, high-impact sensing and control technologies that can significantly increase performance and accelerate adoption of energy storage systems. Cost effective, safe, and long-life energy storage is of interest to DOD, which will work with ARPA-E to assess the technology requirements for storage across military installations and transportation. Research of these technologies is also well-aligned with ARPA-E's mission to enhance the energy security of the U.S. through advanced energy technologies.

Speed, Efficiency and Talent
To remain at the global forefront of energy technology, speed is of the essence. ARPA-E has developed a streamlined process so that it can execute with a fierce sense of urgency and unprecedented speed and efficiency. For example, ARPA-E has reduced contracting time down to three months. ARPA-E has instituted a recruiting and hiring process that attracts some of the best and brightest talent from the technical community to be Program Directors (PDs). The PDs stay for three to four years and then they must leave – this is not a permanent job. The term limits have fostered a focus on outcomes.

Stewardship and Integrity
Being vigilant stewards of taxpayer dollars is built into ARPA-E's DNA. All ARPA-E projects are selected on merit, based on input from a panel of experts. Once selected, ARPA-E PDs work personally with every project they manage to help overcome technical barriers. But if a technology does not work and the project cannot reach its "go-no go" milestones, ARPA-E discontinues the project before the end date.

ARPA-E Energy Innovation Summit

ARPA-E recently hosted its third annual Energy Innovation Summit featuring a number of the nation's leaders across industry, Congress, and academia, and covered a wide range of critical energy topics. The summit included 107 speakers and attracted 2,440 attendees from 49 states and 26 countries. Attendees included members of research and development institutions, global corporations, technology entrepreneurs, investors, policymakers and government officials including two member of this Subcommittee, Representatives Chaka Fattah and Steve Womack.

A key feature of the Summit is the technology showcase, where ARPA-E showcased and displayed over 240 breakthrough energy developments from ARPA-E's awardees and other innovative companies in areas including grid-scale storage, power electronics, batteries for electric vehicles, building efficiency, advanced carbon capture, and electrofuels. The showcase featured not only the technologies that ARPA-E invested in, but also other promising technologies to ensure that America wins the future, regardless of if the technology was supported by ARPA-E or not.

We intend to host another Summit in 2013, and we hope you will join us next year.

2013 Programs – Potential Topics

The President's request of $350 million in FY2013 for ARPA-E includes $325 million that will be devoted to funding projects. The increase in budget compared to FY2012 underscores the Administration's commitment to invest in an "all of the above" approach to energy technology innovation. The increase in funding will enable ARPA-E to fund more projects that could lead to game-changing, transformative technologies for America's energy security.

ARPA-E continues to improve its internal strategic vision for the future direction of the agency. Reflecting this internal strategic thinking on the focus of future projects, ARPA-E has moved to incorporate a project management model hierarchy of thrust-portfolio-program-project. ARPA-E will have two primary thrusts: Transportation Systems and Stationary Power Systems.

Transportation Systems

The ARPA-E Transportation Systems thrust seeks 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, while also focusing on reducing fuel consumption and energy-related emissions through advances in fuel/propulsion and vehicles.

Some broad goals and benefits of the Transportation Systems thrust in FY2013 may include game-changing research into: batteries and energy storage systems, competitively-priced alternative transportation fuels, novel uses of information technology to improve energy efficiency, unexplored ways to more efficiently utilize our natural gas resources, and advanced manufacturing and vehicles research.

Stationary Power

The ARPA-E Stationary Power Systems thrust supports high-impact technologies that are not related to transportation. Some of these fields include: power electronics, solar, wind, osmotic power, smart grid technologies, natural gas, geothermal, and waste heat capture.
ARPA-E will continue its mission in this sector to move beyond incremental changes to existing energy technology and to identify those transformational technologies will make current technologies obsolete. ARPA-E is investing in transformational research in a number of power generation technologies and coordinating that investment with the DOE's Office of Science and applied research programs, to identify programs with potential for game changing developments that meet ARPA-E's statutory mission.

Conclusion

ARPA-E's goal is to help catalyze energy breakthroughs with speed and efficiency to help ensure America's energy security 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.

Again, I thank you for the opportunity to testify before this Subcommittee, and I am happy to answer any questions you may have.

Mr. FRELINGHUYSEN. Mr. Frantz, welcome.

Mr. FRANTZ. Thank you very much, Chairman Frelinghuysen, Ranking Member Visclosky, members of the Subcommittee. Thank you very much for inviting me to be here to talk about our request for the Fiscal Year 2013 budget. Mr. Chairman, as you indicated, we are merely——

Mr. FRELINGHUYSEN. Could you please just move that microphone a little closer to you, please.

Mr. FRANTZ. Thank you. As you indicated, Mr. Chairman, we are merely requesting an increase on our admin budget of $38 million for the Title XVII program, and $9 million to cover the admin budget for the ATVM program. Because we are not seeking an expansion of our loan authority, or any increase in the appropriation for the credit subsidy, I am going to focus my oral comments briefly, very briefly on an update of the program and its current and future work plan.

At the onset, I want to particularly express my thanks to all of you, the members of this committee, as well as your respective staffs. You have contributed over the 5-year period of our program immeasurably to the successes that we have had through your support and interest in the program.

Before highlighting the successes and challenges that we have faced over the past year, I would also like to acknowledge and commend the LPO staff publicly for their unswerving commitment and diligent work associated with the accomplishments of the program. The staff is one of the finest project finance teams assembled in the world today and its record over the past year is unprecedented by world standards. It is comprised of very experienced investment officers, most of whom have worked all over the world, underwriting, structuring, and closing financial transactions in much more challenging legal and regulatory regimes than exist here in the United States.

I would hasten to add that the GAO in its recent audit of the DOE Loan Guarantee Program acknowledged that commercial lenders interviewed by GAO stated that LPO's underwriting and due diligence standards are as rigorous as or more rigorous than those in the private sector.

It is noteworthy that the DOE loan program's office represents the largest single debt financing for clean energy projects in the United States, public or private. Two transactions were recently recognized for their exceptional structure by preeminent journals in the project finance field as "Deals of the Year." At this time, the LPO has committed or closed $35 billion in direct loans or loan guarantees, which financed nearly three dozen projects with total project costs greater than $56 billion. When it ended on September 30, 2011, the Section 1705 program included a portfolio of over $16 billion in loan guarantees for 28 renewable energy projects.

Collectively, the LPO projects are expected to support more than 60,000 jobs and deploy alternative energy that will save nearly 300 million gallons of gasoline per year. It is important to note that the commercial projects closed under Section 1705 fulfilled much of a legislative intent of Section 1703 as well. Together, the innovative and commercial projects closed under Section 1705 represent a broad spectrum of technologies including biomass, geothermal gen-

eration, solar generation, wind generation, transmission and solar manufacturing.

In addition, the LPO issued commitments, as you all know, for loan guarantees for one nuclear power generation and a uranium enrichment project. To date, the LPO has closed five ATVM loans totaling over $8.3 billion. These projects support advanced vehicle projects in the United States. As you have indicated in your opening remarks, Mr. Chairman, we, of course, have been challenged in our activities and we have reacted on a continuing basis to fundamental lessons learned. Particularly, in the manufacturing space, where marketing acceptance of employed technology is much less certain due to the absence of long-term off-take contracts, such as those that we obtain in power purchase agreements which we have in all of our solar, wind, geothermal power-generation projects. In addition, the LPO has placed a high priority in developing and deploying state-of-the-art business systems, including workflow management and records management systems.

We are presently focusing on the staffing and employment of processes and systems to support the LPO portfolio management division. I would reiterate that these practices have been successfully employed at the U.S. EX–IM bank and OPIC for many decades. On the origination side, we are working diligently to close our first advanced nuclear power project, Vogtle, and we are continuing final due diligence and initial closing planning for the AREVA uranium enrichment facility at Eagle Rock in Idaho.

In addition, we are continuing to perform due diligence for several fossil projects and we expect to resume within the next few days the underwriting of Section 1703, qualified renewable projects.

As indicated in my written testimony, we are proactively addressing the dearth of applications in the ATVM program by implementing a very proactive outreach program to the automotive industry.

In conclusion, with your support, we look forward to continuing to promote opportunities for the United States to stay at the forefront of innovation in clean energy generation and manufacturing, at the same time, supporting projects that offer the benefits of job creation, and pollution reduction, while ultimately protecting the interests of the United States taxpayer.

In administering the Title XVII and ATVM programs, we strive continually to improve our systems and processes in order to manage loan transactions and portfolios in the most effective and efficient manner possible. Thank you very much, Mr. Chairman, and I look forward to answering your questions.

[The information follows:]

Written Statement for the Record of David G. Frantz
Acting 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 28, 2012

Introduction

Chairman Frelinghuysen, Ranking Member Visclosky, and Members of the Committee, thank you for the opportunity to testify before you today. My name is David Frantz, and I am the Acting Executive Director of the Department of Energy's (DOE) Loan Programs Office (LPO). I was the first Federal employee hired for the Loan Guarantee Program, and served as its first Director when I joined, moving from the Overseas Private Investment Corporation (OPIC) on August 5, 2007.

The LPO administers two federal loan guarantee programs – Section 1703 and 1705 – for energy technology projects authorized by Title XVII of the Energy Policy Act (EPAct) as amended; and it administers direct loans for the Advanced Technology Vehicles Manufacturing (ATVM) program as authorized under Section 136 of the Energy Independence and Security Act of 2007 (EISA).

DOE's loan programs are a critical part of our nation's commitment to clean energy. I welcome the opportunity to discuss with you the Department's Fiscal Year (FY) 2013 budget request for the programs, and our significant accomplishments to date.

Background on the Loan Programs

The Section 1703 program was established to support the U.S. deployment of new, innovative technology projects that avoid, reduce, or sequester greenhouse gas emissions. Currently, the program has $18.5 billion in loan guarantee authority for nuclear power projects, $1.5 billion 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 authority that is not allocated to a specific technology sector. Under this authority, the applicant is required to pay the credit subsidy cost of the loan guarantee for their project. In addition, the FY 2011 Continuing Resolution provided $170 million to pay the credit subsidy cost of loan guarantees for renewable energy and energy efficiency projects.

The Section 1705 program was created as part of the American Recovery and Reinvestment Act of 2009 (ARRA) to jump-start the country's clean energy sector by supporting projects that deployed commercial technologies, but had difficulty securing financing in a tight credit market. Section 1705 pursued additional objectives and exhibited slightly different programmatic features than Section 1703. Most notably, applicants under Section 1705 were <u>not</u> required to pay the credit subsidy costs associated with the loan guarantees they received. Those costs were paid through funds appropriated by Congress (applicants paid application and other administrative fees).

Additionally, to qualify for Section 1705, projects had to begin construction no later than September 30, 2011. DOE's authority to enter into new loan guarantee agreements under Section 1705 expired on that date, with $552 million in unobligated, no-year emergency balances. This amount can be used for potential modifications of existing loan guarantees, as needed. Program direction is funded through annual appropriations and is expected to be fully offset by fees.

The ATVM Program was established to expand U.S. business opportunities for advanced automotive technologies that contribute to energy independence and security. Section 136 of EISA 2007 authorizes the DOE to finance U.S. based businesses for manufacturing advanced technology vehicles or vehicle components, and engineering integration facilities. The FY 2009 Continuing Resolution provided up to $25 billion in direct loan authority for the ATVM program, with $7.5 billion in appropriated credit subsidy. Unlike Title XVII, ATVM loan applicants do not pay application fees, and administrative fees are limited to ten basis points of the loan and payable by the borrower on the closing date of the loan. Program direction is funded through annual appropriations.

Evolution of the Loan Programs Office

The DOE Loan Programs Office was established, with strong bipartisan support. It was designed to surmount a financing barrier — the lack of available capital for innovative clean energy projects due to high technology risks and the capital-intensive nature of investments. As such, the LPO supports cutting-edge, innovative, energy technology manufacturing and generation projects in the U.S. in a wide range of sectors including renewables, advanced nuclear, fossil, advanced automotive, and transmission.

From its inception, the LPO has grown from a single employee to a professional finance organization with more than 80 federal employees, supported by nearly 100 subject matter experts and consultants. The current staff constitutes one of the best project finance teams in the world today.

It is important to note that the architecture of the LPO was based on the organization, policies and procedures, systems and lessons learned employed by the U.S. Export-Import Bank (EX-IM), OPIC, and other world-class financial institutions.

Each of the policies and procedures implemented by the LPO to effectively underwrite and monitor energy projects are set forth in the Program's *Credit Policies and Procedures Manual*. The *Manual* was last revised in October 2011 to incorporate lessons learned as well as structural and procedural improvements that have been instituted since the original policies and procedures manual was issued in 2009.

In the past year, the LPO has placed a high priority on developing and deploying state-of-the art business systems, including workflow management and records management systems. Organizing and maintaining verifiable electronic records, including the voluminous financial, technical, credit, legal, and other documents for each project, have taken considerable resources, and the LPO is continuously improving its systems to

ensure accurate application tracking, project management, and ready access to historical and current information.

The workflow management system will interface directly with the records management system and is capable of generating routine monitoring reports on all closed projects. Integrating these systems ensures that LPO historical records are maintained according to archive standards and ongoing project reports are available in real-time to assist monitoring the portfolio.

Recent Accomplishments

It is noteworthy that the DOE Loan Programs Office represents the largest single source of debt financing for clean energy projects in the U.S. (public or private). The LPO renewable projects approved for loan guarantees resulted in the Federal Financing Bank being ranked #1 in the world as a Lead Arranger, as recognized in the *Bloomberg New Energy Finance, 2011 Clean Energy & Energy Smart Technology League Tables.*

At this time, the LPO has committed or closed $35 billion in direct loans and loan guarantees, which finance nearly three dozen projects, with total project costs greater than $56 billion. When it ended on September 30, 2011, the Section 1705 program included a portfolio of over $16 billion in loan guarantees for 28 renewable energy projects. Collectively, LPO projects are expected to support more than 60,000 jobs and deploy alternative energy that will save nearly 300 million gallons of gasoline per year. LPO projects include:

- Several of the world's largest solar generation facilities;
- The first distributed solar generation project on a national scale;
- The world's largest wind farm; and
- The first new commercial nuclear power plant licensed by the Nuclear Regulatory Commission in three decades (conditional commitment).

While the majority of projects closed by LPO under Title XVII are innovative, it is important to note that the commercial projects closed under Section 1705 fulfilled much of the legislative intent of Section 1703 as well. Together, the innovative and commercial projects closed under Section 1705 represent a broad spectrum of technologies, including biomass, geothermal generation, solar generation, wind generation, transmission, and solar manufacturing. In addition, the LPO issued a conditional commitment for loan guarantees for one nuclear power generation project and a uranium enrichment project.

To date, the LPO has also closed five ATVM loans, totaling over $8.3 billion. These projects support advanced vehicle manufacturing projects in eight states.

This portfolio of projects is now managed by the LPO Portfolio Management Division, which employs industry "best practices" in asset management and portfolio monitoring processes and systems. Many of these have also been successfully employed at federal institutions such as EX-IM and OPIC.

In addition to active portfolio management, the LPO is working to close the advanced nuclear power generation project (Vogtle Project), and the AREVA uranium enrichment facility; performing due diligence on several fossil projects; and developing a framework to use the $170 million in appropriated credit subsidy for qualified renewable energy and energy efficiency projects under Section 1703.

The LPO is also proactively addressing the dearth of applications in the ATVM Program by implementing a general outreach program to the automotive industry, utilizing digital media as well as participation in industry conferences and meetings.

FY 2013 DOE Loan Programs Budget Highlights

For the Loan Guarantee Program, the Department requests $38 million for administrative expenses, which are expected to be offset by collections, for a net zero appropriation.

In FY 2013, the program will focus on portfolio management and monitoring of the existing portfolio, as well as originating new loan guarantees to utilize remaining loan authority in the nuclear power, front-end nuclear, fossil, and renewable and energy efficiency sectors.

The Department requests $9 million for administrative expenses of the ATVM Loan Program. In FY 2013, the program will focus on portfolio management and monitoring of the existing portfolio, as well as originating new loans to utilize remaining loan authority and appropriated credit subsidy.

Conclusion

Projects at various stages of review in the LPO loan programs could support tens of thousands of jobs and yield significant benefits to the nation's energy sector when fully operational. Federal financing of innovative energy projects is enabling deployment of new clean energy supply sources into the marketplace as envisioned by Congress.

We look forward to continuing to promote opportunities for the U.S. to stay at the forefront of innovation in clean energy generation and manufacturing, at the same time supporting projects that offer the benefits of replication by the private sector, job creation and pollution reduction while ultimately protecting the interests of the U.S. taxpayer. In administering the Title XVII and ATVM programs, we strive continually to improve our systems and processes to manage loan transactions and portfolios in the most effective and efficient manner possible.

Thank you again for inviting me here today. I look forward to responding to your questions.

Mr. FRELINGHUYSEN. Thank you very much, Mr. Frantz.

Doctor, thank you for invoking New Jersey twice in your remarks; not only the trip in the electric car from Washington to New Jersey, but also the role of Thomas Alva Edison, whose ingenuity continues to promote a lot of important research and development across the board.

But the reality is that most of my constituents probably couldn't afford an electric car, so much of the focus of our committee has been what can we do in the short-term to lower gasoline prices. Now, my constituents can't afford a Tesla, and open sources have suggested that the battery you referred to, it is either in The Journal or The New York Times, if that battery dies, there is not much of an ability to resuscitate it. And so you could find yourself with a very expensive car with a battery that could be kerplunk.

So you want to put a little meat on the bones here? I know maybe I should be reluctant to lock horns with you, but, tell me, is there any truth to the fact that if the battery goes out, then you have to go and buy another battery for the same amount. So—this isn't foolproof.

Dr. MAJUMDAR. Well, Congressman, I think the batteries that we are focusing on, number one, is to reduce the cost and make sure that electric cars have the same range and cost as a gasoline-based car so that you do not need subsidies. I firmly believe that is sustainable business. We are at the early stages, and we are investing in a portfolio of 15 or 16 different approaches, and we don't know which one is going to win. We just create the competition. But these are all for rechargeable batteries, and we look for how many cycles. There are two lives that are relevant. One is the cycle life, how many cycles you can charge and discharge, and the other is the calendar life. Our goal, and this is there in our programs, is to make sure that they will outlast the car—that is really the eventual goal. Of course, as I said, this is research right now that we are investing in, but our target is to really make sure that the battery lasts longer than the car.

Mr. FRELINGHUYSEN. But in reality, the battery that I referred to, if it goes out entirely, you have to get a new one.

Dr. MAJUMDAR. Well, you can change the battery, but ARPA-E's goal——

Mr. FRELINGHUYSEN. Change the battery at $30,000 a clip.

Dr. MAJUMDAR. Well, ARPA–E's goal is to look for technologies not used today. This is the research stage, and translating the science into technologies that will at least make cars in the future that the batteries that are rechargeable and outlast——

Mr. FRELINGHUYSEN. Are you looking at any innovative ways to reduce gasoline prices?

Dr. MAJUMDAR. Well, Congressman, this is an issue that I feel I really understand what people are going through. This is difficult for people—teachers, construction workers—they have to travel, and it is really hard on them. I can assure you that we are doing everything that we can in this Administration to reduce the burden on our families. As you know, we now have more domestic production of oil in the last 8 years. We have for the first time in more than a decade reduced imported petroleum to less than 50 percent, but that is necessary, but not sufficient. I think the all-of-the-above

strategy is absolutely important, and if you look at what are the other things that we are doing, we have historical mileage standards that have been created, and that, will save $8,000 for an American family per year. We are looking at natural gas, as I mentioned.

Mr. FRELINGHUYSEN. Assuming they could be met, those standards.

Dr. MAJUMDAR. That is right.

Mr. FRELINGHUYSEN. And you can impose standards, but in reality, we hope that the private sector has the capital to do it. But from everything we have seen, you need to have substantial government support in order to bring people across the finish line. I think my basic question, is there anything that you are actually working on now, and we are highly supportive of what you do. You have a lot of supporters, a lot of ingenuity, a lot of innovation, that actually addresses the issue of reducing gasoline prices?

Dr. MAJUMDAR. Well, as I said, we are doing everything we can within our means to do that.

Mr. FRELINGHUYSEN. For the foreseeable future, we are going to have this incredible reliance on oil. You look at the makeup of our energy picture, that is where the reliance is, nuclear, coal. I just wonder whether you are doing anything in your portfolio that relates to——

Dr. MAJUMDAR. Yes, we are.

Mr. FRELINGHUYSEN [continuing]. New technologies.

Dr. MAJUMDAR. Mr. Chairman, as I said, we are looking at multiple technologies. We are technology agnostic. We created a program for the use of natural gas for electric vehicles, natural gas cars. Natural gas is abundant in the United States. It is a domestic resource, and it is inexpensive. The problem is that if you want to use a natural gas car and refuel at home, it is expensive. Our job is to reduce the cost so that the additional cost of putting a heavy duty tank for high-pressure natural gas that gives you a range of 200 miles, with the compressor cost can pay for itself in 5 years, and after that you save money.

That is the technology that we are going to create. That is a new program that we have created using natural gas that you could then save money.

Mr. FRELINGHUYSEN. There is nothing you are doing in the short-term here that is innovative to reduce gasoline prices.

Dr. MAJUMDAR. Well, ARPA–E is——

Mr. FRELINGHUYSEN. I understand that. That is a long-range commitment, but obviously, you have got some of the best minds and innovators collectively here that we have ever had. And I just wondered in your overall portfolio, whether there has been anybody who has come up with an ingenious idea, that in fact, could get some traction.

Dr. MAJUMDAR. Well, at this point, we are looking at all options, all of the above options, and I would love to engage with you in a discussion as to how we can do that. This is a concern not just of you, Mr. Chairman, but for all of us, and I feel empathy for all of the people who, you know, have the burden of additional gas prices.

Mr. FRELINGHUYSEN. Okay, Mr. Visclosky. Thank you.

Mr. VISCLOSKY. Thank you, Mr. Chairman.

Mr. Frantz, you had mentioned the nuclear program, and you have one conditional commitment. Looking ahead for the rest of 2012, what can we expect as far as any other additional commitments possibly?

Mr. FRANTZ. At this time, Congressman, we are, as I indicated in my remarks, working very vigorously to actually close the Vogtle transaction. The condition of precedents to our activities are focused, as you perhaps well know, the obtaining of the COL license from NRC for each of the projects. The next project to receive that license is the Summer project in South Carolina, and they have not yet received that. I understand it is possibly now within days of occurring. That project is among four of the projects that we have had discussions with. We haven't had an indication from them on how they would like to proceed with us. We haven't been actively pursuing that until they have received their license.

Mr. VISCLOSKY. So that would be a precedent as far as any settlement.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. Has the price of natural gas affected the Department's consideration of the financial viability of the loan guarantees?

Mr. FRANTZ. It has, to a certain extent, relative to those projects that we call merchantman, that we have two projects among the top four projects that are not rate based. Those projects clearly have been affected by the price of natural gas, as well as, frankly, the absence of carbon legislation. So they are both merchantmen, one in Texas and one here in Maryland. I think you are familiar with them.

Mr. VISCLOSKY. Yes.

Mr. FRANTZ. That clearly has been a significant factor in the decisions, particularly with respect to the investment base, the equity investment base for those projects, to say nothing of our concerns. So, yes, it would, in terms of moving to a closing.

Mr. VISCLOSKY. I appreciate your answer, but I have not, in my mind, always discerned the difference between the two types and understand exactly what you are talking about, as far as merchant-based facilities.

Mr. FRANTZ. Yes, there are two—the PGM market here in the East Coast and ERCOT is the market in Texas. Those projects tender on a 24- to 36–hour basis for their power generation. So they are not rate-based, and their power is not guaranteed to be taken. Now, in normal instances, it is taken because of its volume and its reliability, but they tender on a daily basis for the delivery of that energy. In counter-distinction to the rate base which is taken on a full contract.

Mr. VISCLOSKY. Well, along the same lines, if I could draw your attention to the fossil programs.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. I understand you said in your remarks you have about $8 billion as I understand it.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. But at this point again, no commitments. What activities, might we or might we not expect between now and the end of the fiscal year on the fossil side?

Mr. FRANTZ. Thank you, that's a very good question. Actually, on our solicitation, which was issued for the fossil projects in 2008, we obtained eight applications. Of those eight, four are in active due diligence with us under the program. The one right now that we are most active with is a rate-based project. We are in active due diligence on that project, as well as three others. The first one that I am alluding to, there isn't a chance that we can reach a commitment in this fiscal year for that project. The other three, because of the complications of the off-take arrangements, as well as NEPA compliance, will probably be a year from now.

Mr. VISCLOSKY. And at this point in time, you would anticipate continuing to consider these past this fiscal year.

Mr. FRANTZ. Oh, yes, sir, yes, sir. They are in active due diligence, all four of them.

Mr. VISCLOSKY. Is there a time frame that you have established at some point that you cross that it is time to say no?

Mr. FRANTZ. No, not for these particular projects. As I say, they are well underway in terms of obtaining off-take contracts for their power, the disposition of their product. Two of them are gas generators, coal-to-gas generation. One is a coal liquification, and the other is gas-to-electric power. So these are long, complicated, large projects that require significant amounts of time to complete those elements.

Mr. VISCLOSKY. Just one more brief one.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. On that, the differential between the liquification programs because of the environmental concerns, is there any additional impact relative to your consideration on that project?

Mr. FRANTZ. We are still spending a great deal of time looking at all of the issues surrounding that project. It is a very complicated project in that regard and it is under active consideration.

Mr. VISCLOSKY. Thank you. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Mr. Visclosky. Mr. Simpson.

Mr. SIMPSON. Thank you. If his constituents can't afford electric cars, then mine certainly can't, because yours are rich compared to mine.

I have two questions that are kind of philosophical questions. We talked a little bit about one in my office the other day. One to you, Mr. Frantz. Ever since the Loan Guarantee Program, this cloud came over it because of Solyndra; more than a cloud, it was a big black cloud, came over it after Solyndra. The question comes in from the public, why should the government be investing in these technologies, or these programs, or whatever, if the private marketplace won't do it?

The question I have, and this is kind of a question I ask myself, is when you compared your program to the private sector, you said you had more stringent rules and so forth than the private sector, the one thing that the private sector doesn't have is us looking over their shoulder. You get your funding from us. There was criticism in Solyndra or accusations that the administration put pressure on, and et cetera, et cetera. The same things happen in other programs. The AREVA plant, I met with your predecessor several times on the Loan Guarantee Program for AREVA, because it was of interest to me. Maybe undue pressure. I am sure that there are

people from the Ohio delegation that are probably talking to you, or will very shortly about USEC and the potential for the loan guarantee for them.

How does political influence, whether it is from Members of Congress, the administration, whoever, influence your decision? How much does it influence your decision, and is there a way or should there be a way that you can make these loan guarantees based on the marketplace, and what is required, rather than the political pressure from us? And I, you know, I am not criticizing the administration. I throw myself in there with the rest of the people that have been interested in the program.

Mr. FRANTZ. Thank you, Congressman Simpson, a very good question. It could take me hours to answer. I will try to do it very briefly.

Mr. SIMPSON. That is why I said it was a philosophical question.

Mr. FRANTZ. Very briefly. The program with which you are familiar with, was stood up, and I did that, frankly, in 2005 with these considerations very much in mind. And I am in the Senior Executive Service. I am not a political appointee. Both the previous administration in which we stood the program up as well as this administration has been scrupulous in avoiding putting direct pressure on the decisions we make in terms of the underwriting of these projects, the due diligence, and the fundamental decisions that we take on whether to go forward with the project or not.

And that is absolutely true to this very day as it has been from the time we set this program up in August of 2005. So I can assure you that, yes, I hear it. I see it, but it does not impact the fundamental decisions we take on these projects.

Mr. SIMPSON. Should there be a way to reassure the public that that doesn't happen, because I am sure you hear it just like I do from the public, well, yeah, you know, the administration comes and tells them to loan money to their backers and so forth. Well, and I look at them and say, well, you know what? I went and talked to them about AREVA, and AREVA, we are talking thousands of jobs in southeast Idaho, and it was important to me.

Did I put undue influence on the administration? Should there be a way that we can separate those two things so that we can reassure the public that that is not what is driving some of these loan guarantees?

Mr. FRANTZ. Also, a very good question. I have scrupulously, because of the requirements on me, quite frankly, legally, to be as absolutely apolitical as I personally can possibly be. Therefore, I have tried to the best of my ability to avoid discussions that are purely political, and have deferred to the political appointees to handle those conversations and those decisions.

So I, for that reason, also have not been in the public domain. I have not felt it appropriate for me generally to be out giving speeches—and I have had enough work to do at my desk without being in the general public. So I think your question is a very good one. We are going to great lengths to try to communicate what is really transpiring in the program without——

Mr. SIMPSON. And I have to say that when your predecessor and his staff would come in and talk to me, they were really talking

to me about the—well, I always wanted more information. There was stuff they wouldn't tell me——

Mr. FRANTZ. Sure.

Mr. SIMPSON [continuing]. They were telling me about the process and where they stood and so forth. Have you ever pulled the plug on projects?

Mr. FRANTZ. Oh, I certainly have, sir, yes, at all stages. I think the point is, and I tried to present that in my oral comments to all of you, I have been at this business all over the world for over 40 years. I am not atypical of the staff. We have a lot of experience doing these projects. The other thing we emphasize clearly is that there are no guarantee that you are going to be funded until the day we fund. I think this Subcommittee is well aware of a project just recently in which we had already been through the closing documentation, and we are at the point where we could have funded, and we could not get comfortable with something that you have all alluded to, and that is the market conditions. I recommended to the Secretary we not proceed and we did not proceed.

I mean, that is very expensive. That is one extreme. What we attempt to do is to try to reach those conclusions much earlier in the process, although you are well aware that we do get criticized for that as well. You have heard that.

Mr. SIMPSON. Sure, from us.

Mr. FRANTZ. But on that, without sounding defensive, the point and the bias is, particularly from my perspective, we are in the business, at your behest, to complete transactions, not to find ways to not do them. So if there is any fault, and it is my responsibility that we draw out the process of consideration, due diligence, certainly, we do it with the bias with the attempt to try to ultimately do the transaction, not to spend their—the client's—money or to delay them in the decision-making.

Mr. SIMPSON. Well, I appreciate that answer. It is a difficult issue, and if I could ask one brief question of Dr. Majumdar. We talked a little bit about ARPA–E kind of replacing a lot of the Bell Labs and those types of things that used to do this research before. How do you decide whether you are trying to drive the marketplace with your technology, or if you are following the marketplace, if you understand what I am saying.

Dr. MAJUMDAR. Sure, the way we create our programs is, number one, to recruit very smart people. Number two, we give them a little bit of opportunity to understand where the "white space" is. As I mentioned before, our job is to make the U.S. globally competitive; is to reduce the cost of energy, and security for our Nation in the future. That is really what we are trying to do. That could be translated into whether it is natural gas for vehicles, whether it is power electronics that I mentioned to make our grid more secure, and lower the cost of electricity. So we get these smart people to identify the "white space," and the "white space" is where there is a technological gap. We are in what we call the first valley of death, where you have a science, and there is a future market out there, but there is this gap of translating the signs and understanding of nature into something that is tangible.

That is how we do business. That is how we create new programs. Just to give you the natural gas one. It is obvious that we

have a lot of natural gas, and it is inexpensive, and it is just that we do not—it is not cost-effective to use in light-duty vehicles. It is cost-effective to use that in long-haul trucking, and we said we are not going to go there because it is a business proposition today, and our job is to get out of the way. In the case of light-duty vehicles, it is too expensive. Our job is, can we create breakthrough technologies which will enable natural gas to be used in vehicles that is not just cost-effective, but is actually cheaper. That technology does not exist, and that is where you can look at the material signs and computation techniques, et cetera, to see if you can make a technology that will enable the market in the future and make the U.S. more competitive——

Mr. SIMPSON. Thank you. I appreciate both of your programs.

Mr. FRELINGHUYSEN. Mr. Fattah.

Mr. FATTAH. Thank you both. I am a big supporter of both of these initiatives, and I think the chairman was correct to point out that these programs which were launched by legislation passed by Congress, and were started under the previous administration are still needed.

Now, I think we can all agree that you can't have innovation without failure. The two go hand in hand. I happen to have the responsibilities as the ranking member on the NASA appropriations. So you know, we launch a satellite; doesn't make orbit; it falls down; it is $500 million that is gone. We are not getting out of the satellite business. We are going to get right back up and launch another satellite. We have done this throughout the history of our efforts in space, with a great deal of bipartisan support in this Congress and in the country, because there is a realization that innovation and failure go hand in hand. But let me just talk about the Loan Guarantee Program for a second.

In your advanced vehicle program, the largest loan was issued to Ford, almost $6 billion. Can you talk a little bit about that deal, and what it portends?

Mr. FRANTZ. Well, I would prefer not to focus on specific projects today, Congressman, but to the extent that there has been a lot of public information associated with it, I can make a couple of comments.

Mr. FATTAH. Just what the loan guarantee provides Ford the opportunity to be able to do.

Mr. FRANTZ. Well, at the time, it happens to be one of our great stories of the program, I think, and clearly vindicates——

Mr. FATTAH. I agree. There is some notion in the public that Ford didn't benefit and I just want to use this as an example.

Mr. FRANTZ. No, oh, not at all. They desperately needed us. That is probably the fundamental point. The loan was made at a time when we were in a deep recession. The automotive industry was in serious trouble, and certainly, decisions are taken in these major corporations with respect to new capital addition, or what we call discretionary capital addition. It was at a time when the company was fighting for survival, and by virtue of our program, it enabled them to do discretionary capital expenditure and get ahead of the curve for new innovation in automotive applications. It was purely our program that enabled them to do that simultaneously, as they recovered from the recession, and the huge downturn in the indus-

try. So that is one of the great success stories, just very briefly, on how we were very positively utilized in that automotive sector.

Mr. FATTAH. Now, in terms of ARPA–E, you were modelled on the DOD program, DARPA——

Dr. MAJUNDAR. That is right.

Mr. FATTAH [continuing]. Which has been at the very forefront of positioning our Nation in relation to National security, making innovation critical to the development of new systems to project American power and to protect our forces, and to kill or capture our enemies. So the idea of ARPA–E is really a model directly after that. I want you to tell us, given the level of public investment in ARPA–E, how much has been invested by the private sector in the same project that you have; what the leverage has been, I guess vis a vis these investments?

Dr. MAJUMDAR. Well, so ARPA–E has been around only now for almost 3 years. And in those 3 years, what we have found, as I mentioned before, some projects have failed. That is part of the risk that the government has always taken, and this is research. But the ones that have been successful, that have reached the milestones, and they are approaching the targets that we had set out for them. Just to give you an example, 11 projects that received about $40 million for funding from ARPA–E which allowed them to do the research, and translate it into something that is the first breakthrough, have now received more than $200 million from private-sector funding so it is a leverage of 5 to 1, and individually, some projects have gotten 10 to 1 or so.

On an aggregate, the amount of funding that the private sector has made on ARPA–E funded projects, is equal or now increasing to more than what ARPA–E, the Federal dollars, have actually funded on an aggregate basis.

So that is where we are in 3 years. And the private-sector funding is going to keep on increasing.

Mr. FATTAH. All right, thank you very much. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Thank you, Mr. Fattah. Mr. Womack.

Mr. WOMACK. Thank you, Mr. Chairman, and my thanks to the gentlemen for being here today. I will focus most of my comments and questions with Dr. Majumdar, with whom, and his team I have had a great relationship, very splendid cooperation from the agency. And I want you to know how much I appreciate that. And also, thanks for your visit to my district last year. That meant a lot. And congratulations on the summit. That was a terrific well-attended event where the attendance had to be capped, as I understand it, because of the widespread interest. And you are to be commended for your leadership there.

Let me open by offering something. As I was listening to the testimony today, Mr. Chairman, I received an email and I want to read a portion of this, Dr. Majumdar, because it will interest you.

That the Small Business Administration's district office in Arkansas has named Arkansas Power Electronics International as the 2012 small-business of the year. They will be honored at a reception next month. This is a program that has had a relationship with ARPA–E, so you might just explain very quickly what this

power electronics organization has been doing because it fits into what your organization is trying to champion.

Dr. MAJUMDAR. Well, thank you, Congressman, for the news. It is great. I am delighted to hear that. Arkansas Power Electronic International is a small business which has received funding from ARPA–E to create power electronics using chips like this to integrate into a system for battery charging of electric vehicles. And this is going to be made in Arkansas. And they have got Toyota as a partner in there, and Toyota is actually co-investing money into Arkansas Power Electronics International. So I am delighted to hear they were selected to be the top small business and, you know, I wish them all success.

Mr. WOMACK. It is a great segue into our discussion today because I would submit, Mr. Chairman—and I am a huge fan of ARPA–E, because I was a huge fan of the DARPA model, and I know what Dr. Majumdar is doing in his agency—but I would submit that if there were no failures, that you would have to agree that they are into territory that probably the private sector should primarily be in. And if there were only failures, then you would have to agree that their model is probably off base. I think the real test here is, there is going to be some of both, and it is the ability of the organization. This is what I like about the model.

It is the ability of the organization to do periodic assessments with milestone reports, and a quick determination as to whether or not these projects are on the right track, or are not, and whether they should continue to be funded or not. So in a recent conversation, you talked about an organization that really never got off the ground and was canceled post haste.

Dr. MAJUMDAR. Right, thank you for bringing it up, Mr. Congressman. Here is what we do, just to explain our go/no-go milestone, and Congressman Visclosky, we had a discussion on that in your office. We want these teams to do the impossible. That is what we set out for them. Because if they reach that impossible, that is innovation. So we put a target out there, reduce the cost and make the energy density of the battery so much, or reduce the cost of gas tank for natural gas, so on, and on the way, they have annual go/no-go milestones because if they don't reach that first milestone or the second milestone, or if they are off by a factor of 10, they are unlikely to get there. So that becomes a blind alley.

That is why we, you know, we take these go/no-go milestones very seriously. We try to help them. The people we recruit are some of the smartest people. They go and visit them on site visits and try to help them to become successful. But sometimes, the ideas just don't work out, and then based on that big gap between where they are and what the milestones are, we discontinue the projects, and put the money where actually it is working. That is the model that we have used, and it sends a signal to the research community that this is something that they have to take very, very seriously. If something is not working, it is a mutual agreement that they would rather do something else. They learn from the failures, and go back and try again, just like Edison and Tesla, and others have done in the past. That is the American culture that we have created. This is really where we are trying to go.

Mr. WOMACK. You mentioned, not to belabor the point on the natural gas issue, but it is one that I have a significant interest in because of the cost differentiations between what we are able to produce with American resources, and how competitive we are with other nations, particularly in the area of stationary power. But as it goes back to transportation, you have indicated that your agency does not have an interest in the long haul truck fleet operations because that is already being tried and tested in the private sector. But on the passenger side, what specifically—because you have stood up this passenger car program, and I met your program manager recently—but what specifically do you believe that this program is going to be able to demonstrate, if successful, in the near term, to go back to Chairman Frelinghuysen's remarks about what are we doing today to lower gas prices?

People are looking for alternatives, and some of these alternatives are not ready for market. But what, on your milestones, what do you see as being the key? Is it the tank? Is it the capacity to be able to deliver some kind of a system at the home? I mean, just what kind of a process are we going through here?

Dr. MAJUMDAR. Sir, we have to look at this as a system. So if you ask the question, why aren't all of the cars natural gas today? Two things. Number one is that we don't have the infrastructure to, like we have the gasoline infrastructure, we have 120,000 gas stations around the Nation. Now, to create that infrastructure for CNG, compressed natural gas, it will cost more than $100 billion, maybe $150 billion, and that is really expensive. However, natural gas goes to many homes. So the idea is, can you do that at home—refilling at home so that you avoid infrastructure costs. To do that, today you can buy a compressor and put it in your home, and you can buy a Honda CNG car. But the additional cost is cost-prohibitive for most American families.

So what we are trying to do is to create those technologies that would reduce the cost of the system. That means lowerng the cost of the compessors; so, if someone comes up with a really low-cost compressor that can go from 0 to 360 psi, that is great. That is part of the solution. But the other part of the solution is to create a tank which is high strength, lightweight, and low cost. This is not trivial. You need science and engineering to do that. So we have to look at it as a system so that the extra cost of both the tank—maybe it is a new absorbent material that will suck up the natural gas be there or maybe it is a new way of making the tank materials, using carbon fiber and other materials—and the compressor: if you could reduce the cost of the whole system to the point that it pays back itself in 5 years and saves money, that is where we want to go. And it needs innovation and science and engineering to do that.

Mr. WOMACK. Thank you very much for your testimony. Mr. Chairman, I yield back.

Mr. FRELINGHUYSEN. Thank you very much, Mr. Olver.

Mr. OLVER. Thank you, Mr. Chairman. I was trying to get a little bit of background data on this. Let's see. We have had, for 25 years, what is called an SBIR program, Small Business Innovative Research Program, which goes across virtually all agencies, any agencies that do any research and development.

Dr. MAJUMDAR. Right.

Mr. OLVER. They are required to make available for small businesses sums of money that go to programs. It is a very specifically authorized, reauthorized several times, given sizes of programs. In your work, the largest program that you have funded under ARPA–E is how much? How large?

Dr. MAJUMDAR. The average is about $3 million for 3 years.

Mr. OLVER. $3 million.

Dr. MAJUMDAR. The largest is about $9 million for 3 years, and the smallest is roughly $300- or $400,000, something like that. So that is the rough range.

Mr. OLVER. I think we talked about this and I think I asked the same thing, but I am quite a bit older than you are, so I lose some of these numbers over time. Are you exempt from the SBIR program, or do you have authorization under the SBIR functions, does that have any implications for what you do?

Dr. MAJUMDAR. Congressman, as you mentioned, we have to have an SBIR program. That is, I believe, required by law.

Mr. OLVER. Yeah. For 25 years, as I say.

Dr. MAJUMDAR. That is right. So we do have an SBIR program, and as you know——

Mr. OLVER. You have to do—even with money you get, you have to——

Dr. MAJUMDAR. Yes.

Mr. OLVER [continuing]. You have to use the SBIR approach——

Dr. MAJUMDAR. That is right.

Mr. OLVER [continuing]. For a portion of the money?

Dr. MAJUMDAR. That is right.

Mr. OLVER. Really?

Dr. MAJUMDAR. Yes, I believe that is 2.5 percent.

Mr. OLVER. You actually make that available.

Dr. MAJUMDAR. That is right. We are making it available now.

Mr. OLVER. With all of the constraints that it has? I mean, the SBIR program says exactly how much you can give as a first-stage project and how much can you do as a second-stage project and so forth. You must feel tremendously constrained by that.

Dr. MAJUMDAR. Well, let me just say that before I came to Washington, I was at a university, and I had actually started a company which had received SBIR funding. So I am a former recipient of SBIR.

Mr. OLVER. How many first-stage SBIRs did you have to apply for before you got one funded?

Dr. MAJUMDAR. When I was outside the government?

Mr. OLVER. Yeah.

Dr. MAJUMDAR. I believe we wrote, my company wrote about, you know, three or four proposals and got one funded.

Mr. OLVER. And got one. And then did the whole spigot open at that point? You got new first stages, and then on to second and third stages?

Dr. MAJUMDAR. Well, let me just say that one of the things that we faced, and we are going to fix this is that when you do a Phase I in SBIR, you get about 150K or so, 100, 150K.

Mr. OLVER. The most recent authorization, may be larger than that. But yes, it used to be $75,000, I remember.

Dr. MAJUMDAR. Right, and then there is a gap where you have to write a proposal again. It goes through evaluation and then you get Phase II. And that——

Mr. OLVER. And then you can get up to like $750,000 or something like that.

Dr. MAJUMDAR. That is right. And that gap is actually quite difficult. Because for a small company, and this is what we faced, cash flow is everything. So we went under because we could not sustain our operations through the gap.

Mr. OLVER. Okay.

Dr. MAJUMDAR. So I think one of the things that we are going to do in ARPA–E, is to use this go/no-go milestone and close the gap to zero. Because if in Phase I, you can reach the milestones of Phase I, it should be automatic to go to Phase II, so that you don't have a cash-flow problem, and I believe, and I have talked to many small businesses, that this is something that they would love to see.

Mr. OLVER. And you can do that.

Dr. MAJUMDAR. I believe we can do that within the law.

Mr. OLVER. You can do that just administratively, since you must do SBIRs, with those 2 or 3 percent or whatever of the money. You can then change the whole pattern of the program.

Dr. MAJUMDAR. I believe there is flexibility in doing so, but I could take the question for the record, and get back to you in more detail.

Mr. OLVER. Okay, that would be fine. Am I already off my time?

Mr. FRELINGHUYSEN. You are——

Mr. OLVER. Off my time.

Mr. FRELINGHUYSEN. Never off your time. But Mr. Nunnelee is ready.

Mr. OLVER. I will come back.

Mr. FRELINGHUYSEN. Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman. Mr. Frantz, way back in 1976, the Congressional Budget Office had a paper entitled: Loan Guarantees, Current Concerns and Alternatives for Control. It was referenced by a recent Congressional research service report. Let me just quote from that one: "Commercial lenders originate loans that are guaranteed by the government. These lenders may be more concerned with the adequacies of the loan guarantee agreement, than by the actual risk of the project. As a result, projects may not receive an adequate amount of due diligence by the lender. Therefore, increasing the Federal Government's risk of exposure."

Mr. FRANTZ. Yes.

Mr. NUNNELEE. Can you respond to that?

Mr. FRANTZ. Oh, I certainly can. When you, in a bipartisan way, decided to enact the 1705 program under the Recovery Act, we, in our office, took a look at it and created what you may be familiar with, a subset called our Financial Investment Partnership Program. We did it for two reasons. One was to extend the capability of the private markets, to have a greater breadth in the opportunity to loan; and secondly, to drag them kicking and screaming back into this space in terms of new innovative technologies, which they had vacated at the time, particularly during the recession.

So, that program, which was sunset September 30, 2011, was enormously successful. What we did, and I want to assure you that we did, and this was a part, in fact, of the GAO report reflected it—those projects went through double due diligence process. The applicants were required to be financial institutions. They had done due diligence on the projects themselves, and then when they came to us as an application, we started all over again on the projects.

So that those projects actually went through a double credit underwriting and due diligence process. For that reason, by the way, those projects are among the soundest projects we have in the portfolio today. They largely focus on generation, as you would expect, solar generation. So I think, if anything, we have corrected, or at least addressed maybe some of the shortcomings of the earlier program in that regard.

Mr. NUNNELEE. All right, I am still new to this committee and learning, but your contention is that without these loan guarantees, the private sector would not have made the loan, or there are not enough venture capitalists out there.

Mr. FRANTZ. Certainly not. I want to assure the full committee in that regard, and that is true today. We are in constant communication on a weekly basis with the major financial private markets. It is a part of our responsibilities, and they are still in a position where, in many instances, they would not undertake these new and innovative technologies, either in the first instance or at utility scale where we are financing them today.

Mr. NUNNELEE. All right. Mr. Chairman, I will yield back. I will get some more later.

Mr. FRELINGHUYSEN. Some good questions. I referred to it in my opening remarks. I think a lot of players were shaken by some of the challenges you have faced, and it is one of those underlying uncertainties here. I just want to talk for a few minutes, Mr. Frantz, about the Allison Report, and——

Mr. FRANTZ. Yes, sir.

Mr. FRELINGHUYSEN [continuing]. And the report recommending that you better define what is a reasonable prospect for repayment. That is obviously for the purpose of the loan portfolio.

What is your understanding of this recommendation, and what are you doing to implement it?

Mr. FRANTZ. Well, on this particular one, or all of them, Mr. Chairman?

Mr. FRELINGHUYSEN. Well, let's just start with the reasonable prospect of repayment.

Mr. FRANTZ. With respect to that requirement, we have taken a very, very conservative approach to that recommendation. A 50/50 flip of the coin does not meet our criteria. So we are looking at very high percentages, as a function of our total identification of risks and our mitigation of those risks, to ensure that there is a very high probability that, for the benefit of the taxpayer, our loan is going to be repaid. It varies in terms of the percentage. It varies by business sector, as you can well imagine, and——

Mr. FRELINGHUYSEN. So who do you pull from within your organization to do this evaluation? Because I get people from the private sector, shall we say, condemning us all in Government for a

lot of the things that have been happening. You don't have the right people in place? How would you characterize some of the people that are doing these assessments here? Some come from the private sector with pretty remarkable credentials.

Mr. FRANTZ. Virtually all of them do, Mr. Chairman. All of my staff represent people who are essentially from the private sector. For the most part, we are not career government people.

Mr. FRELINGHUYSEN. We salute you, the fact that you are in Senior Executive Service, of course.

Mr. FRANTZ. We do a very thorough due diligence and underwriting of these projects in the first instance with the origination group. These are people who have been doing this virtually for their entire careers. It is then reviewed by what we call a very separate credit group. That group is referred to in the Allison Report as the "risk management group." We are looking to address his recommendation in that area to tighten that up, and change a little bit of its focus. But that group operates and views these transactions very separately from the origination group. So, that is the first checks and balances that occur.

Mr. FRELINGHUYSEN. Well, there is a drum beat, which is maybe over the last couple of days, that somehow we blame it all on the Chinese. But in reality, somebody is looking, you know, we are looking over our shoulder as to what is going on around the world, and in China, and India. I mean, we are taking a look.

Mr. FRANTZ. Exactly.

Mr. FRELINGHUYSEN. That has to be factored into the overall equation here.

Mr. FRANTZ. Yes, and as a matter of fact——

Mr. FRELINGHUYSEN. We understand that there are subsidies here, there is manipulation, there are currency issues——

Mr. FRANTZ. Right.

Mr. FRELINGHUYSEN [continuing]. But in reality, if you have all of these qualified people, they ought to be taking a look at that.

Mr. FRANTZ. They are, and we are putting additional emphasis on that per the recommendation in the Allison Report with respect to the specific responsibilities of the staff and the portfolio management group that I also alluded to. So those folks are constantly looking at the world markets, and the more macro issues that might pertain to these projects down the road. That is a part of their responsibility once these projects move into the portfolio management.

Mr. FRELINGHUYSEN. The stakes are pretty high here.

Mr. FRANTZ. Yes, sir.

Mr. FRELINGHUYSEN. We have this underlying problem that still carries a shadow over something which had been going, I think fairly well, prior to this administration.

Mr. FRANTZ. Sure.

Mr. FRELINGHUYSEN. And within this administration, but obviously highlighted by some really dramatic situations.

Mr. FRANTZ. We also, we diversified the staff, Mr. Chairman, so now within our program we now have a very sophisticated technical group, and that technical group is also separate from the origination group. It does its own analyses, and they are also looking at all of the markets impacting all of our projects.

Mr. FRELINGHUYSEN. Tell us a little bit about the early-warning system, and what you are doing relative to managing information reporting systems and so forth.

Mr. FRANTZ. I am happy to address that, Mr. Chairman. The early-warning system is a process that begins, this—now, we are talking about the portfolio management group.

Mr. FRELINGHUYSEN. Yes.

Mr. FRANTZ. These are once the projects have moved from the origination and closing into the portfolio management group. The first piece of that oversight is what we call our watch list. The watch list is for a variety of reasons and projects move on and off the watch list continuously, but the watch list is for those projects for a variety of different reasons, either specific to the project, or to your suggestion specific to the markets that might be involved, go on this list. That list is reviewed on a weekly basis. The circumstances of the projects on the list, and all issues surrounding them. That is the first step.

The second step is that the officers are responsible on a monthly basis for all of their projects, covering all aspects that might occur. Those are the two first and major steps, and then that feeds into another recommendation that was a part of the Allison Report and that is, we have established a very separate risk committee. That committee convenes every week on Thursdays, and that committee oversees any updates or changes, material or otherwise, on each one of the projects that may be occurring on a weekly basis.

Mr. FRELINGHUYSEN. How would you rate the health of your current portfolio?

Mr. FRANTZ. We think it is very solid. You know, there clearly are unknowns, Mr. Chairman. We are not perfectly clairvoyant. We don't overall know what the future holds.

Mr. FRELINGHUYSEN. But some loans inherently are riskier than others, aren't they?

Mr. FRANTZ. Yes, sir, they are, and I alluded to them in my oral comment, that is in the manufacturing phase. In that regard, just as a parenthetical for all of you, in the manufacturing in the solar phase, we have two projects that have not even funded yet. And we don't know if they ultimately will be. We hope they are. We have also incurred milestones that have to be met both prior to the initial funding as well as the continuing funding, and that provides us off ramps in case these projects get in trouble. We don't commit all of the U.S. taxpayer dollars to the project.

Mr. FRELINGHUYSEN. There have been lots of lessons learned here.

Mr. FRANTZ. Yes, sir, certainly there have been.

Mr. FRELINGHUYSEN. Just to the Doctor. The white spaces you talked about, one of the things that the committee has learned is how many new centers the Department of Energy set up. Across the broad spectrum we have frontier centers, we have hubs. Where do you connect to the hubs?

Dr. MAJUMDAR. Well, it is a different model.

Mr. FRELINGHUYSEN. But in reality, they want us to set up a new hub, and we have a number of functioning hubs. I think the jury is out as to how well they are working, but I assume, do you cross-pollinate? Do you communicate?

Dr. MAJUMDAR. From ARPA–E's position, we coordinate very closely with all of the things that are going on in the Department including the hubs, as well as, you know, all of the EFPCs, I think there was a question about overlap, et cetera. Let me just address that very clearly. When we create programs in ARPA–E, the first thing we do, as I said, is to recruit really smart people, and then have a workshop. In that workshop, we bring in all of the stakeholders, the scientific community that are relevant, and sometimes communities that have not previously interacted with each other. We have people from the Office of Science, and all of the relevant applied energy offices in those workshops and manning them. They take some positions, leadership positions in creating that workshop.

Mr. FRELINGHUYSEN. Why don't you stop there? That is sort of why I, you know, maybe I didn't get into Mr. Frantz' portfolio well enough, is whether there are some things that you are doing that perhaps could be directed towards a look-see at some of those within your portfolio. In other words, there are maybe some other stakeholders that would take a look at some of the risks, or do you?

Mr. FRANTZ. We do. We do.

Mr. FRELINGHUYSEN. All right, and then I will go to Mr. Visclosky, but I just wanted to know whether there is——

Dr. MAJUMDAR. Well, I think one of the questions in the appropriations report is, have some of the practices in ARPA–E been adopted by other parts of the Department? One of the test cases is what we are doing in the SunShot initiative. And as you know, the goal of SunShot initiative is to reduce the cost of electricity from solar to 5 cents, or below a dollar per watt within this decade. But internally, it is also a coordinated management of all solar activities from Office of Science, from EERE, as well as ARPA–E. What they have done is adopted many of the practices of how we create the funding opportunity; how we have a workshop to bring in the stakeholders; how we review application; and how we then contract. Our contracting time in ARPA–E is down to 3 months or sometimes even less.

Mr. FRELINGHUYSEN. Well, you are sort of like the special forces.

Dr. MAJUMDAR. Special ops.

Mr. FRELINGHUYSEN. Yeah, you are special ops. You are like——

Dr. MAJUMDAR. So SunShot is an experiment where we are trying to take some of those best practices and see whether they can work. Some of them are showing some very positive results, and that is what we wanted to know.

Mr. FRELINGHUYSEN. Special ops often doesn't have to wait 7 years for something to be procured. They take it right off the shelf. Mr. Visclosky.

Mr. VISCLOSKY. But then I look at some of the troops behind you, and Doctor—just a joke, I am sorry. You have to know the personalities involved. Sorry about that.

Doctor, I didn't mean to ignore you, I do appreciate your work, and would attach myself to the observations that the chairman just made, especially about the milestones that you had other interchanges with Members. EERE was in yesterday, and many of their contracts are bilateral with both parties, and we did have a discussion about this, have agreed to a determination, and they now are

beginning to more closely integrate some of the milestones and have unilateral authority if they are not met. And again, best of intentions, but there are limited resources, and we ought to focus them. So I appreciate, and again, would encourage you to every degree to continue to do that.

I would just ask for the record, and not now, because I did ask a question in EERE yesterday. You mentioned solar batteries, and they were the two discrete programs I asked them to respond to for the record. To make sure those jobs are clear 5 years from now, the response yesterday was we are looking to create demand, we are looking at tax credits which have nothing to do directly with the Department of Energy, and we are collecting information. Not good enough for me. If you have some ideas, and again, for the record, just what are you looking to do? What should the Department do to make sure that on two programs, solar, and keep the jobs here, create the jobs here? I would appreciate that.

Dr. MAJUMDAR. Well, I am sorry.

Mr. VISCLOSKY. Go ahead. I wanted to have a conversation with Mr. Frantz there.

On the health of the portfolio, and the chairman alluded to that, I would ask if you could address the concerns raised about the exposure concerning First Solar, as well as the Spanish firm Abengoa, I believe it is, because of their out-sized——

Mr. FRANTZ. Sure.

Mr. VISCLOSKY [continuing]. Out-sized appearance in the portfolios. Is there anything in particular you have concerns about looking at as far as your staff?

Mr. FRANTZ. No, Congressman Visclosky, your concerns are well taken. Any time that a concentration occurs in our business, it is of concern, and it does require particular oversight. We make it a priority to look at it. With respect to First Solar, I would like to make two or three comments quickly. One is that First Solar, we have three projects with them; they are the big solar generation projects, but remember that their participation in the projects now, is as the EPC, the construction contractor, and the vendor supplier. Of those three projects that we have, one of them was the deal of the year. General Electric and Nexterra, two of the largest corporations in the United States, are the sponsors and the owners in that project.

Agua Caliente, we just had the experience that while NRG was the primary sponsor, it sold down 49 percent of that to MidAmerica. That has been publicized and that is a very positive thing in terms of the dispersion of the concentration, and Antelope Valley Solar, is one of the largest utilities in the United States as well. So the point is, with respect to First Solar, if there were any hiccups on any one of those projects, which we have no suspicion that there will be, these are sponsored by some of the largest corporations in the United States that could support a financial hiccup, and certainly would be able to readily change the vendor, or the contractor on those projects.

Abengoa, your question, a very good one. On this one, we were frankly delighted that Abengoa is one of our primary project sponsors in the portfolio. Abengoa is a world-class corporation in this space. Revenues of $9 billion this year. Every one of their financial

tests for 2011 are up. Revenues were up 46 percent; EBITDA, 36 percent; net income, 24 percent, and their leverage is going down.

They happen to be one of the most proactive and active and successful corporations in the world in the solar generation space. So they bring to the table enormous experience worldwide, and they have very positive financial performance. So in that regard, we are very pleased with their participation and we are very satisfied with the results that are taking place.

As a matter of fact, the Solana project among them is over half constructed now and is going very, very well. Also a very important point to make with respect to them, they bring to this Nation the follow-down in manufacturing capacity. They have built the plant which is now fully functional in the State of Arizona which is manufacturing to support their projects here in the United States. That is a big, big plus for the U.S. taxpayer, and for us as portfolio managers.

Mr. VISCLOSKY. Okay, thank you. I may have some more for Dr. Majumdar, but I will defer to the Chairman.

Mr. FRELINGHUYSEN. Mr. Nunnelee.

Mr. NUNNELEE. Thank you, Mr. Chairman. Earlier this month, the House Oversight Committee issued a report on the loan program. I have numerous questions. I will just pick a couple of them from that report, and just get you to respond. One, they say that the Department of Energy invested a disproportionate amount of its funds in solar technology leaving taxpayers vulnerable by overemphasizing a single technology.

Mr. FRANTZ. The truth of the matter is, we did invest very heavily in the solar space. It has been revolutionary. The point of it is, and I would like to emphasize this point, that the predominance of solar, we have 12 projects in solar generation. All of those projects have what we call power purchase agreements that exceed the tenure of our employed loans, and that is one of the most solid aspects of our entire portfolio.

So it is true there is a heavy concentration there, but it is also is the safest, and ultimately will be the most successful. There is no question about it. With respect to the solar manufacturing space, I think I previously made the comment, Congressman, that we had four projects in solar manufacturing. They are relatively small amounts, in terms of loan that have been borrowed, as well as project size, and two of the four we have not yet dispersed; and we will not, until we are satisfied that the satisfactory milestones have been completed. So it is true, there is a disproportionate amount, but that was where the demand for this program is. The good news is that we have structured those deals to the point that they are probably going to be our strongest and most viable projects in the portfolio.

Mr. NUNNELEE. All right, in another observation from House Oversight it says that: The Department of Energy's failure to diligently oversee cost and set prudent limitations on executive compensation, while it distributed billions of dollars in loan commitments, has created a significant moral hazard, and has created enormous risk for the Department of Energy and for taxpayer funds. And the report cites Beacon Power Corporation, the second recipient of the 1705 loan, paid three executives more than a quar-

ter of a million dollars and bonuses in March of 2010, and 18 months later declared bankruptcy.

Mr. FRANTZ. Well, a quick answer to that one and a very logical one. First of all, generally, not just us, but generally, in the private markets as well, senior lenders do not participate in board directorships. That is not what we do. So in effect, we do not have direct control over the governance of these projects and these corporations. That is left to their board of directors. So the assertion may be true, but we do not have the ability to control the compensation levels of corporations and projects to which we lend to.

Mr. FRELINGHUYSEN. So, if the gentleman will yield, unlike the TARP, you don't have any role?

Mr. FRANTZ. Yes, sir, Mr. Chairman, correct.

Mr. FRELINGHUYSEN. Troubled Asset Relief Program.

Mr. FRANTZ. Correct.

Mr. NUNNELEE. You need to understand the awkward position it puts me in. I have people in North Mississippi that are spending $4 a gallon to get back and forth to work, and they are struggling. And they get their paycheck, and withheld from their paycheck are Federal income taxes, and that goes to pay companies that pay multimillion dollar bonuses that declare bankruptcy.

Mr. FRANTZ. Uh-huh.

Mr. NUNNELEE. You understand the awkward position that puts me in?

Mr. FRANTZ. Yes, sir, I do. I do.

Mr. NUNNELEE. All right, thank you. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Mr. Nunnelee. Mr. Olver.

Mr. OLVER. Thank you very much. Sir, go ahead.

Mr. FRELINGHUYSEN. Mr. Fattah, sorry.

Mr. FATTAH. Thank you. The loan guarantees, you have done a number of deals in geothermal.

Mr. FRANTZ. Yes, sir.

Mr. FATTAH. Any of them relate to tidal-based energy, tidal waves?

Mr. FRANTZ. Oh, no, no.

Mr. FATTAH. So all of this—none of this is offshore.

Mr. FRANTZ. No, our geothermal projects are all deep drill programs in primarily the West.

Mr. FATTAH. Okay, now, the wind projects, any of them offshore?

Mr. FRANTZ. No, we have none presently. We have four wind projects, and they are all on the Continental United States.

Mr. FATTAH. Now, you have a lot of international experience, right?

Mr. FRANTZ. I do. Yes, sir.

Mr. FATTAH. Honduras has got the largest wind farm. Do you know how that was financed?

Mr. FRANTZ. No, I don't.

Mr. FATTAH. Well, do you know anything about how our economic competitors interact with the generation of renewable energy in general? I know 2 weeks ago the E.U. in its Energy Alliance Agreement talked in large measure about what the United States was doing and how the E.U. needed to compete around some of these same issues.

Mr. FRANTZ. Uh-huh.

Mr. FATTAH. Because not doing so would put them at a disadvantage. And I know here, we got into solar, which I totally support, in part, because the Chinese were——

Mr. FRANTZ. Uh-huh.

Mr. FATTAH [continuing]. Subsidizing it, and Germany has been subsidizing wind in a variety of different ways. So I was wondering whether you could share where we are relative to our competitors in helping to grow these industries.

Mr. FRANTZ. Well, I think generally, it is true, that with respect to the solar and the renewable space, that it is important that there are incentives to encourage that development. As you are well aware, the utilities in the State of California, with the endorsement of their Public Utility Commission, have permitted higher rates for the power purchase agreements which has been very important. I would emphasize the fact, and I think, Congressman, you are alluding to it, that the returns to employed equity on these projects is very, very low, so most investors go into them for strategic purposes, and they go in for the long haul.

There are potentially two applicants in the offshore wind space, and they will be in a position, we feel, that could be very viable based on their location, and incentives that they have locally.

Mr. FATTAH. Well, I think that we have made some very significant strides. Since the chairman spoke about New Jersey, I will mention my hometown of Philadelphia. Our international airport terminal is now completely powered by wind energy. The Eagles, who are going to win the Super Bowl next year, the entire stadium in which they play is now powered by wind and solar power. So I think that there are significant opportunities in pushing clean energy. On the nuclear side, we haven't done any nuclear in 30 years; however, the administration has really crossed a major rubicon in the sense of moving the country out of this kind of a stagnant position relative to nuclear, with a bias towards action. You had mentioned in your testimony, that on the advanced nuclear, you have a deal in, I don't know where it is in your process, but it is in process somewhere.

Mr. FRANTZ. Uh-huh.

Mr. FATTAH. Could you comment on that?

Mr. FRANTZ. Well, I alluded to the Vogtle project, which you are well aware of.

Mr. FATTAH. Right, the Vogtle project.

Mr. FRANTZ. This project is well along. There are over 1,500 people employed on the site. They did receive their license. We are in the final negotiations to close the documentation on that project. I have talked with the senior management. I talk with the senior management of the Southern Companies weekly. They are profoundly committed to completing this project, and we have every expectation that it is going to be a great success story in terms of the renaissance of the nuclear power in the United States. And by the way, there are discussions about destruction. We are in the process of finally negotiating that deal, but it is a classic example of the strength of a public partnership in bringing a very complicated and very large project on line.

Mr. FATTAH. All right. Thank you, Mr. Chairman.

Mr. FRELINGHUYSEN. Keep an eye on the small modular reactors, too. There is a lot of excitement in that area.

Mr. FRANTZ. We have been in discussions, Mr. Chairman, on that subject, as a matter of fact. We are very interested.

Mr. FRELINGHUYSEN. Some real excitement, a lot of different players. Some large, some small.

Mr. FRANTZ. We will have to come back to you with a new solicitation, if you will permit us.

Mr. FATTAH. We would be interested on a bipartisan basis.

Mr. FRELINGHUYSEN. Mr. Olver, you are at the end of the line, but always front and center for us. Want to put a plug in for your home State?

Mr. OLVER. You are going to confuse me if you do that, because I was going to talk again about SBIR, which my home State does very, very well on. But instead, I wanted to talk about carbon capture, and storage, and utilization because we had a long discussion about that yesterday, where I think I raised everybody's level of confusion in the process. You have spoken in your testimony here about the cost of capturing carbon dioxide from a coal-fired power plant at $80 per ton of CO_2. I take it that would apply also to gas-fired plants. They would be of a very similar nature?

Dr. MAJUMDAR. More expensive, because it is——

Mr. OLVER. More expensive? Why is it more expensive for——

Dr. MAJUMDAR. Because the amount of carbon dioxide is of lower concentration in pure natural gas. You have less carbon. So thereby, if you want to purify, you want to extract something out which is more dilute——

Mr. OLVER. Okay.

Dr. MAJUMDAR. As a chemist you would know that it takes more energy to do that.

Mr. OLVER. Okay. But the technique of capture is no different.

Dr. MAJUMDAR. That is true.

Mr. OLVER. Okay.

Dr. MAJUMDAR. Well, that is—see——

Mr. OLVER. Now, are there other places where—we aren't yet getting around trying to do—we are looking at the big points sources, which are these big power plants and the action of capture. We haven't done anything about capture for CO_2 in the case of our mobile sources like our transportation sources, have we?

Dr. MAJUMDAR. Well, Congressman——

Mr. OLVER. Have we done anything on that? Are you doing any research? Are you giving out projects?

Dr. MAJUMDAR. Well, I think there are several ways of addressing that. If you want to decarbonize the transportation sector, you could look at biofuels. The goal that we have set out for ourselves——

Mr. OLVER. But that is not carbon capture.

Dr. MAJUMDAR. That is not carbon capture.

Mr. OLVER. I wanted to see. How many different options are there for carbon capture, or is the technique essentially one technique on whether it is coal, or gas-fired facilities?

Dr. MAJUMDAR. Sure. So today, there are only a few techniques for carbon capture. A few. And they are based on chemicals or a chemical reagent. Either you have chilled ammonia, or you have a

solution of what is called monoethanolamine. And so you have an air separation unit. You pass CO_2 coming out of an exhaust of a coal-fired power plant and you drop this amine solution down and it gets absorbed. Then you take that amine solution with absorbed CO_2 to a separate location and then you have got to heat it to about 100, 120, 150 degrees Celsius to emit the CO_2 again, but now you have got a purified form. Thereby, you can concentrate it and you can then pump it to a location where you can do utilization and pump it down and produce oil, which is the whole idea of carbon capture utilization and sequestration.

You can sequester the CO_2 below and produce oil at the same time. Using that technique today is $80 a ton of CO_2 for capture. While the cost is coming down, in ARPA–E what we created is that look, we have to reduce the cost way further.

Mr. OLVER. So you have given out 15 projects which are intended to reduce the cost.

Dr. MAJUMDAR. That is right.

Mr. OLVER. So it is 15 projects, each of which has a different approach to how they are going to do that.

Dr. MAJUMDAR. Exactly, that is right.

Mr. OLVER. So you are now getting two approaches, and out of that process we might end up with a couple of these approaches that actually meet your goals.

Dr. MAJUMDAR. That is right. And our goal is to reduce the cost to $25 a ton, and why 25? Because the price of CO_2 that is set by EOR and it has to be on the order of 30, 35 or so.

Mr. OLVER. That is an option for utilization, and you don't go from storage. You go from the producing, to the capturing, directly to utilization.

Dr. MAJUMDAR. Well, that is the goal. When you pump CO_2 down to produce oil, it also gets sequestered at the same time. So this is a win/win/win proposition, again, because you can capture the CO_2 from the coal-fired power plants, pump it down, sequester it, and produce domestic oil. So this is something that we are deeply interested in, and the key challenge is to reduce the cost of carbon capture, which is where ARPA–E and the Department of Energy as a whole have focused to reduce the cost of carbon.

Mr. OLVER. What are the sizes of your 15 projects?

Dr. MAJUMDAR. On an average, about $3 million. That is a typical ARPA–E project and some of them are a few hundred thousand dollars.

Mr. OLVER. Oh, you have some techniques for people that propose to do this for much less than $3 million?

Dr. MAJUMDAR. No. In our ARPA–E projects, the program that we have created is focused only on carbon capture, because that is the cost barrier that we have today. We are not focused on pumping down and utilization.

Mr. OLVER. No, I understand. You have all of these different projects. You have some people who are thinking that, have I either only asked for, or you have concluded that it is risky, or something, and you don't want to spend so much to give them all the same number?

Dr. MAJUMDAR. Well, this is on an average. These are risky ideas. These are game-changing potentially. The average is $3 mil-

lion; $1 million a year. This is to try out a new idea; and if it is successful, then they will go to the next stage of scaling and putting it in a power plant, et cetera. But that comes in a pilot plant, and that comes at a later stage. But this is to try out other avenues.

Let me give you an example. There are something called ionic liquids. These are new kinds of reagents, and the idea is that could you take ionic liquids to capture carbon dioxide and then move it away at a much more cost-effective and energy-efficient way. There are other membranes that have been created to do carbon capture. We have enzymes. We are capturing carbon dioxide in our body and we are exhaling it right now and we don't have to heat ourselves to 150 degrees Celsius. There is something else going on.

Mr. OLVER. Well, let me quickly repeat the question that I had asked yesterday, and I had the impression that we had a whole group of options for carbon capture, and we had also a whole group of options for storage, and a group of options for utilization. And you are not certainly contradicting that. Obviously, utilization may be in many different things besides the EOR program, and some of them will appear if we can cheapen the amount so that we are producing CO_2 that you can handle in serious tonnages in a better way than we can do now.

And I was asking, as a one-time chemist, is there someplace where I can see a compendium, not too long, because otherwise I would never get it read, but a review paper, or something like that about the different problems that we have like the problem of sequestration, the problem of capture, the problem of storage, and the problem of utilization.

And sometimes it is going to have all three components, and sometimes it may not have a long storage component. And I wanted to see what we were doing in these, and what our prospects were, how far along we are on this area.

Dr. MAJUMDAR. I would be delighted to share the review papers on these, and where we are on each of those components. I will be delighted to share them with you.

Mr. OLVER. You are talking now about several review papers. There are review papers on each of these, and I will have a pile of paper and it will never get read.

Mr. FRELINGHUYSEN. You will make sure that Mr. Olver has those papers?

Dr. MAJUMDAR. Yes, I will make sure. I will make sure you have those papers.

Mr. FRELINGHUYSEN. We are going to make sure you get those papers. And I want to get back and I think the hour is late, and we were kind of a late start. I just want to get back, Mr. Frantz, you mentioned the 705 loan guarantee, you know, that you ran out of authority on that——

Mr. FRANTZ. Uh-huh.

Mr. FRELINGHUYSEN [continuing]. To issue new loan guarantees. You still have, I believe, over $500 million of emergency funding that you have not yet obligated. Can you—what are you going to use this funding for?

Mr. FRANTZ. Well, we feel it is very important to have this availability, given that our tenures and the complexity of our projects,

and there will be a requirement almost certainly that there be modifications to these transactions. Therefore, this is a safety valve for us to accommodate modifications that may have to be made in these projects in the outyears, given circumstances that we can't foresee right now, but certainly in all probability they will occur.

Mr. FRELINGHUYSEN. So just for the record, how many loan guarantees have been modified to date, and——

Mr. FRANTZ. Well, none have been modified to date because we are just in the initial stages.

Mr. FRELINGHUYSEN. So as we look ahead here, what would you anticipate?

Mr. FRANTZ. You know, I couldn't, Mr. Chairman, put a specific number on it, but they are almost certainly, given the complexity and the size of these projects, there will be a requirement for those modifications in the outyears.

Mr. FRELINGHUYSEN. Doctor, before we close-up here, Mr. Visclosky asked about, and others asked about what are we doing to actually maintain the intellectual property that you have developed to make sure that it stays here——

Dr. MAJUMDAR. Right.

Mr. FRELINGHUYSEN [continuing]. And that there is a direct relationship between the creation of American jobs. I mean, we have heard others from the departments testify, but we don't get much reassurance that all of the creativity, innovation that you are talking about, all of the best minds that collectively you have put together on a variety of these projects, that—we don't have a feeling of assurance that a lot of that is going to stay stateside here. What are you doing?

Dr. MAJUMDAR. Mr. Chairman, I appreciate the question. This is something that is of deep concern to me. I am very passionate about it. Actually, I wrote an article on this called "Make Locally, Sell Globally." And I have outlined some of the issues, and I can share this with you.

Mr. FRELINGHUYSEN. You are going to give that to me when you give Mr. Olver his reports?

Dr. MAJUMDAR. This is a single page.

Mr. FRELINGHUYSEN. I am concerned about patents.

Dr. MAJUMDAR. I agree.

Mr. FRELINGHUYSEN. I am concerned about, you know, we are aware that—it depends where you listen, the Chinese have a lot more patents than we do in certain areas, and that scientific papers are lacking sometimes compared to what we used to do, and I just wondered whether we are keeping intellectual property here as best we can, and protecting our manufacturing base.

Dr. MAJUMDAR. Yes, Mr. Chairman. There is no silver bullet on this one. Let me just explain. There are multiple things that have to be done. Number one is the IP part, and what we have done is, for example, for small businesses, there is the Bayh-Dole Act, and we have gone a little beyond Bayh-Dole to ensure that some of the IP leads to American manufacturing here in the United States. But if you are looking at manufacturing, which as I said, I am very passionate about, there is other things as well. Financing is very important.

So, and this goes beyond ARPA–E now. Because ARPA–E's job is to look at the breakthrough, to demonstrate that something can actually work. But we have created, and this is right in the DNA of ARPA–E, a tech-to-market team within ARPA–E. Their job is to look at the innovations that are coming out, and once they are successful, to create the connective tissue for the rest of the world which includes large business, which includes financing, so that they can succeed in going beyond ARPA–E and leads to manufacturing, and leads to jobs out here. Some of that is showing success. I just heard yesterday there is a team that we funded called Phononic Devices in North Carolina, and our funding was to demonstrate that you have a new kind of solid-state refrigerator, and they have been successful. Now, that is leading to a pilot plant in North Carolina to develop these devices right there.

But if you really want to look at manufacturing as a whole, there are other aspects. There is a human capital aspect, which I think is very important and you and I had a discussion on that. There is a market demand that needs to be created, but that is, frankly, I would say a little bit beyond ARPA–E. We are doing everything we can.

Mr. FRELINGHUYSEN. Well, some of our best human capital, and it is disturbing, but we live in a global economy, have moved to China. I mean, there have been some remarkable people that we have trained and educated who are now, shall we say, setting up shop in China. And just for the record, do the Chinese have multiple ARPA–Es? How would you describe what they are doing?

Dr. MAJUMDAR. I have not heard of an ARPA–E in China, frankly. Maybe they are doing something that I don't know of. They haven't announced it, but what I could say is what we are doing out here. I think we are doing everything we can to transition some of the technology breakthroughs into manufacturing out here.

Mr. FRELINGHUYSEN. I say that because both Mr. Visclosky and I serve on Defense Appropriations Committee, and from one of the military installations I represent, this individual was followed around when he went to China, and he asked many of the students who were gathered around him what they were majoring in, and they said they were majoring in warhead development. There were about like 150 of them. And I just wondered whether what we, obviously—we don't have that type of, shall we say, college or university major, but at the installations we have people who focus on that in research and development. I was just wondering whether you are taking a look over your shoulder.

Dr. MAJUMDAR. We are. All I can say is I strongly believe in the science and engineering infrastructure out here, which is the best in the world. I also believe in the capacity for the United States to manufacture. I strongly believe in that, which is why I am so passionate about it, and that is why I wrote the article. But I really think that we have to align multiple things and I think we have to align the financing. We have to align the market demand created out here. We have to align the human capital so that people get retrained and get into the workforce, and we have to align that with the technology innovations and the IP protection. We are looking at whatever we can in our capacity in ARPA–E to do that.

Mr. FRELINGHUYSEN. Mr. Visclosky, anything further?

Mr. VISCLOSKY. If I could, Mr. Chairman. Mr. Frantz, on the USEC program, it does not lack controversy in your office or on this subcommittee, and I view it as multifaceted as far as your consideration. One, is the technology, and the Department obviously has looked at developing a $300 million research and development program——

Mr. FRANTZ. Uh-huh.

Mr. VISCLOSKY [continuing]. As well as the financial standing of the company itself. Could you bring the subcommittee up-to-date as to your impression from a loan guarantee perspective as to——

Mr. FRANTZ. Well, sure. This project is no longer ongoing. It has been—it is being managed separately within the Department of Energy under a separate program. As you are perhaps well aware, it was an applicant for the front end uranium enrichment in the Loan Guarantee Program. We never have been able to reach a conclusion that the technology was ready for full commercial application, nor have we been able to ascertain that the corporation was financially enough sound to execute the overall project. So based on that determination within my staff, the Secretary has chosen to establish a separate program for that project within the Department.

Mr. VISCLOSKY. On the auto program, markets have obviously changed since the inception of that program, and I believe you have about $4 billion left in the program.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. What is your forecast, if you would, for assumptions going forward? Will it be demand from the industry, and will it be from the manufacturers? Will it be from the component side, and do you draw a distinction between the two?

Mr. FRANTZ. Yes. We do draw a distinction. I will work backwards. You have asked me two or three questions. First of all, given our experience in the sector, and particularly with the OEMs, which the original equipment manufacturers, the major auto companies, it is a known fact, and we hear it in the marketplace all the time that they prefer to control all of the integral parts within their organization from a quality-control point of view, as well as the economics of vertical integration.

So it is very, very difficult for an independent individual component manufacturer who is not underwritten, or subscribed to by the major automobile companies to actually penetrate and become ultimate suppliers to them. So that is the impediment in the first instance.

Yes, there has been a dramatic change, a very positive one, wonderful news for the American economy for sure, that there has been a dramatic turnaround in this industry. For that reason, what I would want to assure the committee, is that we have a very proactive initiative in the automotive industry through Webinars, outreach to all the companies—not only the major automotive makers, but as well as smaller individual companies that we are still in business. We are open for business. We would very much welcome their applications. So I can't comment specifically, but we are doing a full proactive outreach to this industry to make sure that everybody is aware we are here.

We are still open for business, and we are still very interested in helping them, in assisting them to bring new technologies, par-

ticularly as they pertain to the CAFE standards, and the efficiencies of motor gasoline.

Mr. VISCLOSKY. The chairman made a comment, because I have been on the subcommittee for some number of years and have been through the iterations of the 2005 program, the auto program, and the stimulus bill. And while, as far as the dollar amount and the exact configuration of programs, it would be different than if I was writing it individually, this is obviously a collective effort, and I have supported all of them.

It would be easy, because there have been some problems—I wish there had been no problems—to castigate you and the Department for them. I wish they had not happened.

Mr. FRANTZ. Uh-huh.

Mr. VISCLOSKY. I would encourage you as we go forward to continue, from my impression of your testimony today, to exercise that great care. My sense is you have had over 600 applicants. Some you probably threw away the first day. We talked about USEC, it is in a different department now. I urge you to continue to be very careful. I mean, we wouldn't have a Loan Guarantee Program if there wasn't a risk.

Mr. FRANTZ. Correct.

Mr. VISCLOSKY. Whether it is technological, or whether it is financial.

Mr. FRANTZ. Correct.

Mr. VISCLOSKY. Nuclear, I have had interchanges with some of my colleagues who do not share my opinion, and said well, there is not a technical risk. I said, but you and I are having a political conversation. There is other types of risk. There is other types of risk here.

Mr. FRANTZ. Yes, sir.

Mr. VISCLOSKY. I would encourage you to be as attentive as you can on this program. And Doctor, I do appreciate your good work.

Dr. MAJUMDAR. Thank you.

Mr. FRANTZ. Thank you.

Mr. FRELINGHUYSEN. I associate myself with those comments. Mr. Fattah.

Mr. FATTAH. If you are going back around, I will ask some more questions.

Mr. FRELINGHUYSEN. Go right ahead. Mr. Olver is going to be the last one to question. I am sure he will keep his remarks short.

Mr. FATTAH. Question, the CAFE standards, at one point you had the automakers protesting, at and another point or a year or so later after they were finally announced they were standing with the President in agreement that we could get above 50 miles an hour. In terms of the remaining $4 billion in loan guarantees and I am just following up on the ranking member's question about this. What expected deal flow exists going forward to help those auto manufacturers who are on board?

Mr. FRANTZ. Yes, the simplistic answer. That is the——

Mr. FATTAH. We like simplistic answers, thank you.

Mr. FRELINGHUYSEN. Simplistic answers, Mr. Olver. You are the last out of the box here.

Mr. OLVER. Mr. Secretary, early on in your conversation, you said you terminated some projects on your major ARPA–E projects.

You had only been going for 3 years. I think you got your first major money in within fiscal year 2009, but it was actually through the passage of the American Competes Act, or something, I think that may be where it came.

Dr. MAJUMDAR. From the Recovery Act. That is where we got the first dollars.

Mr. OLVER. Was that authorized for $100 million?

Dr. MAJUMDAR. In the Recovery Act, that is right.

Mr. OLVER. In the Recovery Act? All right, okay. So that is the only money that you have actually had up for as much as 3 years, because you got another $180 million in each of the following, or thereabouts in each of fiscal year 2010 and 2011.

Dr. MAJUMDAR. Right, so we had to obligate all of the Recovery Act money by September of 2010, which we did. Then we had fiscal year 2011 as the first budget that you appropriated for us, and now we have the fiscal year 2012 appropriated budget.

Mr. OLVER. Have you terminated any of the projects that you gave out with 2011 money?

Dr. MAJUMDAR. Congressman, it is too early to—we have to give them a chance.

Mr. OLVER. So it would be among the $400 million that you had originally.

Dr. MAJUMDAR. Right, that is right.

Mr. OLVER. And how many of those did you have——

Dr. MAJUMDAR. We have terminated now nine projects, and that money went back to Treasury.

Mr. OLVER. But weren't those all by 3-year contracts?

Dr. MAJUMDAR. The maximum was 3 years. It is anywhere from 2 to 3 years.

Mr. OLVER. So did you terminate before the end of a contract?

Dr. MAJUMDAR. That is right.

Mr. OLVER. You actually terminate before you got to the end of a contract?

Dr. MAJUMDAR. That is right. Because they did not meet their milestones.

Mr. OLVER. And you are actually following milestones.

Dr. MAJUMDAR. That is right. There are go/no-go annual milestones and if they don't meet the milestones we terminate the project. We discontinue the project before the end of the project and we put that money back in Treasury. That is what we did with the Recovery Act.

Mr. OLVER. Okay, but these were fairly large projects. If we were trying to do that sort of thing with SBIR, I am commending you for the innovation that you were able to do. But some of that money, even of the $400 million, had to go out by the SBIR project, 2 or 3 percent of it had to go out by that, so that was under constrained arrangements. You had not yet gotten so innovative that you were trying to do this under entirely different sorts of procedures.

Dr. MAJUMDAR. Well, let me just say that so far, the SBIR program in the Department of Energy has been centralized. This is the first time in fiscal year 2012 that we are going to launch an SBIR effort within ARPA–E. So we don't have a history of doing SBIR before because it is all centralized and went through one of-

fice. This time in fiscal year 2012 we are trying for the first time in the SBIR effort within——

Mr. OLVER. So then I guess you would change the answer to—I asked, did you have to put out 2 or 3 percent of the $400 million into SBIR?

Dr. MAJUMDAR. That is right.

Mr. OLVER. So it was taxed into the central department program?

Dr. MAJUMDAR. That is right. It was a centralized effort.

Mr. OLVER. That percent was taken out and put into the central program——

Dr. MAJUMDAR. That is right.

Mr. OLVER [continuing]. Which was very bureaucratic in nature. I mean, I say it was very bureaucratic. It is very difficult to get it from the first one to the second one and the timing as we talked about it earlier. My State did very, very well. I was in the State Senate at the time that it was created in the middle 1980s, and it immediately got the small businesses in my area into it. And some of them eventually began to get into the swing and others never could get anything out of it. And yet as you said before, it took a long time to get from the first one to the second one.

Dr. MAJUMDAR. Right.

Mr. OLVER. And a whole new application process, where you are operating in a much more flexible way. It is interesting.

Dr. MAJUMDAR. We are starting that SBIR now, and as I said, I had the same experience, and we are going to take the time gap between Phase I and Phase II and make it zero, and thereby enable small businesses not to have this cash-flow problem.

Mr. OLVER. It was a horrible gap.

Dr. MAJUMDAR. That is right.

Mr. OLVER. Okay.

Mr. VISCLOSKY. The gentleman, would you yield? When you were in the—you on the Finance Committee, right?

Mr. OLVER. Yes.

Mr. VISCLOSKY. That is why they all ended up in your district.

Mr. OLVER. No, actually, my district, in general—in Massachusetts my district was in the western part of the State, so we got a few of them anyway.

Mr. FRELINGHUYSEN. We are going to send out an electric car from Washington to Pittsfield. Anything else for the Good of the Order? Gentlemen, thank you very much. We stand adjourned.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

DEPARTMENT OF ENERGY
ADVANCED RESEARCH PROJECTS AGENCY – ENERGY (ARPA-E) AND LOAN GUARANTEE PROGRAM
FISCAL YEAR 2013 BUDGET HEARING

MARCH 28, 2012

ADVANCED RESEARCH PROJECTS AGENCY–ENERGY (ARPA-E)

ARPA-E INVESTMENT AREAS

Subcommittee. So far, ARPA-E has had four funding rounds. In fiscal year 2012, you plan to issue four more funding opportunity announcements, or FOAs, including one for natural gas for transportation systems.

Dr. Majumdar. Between January 1, 2012 and March 28, 2012, ARPA-E issued two Funding Opportunity Announcements (FOAs) and several Requests for Information. A $30 million FOA for Methane Opportunities for Vehicular Energy (MOVE) was issued on February 23, while a $150 million Open FOA was issued on March 2. More recently, on April 11, ARPA-E issued a $30 million FOA for Advanced Management and Protection of Energy-storage Devices (AMPED) and a $13 million FOA to fund energy storage projects under the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

Subcommittee. How did you select this potential area for investment?

Dr. Majumdar. Solutions to current and future 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.

When ARPA-E designed MOVE, like all of its focused research programs, it selected 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 at scale, will ARPA-E invest in technology research. 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, and national laboratories, as well as groups outside of government, such as industry and academia, to identify untapped opportunities or "whitepaces."

ARPA-E has a rigorous program development process. Before announcing a program, ARPA-E undertakes a comprehensive process to ensure that it is identifying a "white space" that is not being addressed by the private sector. The ARPA-E technical staff undertake a thorough review of existing literature in multiple fields. 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. In particular, what is critical is to identify where a field may be going, and potential whitespaces where the integration of two to three different scientific communities that had previously not interacted would produce a quantum leap in technology. 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.

ARPA-E's investment approach is also consistent with the Quadrennial Technology Review (QTR), which stated in part:

"Informed by the QTR process, DOE will give greater emphasis to the transport sector, where innovation can impact all three energy challenges [i.e. Energy Security, Environmental challenges, and Competitiveness challenge]."[1]

Subcommittee. Do you see this as a potential investment area to reduce gasoline prices at the pump?

Dr. Majumdar. ARPA-E focuses on long-term, high-impact solutions that minimize consumers' energy bills, provide economic growth while enhancing national security and minimizing environmental risk. In particular, MOVE is designed to create technologies to reduce the system-level cost for natural gas light-duty vehicles that can be refilled at home. If

[1]U.S. DOE Quadrennial Technology Review Volume I (2011), page 124, available at: http://energy.gov/sites/prod/files/QTR_report.pdf. Note, parenthetical information taken from page 123.

successful, these technologies would be so economically compelling for consumers that it would allow consumers to switch to natural gas fueled passenger vehicles without subsidies while simultaneously reducing their driving cost.[2] This would also lead to a significant reduction in petroleum consumption. Since natural gas is domestically produced with sufficient abundance and at low cost, such a transformation of the transportation sector would significantly reduce our imports of petroleum, thus reducing our trade deficits and enhancing our national security.

Several ARPA-E programs beside MOVE are also focused on research to provide American consumers with cost-effective transportation options. Electrofuels, BEEST (Batteries for Electrical Energy Storage in Transportation), REACT (Rare Earth Alternatives in Critical Technologies), PETRO (Plants Engineered To Replace Oil), as well as several projects funded through ARPA-E's broad funding announcement in 2009 are all focused on providing cost-effective alternatives to American consumers.

Subcommittee. One of the major barriers to natural gas is the availability of refueling infrastructure. Is this activity permitted to be funded in this FOA?

Dr. Majumdar. The primary objective of MOVE is to create systems-level solutions to allow cost-effective at-home refueling of natural gas passenger vehicles - including the research of innovative low-cost high performance compressors. Focusing on at-home refueling side-steps several major barriers, including the significant up-front capital costs required to construct a sufficient number of stand-alone or hybrid gasoline/natural gas commercial refueling stations. At-home refueling also allows consumers to utilize their already existing natural gas supply.

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[2] See ARPA-E Funding Opportunity Announcement DE-FOA-000672: Methane Opportunities for Vehicular Energy (MOVE), § C and D (Program Overview and Program Objectives), available at https://arpa-e-foa.energy.gov/#dc1d731e-f2cf-4be9-b6ac-ab315582d000.

FISCAL YEAR 2012 OPEN FUNDING OPPORTUNITY ANNOUNCEMENT (FOA)

Subcommittee. Doctor, on March 2, you announced a $150 million "open" FOA to support an "all of the above" approach. This was your second open FOA, the first in 2009. How would you characterize the success of your first open FOA?

Dr. Majumdar. ARPA-E's Open FOA in 2009 had several key benefits. It allowed for high-impact research topics across a wide-range of technical areas to be rapidly identified and supported. It kick-started both ARPA-E itself as well as the wider research community into action, accelerating the pace of energy research across former technical and organizational stovepipes. It also allowed ARPA-E to gain insights into the most promising technologies, insights that were utilized in creating several future follow-on programs in specific areas that were developed between 2009 and 2011.

Subcommittee. What do you expect to see from this FOA?

Dr. Majumdar. While ARPA-E's 2012 Open FOA is still in the concept paper and application phases, it is intended to encompass the full range of energy-related technologies and is structured around eight technical categories: (1) Renewable Power (Non-Bio); (2) Bioenergy; (3) Transportation; (4) Conventional Generation (Non-Renewable); (5) Grid; (6) Building Efficiency; (7) Other; and (8) None of the Above.[3] While all technology-focused applied research will be considered, two instances are especially fruitful for the creation of transformational technologies: (1) establishment of a technology upon recently elucidated scientific principles; and (2) the synthesis of scientific principles drawn from disparate fields that do not typically intersect.

When eventually awarded, it is expected that some projects will be along similar lines of inquiry as already existing ARPA-E programs and projects, but by design, some projects will be focused on entirely new approaches. However, all projects selected under the Open FOA are intended to fund

[3] See ARPA-E Funding Opportunity Announcement DE-FOA-000670: Open Funding Opportunity Announcement (Open FOA), Modified Version 1, § I.E (Technical Categories and Subcategories of Interest), available at https://arpa-e-foa.energy.gov/#ecddd983-c274-4374-bb1e-91bb3abe9dfa.

research that is both potentially transformational and disruptive to the marketplace in the long-term.

Subcommittee. You have the ability to direct funding to any subject which shows significant promise. Why do an open FOA?

Dr. Majumdar. ARPA-E prefers to take a balanced approach towards funding transformational and disruptive energy technologies by issuing an Open FOA every two to three years while issuing focused FOAs on an ongoing basis. This allows ARPA-E to periodically "test the waters" across the scientific disciplines through an Open FOA for any early-stage technologies that may provide strategic advantages to the U.S. Issuing an Open FOA every two to three years allows ARPA-E to attract and maintain a high-degree of interest from the scientific research community while not tying up the Agency resources required for an ongoing or even annual Open FOA. At the same time, ARPA-E's focused programs are designed to support solutions geared to a specific set of technical barriers that if overcome offer strategic benefits to the U.S. ARPA-E's organizational model allows a timeline of program conception to execution (i.e. projects are contracted and research has begun) that is greatly accelerated—typically only six to eight months. This allows ARPA-E to create focused programs that rapidly respond to newly emerging technological discoveries and geopolitical events.

Subcommittee. Since this is to support an "all of the above" approach, are you actively seeking out applications to support all energy sources, or do you take a "come what may" approach?

Dr. Majumdar. Ultimately, ARPA-E will only make an award to an entity that has chosen to apply for funding through the competitive merit-based review process. The key factor in selecting a project is whether the idea has technical merit, whether it has the potential to be transformative and disruptive in the future, whether the team has the right expertise to carry out the project, and finally whether, if successful, the project is likely to garner private sector interest. Over the last 3 years and the approximately 180 projects that ARPA-E has funded, the average level of funding for each project is roughly $3 million. Allocating $150 million, which is much larger than individual focused programs (typically $30-35 million) will allow ARPA-E to select approximately 50 projects, which is likely to cover an "all of the above" approach in a balanced way.

Subcommittee. Given that this Administration repeatedly cuts support for fossil and nuclear energy, do you see any way that your office could ensure a truly level playing field for all promising energy sources?

Dr. Majumdar. Through the COMPETES Act, Congress provided ARPA-E with the following goals: (a) to reduce imports of energy from foreign sources; (b) to reduce energy related emissions; (c) to increase energy efficiency across the whole economy. Furthermore, the mission of ARPA-E is to provide the U.S. with a technological lead and ensure its economic and national security. This covers all aspects of energy, including fossil and nuclear.

In accordance with its statutory mandate, ARPA-E has funded a number of research projects involving traditional energy sources. One of the first projects that ARPA-E selected for funding following its establishment in 2009 was a project involving a new process for converting oil refinery exhaust into valuable fuel products. If successful, this project alone could increase domestic production of gasoline by 46 million gallons per year.

Another project that APRA-E funded in 2009 could enable the United States to drill for natural gas in areas previously considered impenetrable. Conventional drill bits penetrate ultra-hard rock formations slowly and wear down quickly, which makes the drilling process time-consuming and expensive. More economical drilling methods are required to enable access to next-generation energy resources, including natural gas. One of ARPA-E's recipients is developing a unique drilling technology involving the transmission of high-power lasers over long distances via fiber optic cables. This laser power is integrated with a mechanical drilling bit to enable rapid and sustained penetration of hard rock formations too costly to drill with mechanical drilling bits alone. The laser energy that is directed at the rock basically softens the rock, allowing the mechanical bit to more easily remove it. These laser-assisted drill bits have the potential to be up to 10 times more economical than conventional hard-rock drilling technologies, making them an effective way to access domestic energy resources currently locked under hard rock formations.

In FY 2011, ARPA-E created a program focused on new transformational technologies for the storage of heat. Since over 90 percent of our primary energy use is in the form of heat, efficient storage of heat could lead to a very significant impact on our energy landscape. In particular, the storage of

heat from nuclear reactions could allow nuclear power plants to respond to peak electricity demands, when the electricity prices are often higher. This would provide nuclear power plants with a new capability, since today they are typically limited to providing baseload electricity.

In FY 2012 and FY 2013, ARPA-E plans to continue its focus on reducing the nation's dependence on imports of energy from foreign sources, with a new focus on natural gas. In February 2012, ARPA-E issued a funding solicitation for novel and low-cost natural gas compression and storage technologies, which, if successful, would enable widespread adoption of natural gas fueled vehicles.

In FY 2013, ARPA-E is prioritizing research on Transportation Systems, which includes research on new ways to produce liquid transportation fuels and other transportation-related energy sources domestically and new approaches to use them efficiently in vehicles. ARPA-E aims to create a diverse portfolio of technological options that would reduce our dependence on imports of energy from foreign sources, and instead promote the efficient use of domestic sources of energy for transportation. This focus may include another round of funding in the Electrofuels program, taking a new look at transformational biofuels approaches, and investing in innovative approaches to natural gas conversion and/or compression/storage for transportation systems. ARPA-E plans to also further explore game-changing battery technologies for plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs).

ARPA-E is interested in investing in the research of sustainable and market-competitive transportation fuels using domestic resources such as natural gas or a combination of carbon dioxide and hydrogen. ARPA-E will explore unique approaches for the conversion of natural gas into energy-dense, infrastructure-compatible liquid fuels for transportation. ARPA-E is also interested in supporting the exploration of methane conversion protocols, including biological routes through methanotrophic systems, to convert natural gas to gasoline and diesel cleanly and efficiently.

In general, ARPA-E approaches energy research from a technology agnostic and market oriented stand point, within the structure of its statutory mission. ARPA-E seeks to invest in technologies that will ensure continued American security and prosperity, as well as ultimately succeeding without subsidies in the competitive marketplace.

TERMINATING PROJECTS

Subcommittee. Doctor, in February you reported that you had terminated six projects for nonperformance, returning almost $4 million to the Treasury. We're fully supportive of efforts to increase accountability for the use of taxpayer dollars. Could you give the subcommittee a bit more information about why these projects were terminated, and how you came to this decision?

Dr. Majumdar. ARPA-E supports research that "swings for the fences" – ARPA-E awardees are competitively selected to conduct challenging research based on aggressive milestones/deliverables ("milestones") that are negotiated and mutually agreed upon by both ARPA-E and the awardee. By their very nature, these aggressive research milestones will often not "pan out" despite the best efforts of recipients. ARPA-E actively manages these research efforts by requiring quarterly progress reports, and conducting regular site visits.

As of April 26, 2012, eight ARPA-E awards have been discontinued by mutual agreement for inability to meet milestones, and one award was discontinued due to apparent fraud by the performer. Each recipient of the eight awards discontinued by mutual consent was provided formal notice of the unmet milestone(s) and opportunity to correct the situation in hopes the research would get "back on track." If not, a notice of intent to suspend the research award is sent to the recipient. In the end, ARPA-E and the eight recipients reached amicable determinations to discontinue the research projects, and focus efforts elsewhere on more promising initiatives.

Each awardee was specifically informed by ARPA-E that "ARPA-E recognizes and appreciates the effort that the team at [awardee] made to demonstrate [specific technical target] … in this high-risk, high-reward ARPA-E project. ARPA-E welcomes the participation of [awardee] on future projects related to disruptive energy technologies."

ARPA-E continues to rigorously monitor current recipients' performance and will discontinue awards that are not meeting milestones.

The eight projects discontinued by mutual agreement for inability to meet milestones as of April 26, 2012, and relevant information follow:

Performer Name	Project Title	Discontinuation Date	Amount De-Obligated
Material Methods	Phononic Heat Pump	21-Sep-11	$198,837
NanOasis Technologies, Inc	Carbon Nanotube Membrane Elements for Energy Efficient and Low Cost Reverse Osmosis	14-Oct-11	$290,900
Inorganic Specialists	Silicon Coated Nanofiber Paper as a Lithium-Ion Anode	3-Nov-11	$358,529
Nalco Company	Energy Efficient Capture of CO_2 from Coal Flue Gas	12-Oct-10	$500,000
Iowa State University	A Genetically Tractable Microalgal Platform for Advanced Biofuel Production	10-Nov-11	$1,906,272
United Technologies Research Center	CO_2 Capture with Enzyme Synthetic Analogue	9-Jan-12	$403,898
United Technologies Research Center	Water-Based HVAC System	16-Mar-12	$1,415,795
Planar Energy	Solid State Lithium Battery: Solid State All Inorganic Rechargeable	26-Apr-12	$1,456,177

	Lithium Batteries		
Total			$6,530,408

Subcommittee. What percentage of projects do you project terminating?

Dr. Majumdar. ARPA-E does not project a specific success or failure rate for its projects. ARPA-E recognizes that by its very nature, investing in high-impact, transformational, and disruptive energy research projects necessitates that some projects will fail to meet the highly aggressive technical milestones laid out for them. Every ARPA-E project has a "go/no go" technical milestone that is usually within the second year of the project. ARPA-E provides project teams with timely feedback and support through its active program management structure to ensure they are given the best chance of success possible. On a program-specific level in practice, the percentage of projects terminated varies by program and will slowly increase over time as the individual projects within each program succeed or fail to meet their milestones. For example, 6 of the 37 projects originally awarded under ARPA-E's first FOA, the 2009 Broad Funding Announcement (e.g. the 2009 Open FOA) have been discontinued as of April 9, 2012, equating to a termination rate of approximately 16% for that group of projects thus far.

Subcommittee. How has this practice affected prospective applicants to your program? Has it scared any off?

Dr. Majumdar. To the contrary, it has been ARPA-E's experience that combining active program management with clearly defined quantitative technical milestones engages and inspires research teams. They realize that eventual success in the competitive marketplace will be made possible and/or greatly accelerated by meeting the aggressive technical milestones identified by ARPA-E, since the milestones themselves were transparently determined with the eventual commercial market in mind. If successful, when the project teams push themselves to meet ARPA-E's milestones, they are in fact laying their own groundwork for later success. The research teams also know that even if, for whatever reason, they fail to meet their technical milestones and the project is discontinued by mutual

agreement, the technology may still have value because the research may produce unforeseen results that could provide new opportunities to learn and then innovate again using a different approach.

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 see extending ARPA-E's success in attracting top talent to the loan guarantee program, and to other applied research offices in the Department of Energy?

Dr. Majumdar. Thank you for your kind words regarding the caliber of talent that ARPA-E has recruited. 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.

ARPA-E has used its special hiring authority to quickly hire scientific, engineering, and professional personnel pursuant to its statute. This special hiring authority is a valuable mechanism for quickly hiring the best applicants. By statute, ARPA-E Program Directors may serve a three year term appointment, subject to renewal. ARPA-E Program Directors 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 office within the Department has a different mission and goals and will have to determine what hiring practices best suit its own needs and statutory authorities.

CRITICAL MATERIALS COLLABORATION

Subcommittee. Dr. Majumdar, in FY 2011, ARPA-E announced a funding opportunity for Rare Earth Alternatives in Critical Technologies (REACT), focusing on electric vehicle motors and wind generators. The FY 2013 budget request would continue to fund similar research through EERE's Vehicles Technologies program, Wind Energy program, and Critical Materials Hub. How have ARPA-E's efforts informed these investments, and how will ARPA-E complement this ongoing research?

Generally, how does ARPA-E coordinate with the other programs to avoid duplication of effort and to communicate findings? Is this coordination documented?

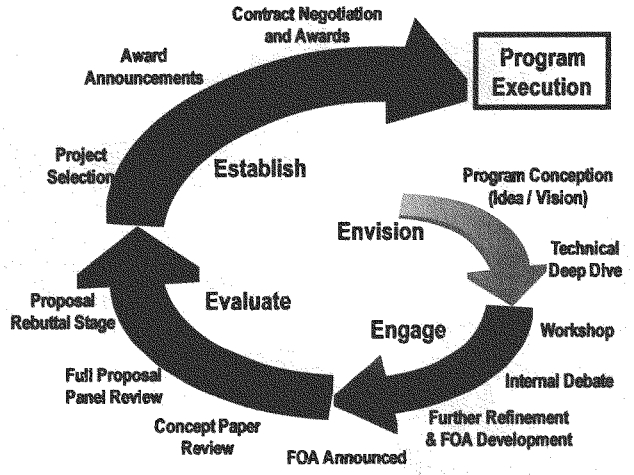
Dr. Majumdar. Across the Department, we share the goal of ensuring DOE uses resources effectively to address critical materials challenges. That's one of the reasons DOE developed its first and second-ever Critical Materials Strategy in 2010 and 2011. Over the past two years, DOE has convened cross-departmental discussions on critical materials research priorities in order to ensure programs are strategically conceived and executed. The multiple offices are supporting complementary work.

ARPA-E invests in research that translates science into quantum leaps in energy technology which create entirely new learning curves that have the potential to be both transformative and disruptive in the future because of lower cost, higher performance, or new energy services, or a combination of these compared to today's technologies. On the other hand, EERE focuses its research, development, and demonstration (RD&D) on technologies that follow existing learning curves by enabling the technology to be de-risked, manufactured and adopted by the private sector. Thus, ARPA-E and EERE are complementary to each other. Furthermore, the research needed in ARPA-E and EERE are based on science, and hence the Office of Science provides the foundational knowledge as an enabler.

ARPA-E is supporting highly transformative, innovative projects to research alternatives to critical materials. EERE focuses its work on using resources more efficiently and effectively, particularly for specific technologies supported by the Vehicle Technologies Program and the Wind & Hydropower Technologies Program. The Office of Science supports basic research activities on the fundamental properties of materials relevant to

energy systems, primarily through its Basic Energy Sciences program. For DOE's 2011 Critical Materials Strategy, the Department developed an R&D plan that integrated the complementary work of the multiple DOE offices and identified potential gaps that may be opportunities for future investment. Incorporating the input across several offices has made the research agenda much more comprehensive than it would be if it were housed in a single office.

In general across programs and technology areas, ARPA-E has 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 report which recommended that it be instituted Department-wide.



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.

Before announcing a new program, ARPA-E undertakes a comprehensive process to identify a technology "white space" that is not likely being addressed by the private sector or other Federal Agencies. ARPA-E technical staff begin by reviewing the scientific literature to identify potential program areas. Next, ARPA-E technical staff examine the current state of the art, the main players in this space, and the major technology challenges. If ARPA-E concludes that a technology white space exists, ARPA-E technical staff organize a workshop, bringing in relevant players from industry, academia, and government to further refine the concept for a potential program. If the workshop is successful, ARPA-E may issue a funding solicitation containing market-based cost and performance metrics that, if achieved, would displace the prevailing technology.

Subcommittee. How do you compare the effectiveness of informal collaboration throughout the formulation of the budget with the more structured collaboration of the SunShot initiative, for example?

Dr. Majumdar. It is difficult to compare the effectiveness of informal and formal collaboration since they are both required for success. Formal collaborations, such as the intra- and inter-departmental budget formulation process, ensure that all relevant stakeholders are taken into account and that decisions are reached only after careful reflection and examination of alternatives has been completed. On the other hand, informal collaboration, such as an ad hoc working group, a "brown bag lunch," or an informal conversation allows for the free flow of knowledge and ideas, where appropriate. Informal collaboration allows for insights and opinions to be rapidly shared, minimizing wasted efforts due to organizational silos. ARPA-E would likely classify the SunShot Initiative as a hybrid of the two approaches. Insights and potential new programmatic approaches may be rapidly shared and considered informally, and then be agreed to through a formal collaborative process that ensures all stakeholders are considered and have buy-in to the final decision.

SBIR/STTR

Subcommittee. ARPA-E intends to administer its SBIR/STTR funding independent of the rest of the Department, promising administrative innovations that will improve efficiency. SBIR/STTR is an authorized program. Does ARPA-E have separate authorization to run its own program?

Dr. Majumdar. To promote competitive free enterprise and the national economy, Section 9 of the Small Business Act (15 U.S.C. § 638) requires each Federal agency to create an SBIR program if its annual extramural research and development (R&D) budget exceeds $100 million and an STTR program if its annual extramural R&D budget exceeds $1 billion. The Small Business Administration (SBA) has issued an SBIR Policy Directive (67 Fed. Reg. 60071 (Sept. 24, 2002)) and an STTR Policy Directive (70 Fed. Reg. 74925 (Dec. 16, 2005)) to provide general guidance on the conduct of SBIR/STTR programs. These policy directives provide each Federal agency with significant latitude to design and implement a SBIR/STTR program in a manner best suited to its particular circumstances.

Nothing in the Small Business Act or SBA policy directives requires a single, agency-wide SBIR/STTR program. For example, the Department of Commerce (DOC) and Department of Health and Human Services (HHS) both allow sub-agencies to establish independent SBIR/STTR programs.

- Within DOC, the National Institute of Standards & Technology and National Oceanic & Atmospheric Administration have independent SBIR/STTR programs.

- Within HHS, the National Institutes of Health, the Centers for Disease Control, the Food & Drug Administration, the Agency for Healthcare Research and Quality, and the National Cancer Institute have independent SBIR/STTR programs.

The ARPA-E SBIR/STTR program will employ the "review, contracting, funding, and organizational reforms implemented successfully" by ARPA-E that the President's Council of Advisors on Science and Technology recommended "extending to all DOE energy programs."[4] For example,

[4] President's Council of Advisors on Science and Technology, "Accelerating the Pace of Change in Energy Technologies through an Integrated Federal Energy Policy" at viii (Nov. 2010).

ARPA-E will use its user-friendly online application portal, ARPA-E eXCHANGE, to receive and evaluate proposals. In addition, ARPA-E will use a three-stage application process (concept paper, full application, and reply to reviewer comments) to solicit a wider range of proposals, facilitate the identification of the most promising technologies, and allow applicants to rebut reviewer critiques. Finally, ARPA-E intends to reduce the average contracting period (from selection to award) to two months.

Subcommittee. Are these administrative improvements uniquely applicable to ARPA-E's mission, or could they benefit the rest of the Department, as well?

Dr. Majumdar. Some administrative improvements, such as the use of eXCHANGE, can and are benefiting other offices within the Department. Other administrative improvements, such as combining multiple SBIR/STTR phases into a single application, are presently unique to ARPA-E within the Department. However, testing some of these improvements on a scale like ARPA-E's SBIR/STTR program is an important intermediate step before other parts of the Department may choose to implement these changes with confidence.

Subcommittee. Are there any reasons, besides efficiency, that ARPA-E should administer its own program?

Dr. Majumdar. In addition to the reasons already outlined above, allowing ARPA-E to administer its own SBIR/STTR program enables it to craft programs that carry forward its own unique mission within the Department. Applicants to ARPA-E's SBIR/STTR program must do more than fulfill the relevant applicant eligibility requirements and have a proposed project that fits somewhere within the broad fields of study encompassed by the Department. Like all of its research programs, ARPA-E's SBIR/STTR program judges the projects through a merit-based review process and requires that projects be potentially transformative and disruptive to the energy market.

ARPA-E is also able to tailor its SBIR/STTR program to ensure it is complementary but not duplicative of research funded through ARPA-E's other programs, other program offices within the Department, etc. For instance, ARPA-E's first SBIR/STTR FOA, issued on April 11, 2012, focuses on innovative energy storage technologies in two aspects of the

stationary and three aspects of the transportation sectors. The FOA provides several specific examples of how research projects may be able to use recent technological discoveries or market developments to further build on ARPA-E's previously funded research.[5]

[5] See ARPA-E Funding Opportunity Announcement DE-FOA-000674: Energy Storage SBIR/STTR Funding Opportunity Announcement (FOA), Modified Version 1, § I.D and I.E (Program Background and Program Objectives), available at https://arpa-e-foa.energy.gov/#aaf3ea13-4fac-48b1-8bde-97893ca77ca6.

PLANNED FOAS

Subcommittee. The budget justification says that ARPA-E would issue 10 funding opportunity announcements in FY 2013 with $350 million. If ARPA-E were appropriated less than $350 million, would you reduce the number of FOAs or would you just reduce the size of each grant? Are there any discrete funding components within ARPA-E?

Dr. Majumdar. If less than $350 million were appropriated, ARPA-E would likely decrease the numbers FOAs issued in FY 2013 as compared to if $350 million were appropriated. Each ARPA-E program is generally worth about $30 million, and has anywhere from 10-15 projects. All our programs and projects are funded with very minimal mortgage, i.e. the funds for the projects are generally obligated upfront.

ARPA-E has no discrete funding components beyond Program Direction and SBIR/STTR.

ARPA-E'S WHITE SPACES

Subcommittee. ARPA-E has been described as covering unique "white spaces" in energy science and technology that neither industry nor other government programs are willing to undertake alone, and accelerating advances to the marketplace as quickly as possible. This is essentially what it was instructed to do by the COMPETES Act. Yet, there is some disagreement and confusion about how ARPA-E overlaps with, or builds upon, previous private or government efforts, and how it attracts follow-on funding. Some contend that any overlap is inappropriate as it "crowds out" private investment or duplicates other programs, and that efforts to attract follow-on investment are similarly inappropriate. Yet, it would be difficult, and possibly unwise, for ARPA-E to only fund ideas that have not had any other public or private interest, especially later-stage research that is typically built on previous work. And many technological advances would go unnoticed were ARPA-E and its performers not active in promoting them.

Does ARPA-E duplicate the efforts of other programs and "crowd out" private investment? If not, how? How are these "white spaces" identified?

Dr. Majumdar. Congress instructed ARPA-E to accelerate "transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty." In accordance with its statutory mandate, ARPA-E makes investments in transformational and disruptive energy technologies that private investors are not likely to fund at their present stage of development.

ARPA-E hires Program Directors who, by virtue of their scientific expertise and business backgrounds, are able to make sophisticated judgments about the types of research projects that are appropriate for ARPA-E to fund. ARPA-E Program Directors meet regularly with companies to get a sense of their appetite for risk and the types of projects they are funding and not funding. ARPA-E follows a practice of "constructive confrontation" throughout its program design and project selection process. Constructive confrontation involves vigorous internal debate and review of programmatic decision by the ARPA-E Director, Deputy Directors, and Program Directors.

Before announcing a new program, ARPA-E undertakes a comprehensive process to identify a technology "white space" that is not likely being

addressed by the private sector or other Federal Agencies. ARPA-E technical staff begin by reviewing the scientific literature to identify potential program areas. Next, ARPA-E technical staff examine the current state of the art, the main players in this space, and the major technology challenges. If ARPA-E concludes that a technology white space exists, ARPA-E technical staff organize a workshop, bringing in relevant players from industry, academia, and government to further refine the concept for a potential program. If the workshop is successful, ARPA-E may issue a funding solicitation containing market-based cost and performance metrics that, if achieved, would displace the prevailing technology.

Applicants are required to disclose in their applications whether they submitted the same or similar concepts to ARPA-E, other Federal agencies, or private investors. In addition, applicants are required to disclose prior and current sources of funding for the proposed research project and related work. Finally, applicants are required to provide a detailed explanation for lack of support from existing sources of funding. For example, large businesses are required to explain why the proposed project is not being sponsored internally.

During the merit review process, ARPA-E utilizes expert reviewers from industry, academia, and government to rate and provide comments on applications. These reviewers help ARPA-E to avoid any with projects funded by other Federal agencies and private investors.

Upon the execution of the funding agreement, ARPA-E invites industry representatives to participate in its meetings with recipients. These meetings enable a free exchange of ideas and encourage collaboration with potential commercialization partners.

ARPA-E recipients are required to disclose in their quarterly performance reports any new funding received from public or private sources. This ensures transparency and enables ARPA-E to make appropriate funding determinations.

Subcommittee. Should ARPA-E only fund either ideas or people that have not had any previous private sector or government investment?

Dr. Majumdar. ARPA-E supports its statutory mission to accelerate "transformational technological advances in areas that industry by itself is

not likely to undertake because of technical and financial uncertainty." ARPA-E is careful to not fund any specific and discrete technical idea that had previously received money from industry. To be clear though, some ARPA-E performers have received funding from public or private sector sources for research projects that are distinctly different from their ARPA-E project. ARPA-E sets market-based cost and performance metrics in technology areas that if met would displace the prevailing technology. ARPA-E is technology agnostic and selects among competing new technologies based upon their potential to meet our cost and performance metrics. ARPA-E seeks to create competition between performers.

Subcommittee. Should ARPA-E encourage or discourage follow-on investment in the successful projects it sponsors, or should it just be passive and hope that someone with money and motivation notices?

Dr. Majumdar. ARPA-E is always pleased when research projects it has funded succeed in securing follow-on funding and eventual success in the commercial marketplace. However, ARPA-E believes this is a result of the technical progress made by the recipient. ARPA-E provides aggressive market-based cost and performance metrics, dependable project funding, active program management, and technology-to-market assistance - such as the Technology Showcase at the annual ARPA-E Energy Innovation Summit.

However, ARPA-E does not pick winners or losers; rather, ARPA-E creates the competition. It 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.

ARPA-E does not judge success simply based upon private sector follow-on-funding. For example, ARPA-E has developed 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.

LOAN GUARANTEE PROGRAMS

FIRST SOLAR OVER-EXPOSURE

Subcommittee. Mr. Frantz, how many of your projects have First Solar involved, either as the supplier of solar panels or as the operator?

Altogether, I'm aware of nearly $3 billion in guarantees which rely upon First Solar. In addition, this company apparently receives significant support for the Export-Import Bank and numerous state support programs. However, according to its latest earning statements, 2011 was not kind to First Solar. While net sales were up slightly, operating expenses increased nearly 200 percent from 2009. Do you have any concerns about the financial health of the company?

Mr. Frantz. It is not appropriate for the Department to comment on the financial health of First Solar. The Department issued loan guarantees to three projects for which First Solar, as the original developer, was the loan guarantee applicant. As planned, however, First Solar has sold its entire equity stake in each of those projects. First Solar is the Engineering, Procurement and Construction Contractor (including the supplier of solar panels) and Operations & Maintenance Provider to the (1) Desert Sunlight, (2) Agua Caliente and (3) Antelope Valley Solar Ranch 1 projects, which are owned by (1) NextEra Energy and GE Energy Financial Services, (2) NRG Energy and MidAmerican Energy Holdings Company, and (3) Exelon Corporation, respectively.

Subcommittee. Do you think it wise investment strategy to be investing so much on one company, and a company which relies upon government policy, at that?

Mr. Frantz. We evaluate each project on its merits, while also taking into consideration other factors, including diversification of risk and the ability of a particular project participant to manage its entire portfolio of projects, not just those within the program. The Department has issued loan guarantees to three separate projects that were initially developed by First Solar, but are each separately owned. First Solar has no ownership interest in the projects, but is the EPC contractor and O&M contractor to each of them. As one of the largest solar developers in the world, First Solar is well qualified to fulfill its obligations under its contractual arrangements with

each of the projects. Moreover, if an EPC or O&M contractor were unable to perform its contractual responsibilities, project sponsors generally have contractual rights to replace the contractor.

Mr. Ahearn stated in his testimony on May 16th that without the benefit of the program his company "would not have been able to enter the U.S. utility market with these projects." Whether or not that is properly characterized as "reliance on government policy", it appears that the program was serving its intended purpose, by facilitating the development of clean energy projects that otherwise may not have been built.

Subcommittee. Have you done any sort of analysis to evaluate how changes in government policy would affect the health of First Solar, and what the secondary effects to your portfolio might be?

Mr. Frantz. It would be extremely difficult to conduct such an analysis without greater specificity as to the nature of the potential change in policy. As part of our regular portfolio monitoring, however, we follow each of the major parties in our transactions, as well as reviewing market, legal, regulatory and policy factors, technology risk, and financial stability. Our loan guarantee contracts includes a variety of protections that may be invoked in the event one of the parties to a transaction is adversely affected by changes in any of these areas. In particular, in the case of EPC contractors and O&M providers, in certain circumstances, DOE generally would have the right to require that the contractor be replaced by another party that does not have the same constraints.

NUCLEAR LOAN GUARANTEES POST FUKUSHIMA

Subcommittee. Mr. Frantz, your program has $18.5 billion for nuclear loan guarantees. One year ago, your program had offered one conditional commitment, for the Vogtle Plant in Georgia. That plant now has been approved by the NRC and is moving forward on construction. Would you give us an update on the status of the nuclear loan portfolio?

How many nuclear generation projects, and for how much, are likely to receive term sheets by the end of fiscal year 2012?

Mr. Frantz. To date, the Department has issued a total of up to $8.3 billion in conditional commitments (to three separate project sponsors) to support the Vogtle nuclear power project. DOE is working with various additional applicants whose submissions are in various stages of review. However, the timing of approval 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 project will be ready to move forward.

Subcommittee. How quickly would this additional $11 billion in 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. Frantz. The timing of approval 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 project will be ready to move forward. Conditional commitment approvals are made by the Department's Credit Review Board. At this juncture there are no projects at a level of maturity that would cause the LPO to seek Credit Review Board approval.

Subcommittee. In your opinion, what are the major factors impacting the viability of these loans, are there factors that are primary drivers, for example whether the plant is in a regulated or unregulated market?

Mr. Frantz. Significant issues, which may include legal, financial, environmental, and technical considerations, NRC plant licensing approval, electricity market dynamics, and a readiness to proceed, need to be resolved

on the various pending applications in order for the LPO to move forward in its due diligence review process.

ALLISON REPORT – FILL MANAGEMENT POSITIONS

Subcommittee. Mr. Frantz, the Allison report found that your program had several key management positions left unfilled, including the slot you currently hold as the Acting Executive Director, and the Director of Credit.

What obstacles have you had in recruiting the "right" people for these jobs?

Mr. Frantz. We have used our best efforts to recruit qualified federal staff, and spent many months engaging in recruitment, screening, interview, and selection processes. Although we have identified a number of qualified finalists for LPO positions, the applicants ultimately have accepted offers at other financial institutions in the private sector or in other federal government agencies. We will continue to search for the "right" people to fill the vacancies.

An additional factor affecting our ability to attract qualified candidates is uncertainty about the future of the program.

As a federal executive agency governed by Title V of the U.S. Code, Government Organization and Employees, LPO adheres to OPM and DOE personnel regulations that require competitive public postings for all federal vacancies. As a new organization, LPO recruitments have required significant advance work to create new federal positions in the specialized job series – for investment officers and loan specialists with corporate and project finance qualifications – which were not previously available at DOE. Combined with the timeframe required for OPM announcements, LPO recruitment actions have typically taken six to eight months. LPO continues working with the DOE Human Capital Office to determine ways to streamline the federal recruitment process to improve federal hiring for the critical skills it requires. These positions will be posted on USAJobs consistent will federal hiring requirements.

Subcommittee. What effect do you think having the positions unfilled is having on your organization?

Mr. Frantz. The impact on LPO of delays in federal hiring for new employees with required specialties translates into certain senior managers fulfilling dual roles for extended periods of time. In addition, contractors

and consultants continue to perform routine work and manage on-going assignments supporting federal staff, where possible and appropriate. . LPO must maintain a reliable, responsive workforce to perform the range of its financial, credit, technical, portfolio, management, and legal functions and meet statutory and regulatory requirements. In order to ensure this, LPO relies more heavily on contractors and consultants than might be preferable.

Subcommittee. What are you doing to fix this situation?

Mr. Frantz. LPO has made presentations to the DOE Human Capital Officer describing its needs and is in daily communication to accelerate personnel actions. After nearly six months of processing recruitments, LPO is soon bringing on board eight new staff for the Portfolio Management Division (LP-50). Regretfully, some attrition has simultaneously occurred, and there have also been positions advertised that have yielded no qualified candidates. An example of this is the recruitment for the Director of the Credit Division (which has been reconstituted as the Risk Management Division). The reason for the lack of qualified candidates is that the market for the expertise that LPO requires is highly competitive.

ALLISON REPORT – LONG TERM FUNDING FOR MANAGEMENT AND OVERSIGHT AFTER ORIGINATION

Subcommittee. Mr. Frantz, your loan terms extend to 30 years from origination, which means that as long as the U.S. government owns these guarantees, we must provide adequate oversight and management of them. However, your ability to collect fees to cover management costs will drop as you no longer originate new loan guarantees.

What is your 30-year cost profile for your team?

Mr. Frantz. LPO has a two-stage cost profile. In the near term, the Program continues to increase its portfolio management and oversight efforts as it resumes underwriting activities to invest remaining authorities across nuclear, advanced fossil, and renewable energy projects. The current funding level is adequate for the Program to meet its obligations.

In the long term, origination costs will gradually decline as such activities decrease. Oversight and management costs for outstanding loans will be more steady, as portfolio projects pass from their construction and start-up phases to steady operations and loan repayment. However, most functions will still be necessary, even if all originating functions cease. The Programs will attempt to manage costs as conservatively as possible.

Subcommittee. If you receive no additional loan guarantee authority or subsidy, when do you expect your ability to cover costs with collected fees to run out?

Mr. Frantz. Actual administrative cost needs over the long term will depend on several variables, including the overall portfolio, risks, and management and oversight needs. Likewise, actual fee collections will depend on originated deals over the next several years. The Department anticipates that existing authorities will be sufficient to cover administrative expenses for the next several years. However, future deal closings are not timed to optimize a consistent flow of fees for off-setting administrative expenses in any given year making it difficult to predict if and when the program may or may not fully offset administrative expenses.

Subcommittee. What other options do you see for managing these guarantees besides a staff at the Department of Energy? Can the government sell these to the private sector as the technologies become more proven?

Mr. Frantz. It may be possible in the future that these projects could graduate to private sector financing, particularly for proven projects. However, an overall strategy of asset sales or other means of moving to fully private credit may not be feasible in all cases, at least in the near term.

ALLISON REPORT – POLICY GOALS VS FINANCIAL GOALS

Subcommittee. Mr. Frantz, one of the conclusions of the Allison report was that your office should better define the desired balance between policy and financial goals. However, the report itself does not fully flesh out this conclusion. It would seem to me to be problematic if your financial objectives were being manipulated by policy considerations – that's precise the sort of manipulation of the program that some have feared. What is your understanding of this recommendation, and what are you doing to implement it?

Mr. Frantz. When evaluating the eligibility and strength of an application, policy (not political) considerations are paramount to ensure compliance with the statutory requirements of the Title XVII and ATVM programs. In addition, protecting taxpayer interests and ensuring a reasonable prospect of repayment is a primary concern in our underwriting processes. DOE constantly strives to improve the efficiency and effectiveness of its underwriting and monitoring processes. While policy considerations are taken into account, they are done so in a way that does not interfere with the overriding objective to ensure a reasonable prospect of repayment.

Clearer goals have been established at the division level and assist senior management in driving those elements of the process that DOE can control. While known policy directives are shared with division managers and incorporated into everyday processes, certain policy matters may arise later in the underwriting process or after a transaction has closed. In those cases, senior LPO management will interact with senior DOE management to resolve any matters where policy concerns impact the underwriting or monitoring of a transaction. Those decisions are then communicated to the deal teams and incorporated in the structuring and monitoring of each transaction.

ALLISON REPORT – DEVELOPMENT OF AN EARLY WARNING SYSTEM

Subcommittee. Mr. Frantz, the Allison report recommended that you develop an early warning system based upon a Management Information Reporting System. What is the status of the early warning system, and is it built on a comprehensive information system?

Mr. Frantz. An early warning system includes a series of activities that are designed to provide early warning of distress in a project company that has an outstanding loan or loan guarantee. To that end, the LPO/DOE has developed processes that allow for continuous monitoring of the financial capacity and performance of each project company during and after the construction period. These include:

- Monthly review of project company capacity, including: i) receipt and review of construction progress reports, which are reviewed by both the independent engineer and an in-house engineer assigned to the project; ii) review of conditions precedent to funding to ensure compliance (these include financial, technical, and legal requirements); iii) review of changes in the ability of counterparties to perform contractual obligations to the project company; and iv) market factors that could potentially impact project economics.

- In addition to these frequent reviews, the LPO/DOE performs quarterly reviews of each individual project company, which entail a comprehensive review of the risk factors analyzed at origination with the objective of assessing the internal rating assigned to the company. When a project company reaches project completion, the reviews become semi-annual unless there are issues that warrant continued quarterly reviews.

- When a determination is made that there has been a material adverse change in one or more of the internal or external factors that affect project performance, the project is placed on the Watch List, which triggers weekly updates, at a minimum. As a matter of practice, if warranted, calls with project company management and/or sponsors can be daily.

Tools currently in use by the LPO/DOE includes a monitoring system that serves as a work flow, information management, covenant tracking, and contact management system. In addition, LPO produces Quarterly Reports for individual project companies and Monthly Portfolio Reports. Annual Portfolio Reports are also planned. Although this system is robust, in order to ensure that we are using best practices, the Department is currently seeking to identify existing reporting systems in use by the Federal government and private sector institutions engaged in similar activity as the LPO. That process commenced in June and is expected to conclude by the end of the fiscal year.

Subcommittee. How would you rate the health of your current portfolio? What is this based upon, if you don't have a comprehensive early warning system set up?

Mr. Frantz. In keeping with the LPO's mandate to support the commercialization of innovative technologies in both the renewable energy and automotive space, the portfolio, on average, exhibits risk that is reflective of the relatively higher technology risk. As indicated above, an early warning system is not one thing but several activities designed to warn an institution of emerging issues as well as policies that allow the institution to respond appropriately to protect stakeholders. Loans and loan guarantees supported by DOE are structured with triggers and LPO has processes and procedures designed to include activities for the identification of emerging issues and appropriate response.

Subcommittee. Is there a class of loans that are more at risk than others?

Mr. Frantz. For every financial institution, loans with limited exposure to market risk are generally less risky. The implication for DOE's portfolio is that loans without off-take arrangements with credit-worthy parties are more at risk due to the additional exposure to price and volume risk.

LACK OF CENTRALIZED REPORTING AND DATA COLLECTION

Subcommittee. Mr. Frantz, the GAO has taken your program to task on several occasions now finding your data management system to be totally inadequate. One of their recent recommendations, from their March report, is that your office commit to a timetable to implement a consolidated data management system to track applications and project performance. The Department disagreed with this recommendation, yet it seems very close to a key recommendation of the Allison report – to develop a Management Information Reporting System. Do you disagree with that recommendation as well?

There are now two significant outside review groups strongly recommending that you implement a centralized reporting system. What are you doing to implement these recommendations?

Mr. Frantz. We disagree with the statement that there are two significant outside reviews recommending implementation of a centralized reporting system. An MIS is not a "centralized reporting system", and the GAO recommended a consolidated tracker of project applications across solicitations. We interpret these as two very different recommendations. While LPO agrees with Mr. Allison, and had previously set up a records management system that will form a platform for the MIS, it should be noted that the GAO's recommendation relates principally to the application review process. The GAO itself acknowledged that it "did not evaluate the quality of the LGP's analyses", meaning that GAO's findings do not purport to assess the merits or creditworthiness of any DOE loan guarantees.

The Loan Programs LPO has a robust technological platform, including state of the art records management, business process, and management information solutions. We constantly strive to improve our systems.

The Loan Programs Office is currently implementing and testing an MIS system that provides a loan management framework and reporting framework for use by the LPO staff. Concurrently, we have developed a comprehensive Records Management platform that includes a certified technology backend and the retroactive collection and re-organization of records into the new system (launching this fall).

ABENGOA OVER-EXPOSURE

Subcommittee. Mr. Frantz, you have provided three loan guarantees to Abengoa, totaling nearly $3 billion. This is similar in scale to the guarantees you provided for projects affiliated with First Solar.

Do you think it wise investment strategy to be investing so much on one company?

Mr. Frantz. We evaluate each project on its merits, while also taking into consideration other factors, including diversification of risk and the ability of a particular project participant to manage its entire portfolio of projects, not just those within the program.

Subcommittee. What are you doing to address this over-exposure?

Mr. Frantz. The project financial structures incorporate numerous contractual protections and parent company supports. On an ongoing basis, we look at all matters as they relate to each of the major parties in all of our transactions. These include market, legal, regulatory, and policy factors, in addition to technological risk, and financial stability. In the event one of the parties to a transaction is adversely affected by changes in any of these factors, and this change calls into question their ability to perform in accordance with contracted agreements with our transaction, we have built in remedies to our project lending agreements, which we exercise as applicable.

ARRA SUBSIDY-PAID LOAN GUARANTEE AUTHORITY

Subcommittee. Mr. Frantz, your office ran out of authority to issue new 1705 loan guarantee projects at the end of last fiscal year. However, you still have over $450 million of "emergency" funding that has not yet been obligated. What do you need this funding for?

How many loan guarantees have been modified to date? For how much?

Mr. Frantz. LPO has responded to Borrowers' requests involving potential modifications for five projects. To date there have been no loan guarantee modifications that required the payment of additional credit subsidy per the Federal Credit Reform Act. There have been amendments that were determined by OMB to be modifications; however, these resulted in savings, or a reduction in the expected cost of the loan or loan guarantee.

Subcommittee. If that percentage is consistent within your 1705 program, how much of this $450 million would be needed for loan modifications?

Mr. Frantz. DOE is in the process of developing an analytical approach to determine an appropriate amount, if any, that should remain available for the potential cost of future modifications as defined by the Federal Credit Reform Act.

FOSSIL ENERGY LOAN GUARANTEES

Subcommittee. Mr. Frantz, 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?

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. Frantz. The Department recognizes the importance of advanced fossil projects and has issued a non-binding draft term sheet to one advanced fossil applicant. 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 issues 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. 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. Frantz. As discussed above, the Department has issued a draft term sheet to one application and 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 issues 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. What are the major challenges for this technology sector in finalizing the loans?

Mr. Frantz. The primary delays in finalizing loan guarantees in this sector are the lack of viable carbon sequestration systems provided in applications as well as the lack of viable specificity for the applicants' offtake agreement. Under statute, the Section 1703 program can only support projects that "avoid, reduce, or sequester air pollutants or anthropogenic greenhouse gasses." Absent a viable carbon sequestration system, no fossil project is likely to proceed.

USEC NUCLEAR "FRONT-END" LOAN GUARANTEES

Subcommittee. Mr. Frantz, 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. Frantz. The USEC loan application is currently inactive while USEC resumes a research, development and demonstration program.

Subcommittee. What issues are they trying to resolve in order to improve their chances of receiving a loan guarantee?

Mr. Frantz. As stated by Secretary Chu in his letters responding to questions raised by members in the House and the Senate, the research development and demonstration program would allow USEC to reduce its technical and financial risks by finalizing the American Centrifuge Plant machine designs and by demonstrating the technology and key systems on a larger scale.

USEC acknowledges this work is necessary saying in its own press releases that:

"The RD&D program provides the bridge to commercialization of the American Centrifuge technology. Our plan for the RD&D is to operate a commercial-size cascade and related plant infrastructure, which reduce the remaining technical risks and also enhance our ability to obtain financing for the commercial plant."

The Department of Energy has requested $150 million in the nonproliferation program to pursue security-related enrichment technology. This would be part of a $300 million research and development program, cost-shared between the Department and USEC.

Subcommittee. What relationship would this program have with the loan guarantee process for USEC?

Mr. Frantz. The RD&D Program will be administered by the DOE Office of Nuclear Energy, which oversees the research and development of front-end technologies and is responsible for the Cooperative Research and

Development Agreements between USEC and the national laboratories that funded the development of the centrifuge machine technology. LPO will have no involvement with the RD&D program.

Subcommittee. What assurances can you give this subcommittee that this $300 million R&D program would satisfy the technical problems that the technology is facing?

Mr. Frantz. At this time the LPO cannot provide any assurances with regard to the success of the RD&D program. As indicated by the Department and by USEC, the RD&D program is to gain additional experience on a larger scale to reduce the technical risks of the program. We have to await the results of the completed demonstration program before a determination can be made on the technology.

Subcommittee. If you assume that the R&D program will address all technology readiness issues to move to commercial scale, how will the financial standing of the applicant weigh against the technological factors?

Mr. Frantz. The financial standing of the applicant changes with time. When the demonstration program is completed, the applicant's finances will be reevaluated to understand how the technological factors weigh against the financial condition.

ATVM ORIGINATION

Subcommittee. The ATVM program has not been originating loans lately, and has recently come under some criticism for this. For example, when the CEO of Bright Automotive announced that it would halt operations, he publicly blamed ATVM's reluctance to issue a loan guarantee despite lengthy preparations.

At your current rate, how long will it take to fully commit ATVM's loan authority?

Mr. Frantz. The ability of the program to "finalize" loans is entirely dependent on the quality of applications received, whether new or existing, and the ability of the DOE and an applicant to reach loan terms agreeable to each side. It is the DOE's goal to minimize the risk to the taxpayer and to advance the state of automotive technologies, while balancing its mission of fuel efficiency and ensuring a reasonable prospect of repayment given financial, market, technical and legal risks.

There are many characteristics of a strong application which may help to streamline the commitment and close of a loan. These include, but are not limited to the following:

- Significant equity or other funding sufficient to operate the business and cover all ineligible project expenses, as well as all necessary cash and other reserve accounts;

- Customer agreements in place for the project itself, or similar significant indicator of successful project execution and market acceptance;

- Significant collateral to ensure sufficient protection of the taxpayer in event of a project failure;

- Detailed financial information, including an integrated, dynamic financial model with NPV analysis indicating financial viability and ability to repay the loan as negotiated;

- Detailed project plan with key activities and milestones defined and tied to funding gates to prevent funding loan dollars to inadequately de-risked projects;

- Audited financial statements for past three years to ensure the validity of corporate performance;

- Control over the selected project site, or at the very least, a verified and validated site identified for environmental review;

- PSAT model outputs for vehicle projects or similarly acceptable modeling for component projects validating the proposed fuel efficiency gains outlined in the application; and

- Experienced management team with a proven track record in successfully executing on similar types of projects

Subcommittee. What specific factors are preventing you from exercising the ATVM loan authority promptly, and how does the FY 2013 budget address them?

Mr. Frantz. The ATVM Program takes very seriously its responsibility to ensure that loans are awarded in the most appropriate way to protect the taxpayer's interests, minimizing risk while achieving policy goals. The program has entered into loan agreements with five borrowers and continues to closely monitor those loan transactions, insisting on the completion of milestones and fulfillment of any conditions agreed to by the applicant and DOE.

The ATVM and its staff endeavor to maintain appropriate openness and transparency with all constituents, including the detailed and timely response to inquiries from interested parties across the public and private sectors. The ATVM understands that its work has the ability to effectuate a large economic impact across a broad geographic area of the United States, including areas that have been negatively impacted during the recent economic downturn. Despite a significant increase over time in the volume of outside inquiry into ATVM, the program continues to work independently with a distinct focus on our core competencies relating to the review, analysis, negotiation and structuring of loan transactions.

Early stage companies (which are the vast majority of applicants) face many challenges in their efforts to obtain a DOE loan. From the financial and credit risks inherent in taking on significant senior debt at an early stage in a company's lifecycle, the quality and experience of the management team, to the technical and execution risks in designing, developing and establishing a manufacturing facility, to the market risk of expected penetration and sales volumes, applicants must carefully consider all aspects of their business plan. These are the same risks analyzed by equity investors, who may or may not be identified in the initial application. To that end, equity investors must be identified, ideally prior to the issuance of a Conditional Commitment Letter, as is the practice in the market for commercial loans. ATVM understands that these equity investors are evaluating the high degree of risks these business plans face, and to achieve an equity return hurdle commensurate with such risk, often require a high degree of financial leverage. The statutory maximum leverage is 80% against eligible costs, and ATVM seeks to strike a balance between the equity return needed to attract investors and the appropriate amount of debt that can be supported by the project.

Automotive component suppliers have also had difficulty qualifying for ATVM loans. Although these automotive suppliers are potentially some of the more credit worthy borrowers within the automotive industry, they have found it difficult to provide a direct connection between their components and qualified advanced technology vehicles, a necessary link to establish eligibility and market acceptance.

Subcommittee. I understand that some believe the authority is really only applicable to OEM, or original equipment manufactures, and not to component manufacturers, how much truth is there to this in your view?

Mr. Frantz. The ATVM Loan Program has worked diligently with a number of eligible component manufacturers in an effort to negotiate and close loan transactions. The inability of automotive component suppliers to qualify and receive loans from the ATVM Loan Program results from several factors. Although these automotive suppliers are potentially some of the more credit worthy borrowers within the automotive industry, they have found it difficult to provide a direct connection from their components to qualified advanced technology vehicles, a necessary link to establish eligibility and market acceptance. In addition, when considering the size of potential projects and the difficulty of establishing a nexus to an advanced

technology vehicle for many components, component manufacturers often choose to pursue private funding sources rather than to incur the costs and government oversight for a reduced project scope and loan amount.

CREDIT SUBSIDY MODEL

Subcommittee. Given the experience the program has had to date, is there reason to change the credit subsidy model? If so, what should be changed?

Mr. Frantz. From a calculation perspective, DOE believes the model has withstood the test of time, including numerous audits, oversight inquiries and dozens of potential or closed transactions. The software platform for the model, calculation methodology used, and the output files have functioned well, providing consistent data to support subsidy scoring on a transaction-by-transaction basis. Notwithstanding this solid performance, over the course of the past three years, DOE has identified areas for improvement in calculation methodologies for specific transaction issues. These changes are largely technical as they involve introducing greater precision and automation into the functioning of the credit subsidy model. DOE is currently in the process of working through a series of such technical changes with OMB. DOE feels that these changes, when implemented, will further automate the credit subsidy process and provide for greater accuracy in budget estimates and re-estimates.

With regard to the inputs to the credit subsidy model, DOE has engaged with OMB on several occasions to develop approaches to address transaction specific issues. While the framework for model inputs has proven to be robust, the diversity in applicants and credit structures often require refinements to inputs in order to adequately quantify the credit subsidy cost on a loan-by-loan basis.

Subcommittee. The model is, of course, only as good as the inputs to it. Have you changed the way you reevaluate the inputs to the model?

Mr. Frantz. While it is recognized that the current model's treatment of inputs could be improved, DOE has not changed the way we evaluate inputs to the model.

CURRENT STATE OF PRIVATE CREDIT MARKET

Subcommittee. The loan program was originally authorized in 2005 with the view that private capital markets would be insufficient for large generation projects and the government backing is necessary. The 1705 program was intended to address a perceived contraction in private sector financing after the economic slowdown. Can you give the Subcommittee a summary of the current state of private capital for large energy projects in the US?

Mr. Frantz. It is the Department's analysis that the current availability of private capital for large renewable energy generating projects in the US is somewhat constrained. Anecdotal reports indicate that some transactions are being completed by lenders on a "club" basis but that larger projects may be of too great a size for such clubs. As the financial and banking crisis in Europe has continued, many of the European lenders who previously were major players in energy project finance have reduced or eliminated their lending in this area. Further, the risk criteria imposed by the remaining lenders generally do not allow for the financing of new or innovative technologies and there appears to be resistance to financing the early projects of a new technology. In addition, commercial lenders continue to avoid lending for the long tenors required for many innovative technology projects.

Subcommittee. Does there continue to be a role for the Federal government in your opinion?

Mr. Frantz. There continues to be a role for the Federal government given the reduction in lending by the private sector and the need for long-term financing.

Subcommittee. How do you believe your process differs from the private sector?

Mr. Frantz. While the Loan Programs' processes are similar to those employed by the private sector, our lending criteria are significantly different due to the statutes under which we operate. For example, the program's transaction structuring, credit and underwriting approach is similar to that employed by the private sector. As the Allison Report indicated, our standards are at least as rigorous as those employed by the

private sector and most of the LPO staff have significant private sector experience. Given the program's statutes, it does have the ability to evaluate and conclude transactions with longer terms than those undertaken by the private sector. Further, since it can undertake large loans the program can do transactions that would require the assembly of an excessive number of lending institutions for an individual large transaction.

DEFAULT RATE

Subcommittee. Mr. Frantz, the Subcommittee understands the LGPO underwriting process is used to evaluate the legal, technical, financial, market and environmental attributes of each project and includes a risk analysis supported by financial modeling. This process, we believe if referred to as Internal Risk Rating and is based on, we believe 11 factors, some of which are quite subjective. Can you discuss briefly, the factors, how they are weighted and the process by which you evaluate them?

Mr. Frantz. DOE's loan approval process is unbiased, process driven, and objective. Loan applications determined to be eligible for in depth review undergo many months of due diligence conducted by internal and third-party experts. This in depth review includes thorough market, legal, technical and financial reviews. Specifically, DOE evaluates the technical aspects of an application to make sure the technology is feasible, works to ensure that projects can be built to scale, does extensive market analysis to ensure there is a place in the market for the product, and evaluates the finances of the project to ensure it is commercially viable. Critical to this analysis is the participation of private equity financiers in the transaction. At no time was or is any favoritism shown and DOE takes its responsibility to protect taxpayers very seriously.

DOE considers all project applications that have been submitted in compliance with an open solicitation and uses various criteria to evaluate the applications, including but not limited to:

- Reduction in GHG
- Third-party supply and off-take agreements
- Strong EPC contracts
- Permitting and environmental review
- Clear rights to intellectual property
- Sources of equity, and magnitude of equity investment
- Demonstration/pilot data
- Control over a project site

Former Assistant Secretary of the Treasury Herbert Allison reviewed DOE's Loan Guarantee Program. The report confirms that DOE's overall portfolio of loans is healthy.

The Federal Credit Reform Act defines the cost of these loan programs as the estimated long-term cost to the government, including the risk of default net of recoveries; for each loan, the subsidy estimate can be thought of as similar to a loan loss reserve. Congress appropriated $10 billion in credit subsidy under the Federal Credit Reform Act for Title XVII and the Advanced Vehicle Loan Programs. Not all of the appropriated credit subsidy has been obligated.

While the portfolio includes loans to a range of projects that carry different levels of risk, the report finds that the Department of Energy has reasonably estimated the costs of these risks. In fact, Mr. Allison estimates that the estimated long-term cost of the outstanding portfolio is $2.7 billion, roughly $200 million lower than Department's most recent estimate.

Herb Allison validated the health of the portfolio and noted strong loan management processes and investment underwriting. The report noted that DOE has the ability to reduce or mitigate risk in the portfolio over time and has "robust tools" for protecting itself from elective risk.

QUESTIONS FROM CHAIRMAN FRELINGHUYSEN OF NEW JERSEY

"THE FINANCING FORCE BEHIND AMERICA'S CLEAN ENERGY ECONOMY"

Chairman Frelinghuysen. Mr. Frantz, your website calls the Loan Guarantee Program, "The Financing Force Behind America's Clean Energy Economy." I think that no matter one's views on the proper size of government, we'd all want our economy to be built on private sector investments. Do you consider it to be a proper role for the government to be the financing force behind the clean energy economy? Isn't that something the private sector should be doing?

Mr. Frantz. There is a proper role for the public sector to support innovative clean energy technologies. When the private sector is unwilling to assume the risks to advance an industry that generates public benefits, it is an appropriate role for the government to provide support.

Chairman Frelinghuysen. If so, what did you find, and how are you using these results?

If not, why not? This would seem to be an important part of program management, and a key piece of information in deciding which guarantees to support.

Mr. Frantz. The Department seeks additional guidance and clarification on the specific reference of "what did you find" in order to answer the question responsively.

Chairman Frelinghuysen. Are you aware of the lawsuits that investors are currently bringing against the company saying that the company didn't tell them how much a manufacturing flaw discovered three years ago would hurt its bottom line? How might this impact the projects that have received Department loan guarantees?

Mr. Frantz. The Department seeks additional guidance and clarification on what company the question is referring to in order to answer the question responsively.

ALLISON REPORT – "REASONABLE PROSPECT OF REPAYMENT"

Chairman Frelinghuysen. Mr. Frantz, the Allison report recommended that you better define what a "reasonable prospect of repayment" is for the purposes of your loan portfolio. Obviously, this definition would not only affect your portfolio's risk profile, it will impact how exposed our taxpayers' funding will be to loss.

How is a "reasonable prospect of repayment" defined today? Are you proposing to change that definition? If so, how?

Mr. Frantz. 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 support first goes through a rigorous financial, legal and technical review process – similar to, and in some ways more comprehensive than, what a private sector lender would conduct – before a single dollar of taxpayer money is put to work.

ATVM OUTSTANDING BALANCES

Chairman Frelinghuysen. Mr. Frantz, your ATVM program currently has approximately $4 billion in appropriated dollars available to it. What is your best estimate of total loan authority that could support?

Chrysler has pulled its application from consideration. Ford and Nissan already have loans, totaling just over $7 billion. What is your current application pipeline, and what is your estimate of how much of the $4 billion of subsidy you will have left at the end of fiscal year 2012?

Mr. Frantz. As of July, 2012, the ATVM Loan Program has a total of 12 open document submissions, 10 of which are deemed as Substantially Complete Applications. Of these 10, 8 applicants have not communicated with the program for an extended period of time and are considered inactive, while the remaining six applications are under review.

It should be noted that application submissions are first reviewed for completeness, prior to any due diligence being performed. Once a company has provided all the required information, the application is deemed "Substantially Complete" and the review process can begin. An application becoming Substantially Complete does not necessarily indicate that an applicant's business plan, technology, market strategy or financial position are fully viable, or that they will meet all criteria necessary to obtain a DOE loan.

The ATVM Loan Program continues to be an attractive source of funding for automotive manufacturers of vehicles and components, receiving new applications and indications of interest regularly.

Subcommittee. Then what about fiscal year 2013? How much are you projecting to use by the end of fiscal year 2013?

Mr. Frantz. The ATVM Loan Program continues to be an attractive source of funding for automotive manufacturers of vehicles and components, receiving new applications and indications of interest regularly.

Subcommittee. Given that funding is so constrained, I would think that this would be a reasonable place to find emergency funding to offset other critical national needs. Mr. Frantz, please submit for the record any

information which you believe would help the Committee to identify a threshold past which rescissions would hurt applicants to the ATVM program who have a good chance of receiving support.

Mr. Frantz. While the ATVM Loan Program continues to move forward with applications, accepting new projects for consideration on a rolling basis, it is the DOE's goal to minimize the risk to the taxpayer and to advance the state of automotive technologies, while balancing its mission of fuel efficiency and ensuring repayment with financial, market, technical and legal risks. To the extent that the ATVM program in its independent analysis determines that any or all of the applicants will not achieve loan funding, we are endeavoring to provide feedback.

This being said, the ATVM program feels strongly that the program should be focused on only the most financially secure and technically prepared applicants in order to reduce taxpayer risk and to facilitate the strong market acceptance necessary to ensure repayment of the DOE loan.

GAS PRICES

Chairman Frelinghuysen. Doctor, your mandate is to support innovations which will enhance the economic and energy security of the United States. We're all concerned with the prospect of higher gasoline prices as we enter into the summer. Your program has the flexibility of directing funding to where it can best help the American taxpayer, our economy, and our security. Have you ever done an investment round focused on innovative ways to reduce gasoline prices? This would seem to fit into your long-term goals, which include making progress in the area of sustainable and market-competitive transportation fuels from domestic resources. You have the advantage of being able to invest into demand AND supply-side technologies.

Why not? This would seem to be a promising area for investment. For instance, the United States holds the world's largest supply of shale oil, but there is no efficient way of extracting it yet. Would you consider this to be a viable area for your program to invest in?

Dr. Majumdar. ARPA-E empathizes deeply with the pain felt by American consumers due to the high price of gasoline. In coordination with other program offices within the Department, ARPA-E focuses on long-term, high-impact solutions that reduce consumers' energy bills while ensuring economic growth, national security, and reducing environmental risks. For instance, the research funded by Methane Opportunities for Vehicular Energy (MOVE) will, if successful, create technologies that make it cost-effective for many consumers to switch to natural gas fueled passenger vehicles without subsidies.[6]

MOVE is not the only example of an ARPA-E investment with the potential to decrease consumers' energy prices. One of the first projects that ARPA-E selected, in 2009, was a project involving a new process for converting oil refinery exhaust into valuable fuel products. If successful, this project alone could increase domestic production of gasoline by 46 million gallons per year. Another project that APRA-E funded in 2009 could enable the United States to drill for natural gas in areas previously considered impenetrable. Conventional drill bits penetrate ultra-hard rock formations slowly and wear

[6] See, ARPA-E Funding Opportunity Announcement DE-FOA-000672: Methane Opportunities for Vehicular Energy (MOVE), § C and D (Program Overview and Program Objectives), available at https://arpa-e-foa.energy.gov/#dc1d731e-f2cf-4be9-b6ac-ab315582d000.

down quickly, which makes the drilling process time-consuming and expensive. More economical drilling methods are required to enable access to next-generation energy resources, including natural gas. One of ARPA-E's recipients is developing a unique drilling technology involving the transmission of high-power lasers over long distances via fiber optic cables. This laser power is integrated with a mechanical drilling bit to enable rapid and sustained penetration of hard rock formations too costly to drill with mechanical drilling bits alone. The laser energy that is directed at the rock basically softens the rock, allowing the mechanical bit to more easily remove it. These laser-assisted drill bits have the potential to be up to 10 times more economical than conventional hard-rock drilling technologies, making them an effective way to access domestic energy resources currently locked under hard rock formations. If successful, this innovation combined with technologies resulting from MOVE may decrease consumers' transportation costs.

Several ARPA-E programs beside MOVE are also focused on research to provide American consumers with cost-effective transportation options. Electrofuels, BEEST (Batteries for Electrical Energy Storage in Transportation), REACT (Rare Earth Alternatives in Critical Technologies), PETRO (Plants Engineered To Replace Oil), as well as several projects funded through ARPA-E's broad funding announcement in 2009 are all focused on providing cost-effective alternatives to American consumers.

ARPA-E FUNDING INCREASE

Chairman Frelinghuysen. Dr. Majumdar, this request includes $350 million for ARPA-E, a $75 million increase from last year. I'd count this request in the same "massive increase" category as the Department's ask for energy efficiency and renewable energy, and raise the same question we did to the Secretary: If the President really believes in an "all of the above" energy strategy, why such dramatic increases for ARPA-E and EERE and such drastic cuts to nuclear and fossil?

Dr. Majumdar. DOE believes that advanced energy and energy security concerns are sufficiently compelling that all technologies that could make a significant contribution should be considered. The questions that DOE particularly focuses on in its budget prioritization deliberations include:

- What technologies can make the greatest potential contributions to energy goals? In particular would be the goal to catalyze the timely, material, and efficient transformation of the Nation's energy system and secure U.S. leadership in advanced energy technologies.

- What is the appropriate Federal role, if any, to encourage the development of high priority technologies in a timeframe that is most relevant? It is important to recognize that the level of funding for a technology in a particular year does not necessarily reflect priority. For example, funding for early stage research and development will usually be lower than for technologies in the demonstration stage.

Both nuclear and fossil energy continue to be a high priority in accomplishing the Department's mission of addressing America's energy challenges through transformative science and technology solutions.

The budget request is well-aligned with the Office of Fossil Energy's (FE) priority of developing advanced technologies to ensure reliable, efficient, cost-effective and environmentally sound use of fossil fuels (coal, oil, and natural gas) to meet the United States' energy needs. FE is investing in the key enabling technologies that are on critical paths and that show the highest potential for achieving the program goals and benefits in the timeframe

needed for commercial deployment. The FY13 request for the Office of Nuclear Energy continues to provide a pivotal investment in Small Modular Reactors (SMR) to support design certification and licensing activities, efforts to extend the lifespan of the existing light water reactor nuclear fleet, and options and technologies for disposing of used nuclear fuel.

QUESTIONS FROM MR. NUNNELEE OF MISSISSIPPI

RENEWABLE ENERGY INDUSTRY INVESTMENTS

Mr. Nunnelee. Dr. Majumdar, as you know from visiting my State, substantial investment has been made in renewable energy related industries and in the technologies that are critical to furthering the development and manufacture of related devices and components.

Would you agree that DOE should continue to make prudent investment in those sectors and the enabling technologies that are best positioned to ensure those industries meet the substantial competitive challenges we confront in the global marketplace?

Dr. Majumdar. Yes, I do agree that we should continue to make these investments. DOE focuses on multiple stages of technology development – from basic scientific research that makes technological advances possible to high-risk, high-reward investments in cutting edge technologies to helping scale-up proven technologies to cost-effective production. At each stage we are focused on making American industry more advanced and more competitive in the global marketplace.

Mr. Nunnelee. Aren't most, if not all, of the leading renewable energy sectors such as solar photovoltaics, wind turbines, energy efficient appliances, energy efficient power supplies for information technology infrastructure, as well as electric and hybrid electric vehicles, dependent upon investment in critical technologies, such as silicon carbide power semiconductors, to ensure their competitive advantage in efficiency and energy conversion?

Dr. Majumdar. Yes, all of these technologies – making them more efficient and more cost effective – rely on ongoing investments in specialized materials, industrial processes, and electronics. For example, we are working with a company called 1366 that is developing a new way of manufacturing photovoltaic solar panels that is significantly more efficient in the way that it utilizes expensive pure silicon crystals. The success of this technology will advance efforts to make photovoltaic solar power fully competitive with conventional electricity generation technologies.

Mr. Nunnelee. What are some of the key R&D focus areas that you see as key enablers for improving the efficiency of solar cells, wind turbines, appliances, power supplies, electric and hybrid electric vehicles?

Dr. Majumdar. One of the R&D research areas across the board is work on adapting critical materials that are cheaper and more widely available than those currently used in the technologies you mention. For example, as you know, high-density batteries rely on lithium to store power, but work is ongoing to test and develop other materials and/or alloys that could be used in lieu of substantial amounts of lithium. Likewise, currently wind turbines rely on sophisticated gear boxes to generate electricity. DOE is looking into the feasibility of direct-drive turbines that would potentially require less maintenance that current models; however, direct drive turbines rely on large rare earth mineral magnets. Research in this area is looking at alternative materials for these magnets that could be deployed more cheaply.

Mr. Nunnelee. Where does DOE see the greatest opportunity in terms of R&D investment that may yield the most improvement in energy efficiency for solar inverters, energy efficient power supplies, or for the power electronics components necessary for future electric and hybrid vehicles?

Dr. Majumdar. The technologies you mention above a critical comment element is the use of rare-earth materials. Production of these materials is currently centered in China and global supplies are limited, pushing up the costs. In fiscal year 2012, the Department requested and Congress provided funds for a Critical Materials Hub to focus research and development in this year by bringing together top researchers from multiple institutions to focus on finding substitutes for and improving manufacturing of rare earths and other critical materials to enable continued American technological leadership.

Mr. Nunnelee. In looking at choices for investing federal R&D funding in the current budget environment, how is the Department looking to support innovative technology providers and manufacturers who are already delivering competitive solutions and products into the global markets?

Dr. Majumdar. One of the key ways the Department is supporting technology providers and manufacturers is through demonstration projects that utilize technologies at or near industrial scale to prove cost effectiveness of production and deployment. Off-shore wind and thermal solar zone demonstration projects are examples of this. Our Innovative Manufacturing Initiative works provides support to companies and training centers to defray the risk of trying new and innovative manufacturing processes that use less energy or more efficiently use inputs and therefore lower cost. Finally, the Title XVII Loan Program supported over $16 billion in clean energy loans to companies that deployed innovative renewable technologies at commercial scale – projects that are now generating clean electricity and returning funds to taxpayers.

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