ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2016

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 2016

WEDNESDAY, MARCH 18, 2015.

DEPARTMENT OF ENERGY—ENVIRONMENTAL MANAGEMENT

WITNESSES

DAVID KLAUS, DEPUTY UNDER SECRETARY, MANAGEMENT AND PERFORMANCE, DEPARTMENT OF ENERGY

MARK WHITNEY, ACTING ASSISTANT SECRETARY, ENVIRONMENTAL MANAGEMENT, DEPARTMENT OF ENERGY

Mr. SIMPSON. I would like to call this hearing to order. Good morning, everyone. We are just a few minutes late, but we have before us today David Klaus, the Deputy Under Secretary for Management and Performance, and Mark Whitney, the Acting Assistant Secretary for Environmental Management. This is the first time for both of you to have testified before this subcommittee and we appreciate your being here today.

While the subject of this hearing is the budget request for the Office of Environmental Management, this hearing will also provide members of the subcommittee an opportunity to discuss issues of management and performance on a department-wide basis.

The budget request for the Office of Environmental Management totals $5.8 billion, $63.8 million or 1.1 percent below the fiscal year 2015 inactive level. I do not include in those figures the $472 million requested for the federal contribution into the Uranium Enrichment Decontamination and Decommissioning Fund. The budget request incorrectly counted this contribution as part of the Defense Environmental Cleanup Appropriation, though the Congress directed how to account for these costs in a transparent manner in the fiscal year 2015 act. Continuing to count these funds as part of the funding for the Defense Environmental Cleanup creates confusion and makes the overall funding levels provided en mass to the overall funding levels provided to those sites.

The Department of Energy is facing some very difficult challenges in its cleanup program this year. Transuranic waste programs are essentially running in place or were stopped altogether following the shutdown of the Waste Isolation Pilot Plant. While the department has set ambitious goals to get that facility operating for fiscal year 2016, there are significant hurdles to overcome to meet this timeline. Meanwhile, relations with many of the states are at an all-time low as milestones previously promised will no longer be met.

The path to resolution is unclear and funding will not be available to make up for the department's management and performance failures. Fortunately, there have been modest gains in project management and project management has been a focus area for this Secretary. Nevertheless, whether these efforts will lead to demonstrable improvements in performance is unclear. Of the 29 projects in the $52 billion project portfolio managed by the Office of Environmental Management, nine of those projects, estimated to cost $20.7 billion to complete, are considered in the red and will not be completed within current estimates.

Restoring confidence in the department's ability to deliver on its commitments will be necessary before progress can be made on renegotiating the numerous cleanup agreements that must be modified over the next several years.

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. I also ask members to submit any additional questions for the record to the subcommittee by close of business tomorrow.

With those opening comments, I would like to yield to today's ranking member, Mr. Honda from California.

Mr. HONDA. Thank you, Mr. Chairman. Ranking member Kaptur is unable to be here at the moment so, Mr. Chairman, I ask unanimous consent that her opening statement be entered into the record.

Mr. SIMPSON. Without objection.

Mr. HONDA. Environmental Management has the important job of cleaning up the environmental impacts of over five decades of nuclear weapons development and nuclear energy research and I believe we have some cleanup still to be done in and around Lawrence Livermore National Lab in California. So I look forward to your testimony about your budget proposal and requested plans for 2016 and to our discussion to follow. And before I yield back, I just want to say good seeing you again, David.

Mr. KLAUS. All right, good to see you.

Mr. HONDA. Thank you.

Mr. SIMPSON. Thank you. David, the floor is yours.

Mr. KLAUS. Thank you, Chairman Simpson, Congressman Honda, and members of the subcommittee to come. I appreciate the opportunity to appear before you today to discuss elements of the Department of Energy's fiscal year 2016 budget request and the efforts of the Office of the Under Secretary for Management and Performance.

Since the onset on his tenure, Secretary Moniz has made clear that the department must renew its focus on improving management and performance in order to address the many challenges presented by the department's portfolio. For that reason, in July of 2013 the Secretary implemented a top-level reorganization, a primary aspect of which was the establishment of the Office of Under Secretary for Management and Performance to focus on having the department operate more as an enterprise rather than a collection of silos, which some have previously described the way in which the department operates. The reorganization also aimed to improve

project management and increase the efficiency and effectiveness of mission-support functions across the department.

Consolidating mission-support functions in the Office of the Under Secretary for Management and Performance establishes a senior policy official dedicated to the task of management improvement on a full-time basis. The continuing goal is to institute enterprise-wide solutions to common challenges faced by programs across the complex such as information management, acquisition, and human resources. Specific examples of key management initiatives undertaken by this office since it was established are included in my full statement.

Separately, moving the Office of Environmental Management under the purview of the Under Secretary for Management and Performance brings the department's strongest project management capabilities, resident in the Office of Acquisition and Project Management, directly to bear on the department's most complexing yet vital challenges in project management.

The fiscal year 2016 budget provides $6.4 billion for programs within the Office of the Under Secretary for Management and Performance. Given the subject of this hearing, the balance of my testimony focuses primarily on project management principles and major projects within the Office of Environmental Management. My colleague, Mark Whitney, the Acting Assistant Secretary for Environmental Management, will focus on the specifics of the budget for environmental management.

The portfolio of large projects undertaken by the Department of Energy is not only unique from other projects in the public and private sector, but with few exceptions, each of these projects is unique from other departmental projects. These diverse, one-of-a-kind projects present uncommon challenges. In light of these challenges, the department has struggled with project and contract management with too many projects going over budget and taking longer than originally planned.

To meet the challenges associated with project management, changes are being instituted to improve the department's performance on major projects across the agency. In addition to the aforementioned reorganization to create the Office of Under Secretary for Management and Performance, the Secretary recently initiated a multi-faceted program to improve project management, including strengthening the Energy System's Acquisition Advisory Board, establishing a Project Management Risk Committee, and improving the peer review process. The department, led by the Project Management Risk Committee, is also exploring other actions that can improve project management.

For projects within the Office of Environment Management, we are strengthening the project review and assessment function, which will bring greater focus and discipline to the major projects in this program, including the waste treatment project at Hanford, the salt waste processing project at Savannah River, as well as numerous smaller cleanup projects across the complex.

Ultimately, though, the key is execution. The reforms that Secretary Moniz is putting in place are designed to emphasize continuous improvement in our contract and project management by, for example, requiring detailed upfront planning before a shovel hits

the ground, ensuring that federal project directors and contracting officers are well trained and certified, improving our cost estimating capabilities, conducting more frequent and better project reviews, selecting proper contract types, and tying fees to final outcomes.

As public servants we have a solemn responsibility to be accountable stewards of the taxpayer dollars. The reforms and processes we are instituting at the Department of Energy with respect to project management are critical to ensuring that we meet this responsibility.

In closing, a primary aim of the Office of Under Secretary for Management and Performance is to serve as a pivotal point where operations, accountability, evaluation, and sound management come together. This responsibility is heavily motivated by the environmental cleanup obligations of the department. With this in mind, the fiscal year 2016 budget request supports clear, discreet progress in the cleanup of the environmental legacy of the Cold War. The department will continue to strive to institute improved and lasting project management processes and standards. More importantly, the department is committed to conducting the environmental cleanup within a framework that integrates worker and community safety, regulatory requirements, and best business practices.

Mr. Chairman and members of the subcommittee, that concludes my statement. I would be pleased to answer any questions you may have.

Mr. SIMPSON. Thank you. Mr. Whitney.

Mr. WHITNEY. Good morning, Chairman Simpson and Congressman Honda. I'm pleased to be here today to represent the Department of Energy's Office of Environmental Management and to discuss with you the achievements that the program has achieved and accomplishments that we anticipate under the President's fiscal year 2016 budget request.

Our request for $5.818 billion will allow the EM program to continue the safe cleanup of environmental legacy brought about by five decades of nuclear weapons development and government-sponsored nuclear energy research. The request includes $5.055 billion for Defense environmental cleanup activities and as you noted, Chairman, an additional $472 million for the Defense contribution to the Uranium Enrichment Decontamination and Decommissioning Fund. The request also includes a total $542 million for the Uranium Enrichment Decontamination and Decommissioning cleanup activities, and $220 million for non-Defense environmental cleanup activities.

EM continues to pursue its cleanup objectives safely within a framework of regulatory compliance commitments and best business practices. The rationale for cleanup prioritization is based on achieving the highest risk-reduction benefit. Most importantly, EM will continue to discharge its responsibilities by conducting cleanup within a safety-first culture that integrates environmental, safety, and health requirements and controls into all of our work activities. This ensures protection for the workers, the public, and the environment.

We continue to make cleanup progress. We have produced nearly 4,200 canisters of vitrified high-level waste at the Savannah River site in South Carolina and at West Valley in New York. Converting it to a solid glass form safe for long-term storage and permanent disposal. This is about half of the entire sludge at the Savannah River site in the Savannah River site tanks.

We converted and packaged additionally over 19,600 tons of depleted uranium hexafluoride for permanent and final disposition at Portsmouth. At Hanford we have completed cleanup of the bulk of the river corridor, including more than 500 facilities and 1,000 remediation sites. At Oak Ridge we are on track to complete preliminary design for the Outfall 200 Mercury Treatment Facility and that will be complete by the end of this fiscal year.

The fiscal year 2016 budget request will allow us to continue to make significant progress in our ongoing cleanup priorities of liquid tank waste treatment and recovery of the Waste Isolation Pilot Plant. For example, at the Idaho National Laboratory the request supports operations of the integrated waste treatment unit in preparing for cleaning and grouting activities to support final closure of the final four tanks there. The request will support high-level waste tank progress at the Savannah River site with planned production of approximately 130 canisters of vitrified waste derived from tanks and processed at the Defense Waste Processing Facility. In addition, the request will support completion of construction of the Salt Waste Processing Facility at the Savannah River site in 2016.

The fiscal year 2016 request will also allow us to expedite tank waste treatment at the Office of River Protection at Hanford through the direct feed low-activity waste approach, by continuing design of the low-activity waste pretreatment system, and continuing construction of a low-activity waste facility, the analytical laboratory, to balance the facilities all in the waste treatment plant.

The fiscal year 2016 request provides funding in accordance with the Waste Isolation Pilot Plant recovery plan. There are, of course, many sites around the EM complex that have TRU waste, transuranic waste, that is planned for disposal at the Waste Isolation Pilot Plant. With that said, resumption of WIPP operation remains a high priority and we will resume waste operations and waste emplacement activities in fiscal year 2016.

Building on the successful demolition of K–25 in Oak Ridge, the fiscal year 2016 request supports demolition activities of the K–27 facility, the last remaining gaseous diffusion plant process facility at the East Tennessee Technology Park in Oak Ridge. The request also allows for continued planning and design of the Outfall 200 Mercury Treatment Facility there.

The request also completes major facility cleanout and demolition projects, including a plutonium finishing plant at Hanford.

Lastly, but certainly not least, the fiscal year 2016 request will also EM to address key infrastructure needs across the complex, especially upgrades to the firewater system and replacement windows in the B hot cell at the Savannah River National Laboratory.

In closing I am honored to be here today representing the Office of Environmental Management. We are committed to achieving our

mission and will continue to apply innovative environmental cleanup strategies to complete work safely and efficiently, thereby demonstrating value to the American taxpayer. Thank you, and I would be pleased to answer any questions you may have.

Mr. SIMPSON. Thank you, and thank you both for being here again today. As you can tell, there are a variety of hearings going on in almost every subcommittee. I am supposed to also be at the Interior subcommittee and at the Labor HHS subcommittee and I cannot, obviously, be in three places. Members have those obligations for a variety of subcommittees, but the EM program in the Department of Energy is obviously a very important program and completing the work to clean up the legacy of the nuclear past is vitally important if nuclear energy is going to be a part of the future frankly.

Mr. Klaus, you lead the Office of Performance Management, which was established by the Secretary not long after he was confirmed. Can you explain your role with respect to overseeing project contract management at the Department of Energy, as well as your responsibilities for the Office of Environmental Management? Is it business as usual within the department or are the Secretary's organizational reforms changing the way the department does business? What do you believe to be the root cause of the department's continued struggle to execute its large capital projects? What is the department doing to get off the GAO's high-risk list entirely? What are you doing specifically to change the way the department is executing EM projects?

Mr. KLAUS. Well, I guess just one note with regard to the high-risk list. We are pleased that when we were first on the high-risk list, it was for all projects. And then as of about two years ago, we were removed from the high-risk list for projects under $750 million on which we are making better progress. We also are working hard within the department and particularly within Environmental Management to break down the larger projects into smaller projects where we have demonstrated greater success. So instead of having one major contract that covers a large number of different elements of a particular cleanup, we have "chunked" it down so that we can work on discreet projects and have greater success on those.

With regard to the Secretary's project management initiatives, one of the things that he has done is to focus on accountability and, frankly, execution and discipline. From the standpoint of accountability, one of the things that we recognize is that not all projects had what we now refer to as a "project owner". The project owner is an official within the department who brings together responsibility for the project, but also the budget and the ability to identify where those funds are. So we have now identified project owners for each of these projects. In fact, Mr. Whitney is the project owner for many of the major projects because he brings together both the budget responsibility, but also the ability to execute on those projects. And that is where we are trying to focus the accountability.

A second aspect is better discipline. We have strengthened our independent review capability or are in the process of strengthening our independent review capability. We also established a

project management risk committee. That project management risk committee is comprised of our best experts in project management from across the department. So, for example, we have the lead project manager from NNSA, the Office of Science, the Office of Environmental Management, and the experts from the Office of Acquisition and Project Management. That group meets as a committee to review projects from each of the different areas. The Committee was recently established and the first project that it reviewed was the low-level activity waste project at WTP. This project was about to reach critical decision 1 from the standpoint of whether it was ready to go, whether the technology was mature, whether we had the appropriate contract managers and officials in place, and whether the contract structure was right. That review took place over two or three different meetings of the Committee and really put the officials who are managing that project on the spot to answer those key questions. The goal is to make sure that when that decision came forward on whether we were ready to go to critical decision 1 that it reflected the best input, knowledge and cross-departmental expertise. We are doing that on an ongoing basis with projects across Environmental Management and, frankly, across the entire department.

Mr. SIMPSON. Speaking of contract management, the Office of Environmental Management has been adjusting its contracting strategies to shift more risk for performance to its contractors. EM tried to do this with its renegotiation of the contract for the Salt Waste Processing Facility, but the contractor would not agree to modify the current contract for what they viewed as unfavorable terms. Now DOE is left with an outdated contract and few mechanisms for keeping the project on track.

In contrast, EM was successful in negotiating a contract change to cap federal costs at the Separations Process Research Unit in New York and progress at that site has been proceeding at a snail's pace since the cost cap was reached several years ago.

EM has proposed a similar contracting model for the award of the EM contract in Idaho, but has met with significant industry pushback. What do you hope to accomplish through the use of the cost-cap contracting model? Do you believe that the department got the outcome it was hoping for at SPRU? Is it really a contract model for success, or are there alternative contracting reforms you are considering? And when you get to the point where a contractor has repeatedly failed under this contracting model, what are the government's options at SPRU? At what point does the department take responsibility for completing the cleanup in a timely manner? And what have you learned from these experiences with this contracting model?

Mr. WHITNEY. Do you want me to start?

Mr. KLAUS. Why don't you start, sure.

Mr. WHITNEY. Okay. Thank you Chairman Simpson. Yes, I think one thing I would like to point out is the recent request for proposal that was released Friday for the Idaho Corps Clean Up Project. That did not have a cost cap. I think each project, each scope of work needs to be treated differently, and different types of contracts need to be used depending on the type of work, if it is a discrete project, very discrete activities, discrete scope of work.

You can use one type of contract that might have more of a fixed cost or a fixed unit rate associated with it, but there are other projects that have less certainty and perhaps more risk, those are not appropriate for. The RFP that came out for the Idaho Clean Up Contract on Friday did not have the cost cap and, but I do think that our intent is to balance the risk and the rewards between the taxpayers and the contractors doing the work. And so we share in the risk and we allow the contractors to share in the rewards when the job is performed well. And so we are continuing to learn how to best structure these. As new contracts, we have several new contracts coming up within the next few years and we will try to continue to find the right balance to achieve that.

Mr. SIMPSON. One of the challenges I guess is to make sure, or ensure that when we do a bid, we have a sufficient number of bidders to make it a true bid. And that was kind of the challenge at the Idaho, when they were originally talking about it before you made the changes to the RFP that came out on Friday. Are you finding that we have a sufficient contract bidding under this model that we are moving towards I guess?

Mr. WHITNEY. I think to date we would say that we have had a level of competition that we are comfortable with that gives the government and the taxpayer the best value and for the Idaho contract of course, we have had a lot of discussion. And one of the reasons that we engage so much with industry, when we came out initially with draft information on the proposed contract, and then with the draft request for proposals in December, was to get their feedback. And so we have spent a lot of time meeting with them, doing site tours, doing individual sessions, to try to understand what the contract terms would mean for that competition in ensuring that we have a level of competition. And so with the release of the RFP this past Friday, and the proposals anticipated within the next 60 days, we hope that the final RFP is structured in a way to encourage as much competition as possible. Because you are right, we think that is how you get value for the government, the more competition the better.

Mr. SIMPSON. What do you do, like in SPRU, where the cost cap is met and the activity is essentially slowed down? What options does the department have?

Mr. WHITNEY. On SPRU, we negotiated with the contractor and it was a bilateral agreement to cap the government's cost at 145 million dollars. There were some mistakes made, quite frankly, by the contractor, that contribute to the situation we are in right now with the project not being complete and us having exceeded that 145 million dollars. The contractor has accepted that responsibility, is moving forward with the project. I understand they are probably spending about three million dollars a month to complete the clean-up of the project. It is not going to be complete on the schedule that we would like but we think we have protected taxpayer interests on the cost and we will continue to work with the contractor. And that clean up job at SPRU is important for us and we are still committed to completing that, working with the contractor there.

Mr. SIMPSON. Okay. The largest increase in the EM budget request is for the Office of River Protection, which is requested at 1.4 billion, or 202 million over the fiscal year 2015 level. Part of this

increase is to support modifications to the waste treatment plant consistent with the Department's new framework agreement, even though the funds requested for the WTP line itself is flat at 690 million. It has been three years since the subcommittee first directed the department to re-baseline the WTP project. That still has not happened. Why should Congress dedicate an even greater portion of overall clean up funds to advance WTP before a performance baseline is established?

Mr. WHITNEY. Thank you. Thank you for acknowledging also the department's new approach. I think under this new approach, which we have proposed to modify the consent decree with the State of Washington, we are trying to achieve a treatment of tank waste as soon as reasonably possible, as early as 2022, and that is through the direct feed activity waste approach. And Mr. Klaus mentioned that low activity waste pretreatment system which is a critical component for that and our funding for that in the FY16 budget as well. The low activity waste makes up about 90 percent of the waste in those tanks and we admit that we of course have had technical issues with the high level waste portion of the project and the pretreatment system, and we need to work through those. Until we are able to work through those technical issues and we have a technical issue resolution project ongoing, and we anticipate that concluding in FY16, perhaps into FY17, only then will we understand completely the schedule and the cost associated with the project. We are continuing to move forward. We think this is the right approach, to one, start treating waste as soon as possible, two, once we have resolved the technical issues associated with the other facilities and the waste treatment plant, we will have a basis with treating the low activity waste that will help us as we learn lessons in that process, and feed into the high level waste mission as well. So we feel like this is the right approach. We feel like it is a sound approach. We do not have the same technical issues with the low activity waste approach as we do with the high level waste approach.

Mr. SIMPSON. So is it the technical issues that you have got to resolve that have kept you from re-baselining the project?

Mr. WHITNEY. Yes, sir.

Mr. SIMPSON. Basically. Okay, Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman and thank you for being here. Sounds like you got a job that is virtually almost impossible. And I wanted to ask a question about the thing you call root cause analysis and it sounds like it is a process by which you go back to the get go and try to figure out what happened and how it can be, how some of the mistakes can be avoided and what lessons are learned. Could you explain a little bit about the root cause analysis and help me understand its application on the kinds of projects that you are working on and the projects that we are working, I guess you could start out by saying these projects were required or came about because, and then go from there.

Mr. KLAUS. The root cause analysis with regard to project management really took place and was initiated in conjunction with being put on the GAO high risk list—we did a substantial root cause analysis of our entire project management system and what we tried to do is identify why it is that we were missing schedules,

why we were going over budget and what mistakes we were making. I think we have instituted a number of changes. One of the ones that I mentioned earlier was that instead of doing a single large contract that covers five or six different types of clean-up activities in a particular site, we issue five contracts, where we have a much more definable scope of work where we can define what the risks are, that we can as Mr. Whitney suggested, where if we can really define what the risk is and what the scope of work is, identify where we can do it on a fixed fee contract or one that really minimizes the risk to the government by putting the responsibility to implement that on the contractor insofar as they have the ability to perform. The Secretary's project management reforms build on that initiative. One of the lessons we learned when we went back is that we discovered we were getting pressed by, frankly, regulatory requirements or pressure from, "why are you not cleaning up this site now." When asked why are you not moving forward, we would rush to start building a project before we had fully reached design maturity. And that would cause us to go back and then redo some work or restructure issues, et cetera. So one of the things that the Secretary's project management reforms do is reinforce the discipline that we have on making sure that we do not start digging before we are really ready to do it and that we have broken contracts out in discrete ways in which we can. And as I said, we have made sure that we provide training and certification to all of our project managers. We have actually reached a point where 100 percent of our major project managers are certified at appropriate levels. So we have really moved forward in terms of doing that.

With regard to why we moved forward on those projects, you know we are dealing with the legacy waste of the atomic weapons complex. The nuclear weapons program moved forward for 50 to 60 years and left a residue of cleanup challenges that are going to take us 30 or 40, or if not more, years to clean up. They were very focused on meeting the mission and basically put, in many instances, for example, in Washington, at Hanford, they put the waste into tanks, saying we will deal with that later. Well, later is now. And that is what drives our requirement to move forward on those cleanups and make sure we prioritize them so we deal with the risky ones first and protect the environment and protect the public that surrounds our sites.

Mr. HONDA. Someone through the Chair, then what I gather is that at one point in our history we had initiatives of developing nuclear power, nuclear weapons, and other kinds of activities around this country in certain places, and we went forward without really thinking of its total future impact. We just did not know enough about it then probably, and now, from hindsight, we understand what it is that we left behind with what kind of problems that we caused. So this is really an effort by the government to clean up the kinds of messes that we have created and in doing so, we provided sufficient funding to be able to do this in a timely manner so that you are not caught up in a lot of litigation or a lot of pressures coming from the outside rather than being internal pressures.

Mr. WHITNEY. Want me to take it?

Mr. KLAUS. Well, I will take a quick bite at it. I think folks have—I think the estimates that I have seen are that We probably have somewhere between a 190 and 220 billion dollars' worth of clean up effort to go forward. Congress and the administration have identified that you can only tackle that in, I guess at this point our proposal is a 5.8 billion dollar bite at a time. It is a long term challenge. I think we are going to be at this a while. And we have made enormous progress. I mean, I do not want to—at one point we had 107 sites that we were cleaning up. We are down to 16. At one point we had 3000 square miles of area that had potential contamination. We are down to about 250 square miles of contamination. That is not small. And the challenges that are left are in many respects those we find to be the toughest challenges. But I think it is really a question of how we as a country are tackling the legacy of the nuclear weapons system that we built for protecting the national security of this country, going back to World War II. We started this with the Manhattan Project and from that point forward, that is kind of how we got there.

Mr. HONDA. Thank you Mr. Chairman.

Mr. SIMPSON. And I would just say, along the very lines that Mr. Honda was talking about, the science changes also. In Idaho we dug trenches and they buried nuclear waste in the trenches because earth is a great barrier. We found out that probably was not the best thing to do, but at the time it was the best thing that we thought. And things change over time and I am certain that as we sit here today, there are things that fifty years ago, or that fifty years from now, we will look at and go, yeah, maybe that was not the best thing to do. But at the time, you have to do and go with the best knowledge you have and the best science that you have. So that is not only true in this arena, it is true in every arena we deal with. So that does create challenges. And even if we could put the 220 billion dollars this year all appropriated, you still could not clean it up this year. I mean, some of this is long term stuff. The challenge that you really face, a lot of the challenge you face, is a lot of this is new stuff. And while it sounds like I am being very critical of the department and I do want you to get off the high risk and all that kind of stuff, a lot of these things are the first time they have ever been built or designed and they present unique challenges. If I ask the Army Corps to go build a dam, they have built a lot of dams. They can pretty much tell me what it is going to cost to build that dam. This is a little different. So while we are critical, and we want to hold your feet to the fire as we have tried to do in this committee to make sure that we are getting the best buck for the taxpayer, I am sure you want to do the same thing. And we do want to, as I said, we do want to clean this up, because if we do not, there will not be a nuclear future in this country. That is just the reality. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you Mr. Chairman. I appreciate your comments. Mr. Klaus, good to see you this morning. Mark it is always great to see you. I do want, for the record to say I am the chairman now of the nuclear clean up caucus and I cherish that position and Mr. Whitney, I appreciate your being at our inception meeting and I know our great chairman is also a member of that caucus as we can come together in a bipartisan, in a nonpartisan

way, to clean up these nuclear legacy sites, particularly all across the nation, but we have a particular problem as you all well known in Oak Ridge. Mark, you know our site well. If East Tennessee Technology Park, ETTP, is only funded at the President's budget request level, what will be the impacts to the ETTP D&D work?

Mr. WHITNEY. Thank you Congressman Fleischmann. The budget request for Oak Ridge is 366 million dollars and I believe with that request, and really building off the tremendous momentum that we have at that site and the great work that the team there has done, building off of the K–25 demolition project success just last year, moving straight into K–31, that demolition project will be complete in the very near future and we will be able to move right into K–27 and begin the demolition of that. I do not anticipate we will necessarily be able to finish the demolition of K–27 in FY16 but we will be well on our way. And that as I noted, in my opening statement is the gaseous diffusion plant process building at ETTP, and that will be a significant milestone, not just for Oak Ridge, but for the EM clean-up program.

Mr. FLEISCHMANN. Okay, thank you sir, now, at that 366 billion level though, I have heard that there is potentially a high number of layoffs. Could you speak to that?

Mr. WHITNEY. I do not have the data on that. Of course we will, when we provide funding guidance to the contractors and they will prepare analysis and provide us the impacts of the funding guidance, we will be able to address that, and I will certainly be happy to come back and talk to you about that when we have that information.

Mr. FLEISCHMANN. Sure, because as you can understand, one of our missions of course, is to protect our workers that do such a tremendous job there in this clean up mission. My understanding is also that the TRU waste processing center would be impacted with an expected shortfall of 3 million dollars in funding required to maintain facility work at ORNL in Y12. Including the layoff of approximately 30, possibly 30 full time equivalent workers, is that your understanding as well sir?

Mr. WHITNEY. That is not my understanding at this point. The TRU waste processing center, of course we are recompeting that contract right now. And so a lot will depend on how that contract, how we end up structuring the final contract, the winning proposer and what the price tag associated with that work is. And again, on that one, I will certainly of course come back and talk to you when we have more information associated with that.

Mr. FLEISCHMANN. Appreciate that. And my final question sir, it is my understanding that the L Basin at Savannah River is at storage capacity for spent HIFER fuel and rapidly approaching capacity for other nuclear fuel. I am concerned that the H Canyon funding is not adequate to meet current reprocessing needs. Have your plans for reprocessing spent fuel changed? Do you anticipate any future storage costs or delays in being able to receive shipments? And what impact, sir, if any, will there be to Oak Ridge considering L Basin is at storage capacity for the HIFER cores?

Mr. WHITNEY. Yes, the L Basin right now, has 120 of the HFIR cores, and in order to receive additional cores from HFIR, we would need to create additional space, re-rack or install additional racks

in L Basin. We, of course, have been working very closely with our colleagues in Office of Science, and at the Oakridge National Laboratory in the Federal Officer there as well, to understand their timeframe.

Right now it looks like, you know, their onsite storage at HFIR for their fuel, for their spent fuel, would probably be exhausted later this decade or early next decade. We are continuing to work with them, have had detailed discussions. We certainly want to make the EM assets available to other programs, to support their missions, and part of that is understanding the incremental costs associated with processing the fuel in H Canyon, so we are working through those thing with Office of Science right now, and I suspect that ultimately that will not be an issue.

Mr. FLEISCHMANN. Well, again, Mark, I want to thank you for your commitment to clean up. That is my steadfast commitment as well, and I look forward to working with your office, so that we can ultimately tackle this problem, which is national problem. And I thank you. And Mr. Chairman, I yield back.

Mr. SIMPSON. Thank you. And before I turn to Mr. Fortenberry, let me must follow up for a second and ask a question on the line of questioning that Mr. Fleischmann was asking. When you put together your budget, do you do an analysis of the potential impact on jobs at the various sites? Because it is—these are not jobs programs, these are mission programs, and yet we represent people who are employed, and to be fair to them, they need to know, or at least roughly know if the potential budget you are proposing for a given site is going to cause layoffs on the site, so that they can make plans and stuff. Do we do an analysis of that?

Mr. WHITNEY. Yes. Yes, we do. You know, generally, from the time that we formulate the budget and prepare the budget, a lot can happen between that, and the budget actually being enacted including Congress, among other things, and understanding what the carryover is, as you move into the next year to help, potentially, offset a lower funding level. And so we do an initial valuation to try to understand some of the workforce impacts.

You are right, we try to look at the—we do not try to, we look at the complex as a whole and try to allocate our resources where we get the most risk reduction benefit, and so that is what is reflected in our budget request this year. Of course with the high-level waste tanks and WIPP recovery, continuing those, and you see that.

And what it does mean is many other sites have a lower budget number than they did previous years. And so we do a calculation in the type of work impacts, the type of calculation you do; $100,000 per FTE is one calculation that is commonly used, and you can do the quick math that, the bottom line is a lot can change between the time that you formulate the budget, and the time that the budget is actually enacted the following year. So to give a specific number is just very difficult to do.

Mr. SIMPSON. No. And you hate to throw a number out there and scare the heck out of people, and say there is going to be 30 people laid off at this facility in Oak Ridge; when in fact, that might not happen until you know what the budget is going to look like.

Mr. WHITNEY. Yes.

Mr. SIMPSON. I understand. Okay. Mr. Fortenberry?

Mr. FORTENBERRY. Thank you, Mr. Chairman. Good morning, gentlemen.

Mr. WHITNEY. Good morning.

Mr. FORTENBERRY. Are we paying for Canada's reprocessing of their spent fuel?

Mr. WHITNEY. No, sir. We are not. Canada is funding the entire project, and we anticipate actually being able to process the HEU liquids in FY '16, at least beginning the campaign. And so that, the HEU liquids that are coming in that Canada is funding, as well as some pre-stage spending for fuel of our own, will be processed in H Canyon, in FY '16.

Mr. FORTENBERRY. So the full cost of that are being borne by the Canadians?

Mr. WHITNEY. Yes, sir. That is my understanding.

Mr. FORTENBERRY. And the plans to reprocess the Japanese and German spent fuel as well?

Mr. WHITNEY. The processing of the German material, are you referring to the German spheres, Congressman?

Mr. FORTENBERRY. I do not have that——

Mr. WHITNEY. Okay. Let me, I think that might be it, that will also be paid for by the Germans if it occurs. You know, we have to make sure the technology is right before we receive that material to make sure it is actually workable. It is a unique fuel type, we have not necessarily processed at H Canyon before, and so they are also funding that effort to develop the technology and make sure the technology readiness level is appropriate before we even receive the waste. So we will not receive waste, we will not agree to do anything until we know that the technology works, and they will fund that technology development effort.

And on the Japanese material, that is part of the global threat reduction initiative, and under that Foreign Research Reactor Return Program, this is a little different but it is part of the Non-proliferation Program. High-income countries pay for the campaigns.

Mr. FORTENBERRY. Okay. So we are not subsidizing stable, high-income countries, as you put it, their return or their movement of fuel to us for reprocessing blending down?

Mr. WHITNEY. We are not subsidizing the movement of the fuel or the processing campaign, there is, of course we maintain the facilities, and so we pay for the base operations of H Canyon, and K–Area to receive the material, and so that is part of our appropriation in the request we make.

Mr. FORTENBERRY. So, we are subsidizing it through the hard cost, that they pay for variable to cost, we are paying for fixed cost?

Mr. WHITNEY. They pay for the incremental cost.

Mr. FORTENBERRY. The question then becomes, is that fair?

Mr. WHITNEY. I believe the——

Mr. FORTENBERRY. I am with you on the non-proliferation goals, please understand, and if the United States has to take a decided leadership role here, who else will? But at the same time other countries with thriving economies, with stabilized governments; we are not talking about Former Soviet Bloc countries here, with minimal threats for the prospects of some kind of proliferation, the need to cost share.

Mr. WHITNEY. And I will tell you that we have begun a working group within the department, NNSA and EM, to look exactly at the cost of operations of our facilities specifically Savannah River, where both programs are users of the facilities to try to understand. Sometimes it is very difficult to actually, you know, you have a base operations in trying to determine exactly what one campaign share of the cost is.

And so that is one of the things that we are looking at; one, understanding all the campaigns and the needs for the different programs over the next several years, and then trying to see if we can attribute the cost appropriately across the program.

Mr. FORTENBERRY. It is just math. It is just math. If the facility costs a certain amount, it has a lifetime of a certain amount, this processing from other countries takes up 5, 10 percent of your capacity, there is your number.

Mr. WHITNEY. And we, of course, are willing to talk to you more about this, and probably better if also have our colleagues from NNSA with us when we do. And so, we would definitely like to reach back out to you.

Mr. FORTENBERRY. The point being, in certain circumstances there might be reasonableness to subsidize, indirectly, the movement of these fuels, particularly when there is proliferation threat. But again, with strong partner countries with strong economies, you called it high-income, to ask for a fairer portion that is beyond just the variable or incremental cost, as you put it, seems to me to be reasonable.

Mr. WHITNEY. Mm-hmm. I will look at that.

Mr. FORTENBERRY. Is that reasonable to you, Mr. Chairman?

Mr. SIMPSON. It sounds reasonable.

Mr. FORTENBERRY. Okay. I will yield back.

Mr. WHITNEY. Thank you.

Mr. SIMPSON. Thank you. The Department reported to place conditions on the extension of the $2.2 billion annual contract in order to meet deadlines for packaging TRU waste, according to an accelerated timeframe and Los Alamos, which may have inadvertently provided incentives for the contractor to cut corners, in a way that ultimately led to the shutdown of WIPP.

These circumstances sound disturbingly similar to the story we heard at the waste treatment plant, where the contractor provided strong financial incentives to the contractor; or the contract provided strong financial incentives to the contractor, to improperly declare safety-related design issues solved, or resolved.

What exactly failed at Los Alamos? Why do we believe the contractor—or do you believe the contractor cut corners? Why does EM continue to struggle to provide effective oversight of its clean up contractors? Is this a problem with contract structure? Or is there an inadequate focus on safety issues as EM struggles to meet its performance goals?

And the more difficult question, which I do not know that you can answer, because it is kind of a relative sort of thing. Where should the line be drawn between providing incentives to achieve a certain level of performance from the contractor, in setting up a situation where only bad things can happen? How will the New

Federal Oversight Plan prevent these events from happening in the future, to the extent we can?

Mr. WHITNEY. I will start and then you can?

Mr. KLAUS. Sure. Sure.

Mr. WHITNEY. Yeah. Congressman Simpson, you are exactly right. It is the balance; it is a very delicate balance. You want to incentivize the contractors to get the work scope done, and particularly when you have tangible, concrete performance elements that you can assign to the contractor and to the scope of work.

At the same time, safety, and we say this and we have to mean it, safety is our top priority, and we have prioritize that above everything, and having a strong safety culture is not mutually exclusive with having a strong performing contractor that is heavily incentivized, or properly incentivized to get the work the work done. We have to have both and they can both coexist, and we have to find that balance.

With respect to Los Alamos, we have, actually on Sunday, we will be formerly standing up the Environmental Management Los Alamos Field Office, and one of the reasons is to align accountability and responsibility for the cleanup program, from Los Alamos directly to EM Headquarters, instead of having that managed by another program.

And so there is focus on the cleanup, a singular focus on the cleanup activities, and accountability will also—you know flows through that chain as well. This also allows the other contractor to focus on their core national security mission, so it is a balance.

With respect to LANL, there is the final—the Phase 2 Accident Investigation Board Report will be coming out soon, and that will outline some of the things that we need to address, and look forward to correcting those items and working with the contractor to do so.

Mr. SIMPSON. Okay. In their October 2013, letter—the item was submitted to the Advisory Board, you stated DOE has taken steps to form an independent project team to evaluate potential future missions for the advanced mixed waste treatment plant. Who are the members of the project team, and have they made any progress?

Will EM issue publicly-available report for their work? And how serious is EM in identifying future missions?

And are you identifying infrastructure improvements that might need to be made? Is there any funding in your budget request for any infrastructure investments that the advanced mixed waste treatment plant to complement the current and future missions?

Mr. WHITNEY. So the Advanced Mixed Waste Treatment Plant has been a very successful facility, and has operated very successfully for many years. And so, definitely as a department, and the environmental management, when we have a facility that is operating well, if it is possible to reuse that facility rather than building another one we would like to do that. I will have to get back with you, Chairman Simpson, on that letter and where we are with respect to the commitments made in that letter. And I will do so.

[Insert]

Mr. SIMPSON. Okay. Mr. Whitney, if higher levels of spending were possible, persistent management mishaps and difficult tech-

nical issues, both of those, continue to plague the cleanup program, how many of the missed milestones, or of those that you anticipate you will miss over the next few years, are strictly funding related? And how many are due to other issues, and what are those issues? And what are you doing to improve your relationship with state regulators in the communities as you work through these site-by-site challenges?

Mr. WHITNEY. I will have to get back with you, Chairman, on the exact numbers and the attribution of those, whether it is funding or technical issues. It is generally a combination of both. For the FY '16 budget, we have—in FY '16 we have over 100 milestones. We have 40 compliance agreements that help govern our work, and in the past we have been pretty successful.

Ideally we would be 100 percent successful on the inner milestones, but there have been a combination of technical issues that have arisen, as well as some budgets that ultimately did not, you know, come to the fruition of what we anticipated when we signed up to the milestone. But we have been successful in about 90 percent of the—of meeting about 90 percent of our milestones. Again, ideally we would meet them all.

And our relationship with the regulators is absolutely critical to us, we treat it very seriously. And I think the fact that we have met 90 percent of those, and we are able to work in the vast majority of cases with our regulators, both the state and with the EPA to find a common ground on how to renegotiate the milestones in the path forward. I think we have been fairly successful there.

Mr. SIMPSON. Well, the Department's relationship with the stakeholders could be adversely impacted by missed cleanup milestones. Many states either have already levied fines or looking to levy fines. New Mexico, in particular, has announced unprecedented amounts for such fines. Can you please clarify for us, what you see as the Department's responsibility at Los Alamos and other sites for paying fines? How will you determine whether the Department has a liability to New Mexico or any other state where fines might be imposed?

And if fines are due, can you verify the Department has the authority to pay fines from appropriated funds, and does it come from appropriated funds or from the Justice Fund?

Mr. WHITNEY. I will, on New Mexico specifically, if you do not mind Congressman, sine that is the subject of active administrative litigation based on the compliance orders issued by the State.

Mr. SIMPSON. Okay.

Mr. WHITNEY. I would just say that we are in discussions with the State, and our relationship with New Mexico and the New Mexico Environment Department is very important to us, and we treat very seriously, like all the regulators. And we are committed with respect to LANL, to doing the cleanup there, and to get the LANL up and operating again, and the same with WIPP, of course, as I had mentioned. And with respect to the ability to use appropriations, I think we will have to get back with you on that, if you do not mind.

Mr. SIMPSON. Okay. Well this whole idea of fines, as I told you yesterday when we talked, that I am fearful that states are looking at fines as the golden goose, if you will, getting money, because

they are under budget constraints also, and if they can receive money for some of these things, and I think that is the inappropriate use of fines.

Fines are imposed that, if you miss milestones because you are holding back, you are not doing your job, you are not paying attention, you are not spending the money that has been appropriated to do something. It is to keep your feet to the fire. When you have challenges that you meet that were unanticipated and that kind of stuff, but you are trying to address them, then I think fines are kind of inappropriate.

But I think states, as I said, might be looking, or some states anyway, might be looking at it as a way of getting additional revenue for a variety of things. So I do have some concerns about that. I would like to know where the fines come from, where the money comes from, and whether it is appropriated dollars, or if it can be appropriated dollars, or if it is out of the Justice Fund.

One other question I have. The Department issued a notice this week, for public comment on using new criteria to determine whether a planned uranium transfer would have an adverse material impact on the uranium industry, and is required by statute. How does the Secretary currently make this determination? If not, the impacts on the price of uranium, what additional factors do you have in mind that you believe should be taken into account? And do you believe these additional factors will make it easier or harder for the department to meet the criteria to transfer uranium?

Has the Department ever held back on a planned transfer because you were concerned about the impact on the industry?

Mr. WHITNEY. Well, certainly the department is concerned about the impact on industry, and the public comment period for the most recent secretarial determination began in December and extended until January 22nd, I believe. We actually extended it for a time just to ensure that we received all the comments, and I understand they were very substantive comments. We are currently reviewing those prior to the determination being made.

Mr. SIMPSON. Okay. Ms. Roybal-Allard.

Ms. ROYBAL-ALLARD. Thank you, Mr. Chairman. I apologize for being late. I was in labor H and——

Mr. SIMPSON. I told them that. I should have been in labor H.

Ms. ROYBAL-ALLARD. Yes. The chair was most generous in letting all six members respond to my questions, so it took a little bit longer than I anticipated. Assistant Secretary Whitney, first of all, I would like to commend you for the work that the department has done in cleaning up 107 sites throughout the nation.

Today I'd like to talk about one of the 16 remaining sites in my State of California, the Energy, Technology, Engineering Center. In your opinion, is the department on track to issue the draft environment impact statement for this site this year? Is the department on track to meet the 2017 deadline for soil remediation, including the establishment of a clean-up remedy for the ground water?

Mr. WHITNEY. Thank you, Congresswoman. I actually recently had the opportunity to visit ETEC, just within the last couple months. That is a very important site for us, of course, and we are committed to doing the clean-up there. I need to better understand it.

Ms. ROYBAL-ALLARD. In the middle of our winter, you were lucky.

Mr. WHITNEY. Yeah, it was nice.

Ms. ROYBAL-ALLARD. Yes.

Mr. WHITNEY. It was nice. I did have to come back.

Ms. ROYBAL-ALLARD. Good timing.

Mr. WHITNEY. But it was very nice. The FY–16 budget does fully fund our NEPA activities, including the draft environmental impact statement. Once the environmental impact statement, of course, is published there will be a public comment period, and then we will work towards a final EIS. So the FY–15 budget and the FY–16 budget fully fund those NEPA compliance activities.

In parallel, the state, has a CEQA process which is similar in nature to the federal NEPA process. They are currently going through that as well. Once we have that final environment impact statement we will better understand the nature and the full scope of the work and the schedule. I would be honored to come back and talk to you as we move through the process.

Ms. ROYBAL-ALLARD. But so far you feel like it is moving in a timely manner——

Mr. WHITNEY. I do.

Ms. ROYBAL-ALLARD [continuing]. And they may meet the goal?

Mr. WHITNEY. I do.

Ms. ROYBAL-ALLARD. Okay. Undersecretary Klaus, the department is doing incredibly important work right now. Since 2011 under the cloud of the Budget Control Act reductions, the Department of Energy has been asked to do more with less. Can you address the impact that the FY–16 spending reductions will have on your operations, including your work on the sites in my State of California?

Mr. KLAUS. Well, I do not have the specific numbers if you are asking in terms of science budgets, and in terms of how that affects the labs or whether you are asking about the clean-up program. The major one of which, I think, Mr. Whitney just addressed.

I can tell you that within your state you have the Berkeley Lab, you have got SLAC up at Stanford, and you have the Lawrence Livermore Lab. I can say that those are—and I have visited two of the three of those—those are very important laboratories. Not just from the standpoint of the government work that goes there, but from the standpoint of the many users who use those facilities.

I think the number at Berkeley, I believe, is there are over 10,000 users per year of those one-of-a-kind facilities. It is where we develop the new biotech drugs. It is where the drugs come from. It is material science that affect our ability to do all sorts of requirements. It is where nanotechnology takes place, etcetera. I do not know specifically the reductions that you are referring to, but I do think that if we reduce the level of funding at those facilities, I think there are something like 60,000 applicants for the 10,000 slots that are available to utilize some of those user facilities. If we have to cut the number because we do not have the capacity, the dollars to be able to do that basic science, I think it is critical to moving the U.S. innovation economy forward. If that is what you are referring to——

Ms. ROYBAL-ALLARD. Yes.

Mr. KLAUS [continuing]. From the clean-up standpoint, you know, we just face a continuing challenge to try and accomplish as much as we can within the resources that are available, recognizing this is a long-term challenge that we have got to meet.

Ms. ROYBAL-ALLARD. I have one other question for you.

Mr. KLAUS. Sure.

Ms. ROYBAL-ALLARD. Secretary Klaus, I realize that this hearing is on the EM program specifically, but I would like to take advantage of having you here to ask a question related to your role as the Chief Operating Office at the department.

My colleagues and I, we spend a great amount of time thinking about cyber security and how we can best mitigate cyber risks in this constrained funding environment. Can you tell us a little bit more about the efficiencies achieved by the cyber security crosscut?

Mr. KLAUS. Sure. Actually, one of the things a cyber security crosscut does is, in fact, what it is designed to do is to give us an accurate assessment of what we are spending on cyber security across the department. The reason that we need to do that is that there is no central funding for all cyber security across the department. We do fund a portion of that through our CIO office, but a lot of the cyber security work takes place in the Office of Intelligence, in the NNSA.

Part of what is going on, and just, sort of, to take two or three steps back, historically IT really developed in each of the programs. We have never really had a centralized IT system within the department, so each of the programs, as IT became more and more important, developed their own IT. They built their own central servers, etcetera.

We are at a point now where we have multiple IT systems in different programs. From a cyber security standpoint that is a much bigger challenge because we have to develop cyber security and put it in place at each of the different systems, and each of the different access points. One of the things that we are trying to move forward to with the Secretary's overall management iniative is to bring those systems together and operate more as, if you will, an enterprise. If we can consolidate those systems then we have fewer access points, and we will have more of an ability to manage cyber security effectively. I don't know the number of systems we have, but if we can consolidate down to fewer systems then we will achieve both efficiency, as you ask, and we will be able to see from the crosscut that we have achieved efficiently from the standpoint of better use of our IT dollars. We will do a better job on cyber.

Also, we will be better prepared, for example, to take advantage of the new technologies, to go to the cloud. It is much harder to do that through multiple systems than it is if we can consolidate and reduce the number of pathways and systems that we need to do that. So I think that is a good example of, frankly, why the Office of Undersecretary for Management Performance was created. It was to have the department operate as an enterprise as opposed to silos. In this case, accomplishing the cyber, particularly given, as you know, the nature of the information that we have within the department, it is something we can better achieve if we do that as an enterprise rather than in silos.

Ms. ROYBAL-ALLARD. Okay. I would like to follow-up with you on that.

Mr. KLAUS. Sure. Be pleased to do that.

Ms. ROYBAL-ALLARD. At a later time, okay? Thank you.

Mr. SIMPSON. One last question, many of the clean-up sites have coped with tight budgets by first reducing workforce for subcontractors, resulting in a disproportionate impact on small business. Is the number of subcontracts going to small business decreasing for the Office of Environment Management, and have you identified new strategies to promote greater opportunities? Are you taking any actions to make sure the bulk of the reductions do not fall on small business?

Mr. WHITNEY. Thank you, Congressman Simpson. The small business participation in the Environment Management program we feel is critical, for many reasons, including the performance of the program. I wish I had our score card for this past year on small business participation, on my desk before I left, I wish I had brought it, but yes, we have exceed the Department's goals for small business participation.

I believe prime subcontracts, it was around 8 percent, and if you include the direct contracts through our M&O contracts it was over 10 percent small business participation, so we are very proud of that, and definitely are mindful of anything that we do that might have impacts on the small business community because of importance.

Mr. SIMPSON. I appreciate that. I bring that up because I just want to know that you have got your eye on the ball there because it is part of the infrastructure in these communities of cleaning up these sites and so forth.

Lastly, not a question, let me just say I encourage you to get out to Idaho and meet with our Attorney General and other officials and resolve the disagreements or different interpretations of the agreement because I really do not want the EM side of this laboratory in Idaho to affect the lab site. Our inability, or if they prevent us from bringing in research quantities of nuclear material.

It would greatly impact the future of the Idaho National Lab and our ability as the lead nuclear lab in the country to do the job which we have asked them to do. So I really do not want these two entities going at one another, so I would encourage you to get out and resolve these differences so that we can resolve the overall issue of allowing these research quantities' material to come into the state. It makes sense to do it, and it is the smart thing to do, so thank you for doing that.

I will tell you that every person that held this job before you has left with grey hair. Now, that didn't affect you, Mr. Klaus.

Mr. KLAUS. I will be glad to have more of it, sir.

Mr. SIMPSON. You have already got it.

Mr. KLAUS. Thank you, sir.

Mr. SIMPSON. I hope you are getting some of that coloring.

Mr. KLAUS. I know. I am, sir.

Mr. SIMPSON. It is a difficult job you all do, but it is a highly important job for the future, and thank you for the work that you do, and the challenges that you face, and trying to meet those for both the taxpayers of the country, for cleaning up the waste, and to do

it in an efficient manner. So thank you all and thank you for being here today.

Mr. KLAUS. Thank you.

Mr. WHITNEY. Thanks for the opportunity.

Mr. SIMPSON. The hearing is closed.

QUESTIONS FOR THE RECORD

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the Budget for the Office of Environmental Management
March 18, 2015

CHAIRMAN'S QUESTIONS

CONTRACTING STRATEGIES – SHIFTING RISK TO CONTRACTORS

Chairman Simpson. The Office of Environmental Management has been adjusting its contracting strategies to shift more risk for performance to its contractors. EM tried to do this with its renegotiation of the contract for the Salt Waste Processing Facility, but the contractor would not agree to modify the current contract for what they viewed as unfavorable terms. Now DOE is left with an outdated contract and few mechanisms for keeping the project on track.

In contrast, EM was successful in negotiating a contract change to cap federal costs at the Separations Process Research Unit (SPRU) in New York and progress at the site has been proceeding at a snail's pace since the cost cap was reached several years ago. EM has proposed a similar contracting model for the award of the EM contract in Idaho, but has met with significant industry pushback.

What do you hope to accomplish through the use of the "cost cap" contracting model? Do you believe that the Department got the outcome it was hoping to get at SPRU?

Mr. Klaus. Cost caps are utilized to help control costs and assure that the party responsible for cost growth is held accountable. With respect to the SPRU project, the Government has been able to control the growth of costs associated with the cleanup effort.

Chairman Simpson. With respect to SPRU, once the contractor reached the agreed upon cost cap, additional expenditures have been borne by the contractor team. Cleanup pace has been slowed, but the contractor is being more efficient in the work being completed. Is this really a contract model for success or are there alternative contracting reforms you are considering?

Mr. Klaus. Utilization of cost cap can be an effective means of contracting. Thus far, EM has attempted to utilize a cost cap on specific contracts that were already in a difficult situation (i.e., SWPF and SPRU). Cost caps may be more effective if placed as a contract requirement at the start of the contractor's period of performance. This would make the approach similar to having had the work performed as a fixed price scope

with the primary difference being that fixed price contracts require the entire scope to be defined up front (at time of contract award).

Chairman Simpson. When you get to the point where a contractor has repeatedly failed under this contracting model, what are the government's options? At SPRU, at what point does the Department take responsibility for completing the cleanup in a timely manner?

Mr. Klaus. As with all contracts, the Government has the option to terminate the contract - either for default (failure of the contractor to perform) or for convenience of the Government. The SPRU contractor is scheduled to complete all required action by December 2016.

Chairman Simpson. What have you learned from these experiences and is that feeding into how you are structuring the new Idaho cleanup contract? Do you expect the contract terms will attract enough competition?

Mr. Klaus. The Office of Environmental Management consistently reviews all of its prior acquisition efforts to evaluate and share lessons learned. EM also prepares draft Requests for Proposals (RFPs) and holds industry days with potential proposers to allow an opportunity for feedback before finalizing the RFP. As was the case with the Idaho Cleanup RFP, the feedback is used to refine the final RFP to ensure the Government is obtaining the best value and that sufficient competition is garnered in its acquisition efforts. We believe adequate competition will occur for this procurement.

SECRETARIAL REFORMS FOR PROJECT MANAGEMENT

Chairman Simpson. Mr. Klaus, you lead the Office of Performance and Management, which was established by the Secretary's reorganization. Can you explain your role with respect to overseeing project and contract management at the Department of Energy, as well as your responsibilities for the Office of Environmental Management? Is it business as usual within the Department or are the Secretary's organizational reforms changing the way the Department does business?

Mr. Klaus. The Office of the Under Secretary for Management and Performance is responsible for overseeing various mission support organizations, including the procurement and project management areas. The project management office establishes policy, following Federal statutes and regulations, and assesses performance for all contracting and project management for our operational and line item related projects. Furthermore, the Office of the Under Secretary for Management and Performance has direct line authority over the Office of Environmental Management (EM), including oversight responsibilities for EM capital asset projects. I am also a member of the Energy Systems Acquisition Advisory Board (ESAAB), advising the Deputy Secretary on project Critical Decisions and other project management issues and challenges.

A number of organizational reforms have been instituted to improve the Department's performance on major projects across the DOE enterprise on several tracks. One of the first actions undertaken by the Secretary was to reorganize the Department at the Under Secretary level to create an Under Secretary for Management and Performance focused specifically on improving project management and performance and bringing the Office of Environmental Management, the Office of Legacy Management and the Office of Management under the purview of this new Under Secretary. In addition, in August 2013, the Contract and Project Management Working Group was established and its findings were issued in a December 2014 report titled "Improving Project Management," which led to the implementation of several additional efforts to improve project management. These included strengthening the ESAAB, establishing a Project Management Risk Committee comprised of the most senior project management officials from each Under Secretary's office to advise the ESAAB, and improving the lines of responsibility and the peer review process.

Chairman Simpson. What do you believe to be the root causes of the Department's continued struggle to execute its large capital projects and what is the Department doing to get off the GAO's High Risk list entirely?

Mr. Klaus. The Department is committed to real, measurable, and sustainable performance improvement in contract and project management. The Department has made significant progress over the last five years and this progress was acknowledged by GAO in the High Risk update in 2013 when the GAO narrowed its focus to projects valued at more than $750 million in the Department's Office of Environmental Management and National Nuclear Security Administration.

As a Department, we are strengthening the Energy Systems Acquisition Advisory Board (ESAAB). The ESAAB, comprised of the Department's most senior leaders, was originally charged with overseeing all projects larger than $750 million and making recommendations to the Deputy Secretary. In addition to meeting to review Critical Decisions now for all projects $100 million or greater, the ESAAB now meets on a quarterly or more frequent basis to review developments on these projects. The ESAAB is now supported by a new Project Management Risk Committee consisting of the Department's top project management experts. These project management experts are the same people who spent a year developing key project management recommendations and writing the "Improving Project Management" report. The Project Management Risk Committee is providing risk assessment and advice to the Department's senior leadership. It is also reviewing and analyzing projects before all critical decisions and baseline change proposals and providing in-house consulting to projects across the entire Department. The committee meets twice a month at a minimum and focuses on projects with a budget of $100 million or more.

Also, going forward, the Department is improving accountability by ensuring that for each project the appropriate Under Secretary will now designate a clear "owner" who has budgetary and programmatic responsibility. There must also be a clear line of responsibility that extends from the Under Secretary to the project owner to the Federal Project Director.

Chairman Simpson. What are you doing, specifically, to change the way the Department is executing EM projects?

Mr. Klaus. The project management improvement initiatives discussed above specifically apply to EM as well. Furthermore, some of the additional project management initiatives being implemented (that apply to EM as well as the rest of the Department) are as follows:

Large projects are being broken down into smaller, more discrete projects such that the work can be funded and executed with a higher probability of success. Large, multiyear projects were frequently vulnerable to scope changes that resulted in significant cost and schedule growth.

Projects will be fully funded where feasible, and full funding for projects less than $50 million will be requested. Full funding would facilitate the use of less risky acquisition approaches such as fixed-price procurements.

Increased focus on fully identifying project risk as early as possible and before critical decision points, supported by a thorough review by the Project Management Risk Committee.

Increased emphasis on obtaining a higher level of design and technical maturity before a project is baselined.

For projects greater than $50 million, a new requirement to conduct an alternatives analysis by a party independent of the contractor organization that is executing the project. This will eliminate any bias towards a specific solution early in the project's lifecycle.

Establishment of an independent organizational entity that reports directly to the Under Secretary in the conduct of all future project peer reviews of EM projects.

Finally, as the Project Management Executive for non-major system projects less than $750 million, I chair quarterly project reviews for all EM projects with a project cost greater than or equal to $100 million.

Taken as a portfolio of project management initiatives, these new approaches are changing EM project management through an increased emphasis on accountability, proactive and early leadership engagement on risk issues, and avoiding known causes of previous project failures.

PROJECT MANAGEMENT – WTP

Chairman Simpson. Mr. Whitney, the largest increase in the EM budget request is for the Office of River Protection, which is requested at $1.4 billion or $202 million over the fiscal year 2015 level. Part of this increase is to support modifications to the Waste Treatment Plant consistent with the Department's new framework agreement, even though the funds requested for the WTP line itself is flat at $690 million.

It been three years since this Subcommittee first directed the Department to re-baseline the WTP project. That still has not happened. Why should Congress dedicate an even greater portion of overall cleanup funds to advance WTP before a performance baseline is established?

Mr. Whitney. Because technical issues with the WTP Pretreatment Facility and, to a lesser extent, the WTP High Level Waste Facility, were more intractable than previously envisioned, the Department determined that a new approach called Direct Feed Low Activity Waste (DFLAW), was necessary in order to achieve tank waste treatment as soon as practicable. The resolution of the technical issues, and the implementation of the DFLAW approach, positions the project to rebaseline the project in phases. Phase one of the rebaseline is for the near term activities of completion of the Low-Activity Waste (LAW) Facility, Balance of Facilities, and Analytical Laboratory, together called the LBL base scope and the new DFLAW scope. This rebaseline activity is underway. Approximately one-half of the $202M increase is for the Tank Farm Activities, including design work on the Low-Activity Waste Pretreatment System (LAWPS) that is necessary to facilitate the DFLAW capability. The other half supports retrieval of the AY-102 double shell tank, additional single shell tanks and implementation of the vapor control plan.

Chairman Simpson. With these modifications, the Department is also deviating from its construction contract and its contractor is only providing limited project status information. What is the plan to put in place the contractual mechanisms to provide accountability for executing this new project scope?

Mr. Whitney. For the WTP project contract, DOE requested modification proposals to complete the LBL and to perform the design and engineering of the plant modifications needed to support the DFLAW approach. DOE and

the contractor are currently engaged in negotiations on the contract modification proposal.

For the tank farm contract, DOE requested a proposal for design and engineering for the new Low Activity Waste Pretreatment System Facility, which is needed to facilitate the DFLAW approach. This scope of work is being implemented under the tank farm operations contract, in accordance with DOE 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* that will lead to establishing a project baseline.

Chairman Simpson. Do you have a forecast for the amount of funding it is going to take to get this facility up and running and how soon that can be accomplished?

Mr. Whitney. The WTP rebaseline is being implemented in phases. Since the LBL portion of the project is well along in construction and not affected by the technical issues implementing the rest of the project, the priority for rebaselining WTP is the LBL portion of the WTP project. Once this rebaseline effort is complete, the Department will have a better understanding of the requirements to successfully complete this portion of the WTP project.

For the High-Level Waste (HLW) Facility and Pretreatment Facility portions of the WTP project, once the technical issues have been resolved and sufficient design is completed, a revised estimate to complete these facilities will be prepared.

MANAGEMENT FAILURES AT LOS ALAMOS

Chairman Simpson. Mr. Whitney, the Department reportedly placed conditions on the extension of a $2.2 billion annual contract in order to meet deadlines for packaging TRU waste according to an accelerated timeframe at Los Alamos, which may have inadvertently provided incentives for the contractor to cut corners in a way that ultimately led to the shutdown of WIPP. These circumstances sound disturbingly similar to the story we heard at the Waste Treatment Plant, where the contract may have provided financial incentives to the contractor to improperly declare safety-related design issues resolved.

What exactly failed at Los Alamos?

Mr. Whitney. The Accident Investigation Board (AIB) Phase II Radiological Release Event Report, issued April 16, 2015, documented the failures at Los Alamos National Laboratory (LANL) and the Waste Isolation Pilot Plant (WIPP). In summary, the AIB identified the direct cause of the radiological incident to be an exothermic reaction of incompatible materials in LANL waste drum 68660 that led to thermal runaway, which resulted in over-pressurization of the drum, breach of the drum, and release of a portion of the drum's contents (combustible gases, waste, and wheat-based absorbent) into the WIPP underground. This conclusion is consistent with the event cause described in the Technical Assessment Team report.

As stated in the AIB Report, the AIB identified the local root cause of the radioactive material release in the WIPP underground to be the failure of Los Alamos National Security LLC (LANS) to understand and effectively implement the LANL Hazardous Waste Facility Permit and Carlsbad Field Office (CBFO) directed controls. Specifically, LANL's use of organic, wheat-based absorbent instead of the directed inorganic absorbent such as kitty litter/zeolite clay absorbent in the glovebox operations procedure for nitrate salts resulted in the generation, shipment, and emplacement of a noncompliant, ignitable waste form.

Additionally, the Board identified the systemic root cause as the Los Alamos Field Office (NA-LA) and National Transuranic Program/CBFO failure to ensure that LANL had adequately developed and implemented repackaging and treatment procedures that incorporated suitable hazard controls and included a rigorous review and approval process. NA-LA and CBFO did not

ensure the adequate flow down of the Resource Conservation and Recovery Act and other upper tier requirements, including the WIPP Hazardous Waste Facility Permit, Attachment C, Waste Analysis Plan, WIPP Waste Acceptance Criteria, and the LANL Hazardous Waste Facility Permit requirements into operating procedures at LANL.

While the award fee plan for the LANL contractor included consideration of performance of legacy transuranic (TRU) work in support of compliance commitments, there was no financial incentive to "cut corners." The amount of time to process this waste stream was not reduced by the use of the incorrect absorbent as opposed to the correct absorbent. As a result of the event, the LANL contract lost award fee.

Chairman Simpson. Why does EM continue to struggle to provide effective oversight of its cleanup contractors? Is this a problem with the contract structures or is there an inadequate focus on safety issues as EM struggles to meet its performance goals?

Mr. Whitney. The unique and complex nature of environmental cleanup work may present oversight challenges, which the Office of Environmental Management (EM) is actively working to address. Protection of the workers, the public, and the environment remains EM's highest priority and is a consideration in all aspects of EM's program and project planning.

The three AIB reports related to the salt haul fire and the radiological release at WIPP have identified the root and contributing causes for the events, and identified weaknesses in Department of Energy and contractor oversight. To enhance accountability and ensure focus and expertise on the cleanup mission, the Department has separated the environmental cleanup work at LANL from the National Nuclear Security Administration (NNSA) mission and added it to the EM scope. The EM Los Alamos Field Office was established on March 22, 2015. EM is working to staff up this field office and to compete the legacy environmental cleanup work at Los Alamos.

To ensure that safety is the top priority, EM is evaluating the safety culture issues identified in the AIB reports and will adjust the safety culture sustainment plans for Los Alamos and the Carlsbad Field Office (CBFO) as needed, based on the Judgments of Need in the reports. HQ EM has committed to provide safety culture subject matter expertise who will assist

Los Alamos in identifying additional training and a schedule for additional assessments.

Chairman Simpson. Where should the line be drawn between providing incentives to achieve a certain level of performance and setting up a situation where only bad things can happen?

Mr. Whitney. The Department is committed to achieving results without sacrificing safety or environmental protections. The contract structures must balance both. EM contracts have incentives for environmental safety and health and mission performance and disincentives for lack thereof.

For example, the Department and the NNSA strongly weighted the events that contributed to the radiological release at WIPP when determining the award fee for the LANL management and operations contract (LANS) for Fiscal Year (FY) 2014; of a possible award fee of $63.4 million, LANS received $6.2 million. The $6.2 million was fee which it earned for work performed for non-DOE agencies.

On two occasions during FY 2014, the CBFO issued letters to the WIPP management and operations contractor, Nuclear Waste Partnership LLC (NWP), significantly reducing the total fee available to the company in accordance with the contract. These letters were issued following determinations by the DOE accident investigation board regarding NWP's level of culpability and poor response to the February 2014 fire and radiological release events that temporarily closed the WIPP facility. As a result of the two contract actions, NWP earned a total fee of $561,266. This is approximately 7% of the total $8,192,895 maximum available.

Chairman Simpson. How will the new federal oversight plan for the Los Alamos site office prevent these events from happening in the future?

Mr. Whitney. In order to prevent a reoccurrence of the kind of issues that led to the event at WIPP, changes within both the contractor organization and within the Field Office must occur. These weaknesses are highlighted as Judgments of Need (JONs) in the AIB Phase II Radiological Release Event report. Each JON will be addressed before the site begins processing any TRU waste, as TRU waste processing at Los Alamos is currently curtailed.

Oversight at Los Alamos will be strengthened as part of the corrective actions to the AIB Phase II Report. These actions will be identified in the Corrective Action Plan (CAP). The establishment of the EM Los Alamos (EM-LA) Field Office is the first step in aligning the mission and the oversight responsibilities. As the transition at LANL evolves and EM-LA office establishes a nuclear safety staff separate from the existing NNSA safety organization a formal alignment of nuclear safety oversight responsibilities will ensure a more robust oversight model as we move forward. More broadly, EM is increasing direct oversight and integration on all environmental cleanup matters, which will facilitate greater integration with other EM sites, including sharing lessons learned among EM sites. Proper training and qualifications for oversight staff will occur during the transition period from NNSA to EM.

FUTURE MISSIONS FOR ADVANCED MIXED WASTE TREATMENT PLANT

Chairman Simpson. Mr. Whitney, in your October 23rd, 2014 letter to the Idaho Citizens Advisory Board, you state that DOE has taken steps to form an independent project team to evaluate potential future mission for the Advanced Mixed Waste Treatment Plant (AMWTP).

Who are the members of the project team and have they made any progress? Will EM issue a publicly available report on their work?

Mr. Whitney. The Office of Environmental Management's (EM) current focus is to complete the processing and removal of Idaho transuranic waste in compliance with Idaho cleanup requirements. For this goal, our priority is to complete Waste Isolation Pilot Plant (WIPP) recovery activities and resume transuranic waste shipments from Idaho to WIPP.

Chairman Simpson. How serious is EM in identifying future missions and are you identifying infrastructure improvements that might need to be made? Is there any funding in your budget request for any infrastructure investments at AMWTP to complement current or future missions?

Mr. Whitney. The Office of Environmental Management's (EM) current focus is to complete the processing and removal of Idaho transuranic waste in compliance with Idaho cleanup requirements. For this goal, our priority is to complete Waste Isolation Pilot Plant (WIPP) recovery activities and resume transuranic waste shipments from Idaho to WIPP. The budget does not include funding for any infrastructure investments at AMWTP to complement future missions.

MISSED CLEANUP MILESTONES

Chairman Simpson. Mr. Whitney, even if higher levels of spending were possible, persistent management mishaps and difficult technical issues continue to plague the cleanup program.

How many of the missed milestones, or those that you anticipate to miss over the next few years, are strictly funding related, and how many are due to other issues? What are those issues?

Mr. Whitney. The Department is actively working to meet its cleanup commitments. To the extent milestones are delayed, DOE will follow the provisions in its cleanup agreements for making notifications and working with federal and State regulators regarding schedule adjustments if necessary.

Chairman Simpson. What are you doing to improve your relationships with state regulators and the communities as you work through these site by site challenges?

Mr. Whitney. EM is committed to working collaboratively and constructively with its regulators and local communities. We routinely engage our regulators, early and often, to discuss priorities, report progress, and find solutions to challenges faced by our program. We post much of our cleanup data and status on our public webpage and host numerous public meetings with regulators, state and local elected officials, tribal nations, and other stakeholders to solicit feedback on cleanup decisions. We also have site specific advisory boards, established under the Federal Advisory Committee Act, that provide advice to our program.

CLEANUP FINES

Chairman Simpson. Mr. Whitney, the Department's relationships with its stakeholders are being adversely impacted by missed cleanup milestones. Many states either have already levied fines or are looking to levy fines. New Mexico in particular has announced unprecedented amounts for such fines.

Can you please clarify for us what you see as the Department's responsibilities at Los Alamos and other sites for paying fines?

Mr. Whitney. Historically, the Department and its predecessor agencies are self-regulating under the Atomic Energy Act (AEA). While DOE still self-regulates the radioactive components of the waste at its facilities pursuant to the AEA and DOE Order 435.1, as a result of the passage of a number of environmental laws and the Federal Facilities Compliance Act, DOE has negotiated a series of site-specific agreements with its state and federal regulators to bring each site in compliance with applicable environmental laws.

Most of EM's cleanup is performed under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) through Federal Facility Agreements and under Resource Conservation and Recovery Act (RCRA) through various consent and compliance orders. There are approximately 40 compliance agreements in place with state and federal regulators. Such compliance agreements typically include a number of milestones for the cleanup process, expressed in terms of specific actions to be taken or results to be achieved by a given date. There are generally two types of cleanup milestones: enforceable milestones, that if missed can subject DOE to fines and penalties; and "rolling" or "target" milestones established for planning purposes, but that are subject to negotiation and change before becoming enforceable, or in some cases may never become enforceable.

If the Department has signed a compliance order, it may be subject to fines and penalties from a state.

Chairman Simpson. How will you determine whether the Department has a liability to New Mexico or to any other state where fines might be imposed?

Mr. Whitney. As with the alleged environmental violations at the Waste Isolation Pilot Plant (WIPP), the Office of Environmental Management (EM) evaluated claims by the regulatory agency, the New Mexico Environment Department (NMED), and entered into negotiations with NMED to engage in settlement discussions. On April 30, 2015, general principles of agreement were agreed upon by the New Mexico Environment Department, the United States Department of Energy (DOE), Los Alamos National Security contractor, and Nuclear Waste Partnership contractor for the purpose of resolving and settling present and future claims, penalties, fines, or other sanctions, against DOE and DOE contractors arising from or relating to the February 2014 incidents at the WIPP. If settlement negotiations would have not been successful, an administrative hearing had been scheduled for July 2015, at DOE's request. EM would have paid fines for environmental violations in accordance with the decision of the hearing. For environmental violations and fines that are not disputed, EM will pay such fines.

Chairman Simpson. If fines are due, can you verify that the Department has the authority to pay fines from appropriated funds? How might the Department go about meeting those costs and what would be the impact to ongoing cleanup efforts?

Mr. Whitney. Yes. In general, the source of funds for fines and penalties under Federal environmental statutes is the appropriation that funded the underlying activity that gave rise to the fine or penalty. In most instances that would be DOE's Defense Environmental Cleanup appropriation, since that appropriation funds the bulk of DOE's environmental remediation work. Office of Environmental Management contractors may be accountable for paying fines (without reimbursement) which would not have an impact on planned cleanup work.

Under Section 301(d) of DOE's current appropriation, amounts paid to regulators would be paid out of the appropriate sub-line, which is the legal control for purpose availability. Because those sub-lines are the same lines that fund cleanup work, there may be impacts to ongoing cleanup efforts. DOE works closely with its stakeholders and regulators to negotiate changes to milestones, including addressing potential fines and penalties and their impact on ongoing work.

EM MANAGEMENT

CONTINUED DEFERRED MAINTENANCE

Subcommittee. Mr. Whitney, the Secretary of Energy has reported that EM has deferred $30 million in infrastructure upgrades needed at the Waste Isolation Pilot Plant to fund recovery activities and that there are as many as 1,800 safety related and non-safety related maintenance activities that have been deferred at the facility since 2009.

How extensive is the deferred maintenance problem for EM's operating facilities?

Mr. Whitney. EM requires maintenance be performed for all safety significant and safety class systems. This is included in each site's budget request. For systems that are not classified safety significant or safety class, maintenance is sometimes deferred to provide funding for other activities. The Secretary has directed all programs to begin addressing the deferred maintenance issues.

Subcommittee.What is your plan to work off this maintenance backlog?

Mr. Whitney. In general, EM sites routinely evaluate the infrastructure to support mission accomplishment. Infrastructure-related decisions are made to ensure operations are supported in a safe and effective manner.

For WIPP, many facility maintenance repairs and equipment replacement activities were in progress when the two February 2014 incidents occurred. Maintenance activities are currently focused on those required as part of recovery, e.g., re-establishment of the safety envelope (e.g., waste hoist for emergency egress, emergency equipment, support of Accident Investigation needs (extensive video mapping of Panel 7, Room 7, etc.), cleanup and restoration of underground zones), decontamination of equipment and mine areas, High Efficiency Particulate Air filter ventilation, mine stability/ground control (bolting). As these activities required for recovery are completed, the focus will shift to other maintenance activities.

Subcommittee. Will you be able to accomplish all safety-related deferred items prior to restarting waste operations at WIPP?

Mr. Whitney. Yes, DOE will resume disposal operations at WIPP when it is safe to do so.

HIGH RISK EXCESS FACILITIES

Subcommittee. Mr. Whitney, in September, the DOE Inspector General recently assessed the status of the Department's infrastructure and identified several Manhattan Project-era facilities at Y-12 as the "Worst of the Worst". These facilities are waiting to be accepted by the Office of Environment for cleanup.

Who is responsible for the unacceptable condition of these facilities?

Mr. Whitney. Most of the facilities at Y-12 are owned by NNSA. Consistent with DOE Orders, NNSA is responsible for the upkeep of these facilities, which is accomplished through ongoing surveillance and maintenance activities.

Subcommittee. When do you plan to accept these facilities and commence cleanup?

Mr. Whitney. As the Department committed to the Inspector General, the Department is working to develop an analysis that can facilitate a path forward for addressing these excess facilities. In January 2015, the Secretary directed the establishment of a new working group on excess facilities which has representation from offices across the Department, including EM and NNSA. The working group is developing strategic approaches and options for how the Department may address the numerous excess facilities owned by the various DOE program offices.

Subcommittee. What is the extent of the cost increases that result from continuing to defer the cleanup work?

Mr. Whitney. Surveillance and maintenance is an annual cost that a program must sustain until an excess facility is dispositioned.

ADEQUACY OF DOE'S ALTERNATIVE FRAMEWORK PROPOSAL FOR HANFORD

Subcommittee. Mr. Whitney, the State of Washington has been adamant that a new path forward at Hanford must be comprehensive and must have a clear schedule for all tank waste retrieval and treatment requirements. Few details are provided in the budget request to describe the programmatic requirements for your alternative framework.

Do you believe the DOE framework proposal can provide a solution for 100% of the tank waste at Hanford?

Mr. Whitney. DOE's 2013 Hanford Tank Waste Retrieval, Treatment, and Disposition Framework provided options for a path to completion of the WTP project. More specific, current information on the Department's approach to completion of the WTP project is in the Department's proposal to modify the Consent Decree with the State of Washington. That proposal, if accepted by the district court, would require the Department to begin treating low-activity tank waste by 2022. Milestones for initiating the treatment at the Hanford site of high-activity waste would be established after technical issues affecting other parts of the WTP are resolved. Under the Department's proposal, the milestones for completing the tank waste mission would continue to be governed by the Tri-Party Agreement. Note that the WTP sizing from the beginning of the project did not plan for treating 100% of the tank waste. The current scope of the project is to treat 100% of the high-level waste and a reasonable portion of the low-activity waste (approximately 40%). Additional capacity has always been required to treat the balance of the low-activity waste.

Subcommittee. What factors will determine whether you can meet the existing 2040 and 2047 deadlines for tank waste retrievals?

Mr. Whitney. Completing the tank retrieval mission depends on a number of factors. The number one factor is the availability of WTP which requires the resolution of technical issues and completion of the WTP. Additional factors for completing the tank retrieval mission include sufficient double-shell tank space available to support retrievals, completion of additional capital facilities to complete retrievals, and operational rates for the various facilities needed for mission completion. DOE is continuously evaluating these factors to determine the impacts on the 2040 and 2047 deadlines.

Subcommittee. Considering the long timelines involved and the unclear solution for the path forward, how can you reduce the risks to the environment in the meantime as the tanks continue to age and new leaks are discovered?

Mr. Whitney. Leaks from the single shell tanks do not pose an immediate risk to the public or to the Columbia River. DOE has significantly reduced the risk of future leaks by transferring much of the pumpable liquids from the single shell tanks to double shell tanks. DOE is actively planning the retrieval of the next two tank farms, A and AX. Retrieval of other tank farms will follow the completion of A and AX tank farms. DOE actively mitigates the effects of past leaks through groundwater pump and treat activities in various parts of the tank farms.

RESOLVING TECHNICAL SAFETY ISSUES AT THE WASTE TREATMENT PLANT

Subcommittee. Mr. Whitney, the previous Secretary of Energy assembled a panel of experts and conducted a technical review of the Waste Treatment Plant design. These teams were disbanded but there is still considerable uncertainty regarding resolution of safety issues.

What progress have you made on resolving these safety design issues?

Mr. Whitney. There are three primary nuclear safety issues associated with the Pretreatment facility design. These, along with current status, are presented below:

Hydrogen Gas Events in Pretreatment Vessels: A preliminary assessment of the safety classification of the smaller standard high solids vessel has been completed. The assessment concludes that the vessels can be designated as safety significant. If confirmed, the smaller standard vessels would replace a number of large vessels of varying design. This outcome would simplify the design and operations of the vessels. In addition, an identification of the gas event control strategy has been completed. A proposed revision to the safety basis to incorporate these changes is under development and is expected to be completed in late FY 2015.

Criticality in Vessels and Equipment: A preliminary hazards and accident analyses associated with a potential criticality in pulse-jet mixed vessels has been completed. This preliminary work indicates that the control system selection for these vessels is appropriate. This will be further analyzed when DOE receives a criticality safety evaluation report for review in mid-summer 2015.

Hydrogen in Piping and Ancillary Vessels (HPAV): DOE is evaluating a change in both the facility design (reduction in areas where hydrogen could potentially build-up) and facility safety requirements that will mitigate this issues. The evaluation should be completed in early FY 2016.

Subcommittee. You've initiated a vessel testing program. Have the results of the tests deviated significantly from your predictions?

Mr. Whitney. Initial full-scale testing on the first vessel is showing results that are consistent with expected outcomes. As the results are further analyzed and evaluated, the WTP project team will have more information on how well the data gathered aligns with the predictions. This will aid in the development of further testing parameters and requirements needed to ensure the issues are resolved in all facility vessels.

Subcommittee. When will you release more information about your results?

Mr. Whitney. The test report for the first phase of pulse jet mixer controls testing in the 13-foot vessel is scheduled for release by the end of FY 2015. The test report for the 8-foot vessel informational testing is scheduled for issue in the first quarter of FY 2016.

WHISTLEBLOWER PROTECTIONS

Subcommittee. Mr. Whitney, the Secretary of Energy initiated an Inspector General investigation in response to allegations of whistleblower retaliation at Hanford, but the DOE Inspector General was unable to reach a conclusion because the cleanup contractors involved refused to make documents and emails generated by the DOE contract available to the IG.

Do you agree that DOE contractors are exempt from investigation based on the possibility of future legal dispute or because a contractor believes the IG is not looking at relevant information? Do you intend to enforce the clause in DOE contracts that requires contractors to produce these documents?

Mr. Whitney. DOE does not agree that contractors are exempt from investigations conducted by the Inspector General. In the particular case you referenced, DOE's Chief of Staff requested the IG to conduct a review of the circumstances surrounding the termination of Ms. Donna Busche by URS Energy and Construction, Inc. In the course of the IG's investigation, attorneys representing Bechtel and URS asserted attorney-client or attorney work product privilege over certain specific documents and thus withheld their production to the IG.

The Department took many steps to facilitate and support the IG's review. The IG report specifically acknowledges that senior officials at the Department encouraged the contractors to cooperate fully with the investigation.

The original purpose of the contract clause in question was not to require contractors to make available information that is subject to attorney-client privilege when a contractor is engaged in ongoing litigation concerning the same subject matter. The Department updated the Acquisition Regulation in 1997 to address concerns about the Freedom of Information Act (FOIA). The Department distinguished between government-owned and contractor-owned records and determined that "contractor-owned records in the possession of the contractor are not subject to FOIA, even though they are accessible to the Department." 62 Fed. Reg. 34855. Notably, the clause permits "inspection, copying, and audit by the Government or its designees *at all reasonable times* (emphasis supplied)." It is unclear if requiring production of privileged materials when a contractor is engaged in ongoing litigation concerning the same subject matter is properly deemed a

"reasonable time." The Department is unaware of any instance in which the clause you reference has been used to override the attorney-client privilege in the context of ongoing litigation, as is the case here.

Subcommittee. Has the Department taken any action to ensure the ability of the Inspector General to perform his duties?

Mr. Whitney. The Department encouraged the contractors to cooperate with the IG's investigation, as noted in the IG report. While DOE does not have privity of contract with URS under the Waste Treatment and Immobilization Plant contract, the prime contractor was encouraged to ensure that all direction given to the contractor was to be flowed down to URS through the subcontract with URS, and that the prime contractor was to ensure that URS complied with the direction in accordance with its subcontract.

Subcommittee. Is there another way to hold contractors accountable and ensure cooperation, perhaps by strengthening contract enforcement mechanisms?

Mr. Whitney. While DOE does not have privity of contract with URS under the Waste Treatment and Immobilization Plant contract, the prime contractor was directed to ensure that all direction given to the contractor was to be flowed down to URS through the subcontract with URS, and that the prime contractor was to ensure that URS complied with the direction in accordance with its subcontract. The Department agrees that it is important to hold contractors accountable, and the Department intends to review the appropriate section of DOE's acquisition regulations.

Subcommittee. How much has the Department reimbursed in contractor legal expenses related to this particular whistleblower case? Why are these costs allowable if the contractor is not in accordance with all of its contractual responsibilities?

Mr. Whitney. No. Under Departmental regulations, DOE may find that legal costs incurred by contractors related to whistleblower allegations are not allowable if, after the legal proceedings conclude, the whistleblower's allegations are substantiated. In cases where the whistleblower's allegations are unsubstantiated, the Department may find the contractor is entitled to receive final payment for the incurred costs.

Where the whistleblower's claims are unsubstantiated and the contractor's associated legal costs may be allowable, the Contracting Officer determines allowability after consulting with legal counsel to consider the terms of the contract, relevant cost regulations, and the relevant facts and circumstances, including federal law and policy prohibiting reprisal against whistleblowers.

At this time, there has been no final resolution of the merits of this particular individual's pending claims against the contractor (and/or subcontractor). Thus, a final determination on the allowability of the contractor's legal defense costs is premature. DOE has directed the contractor to segregate the legal costs associated with the defense of the wrongful termination/whistleblower reprisal lawsuit, as well as legal costs associated with the related IG investigation; such legal costs have been segregated by both Bechtel and URS. DOE has not reimbursed any contractor legal costs associated with the IG investigation.

Subcommittee. Please provide for the record, all reimbursed contractor legal fees by site.

Mr. Whitney. The Department has provided costs in a separate attachment from FY 2014 reported in the legal management tracking system (LMTS). This data includes reimbursed contractor legal fees by site on whistleblower matters. While LMTS is not set up to specifically track all whistleblower litigation, it is a useful repository of information on contractor legal reimbursements that can provide some information on whistleblower expenses. The LMTS system principally tracks reimbursements to contractors for outside counsel costs in significant legal matters. As a result, there are some matters resulting in insignificant or nominal reimbursement amounts that have not been included in LMTS.

Additionally, the system was set up to track expenses for outside counsel costs retained by contractors, however, some field offices have included data regarding the status of matters handled by in house counsel as well. Finally, although a cost has been provisionally reimbursed and may be contained in this data set, DOE may ultimately determine that legal costs incurred by contractors related to whistleblower allegations are not allowable if, for example, after the legal proceedings conclude, the whistleblower's allegations are substantiated.

SPENT FUEL MANAGEMENT OF DEFENSE WASTE

Subcommittee. Mr. Whitney, the Department issued an amended record of decision to expand operations at H-canyon at Savannah River in order to receive and down-blend fuel from Canada as part of a deliverable from the 2012 Nuclear Security Summit. However, support for H-canyon is down in this budget request.

Have your plans for reprocessing spent fuel changed?

Mr. Whitney. The Department continues to plan processing of Spent Nuclear Fuel, along with the Canadian Target Residue Materials (Highly Enriched Uranium liquids) in FY 2016.

Subcommittee. Will this prevent the nonproliferation program from being able to accept future receipts of foreign reactor fuel?

Mr. Whitney. No, the Department will maintain the capability for future receipts of Foreign Research Reactors (FRR) spent nuclear fuel at the Savannah River Site.

Subcommittee. Do you anticipate any future storage costs or delays in being able to receive shipments?

Mr. Whitney. Since L-Basin will continue managing the fuels currently in storage and provide for additional fuel receipts until they are dispositioned in the future, DOE anticipates future costs and schedules will be consistent with updated plans.

Subcommittee. What impacts, if any, will there be to Oak Ridge considering L-Basin is at storage capacity for High Flux Isotope Reactor (HFIR) cores?

Mr. Whitney. EM is working with the Office of Science to ensure that management of storage capacity at Oak Ridge and Savannah River does not affect HFIR operations.

COSTS OF NONPROLIFERATION ACTIVITIES

Subcommittee. Mr. Whitney, the plan to reprocess Canadian spent fuel is being driven by nonproliferation goals to minimize highly enriched uranium. However, the Canadian economy is strong and Canada does not need aid from the United State to pay for processing of their nuclear materials. There are other plans in the works for DOE to process German materials and to receive Japanese materials.

How is the Department paying for the costs of managing spent fuel and other materials transported to DOE sites from other countries?

Mr. Whitney. With regard to the Foreign Research Reactors (FRR) program which was established in 1996, including the Canadian Spent Nuclear Fuel, the Department pays for the cost of managing and disposition of this FRR. The Department receives fees from high income economy countries. The latest fee structure was published in the Federal Register on January 31, 2012 (77FR4807). These fees help partially offset the cost of managing and disposition of the FRR. Concerning the Canadian Target Residue Materials (Highly Enriched Uranium liquids), Canada is paying for the full incremental costs to receive and disposition these materials in accordance with the contract terms between DOE/NNSA and Canadian National Laboratories (previously known as the Atomic Energy of Canada Limited). No decisions have been made to receive other nuclear materials.

Subcommittee. The EM program already has significant costs related to taking care of the legacy of the US nuclear weapons stockpile. Why does DOE consider this a cost of the EM program?

Mr. Whitney. At SRS, EM has responsibility for management of the facilities (H-Area, L-Area, and K-Area) and for management and disposition of the legacy materials.

Subcommittee. How much is provided to the EM program by foreign government contributions to meet the annual costs of taking care of foreign materials?

Mr. Whitney. The Department receives fees from high income economy countries. The latest fee structure was published in the Federal Register on January 31, 2012. These fees help partially offset the cost of managing and

disposition of the FRR. Costs to receive, manage, and disposition other nuclear materials are determined in the contract terms between DOE and foreign country, such as the Canadian Target Residue Materials (Highly Enriched Uranium liquids).

SUPPORT FOR SMALL BUSINESSES

Subcommittee. Mr. Whitney, many of the cleanup sites have coped with tight budgets by first reducing work for subcontractors, resulting in a disproportionate impact on small business.

Is the number of subcontracts going to small businesses decreasing for the Office of Environmental Management?

Mr. Whitney. The number of subcontracts of our prime contractors may fluctuate based on many factors. For instance, completion of work, more effective processes, and new requirements may alter how our prime contractors accomplish the mission. In FY 2014, over $420 million was obligated to prime small business, or approximately 8 percent of the EM procurement base. In addition, there is the contribution of the subcontracting to small business by prime contractors.

Subcommittee. Have you identified new strategies to promote greater opportunities?

Mr. Whitney. EM continues to be a strong advocate of doing business with the small business community. EM has a "Small Business First" Policy requiring due diligence in reviewing market research to ensure that if two or more capable small businesses are interested, we set aside the procurement for small business. EM tracks and monitors our prime contractors subcontracting plans to ensure they are in alignment with the contract terms in regard to small business participation. EM conducts quarterly Business Opportunity Forums and invites large and small business to participate and learn about the business opportunities that EM is offering. The events also provide the opportunity for businesses to network and interact with potential partners in future DOE/EM procurement opportunities.

Subcommittee. Are you taking any actions to make sure the bulk of the reductions don't fall on our small businesses?

Mr. Whitney. EM continues to monitor and hold our prime contractor accountable for meeting subcontracting small business goals as outlined in their respective subcontracting plans.

Subcommittee. How can you provide further opportunities for small business in a constrained budget?

Mr. Whitney. EM has prime small business contracts in place and will be awarding future contracts to small businesses. These prime small business contracts provide a multitude of services to EM including facility management, cleanup activities, and environmental services to mention a few. These significant business opportunities build on our efforts for a "sustainable small business" cadre to be available for future EM procurement opportunities.

DOE PROJECT MANAGEMENT

CONTINUED PLACEMENT ON THE 2015 HIGH RISK DESIGNATION

Subcommittee. Mr. Klaus, the Government Accountability Office's 2015 high risk report found that the department has only met one of GAO's five criteria for being removed from its high risk list. GAO cites a litany of problems associated with most of DOE's major projects. Many of these major projects remain stalled in the middle of construction while others have languished in the design phase with billions already spent. What is your understanding of the issues that have kept the department from making progress on problem projects that have been under construction for years?

Mr. Klaus. The Department continues to struggle with its larger, legacy projects that were established prior to establishing new project and contract management approaches. When these legacy projects were initiated fifteen to twenty years ago, we simply did not have the right people, the right contracts, and the right processes to manage our unique, complex, and in many cases first-of-a-kind projects. The primary root causes include insufficient initial planning, inaccurate and overly optimistic cost estimates, an ineffective organizational structure to drive desired outcomes, insufficiently resourced Federal and contractor project teams, and contract structures and incentives that did not align with taxpayer interests. In addition, atrophy of the nuclear industry and supply chain has also resulted in loss of nuclear quality assurance experience and expertise.

Subcommittee. Can you explain the reasons behind the substantial delays in completing the designs of some of these major facilities, such as the Uranium Processing Facility, Waste Treatment Plant, and the Chemistry and Metallurgy Replacement Facility? Why weren't the design issues identified earlier on?

Mr. Klaus. DOE manages some of the largest, most complex, and technically challenging projects in the public or private sector. Many of these large projects are over budget and behind schedule, but we have had some major project successes across the Department that I would like to highlight. For example, for years we had been planning a multi-billion dollar construction project to replace the nation's uranium manufacturing capabilities, but we had started to see signs of cost overruns, schedule delays, and design issues. To address these issues, the project team

developed a new multi facility approach based on tailoring each buildings design to the specific safety and security criteria for the operations that would be performed in them. To ensure this approach was sound, NNSA chartered an independent team to validate this concept. The team validated the approach and made several other recommendations that the Department adopted. Most significantly, the Department asked Oak Ridge National Laboratory to lead a peer review of the project. The results of this review compelled the Department to make two major changes: establishing a Uranium Program Manager to create an overarching uranium manufacturing strategy and focusing this strategy on a smaller, modular approach instead of one large facility to replace the old facilities. The new strategy will minimize the need for newly constructed space – saving money in the long run – and allow us to begin reducing the hazards in the old facility even before finishing construction of the Uranium Processing Facility.

Similarly, the Chemistry and Metallurgy Replacement Facility's (CMRR) design approach was revised and clear program/project owners were identified for this major system acquisition project. By following our processes, the CMRR Project Team achieved a revised Critical Decision 1 approval from the former Deputy Secretary in 90 days, that will save the taxpayers approximately $3 billion, and received approval from the Deputy Secretary to proceed with long-lead procurements and D&D work allowing the Department to move forward to meeting its commitments to get out of the aging CMR facility.

Additional efforts are now under way to address the challenges confronting several of the other large, one-of-a-kind projects. For the Waste Treatment and Immobilization Plant project, we have submitted a proposal to the court to amend the Consent Decree that governs its construction and initial operation. DOE's proposal involves, among other things, the installation of new infrastructure that will allow DOE to begin vitrifying low activity waste by the end of 2022, while efforts continue to resolve technical issues at the Pretreatment Facility and to a lesser degree, the High Level Waste Facility. The improvements to the project management system, including the new Project Management Risk Committee, will bring a renewed focus on delivering this new infrastructure on schedule.

Subcommittee. Would you provide for the record a list of all the department's major contracts and projects, the initially estimated cost and

schedule for completion of these contracts and projects, the current estimated cost and completion dates, and the amounts expended thus far?

Mr. Klaus.

Major System Projects (Greater than $750M)

	Major Contracts and Projects	Contractor	Initially Estimated			Current Estimated			Amount Expended[1]
			Initial Estimate Date	Cost	Schedule	Current Estimate Date	Cost	Schedule	
Post CD-2	Waste Treatment and Immobilization Plant[2] (WTP)	Bechtel National Inc.	4/21/2003 (CD-2)	$5.78B	7/31/2011	12/22/2006 (BCP-01)	$12.26B	11/30/2019	$8.80B
Post CD-2	Mixed Oxide (MOX) Fuel Fabrication Facility[2]	CB&I AREVA MOX Services, LLC	4/11/2007 (CD-2)	$4.81B	9/30/2016	12/17/2008 (BCP-01)	$4.857B[3]	10/14/2016	$4.35B
Post CD-2	Nuclear Facility D&D – River Corridor Closure Project[2] (RCCP)	Washington Closure Hanford, LLC	1/11/2008 (CD-2)	$2.25B	9/30/2019	1/11/2008 (CD-2)	$2.25B	9/30/2019	$1.61B
Post CD-2	Salt Waste Processing Facility (SWPF)	Parsons Government Services Inc.	9/24/2007 (CD-2)	$0.9B	11/30/2013	8/22/2014 (BCP-02)	$2.32B	1/31/2021	$1.38B
Pre CD-2	Uranium Processing Facility (UPF)	Consolidated Nuclear Security, LLC	8/21/2007 (CD-1)	$1.4B-$3.5B	9/30/2018	6/8/2012 (CD-1R)	$4.2B-$6.5B	9/30/2025	$1.03B
Pre CD-2	Chemistry and Metallurgy Research Replacement (CMRR) Facility	Los Alamos National Security, LLC	5/18/2005 (CD-1)	$0.75B - $0.98B	12/31/2017	8/21/2014 (CD-1R)	$2.4B-$2.9B	12/31/2024	$0.87B
Pre CD-2	Linac Coherent Light Source (LCLS) II	Stanford University	4/22/2010 (CD-0)	$0.3B-$0.4B	9/30/2017	8/22/2014 (CD-1)	$0.75B -$1.2B[4]	9/30/2021	N/A
Pre CD-2	Long Baseline Neutrino Facility (LBNF)	Fermi Research Alliance, LLC	1/8/2010 (CD-0)	$0.66B - $0.94B	3/31/2020	12/10/2012 (CD-1)	$0.8B-$1.1B[5]	6/30/2025	N/A

Notes:

1. Amount expended as of May 2015.

2. Projects are experiencing performance baseline deviations and may be re-baselined with revised scope, cost and/or schedule, as appropriate.

3. While the current estimate shown ($4.857B) is the approved baseline for MOX design and construction as of December 2008, the Department has authorized the project to spend up to $5.260B, while a decision is made on a path forward. In April 2015 Aerospace Corp., a Federally Funded Research and Development Center, produced a report which estimated the lifecycle to-go costs (beyond the $4.43B spent to date) for the MOX fuel approach at $47.5B. This estimate included: increased project costs and contingency, operations of the MOX facility, and other necessary activities (e.g. feedstock preparation and transportation) to implement the program. Out of the $47.5B, the Aerospace Corp. estimate for the design and construction of the MOX facility is $17.1B. (beyond the $4.43B spent to date).

4. The Linac Coherent Light Source (LCLS) II Mission Need Statement was revised in September 2014 to incorporate recommendations from the "Report of the Basic Energy Sciences Advisory Committee (BESAC) Subcommittee on Future X-ray Light Sources". Based on the revised Mission Need, Critical Decision (CD)-1, Approve Alternative Selection and Cost Range, was also revised.

5. While international collaborations will make significant in-kind contributions, the LBNF TPC range only includes DOE's cost consistent with past practice. The Office of Science is in the process of updating CD-1, Approve Alternative Selection and Cost Range, for LBNF with the goal of attaining the Project Management Executive's approval by end of summer 2015. Therefore, until an updated CD-1 is approved, the information in the table is accurate as it reflects the currently approved "program of record."

ADDRESSING PERSISTENT PROJECT MANAGEMENT FAILURES

Subcommittee. Mr. Klaus, the Government Accountability Office (GAO) indicates that while the Department of Energy has generated a report that claims it has completed the corrective actions needed to address its issues in project management, DOE is still struggling to stay within cost and schedule estimates for its major projects. GAO also reported that progress had not been made over the last year compared to what was observed for the management of smaller projects in previous years.

What are your views on how to fix the Department's persistent problems with its projects and how will the actions you are taking address the root causes of the project management problems? Please keep in mind for your response that, while this Subcommittee has generally heard the same response to this question for many years, we've continued to see the Department waste hundreds of millions of dollars on floundering projects.

Mr. Klaus. The Department has made considerable strides in project management since conducting the Root Cause Analysis (RCA) and publishing our Corrective Action Plan (CAP) in 2008. Clearly, we continue to be challenged on many of our legacy major system projects. It's important to understand many of these projects are high-risk, complex, first-of-a-kind nuclear projects.

Recognizing that project management excellence requires continuous improvement and to address the challenges of our largest, most complex projects, the Secretary chartered a senior working group of our top project management experts from across the Department. After a year of in-depth analysis, the working group produced a comprehensive report entitled, "Improving Project Management." After reviewing and discussing the report, the Secretary issued a December 1, 2014 memorandum entitled, "Improving the Department's Management of Projects" that implements the following initiatives:

Strengthening the Energy System Acquisition Advisory Board (ESAAB)

Establishing a Project Management Risk Committee (PMRC)

Improving the Lines of Responsibility and Peer Review Process

We expect this new senior level emphasis on project management to yield positive results.

GAO HIGH RISK LIST – UNRESOLVED PROJECT PROBLEMS

Subcommittee. Mr. Klaus, the Government Accountability Office's 2015 high risk report expresses a concern about the Department of Energy's cycle of announcing corrective actions, declaring problems solved, and then identifying more needed actions when the outcomes are not attained. Most recently, a project management report released in December 2014 identified another 4 root causes and 21 recommendations to fix the problems.

Has DOE really come to terms with the root causes of its project failures or is the need to identify additional actions just a failure to fully implement the previously prescribed corrective actions?

Mr. Klaus. The Department has made significant improvements in its project and contract management processes and practices since the Root Cause Analysis (RCA) and Corrective Action Plan (CAP) reports published in 2008. Accordingly, DOE has commenced follow-on contract and project management improvement initiatives since then to keep the Department's leadership, management, and staff focused, but with a fresh perspective, on the continuing challenges. This includes the Contract and Project Management Summit in December 2010 as well as the most recent efforts under the Secretary, documented in the December 2014 memorandum entitled, *Improving the Department's Management of Projects*, which builds on the past progress by making improving project management a continuing priority.

Subcommittee. What is the difference between the root causes the Department identified in December and those identified in the 2008 and 2010 corrective action reports?

Mr. Klaus. A significant issue raised by the most recent review is the need to change DOE's project management culture. The review identified an "informal culture" within DOE with regards to project and acquisition management, which is misaligned with the formal structure that includes policies, orders and guidance. Because of this misalignment, the informal culture overtakes recognized systems, processes, and procedures resulting in less than acceptable outcomes. DOE needs to transform its culture to one of collaborative problem solving and transparency.

Subcommittee. Why will the department be successful in addressing problems this time around, considering it continues to struggle with some of the same root causes that were identified in these previous reports?

Mr. Klaus. While the Department has made significant improvements in its project and contract management processes and practices since the start of the Root Cause Analysis (RCA) and Corrective Action Plan (CAP) process, it recognized early on that continuous improvement in this vital area must be the norm. As a result, the Secretary's December 2014 memorandum entitled, *Improving the Department's Management of Projects*, has made improving project management a continuing priority and directed: 1) the strengthening of the Energy System Acquisition Advisory Board (ESAAB), 2) the establishment of the Project Management Risk Committee (PMRC), which provides enterprise-wide project management risk assessment and expert advice to the Secretary and Project Management Executives on cost, schedule, and technical issues regarding capital asset projects with a total project cost of $100 million or greater during Critical Decisions, including assessing the scope, schedule and cost; and 3) the refinement in the lines of responsibility of the project owner and alignment of the Peer Review process.

GAO HIGH RISK LIST - BEST PRACTICES.

Subcommittee. Mr. Klaus, according to Government Accountability Office's 2015 high risk report, the GAO recommended in 2014 that the department adopt best practices for both cost estimating and for selecting project alternatives. DOE agreed to implement these recommendations, but the GAO noted that the department's unspecified, open-ended date for implementing may indicate a lack of urgency or concern about the need to implement them.

Can you clarify whether the department is "considering" implementing these recommendations or whether has it committed to implementing them? If so, when do you expect the recommendations to be implemented?

Mr. Klaus. The Department has accepted the Government Accountability Office's recommendations to update its requirements and guidance to adopt best practices for both cost estimating and for selecting project alternatives. In the December 2014 memorandum on *Improving the Department's Management of Projects*, the Secretary mandated an Analysis of Alternatives (AoA) for all projects with an estimated Total Project Cost (TPC) of $50 million or greater currently seeking Critical Decision (CD-1) approval be conducted by the responsible DOE program office independent of the contractor organization responsible for the proposed project. An alternatives analysis may also be conducted if a performance baseline deviation occurs or if new technologies or solutions become available. DOE's Office of Acquisition and Project Management is also developing a DOE Order 413.3-series guide on Analysis of Alternatives based on GAO's report and industry best practices that will codify AoA expectations.

With respect to cost estimating, DOE's Office of Acquisition and Project Management is updating the cost estimating guide (DOE G 413.3-21). The guide already incorporates the 12 cost estimating best practices albeit not in the same format as the GAO Guidance. The update will elevate the significance of the 12 cost estimating best practices within the content of the guidance and will fully discuss the two cost estimating best practices that GAO found to be only "partially addressed" in the current guide.

Subcommittee. Is there a reason why the department might be hesitant to immediately implement these best practices?

Mr. Klaus. As noted above, DOE's Office of Acquisition and Project Management is developing a DOE Order 413.3-series guide on Analysis of Alternatives based on GAO's report and industry best practices that will codify AoA expectations. With respect to cost estimating, DOE's Office of Acquisition and Project Management is updating the cost estimating guide (DOE G 413.3-21). The guide already incorporates the 12 cost estimating best practices albeit not in the same format as the GAO Guidance.

ROOT CAUSE ANALYSIS

Subcommittee. Mr. Klaus, the Government Accountability Office's 2015 high risk report notes that GAO recommended in 2014 that DOE require a root cause analysis of all projects that experience cost increases or schedule delays that exceed a certain threshold. Such analyses can help ensure that a project has correctly identified the underlying causes of its problems to ensure that projects will not repeat the same mistakes.

Can you explain why the department disagreed with this recommendation and instead stated that it would continue to conduct these analyses on a case-by-case basis?

Mr. Klaus. Departmental program offices already perform Root Cause Analyses to inform the Project Management Executive as to the underlying cause(s) for cost increases and schedule delays as part of the Baseline Change Proposal process outlined in DOE Order 413.3B. In addition, in accordance with the requirements of DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, each project documents lessons learned at two distinct points in the project acquisition lifecycle: following Critical Decision 3 (CD-3), Approve Start of Construction/Execution, to document and share lessons learned during the planning and design evolution, and following Critical Decision 4 (CD-4), Approve Start of Operations or Project Completion, to document and share lessons learned during the construction, startup and commissioning phases.

Subcommittee. For which projects has the Department conducted a root cause analysis and have you noticed any trends across projects? What lessons have you found and shared across the Department?

Mr. Klaus. Most recently, root cause analyses have been conducted and associated lessons learned reports documented and shared for the following projects: Depleted Uranium Hexafluoride (DUF6) project, Waste Solidification Building (WSB) project, and Salt Waste Processing Facility (SWPF) project. The latest root cause analysis on the MOX facility was briefed and presented to nearly 400 DOE federal contract and project management professionals at our March 2015 Acquisition and Project Management Workshop.

Subcommittee. Does the Department intend to conduct a root cause analysis for any particular projects over the next two years? Which projects?

Mr. Klaus. Each project is required to document and share lessons learned following completion of planning and design, and following completion of construction, startup and commissioning. Root cause analyses will be developed and shared in the specific instances where a project has breached its Performance Baseline and is undergoing a Baseline Change Proposal process.

ESTABLISHING A PROJECT BASELINE FOR THE WASTE TREATMENT PLANT

Subcommittee. Mr. Whitney, there must be accountability for delivering a project at a particular cost and to a particular timeline for these expensive investments that are being made by your program. But EM's budget request contains few details about its largest project, the Waste Treatment Plant, even though it has been three years since the Department admitted the extent of problems on the project. Nevertheless, the Department has still not established a valid baseline against which it can manage performance of the project and it doesn't appear that there are any immediate plans to do so.

How long do you intend to perform construction without a valid performance baseline?

Mr. Whitney. DOE is continuing with construction on the Low Activity Facility, Balance of Facilities, and Analytical Laboratory (including design of needed plant modifications for DFLAW); resolution of technical issues continues for the PT Facility, and to a lesser extent, the High Level Waste (HLW) Facility; and full production engineering and limited construction continue on the HLW Facility.

The WTP contractor is currently working to and reporting performance against an internal forecast that corresponds to the current contract modification proposal for LBL that is under evaluation. This provides the Department the ability to evaluate the contractor's performance while a new baseline is being established.

The HLW and PT Facilities are currently proceeding under a Two-Year Interim Work Plan. This plan documents the testing, analysis, and other related activities necessary to resolve technical issues for the HLW and PT Facilities.

Subcommittee. Why isn't there a greater sense of urgency for carrying out these basic management responsibilities?

Mr. Whitney. DOE has been proceeding as quickly as prudence allows, while making safety the highest priority. The contractor has submitted a contract modification proposal that DOE is currently evaluating. A lead

negotiator has been assigned to facilitate contract negotiations for this proposal. Through negotiations, the proposal and the baseline will be aligned and the two will be submitted concurrently to the DOE Chief Executive for Project Management.

Subcommittee. What is a reasonable timeframe to allow the Department to perform these tasks and when do you expect to provide the Committee with information that would describe the extent of the cost growth associated with this project?

Mr. Whitney. As DOE better understands the requirements for completing the project through the rebaselining and contract modification efforts, we will provide information to the committees in a timely manner.

SALT WASTE PROCESSING FACILITY (SWPF)

Subcommittee. Mr. Whitney, the Salt Waste Processing Facility is one of the large nuclear construction projects with significant cost growth and major delays. This year, EM was able to re-baseline the project, but was unable to renegotiate the terms of the construction contract to reduce the risk of further cost growth to the government. There are several years left before this facility will be completed.

Is this project on a path to success now? What confidence do you have that you will be able to get this facility up and running within the current baseline?

Mr. Whitney. Recent independent reviews have concluded that construction is projecting to meet the current cost estimate and schedule deadline; however, project management improvements are needed to successfully achieve CD-4 (start of operations). The new Total Project Cost, CD-4 project completion date and cost estimate were approved by the Secretarial Acquisition Executive in August 2014. The costs and completion date were based on an independent government cost estimate and an external independent review conducted by the Office of Acquisition & Project Management (OAPM).

The project's forecasted construction completion date is approximately 7 months ahead of the December 2016 contractual date. The project's approved CD-4 completion date is January 2021.

Over the last four months, the SWPF Federal Project Director Integrated Project Team has supported and conducted two separate in-depth external reviews of the construction and commissioning phases. Where necessary, enhancements to the project's integrated performance management baseline are being made to add additional clarity and fidelity.

The SWPF Federal Project Director's Integrated Project Team has identified risks, developed, and implemented a risk management plan to mitigate risks that may impact a facility of this complexity and scale. Based on the reviews, assessments, and ongoing monitoring and evaluation of the work scope and performance, it is expected that the facility will be fully operational within the current cost and schedule.

Subcommittee. What specific project management improvements have you put into place to keep this project on track?

Mr. Whitney. The SWPF Federal Project Director's Integrated Project Team has implemented key improvements in project management approaches to ensure successful completion of the project. These improvements include:

Reinforcing project goals at periodic DOE (HQ and SWPF field personnel) and contractor partnering sessions;

Ensuring that directed changes are made to the project only when essential;

Enhancing evaluation of monthly performance to not only use Earned Value Management System metrics, but also analysis of critical path activities, production rates, and individual system completions, to identify any issues early and work them to prompt resolution;

Establish a contract "clawback" clause that states Parsons can only earn Construction Completion fee if they successfully pass the DOE Operational Readiness Review (i.e., demonstrates the facility can operate safely); and,

Conducting regular interface meetings between the DOE SWPF Project Office, the SWPF contractor (Parsons), and the site's liquid waste management contractor (SRR- Savannah River Remediation) to plan for the execution of all activities required for startup and commissioning of SWPF.

The Project Office has developed its own baseline schedule to identify the number and type of resources needed to support successful operations of the facility.

Conducting frequent meetings between key PO leads and their contractor counterparts identify opportunities and resolve challenges.

Subcommittee. Why weren't the contract negotiations successful and what tools are available in the current contract to ensure that you can deliver this facility on time and within budget?

Mr. Whitney. Deputy Secretary Poneman issued a memorandum on aligning contract incentives for capital asset projects, indicating that to

improve the structure and management of the Department's contracts, the Department will adhere to two primary principles:

The Department will align taxpayer and contractor interests

The Department will structure these contracts so that the contractor will bear responsibility for their actions

Negotiations between the Department and the contractor focused on the effective implementation of these primary principles. In the end, the Department and the contractor were not able to reach agreement on a contract for the commissioning phase. However, the Department has a baseline in place for the commissioning phase, and plans to utilize management tools identified above to ensure that the project is completed within the current baseline for cost and schedule.

WASTE ISOLATION PILOT PLANT (WIPP) SHUTDOWN

WASTE ISOLATION PILOT PLANT SHUTDOWN IMPLICATIONS

Subcommittee. Mr. Whitney, the Waste Isolation Pilot Plant was formerly the nation's only operating permanent repository for nuclear waste and there was interest in expanding the amount of waste that would be emplaced in WIPP. This shutdown has both programmatic and national level implications.

What are the implications of the shutdown to the Department's transuranic waste programs? How many milestones have been missed or are unlikely to be met?

Mr. Whitney. In February 2014, the Department of Energy (DOE) suspended operations at the Waste Isolation Pilot Plant (WIPP) following a salt truck fire and a subsequent radiological event underground. As the nation's only geologic repository for the permanent disposal of defense-related, transuranic (TRU) waste, WIPP's recovery is central to the DOE's cleanup mission. DOE's September 30, 2014, WIPP Recovery Plan provides a goal for the resumption of waste emplacement in the first quarter of calendar year 2016.

Active TRU waste generators site are continuing characterization and certification activities and are providing interim storage of TRU waste for eventual shipment to WIPP. It is premature at this stage of the recovery to predict the effects of the WIPP suspension on the cleanup milestones at other EM sites.

Subcommittee. What are the implications for repository programs in the U.S. and abroad?

Mr. Whitney. Nothing about the WIPP events of February 2014 calls into question the Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (January 2013). As stated in the strategy, "There is international consensus that geologic repositories represent the best known method for permanently disposing of used nuclear fuel and high-level radioactive waste, without putting a burden of continued care on future generations."

All the experts' observations and recommendations to resume WIPP disposal operations involve such things as equipment maintenance, facility housekeeping, waste treatment, and safety systems and culture. These observations and recommendations address operational issues. None of the experts' reports identified any problem with deep geologic disposal or the use of deep salt formations as a host medium.

IMPACT ON TRU WASTE REMOVAL COMMITMENTS

Subcommittee. Mr. Whitney, at last year's EM hearing, this Subcommittee asked your predecessor how the closure of WIPP will impact The Department's ability to meet commitments for the removal of transuranic waste at other DOE sites. EM's response for the record was that "We are carefully evaluating the impacts to other Department of Energy sites, including potential impacts on commitments with state regulators." No specifics were provided.

Now that you've had a year to evaluate the situation, what will be the impacts? What are the main obstacles you are facing?

Mr. Whitney. It is premature at this stage of the recovery to predict the effects of the WIPP suspension on the cleanup milestones at other EM sites. The Department is actively working to meet its cleanup commitments. To the extent milestones are delayed, DOE will follow the provisions in its cleanup agreements for making notifications and working with federal and State regulators regarding schedule adjustments if necessary.

Subcommittee. Sites are continuing to characterize and certify transuranic waste for shipment to WIPP. Is there adequate storage at the sites to store certified waste until such time shipments to WIPP resume? If the 2016 date for resuming limited operations slips, at what point will EM need to make some investments?

Mr. Whitney. TRU waste generator sites currently have sufficient storage capacity for certified waste ready for WIPP disposal through at least fiscal year 2016. The Department of Energy will continue to evaluate sites' storage capacity and available off-site options beyond that date, if necessary.

WASTE ISOLATION PILOT PLANT ROOT CAUSES

Subcommittee. Mr. Whitney, the shutdown of WIPP has put transuranic waste programs on hold across the country and there will be tremendous pressure on the Department to reopen WIPP to satisfy those deadlines. But addressing the systemic safety and cultural operating issues at WIPP is imperative in order to protect the workforce and to reestablish confidence in the Department's ability to operate the repository.

How will you ensure that the root causes are fully addressed before restarting waste operations?

Mr. Whitney. The root causes for the Waste Isolation Pilot Plant (WIPP) events are identified in the Accident Investigation Board (AIB) Report for the Underground Salt Haul Truck Fire, issued March 13, 2014, the AIB Phase I Report, issued April 22, 2014, and the AIB Phase II Report, to be issued April 16, 2015. To address these root causes, and other contributing factors, the AIB determined Conclusions and Judgments of Need. For each Judgment of Need, the Department, or Nuclear Waste Partnership LLC (NWP), the WIPP management and operations contractor, as appropriate, developed corrective actions. These actions are, or will be, documented in formal, approved Corrective Action Plans. Completion and validation of the pre-start actions and activities will address the root causes prior to restarting waste operations. Similarly, for AIB Phase II Report, the EM Los Alamos Field Office and the contractor, Los Alamos National Security LLC, will need to develop separate Corrective Action Plans.

Subcommittee. The WIPP Recovery Plan says the current schedule is aggressive. Can you define for the subcommittee what you mean by aggressive—what parts of the Recovery Plan in particular have an aggressive component with little margin for error? What major activities and milestones are on the schedule's critical path for meeting the goal to resume waste emplacement operations in first quarter of calendar year 2016?

Mr. Whitney. The WIPP Recovery Plan states "...the schedule will continue to be refined as recovery activities are performed and additional information is learned. The current schedule is aggressive, and the Department will continue to look for opportunities to accelerate activities and execute work in parallel, reducing the time needed for critical activities." This means that if a certain activity takes longer than defined in

the schedule, either (a) a subsequent activity must be performed in a shorter period of time than defined to make up the difference, (b) a work-around is needed (e.g., perform activities in parallel, identify a more efficient method to achieve the same result, etc.), or (c) the overall schedule will slip.

Actions and activities of the WIPP Recovery Plan that have little margin for error are those on the critical path. Activities on the critical path include establishment of the safety envelope (includes revision of the Documented Safety Analysis and upgrading the safety management programs), preparation and training for operations ("integrated cold operations") and completion of the contractor and DOE operational readiness reviews and associated corrective actions. Other key activities include installation and operation of the interim ventilation system and underground recovery activities (e.g., prepare the underground for waste emplacement).

WIPP RECOVERY PLAN - RISKS

Subcommittee. The WIPP Recovery Plan lists eight key risks to successfully implementing the plan. Can you share with the subcommittee the plans to mitigate these risks? Can you share also the other high risks that could impede your ability to bring WIPP back online and your plans to mitigate these risks?

Mr. Whitney. The Waste Isolation Pilot Plant (WIPP) Recovery Plan identified key risks known at the time it was issued. The status and plans for mitigation are as follows:

1. Ventilation: To date the underground has had adequate ventilation and bolting, characterization and decontamination activities have not been adversely affected. A risk that remains is that the New Mexico Environment Department (NMED) will need to allow waste emplacement at a ventilation rate below the current permit requirement of 260,000 cubic feet per minute (cfm). Interim and Supplemental ventilation is not expected to provide this rate of airflow (180,000 cfm expected). To mitigate this risk, the Carlsbad Field Office will be working closely with NMED on a planned change notice.

2. No identifiable root cause: This risk has not been realized, and there is no further mitigation required due to the conclusion of the Accident Investigation Board (AIB) Phase II Report. The AIB identified the direct cause of the radiological incident to be an exothermic reaction of incompatible materials in LANL waste drum 68660, which resulted in over-pressurization of the drum, breach of the drum, and release of a portion of the drum's contents (combustible gases, waste, and wheat-based absorbent) into the WIPP underground. This conclusion is consistent with the event cause described in the Technical Assessment Team report. No further mitigation is required.

3. Bolting operations cannot be done in current personal protective equipment: This risk has not been realized, as bolting operations are proceeding in the typical personal protective equipment, as originally planned. No further mitigation is required.

4. Further degradation or failure of critical equipment: This risk has not been realized to date, however, maintenance issues with repository equipment and infrastructure continue. Mitigation continues by performing preventative maintenance and replacing equipment in accordance with planned activities, and providing work-arounds and corrective maintenance, repair and replacement as needed for unplanned activities.

5. Permit Modification for permanent ventilation system: This is not a risk for initial operations in early 2016. To mitigate this risk, the Carlsbad Field Office will be working closely with NMED.

6. Agreement on the substantial panel closure approach for Panel 6 and Panel 7, Room 7: This risk has not been realized. NMED has approved the initial closure approaches for both Panel 6 and Panel 7, Room 7. No further mitigation is required.

7. Decontamination methodology does not work: This risk has not been realized. The decontamination approach of a combination of water spray to create a crust, application of fixatives, the use of brattice cloth and a layer of salt on the floor, have all been successful at securing contamination for recovery activities and future waste emplacement operations in personal protective equipment, as originally planned. No further mitigation is required.

8. Procurement: Procurement of equipment and services continues to be a risk. Examples are obtaining subject matter expertise (safety, engineering) in needed areas, interim ventilation, interface controls. Mitigation is additional due diligence up-front in defining requirements and extra oversight in execution, and providing work-arounds as necessary.

Additional risks not identified in WIPP Recovery Plan:

Revision of the Documented Safety Analysis: The Office of Environmental Management (EM) is working closely with the contractor to revise WIPP Documented Safety Analysis (DSA) to establish a bounding safety envelope for the facility using current safety standards. As information becomes available from this effort and as a full suite of corrective actions for the AIB Phase II report is developed, EM will continue to evaluate whether there will be an effect on the March 2016 target date for resumption of operations. Mitigation of schedule risk includes the creation of a working group of

subject matter experts (e.g., writers of the Department's standard for development of a DSA) to closely shepherd preparation, review and approval of the DSA.

Safety Culture: DOE is evaluating the safety culture issues identified in the AIB report and the WIPP site, including Carlsbad Field Office and NWP, are updating their Safety Culture Improvement Plan(s) to identify supplemental safety culture sustainment tools, based on the judgments of need in the report. EM is providing subject matter expertise to provide guidance and advice to address organizational culture, safety culture, and SCWE actions to improve the overall WIPP culture.

Suspect Waste Stream: Drums containing nitrate salts in the underground at WIPP in panel 6 and panel 7, room 7 will be isolated in accordance with the closure requirements documented in the WIPP Nitrate Salt Bearing Waste Container Isolation Plan, approved by New Mexico Environment Department. The plan includes measures to provide confidence that the risk of a future event would be adequately mitigated. In the meantime, protective measures are in place underground (e.g., underground continuous air monitoring, temporary safety documentation in place, high-risk areas are restricted and require radiological personal protective equipment, High Efficiency Particulate Air filtration, real time monitoring). Initial closure of Panel 6 is scheduled to be completed in May 2015, and Panel 7, Room 7, by June 2015. Extent of condition reviews are ongoing at the Los Alamos National Laboratory and at WIPP.

Capital Asset Project (line item) Decisions: This is not a risk for initial operations in early 2016. The capital asset projects (line items) at WIPP are on an aggressive schedule. Timely reviews and decisions are necessary to meet the current schedule of the capital asset projects that will allow WIPP to resume full operations. As this process continues to mature, EM will continue to evaluate if there will be an effect on the resumption of full operations. Mitigation is additional due diligence up-front in defining requirements and extra oversight in execution, and providing work-arounds as necessary. Development is in accordance with DOE's project management order, DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

WIPP RECOVERY PLAN –SCHEDULE

Subcommittee. The WIPP Recovery Plan is a bit vague on when exactly EM plans to bring WIPP online.

Can you share with the subcommittee the proposed schedule for resuming emplacements in the facility, including estimated monthly volume emplaced beginning in 2016 and going through to full operations?

Mr. Klaus. The Department's target for initial resumption of waste emplacement at the Waste Isolation Pilot Plant (WIPP) is the first quarter of calendar year 2016. Nevertheless, DOE will only resume operations when it is safe to do so.

It is premature at this stage of the recovery to estimate the rate of waste emplacement.

Subcommittee. What is the current status of meeting the WIPP Recovery Plan schedule for resuming initial operations?

Mr. Klaus. The Department's target for initial resumption of waste emplacement at WIPP is the first quarter of calendar year 2016. Nevertheless, DOE will only resume operations when it is safe to do so.

Subcommittee. Are you on track for meeting the estimated costs of the efforts conducted thus far?

Mr. Klaus. Yes, the combined WIPP recovery funding in fiscal year (FY) 2015 ($127 million) and FY 2016 request ($87 million), in addition to the repurposed WIPP funds of $23 million in FY 2014, allow for resuming operations in early 2016.

Regarding the permanent ventilation system needed for full operations, the funding level for the WIPP line items in FY 2015 is $16 million, and the FY 2016 budget request for the line items is $31 million. The WIPP Recovery Plan provided a pre-conceptual rough order of magnitude range of $77-$309 million for the permanent ventilation system. The capital projects are still early in the planning process. As the Department considers design

alternatives later this year, we will have better information on this cost estimate.

WIPP RECOVERY PLAN PROJECTS

Subcommittee. The WIPP Recovery Plan says that to restore WIPP to full operations, two capital asset project line items are required: a new permanent ventilation system, with an estimated cost range of $65 million–$261 million, and a supporting exhaust shaft, with an estimated cost range of $12 million–$48 million.

To what extent has DOE identified and analyzed a range of alternatives to completing these projects?

Mr. Klaus. Alternatives for completing these projects will be reviewed and analyzed as part of the Department's Critical Decision-1, *Approve Alternative Selection and Cost Range.*

Subcommittee. Can you explain to the subcommittee what will be the long term impact of the recovery efforts on WIPP's baseline operating costs (post-capital asset projects and full operations)?

Mr. Klaus. In March 2013, Department of Energy began the process of evaluating a revision to the Waste Isolation Pilot Plant (WIPP) life cycle cost estimate, which includes operating costs over the long-term. The proposed update will extend the performance period for WIPP operations to fiscal year 2050. The Department is continuing to evaluate this change. Once the impacts of the WIPP recovery are better understood, the Department will be able to complete the process to update and approve the change to the WIPP life-cycle baseline.

Subcommittee. The subcommittee noticed that both accident investigation reports were headed by EM staff.

Can you share with the subcommittee the appropriateness of having EM staff head an investigation of their own facility? Is this a common practice for accident investigation boards?

Mr. Klaus. The Department of Energy (DOE) Office of Environmental Management as the lead organization responsible for the Waste Isolation Pilot Plant (WIPP), formally appointed Accident Investigation Boards (AIB) to investigate both accidents in accordance with DOE Order 225.1B, *Accident Investigations*. Establishment of the two WIPP Accident Investigation Boards followed DOE's common practice for establishing accident investigation boards.

The Accident Investigation Board Chair for both WIPP events is a member of the Senior Executive Service, and had no line management responsibilities related to WIPP or the National Transuranic Program. DOE Order 225.1B requires all accident board members must be DOE Federal employees with subject matter expertise in areas related to the accident, including knowledge of the Department's Integrated Safety Management directives. All of the Accident Investigation Board members were selected from different duty stations other than the accident location. These professionals were also independent of the management chain of command responsible for the WIPP site.

Subcommittee. The Fiscal Year 2015 House appropriations report included a suggestion that DOE conduct an independent investigation of the factors that contributed to each event in Feb. 2014. What is EM's position on this suggestion?

Mr. Klaus. The Department of Energy is supporting the New Mexico Institute of Mining and Technology's independent review of the DOE's Technical Assessment Team report on the radiological event at WIPP, as requested by and agreed to with the State of New Mexico Environment Department. The review period started March 2015.

WIPP ACCIDENT INVESTIGATION – RADIOACTIVE RELEASE

Subcommittee. DOE continues to investigate the cause of the radioactive release. The most commonly offered reason for the event is that the presence of acidic nitrate salts mixed with an organic wheat-based absorbent caused the breach in the container and the radioactive release.

Aside from the final results of the investigation, can you explain to the subcommittee who is responsible to ensure that the material in the containers sent to WIPP meet the waste acceptance criteria (WAC)?

Mr. Klaus. The responsibility for ensuring that the waste meets the WIPP waste acceptance criteria (WAC) is shared by two organizations:

The transuranic (TRU) waste generator site makes the hazardous waste determination. The waste generator prepares the TRU waste for certification, and manifests the waste for shipment.

The TRU waste characterization program is approved by the Carlsbad Field Office (CBFO) to certify TRU waste to meet the applicable requirements. There are currently two organizations approved by CBFO to certify TRU waste:

The Central Characterization Project (CCP), managed by the WIPP management and operating (M&O) contractor, certifies TRU waste to meet transportation and disposal requirements at all TRU waste generator sites.

The Advanced Mixed Waste Treatment Project (AMWTP) certifies TRU waste to meet disposal requirements at Idaho National Laboratory only.

Subcommittee. Is the WIPP contractor responsible for ensuring that all shipments meet the WAC or is the generator site responsible?

Mr. Klaus. The responsibility for ensuring that the waste meets the WIPP waste acceptance criteria (WAC) is shared by two organizations:

The transuranic (TRU) waste generator site makes the hazardous waste determination. The waste generator prepares the TRU waste for certification, and manifests the waste for shipment.

The TRU waste characterization program is approved by the Carlsbad Field Office (CBFO) to certify TRU waste to meet the applicable requirements. There are currently two organizations approved by CBFO to certify TRU waste:

The Central Characterization Project (CCP), managed by the WIPP management and operating (M&O) contractor, certifies TRU waste to meet transportation and disposal requirements at all TRU waste generator sites.

The Advanced Mixed Waste Treatment Project (AMWTP) certifies TRU waste to meet disposal requirements at Idaho National Laboratory only.

Subcommittee. Can you explain to the subcommittee what changes are being contemplated to change the current process for properly ensuring that all shipments to WIPP meet the facility WAC to avoid unacceptable combinations of material being emplaced at WIPP?

Mr. Klaus. A number of changes are being contemplated to ensure that all shipments meet the WIPP WAC, including:

CBFO: Enhancing oversight, including waste generator site reviews of TRU waste processing systems; approval of all new and revised Acceptable Knowledge (AK) Summary Reports prior to certification; increasing CBFO oversight at waste generator sites; increased reviews of procedure changes (e.g., changes that could lead to waste incompatibilities); increasing interactions with generator site DOE offices to verify appropriate levels of oversight are provided; increasing oversight of the CCP in the area of AK verification, and clarifications of roles and responsibilities.

CCP: updating interface agreements with waste generator sites to require process changes impacting TRU waste be fully communicated; verifying information provided for AK by walking down processes that generate, package, remediate, or otherwise change the waste form; and, revising the Interface Agreement with the waste generator to ensure any direction on the handling of specific waste or waste streams is directed through the proper channels such that the directed controls are fully understood, formalized and implemented.

Waste Generators: Ensuring that the waste generator procedure development process is incorporated integrated into the Integrated Safety

Management which includes hazard identification and controls.

WIPP ACCIDENT INVESTIGATION REPORTS

Subcommittee. According to the WIPP Recovery Plan, the key to the recovery is addressing the deficiencies identified in the accident investigation board reports on the underground fire and ineffective response to the radiological release. The accident investigation report on the underground fire identified 10 contributing causes and 35 areas where EM and WIPP's management and operating contractor, Nuclear Waste Partnership, LLC (NWP) would be required to evaluate processes or procedures and develop and implement corrective actions. The accident investigation report on the response to the radiological release identified eight contributing causes and 47 areas of improvement for the EM and NWP.

Can you explain to the subcommittee whether EM has developed corrective action plan(s) that describe the actions being taken or planned to address the accident investigation board reports and when such plan(s) will be made available to the subcommittee and public?

Mr. Klaus. The Office of Environmental Management and the Waste Isolation Pilot Plant management and operations contractor (Nuclear Waste Partnership LLC (NWP)) have issued Corrective Action Plans (CAP) as follows:

DOE Headquarters CAP in response to Accident Investigation Board (AIB) Report on the fire was issued August 27, 2014.
http://www.wipp.energy.gov/Special/DOE_WIPP_Salt_Haul_Fire_Corrective_Action_Plan.pdf

DOE Headquarters CAP in response to AIB Phase I Report was issued March 11, 2015.
http://www.wipp.energy.gov/Special/DOE_Rad_Phase1_CAP_Report.pdf

Carlsbad Field Office CAP on Fire/Phase 1 approved February 6, 2015.
http://www.wipp.energy.gov/Special/Signed%20Final%20CBFO%20CAP_REDACT.pdf

The NWP CAP on Fire/Phase 1 issued on February 12, 2015.
http://www.wipp.energy.gov/Special/FINAL%20NWP%20Fire%20and%20Phase%201%20Rad%20CAP_REDACT.pdf

The AIB Phase II Report was released April 15, 2015. CAPs are being developed.

Subcommittee. Can you explain to the subcommittee what actions or plans DOE and NWP have to address the investigation reports judgments of need?

Mr. Klaus. The detailed corrective actions for the AIB Reports issued to date are documented in the approved CAPs. The CAPs are publicly available at links provided above.

WIPP ACCIDENT INVESTIGATION REPORTS –FEDERAL OVERSIGHT

Subcommittee. Both accident investigation board reports identified failures and deficiencies in EM headquarters and the DOE Carlsbad Field Office's line management oversight of the WIPP contractor, NWP.

Can you explain to the subcommittee the steps EM HQ and CBFO are taking to improve their oversight of the WIPP contractor to ensure that WIPP is operated safely as a Hazard Category 2 Nuclear Facility?

Mr. Klaus. The steps the Department is taking to improve oversight are documented in the Waste Isolation Pilot Plant (WIPP) Corrective Action Plans (CAP), which are available at links provided above.

WIPP ACCIDENT INVESTIGATION REPORTS –CONTRACTOR ASSURANCE

Subcommittee. Both accident investigation boards found that NWP's Contractor Assurance System was ineffective at identifying the conditions, inadequacies, and precursors associated with the root cause of the fire and the ineffective response to the radiological release.

Can you explain to the subcommittee what steps EM is taking to ensure the contractor's future effectiveness in identifying and correcting issues in a timely manner?

Mr. Klaus. contractor effectiveness in identifying and correcting issues are documented in the Waste Isolation Pilot Plant (WIPP) Corrective Action Plans (CAP), which are available at links provided above.

WIPP ACCIDENT INVESTIGATION REPORTS –PERSONNEL

Subcommittee. Both accident investigation board reports noted significant deficiencies in the training/skills/job knowledge of the Carlsbad Field Office and the NWP contractor, in critical areas such as the radiation control program and emergency management and response. In addition, the WIPP recovery plan says the WIPP workforce will need to be retrained for new activities specific to recovery and for future, more complex contaminated operations in personal protective equipment and under nuclear management controls. Moreover, both reports noted degradation in the nuclear safety culture in the Carlsbad Field Office and NWP.

Can you explain to the subcommittee the steps EM is taking and its contractor at WIPP to ensure sufficient technical and managerial expertise is on board to safely and compliantly oversee and operate WIPP as a Hazard Category 2 Nuclear Facility and what steps EM and its WIPP contractor are taking to establish an effective safety culture for a Hazard Category 2 Nuclear Facility?

Mr. Klaus. Sufficient technical and managerial expertise: The DOE Headquarters has assisted the Carlsbad Field Office (CBFO) in the direct hiring process, participating in the interview and selection process to identify the best and most technically qualified applicants. To date, CBFO has brought onboard a number of highly experienced and competent senior personnel with extensive experience in safety oversight and nuclear safety. In the interim, DOE Headquarters has provided direct staffing support to CBFO and provided staffing assistance to CBFO in the areas of nuclear safety, quality assurance, safety, security, safety culture/Safety Conscious Work Environment (SCWE), and other areas. DOE has increased oversight in these areas as well to strengthen the systems, structures and processes. The contractor is taking similar steps to ensure sufficient technical and managerial expertise is on board to safely and compliantly oversee and operate WIPP as a Hazard Category 2 Non-reactor Nuclear facility.

Effective safe culture:

EM has taken a number of steps to enhance the effective safety culture for a Hazard Category 2 Nuclear Facility. CBFO commissioned the assistance of an external organization to conduct an external safety culture assistance visit. The team included safety culture experts from various organizations,

including the Nuclear Regulatory Commission, **National Aeronautics and Space Administration**, the commercial nuclear industry, and other experts from the DOE complex. EM's Senior Advisor for Nuclear Safety Culture has been assigned to assist DOE and the contractor in identifying supplemental safety culture sustainment tools and resources to improve the overall organizational culture, safety culture, and Safety Conscious Work Environment based upon the AIB report conclusions.

In addition to providing the SCWE for DOE/DOE Contractor Senior Leaders, training in November 2014 to 44 additional senior leaders, CBFO and the management and operations contractor, Nuclear Waste Partnership (NWP), have collectively invested significant efforts to safety culture and SCWE training over the past year. NWP leadership developed and conducted the "Right Picture" workshop training, targeted to managers and supervisors (including union leaders and safety representatives). The 8 hour course focuses on values and behaviors needed to support a nuclear safety culture using DOE's Integrated Management System Guide, DOE Guide 450.1-4C, Safety Culture Focus Areas and Associated Attributes. The course was recognized as a Best Practice in EM's Safety Culture Sustainment Plan Summary Report, dated April 2015.

Headquarters and CBFO understand that training is only one piece. Implementation of improvement actions is another. NWP continues efforts for safety culture improvements, including responding to the most recent recommendations identified from the Safety Culture Assist Visit and the Accident Investigation Board Report for Phase II. In addition, EM will continue to provide safety culture subject matter expert support to CBFO and NWP. EM and WIPP leadership are committed to the ongoing improvements to the safety culture at the WIPP facility.

URANIUM ENRICHMENT D&D FUND

REPLENISHING THE URANIUM ENRICHMENT DECONTAMINATION AND DECOMMISSIONING FUND

Subcommittee. Mr. Whitney, the past several budget requests have contained a legislative proposal to reinitiate contributions into the Uranium Enrichment D&D Fund (Fund) using the same formula that first populated the Fund –by taxing the nuclear industry and providing a federal contribution from the defense accounts. However, Congressional authorizers have not acted.

What is the Department doing to plan for the UE D&D Fund? Are you meeting with the authorization committees to press to move forward with an acceptable solution to the status of the Fund?

At current funding levels, how long will the resources in the Fund last?

The Committee directed the Department to provide a report on the Fund and the Department's plans for cleanup. The report is due this month. What is the status of the report?

Mr. Whitney. As requested in the Explanatory Statement to the "Consolidated and Further Continuing Appropriations Act, 2015" (H.R. 83), the Department will provide a report to Congress that will describe the status of the Uranium Enrichment Decontamination and Decommissioning Fund, provide a status update at the three gaseous diffusion plant cleanup sites, and describe the most recent projected cost and schedule to complete the mission.

URANIUM TRANSFERS

Subcommittee. Mr. Whitney, the Department continues to inappropriately supplement its appropriations for cleanup at Portsmouth by bartering uranium.

How much funding do you intend to generate for cleanup activities through the use of the uranium transfers in this budget request?

Mr. Whitney. On May 1, 2015, the Department issued its most recent Secretarial Determination for the Sale or Transfer of Uranium. The recent determination reduced the amount of natural uranium hexafluoride which can be used for cleanup services at Portsmouth to up to 1,600 metric ton of uranium (MTU) in calendar year 2016 and beyond. At today's prices, the Department estimates that this amount of uranium would translate into around $145-150 million worth of additional cleanup services.

Subcommittee. How much longer will these uranium stocks last?

Mr. Whitney. At the current rates allowed under the latest Secretarial Determination, the entire current stockpile of excess natural uranium could last into 2020. However, some of this material was previously cleaned of Technetium-99 ("Tc-99 material") and may be unusable due to residual contamination. If this Tc-99 material cannot be used, the available inventory most likely last into 2018 due to the currently unusable Tc-99 cleaned material.

Subcommittee. Starting from the time you first began transferring uranium to generate funds for cleanup at Portsmouth, did the Department barter away any unobligated uranium that could have been used to meet the Department's defense needs for low-enriched uranium? Do you intend to do so in the future?

Mr. Whitney. No, since starting uranium transfers the Office of Environmental Management (EM) has not bartered any unobligated uranium to fund cleanup work that could have been used to meet the Department's defense needs for low-enriched uranium. In addition, I want to take the opportunity to clarify that EM has not bartered enriched uranium and has no plans to do so.

In the future, the entire stockpile of EM inventory of excess natural uranium is assumed to be available for transfers in support of EM's cleanup mission. However, the Department continues to evaluate the Department's needs for national defense or security purposes and any reallocation for those purposes could reduce the amount of material available for EM cleanup work.

Subcommittee. If the present litigation from the uranium mining and conversion industry were to result in the order by a judge to immediately terminate these transfers, what would be the impact to the site?

Mr. Whitney. The Department would prefer not to speculate on ongoing litigation.

FUTURE PLANS FOR REUSE OF CLEANUP SITES

Subcommittee. Mr. Whitney, last year the Department submitted a request for interest for the use of DOE facilities and stockpiles of depleted uranium to support new missions at Paducah. The Department announced last fall it had selected a reuse proposal.

Has there been any progress in moving forward with the Paducah solicitation?

Mr. Whitney. The Department is engaged in ongoing negotiations with Global Laser Enrichment.

Subcommittee. Is legislation required before the DOE could move forward and does the Department currently have the authority to transfer uranium tails to support a deal?

Mr. Whitney. The Department has the authority to transfer tails.

COMMENCING D&D AT PADUCAH

Subcommittee. Mr. Whitney, in last year's House report, the Committee made it clear that it does not support the Department's plan to maintain the Paducah gaseous diffusion plant in a cold and dark state. As a result, you were directed to prepare a report for the Committee that describes your assumptions for commencing deactivation and decommissioning work, but we do not yet have that report. Few details are provided on your plans in the budget request.

What are your plans at Paducah in fiscal year 2016 and when do you plan on commencing decommissioning work at Paducah?

Mr. Whitney. DOE will continue work towards meeting regulatory milestones established in accordance with the Federal Facilities Agreement, as well as focusing on deactivation activities of the large Gaseous Diffusion Plant facilities returned by USEC in 2014 and optimization of site infrastructure.

FY16 activities include removing waste and hazardous materials from the process buildings; continuing uranium deposit removal from the cascade system; implementing utility optimization plans for the site; stabilizing and deactivating support buildings for the gaseous diffusion plants; and continuing environmental monitoring and cleanup work. DOE will continue to perform surveillance and maintenance on the shutdown facilities while any deactivation or stabilization takes place. Some decommissioning work on smaller ancillary facilities is being evaluated. Detailed plans, including schedules, for full scale decommissioning of the large process buildings are being developed by the new deactivation contractor.

Subcommittee. Do you anticipate that your new contractor will be able to employ the existing workforce at the site or will there be any layoffs?

Mr. Whitney. DOE estimates site staffing, including subcontractors, will remain at approximately 1,100-1,200 employees.

Subcommittee. Last year, you requested to initiate a project to build an onsite waste disposal facility, which will be required to prepare for commencing D&D work. However, you did not request additional funding

to continue the project this year. Why not? Are you proceeding with the project?

Mr. Whitney. The onsite waste disposal facility remains a DOE priority to support future D&D at the PGDP. The FY16 budget request anticipates activities that can be completed during that fiscal year, such as completion of the CERCLA record of decision.

LEGACY MANAGEMENT

MERCURY STORAGE FACILITY

Subcommittee. Mr. Klaus, U.S. companies that generate excess mercury have only one option available for managing that mercury: sending it to facilities permitted under the Resource Conservation and Recovery Act ("RCRA") for temporary storage until the DOE facility is operational to provide long-term storage. Due to the lack of a DOE storage facility, industry must ship their mercury twice – once to the private facility and then later to the DOE facility (once it becomes operational), with attendant increased costs and environmental risks. The project of choosing a site for, constructing, and having operational a long-term mercury storage facility is way behind the schedule established by the Congress.

What has the Department done, since issuing the Supplemental EIS in September 2013, to move this project forward?

Mr. Klaus. The Department and representatives from Nevada Governor Sandoval's office recently met with representatives of the gold mining industry, the primary generator of elemental mercury, to discuss a path forward.

Subcommittee. When does the Department expect to issue a Record of Decision (ROD) with a final decision on the location of the storage facility?

Mr. Klaus. The timing for issuance of the ROD remains uncertain.

Subcommittee. Is issuance of the ROD contingent on funding? If not, what is holding up the issuance of the ROD?

Mr. Klaus. The Department's planning and engagement with stakeholders to make a final selection for the location of the elemental mercury storage facility.

Subcommittee. What timeline is the Department planning for meeting its legal obligation to build the mercury storage facility? What is the expected cost of constructing the storage facility?

Mr. Klaus. The Department does not currently have an estimate for when an elemental mercury storage facility could be available.

Subcommittee. Does the fiscal year 2016 budget request include any funds to advance the project?

Mr. Klaus. No funding has been requested in FY 2016 for the construction of an elemental mercury storage facility due to ongoing planning and engagement with stakeholders.

TUESDAY, MARCH 24, 2015.

NUCLEAR REGULATORY COMMISSION

WITNESSES

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Mr. SIMPSON. Hearing come to order. Today's hearing is on the budget of the Nuclear Regulatory Commission. We have before us Stephen Burns, the Chairman of the Commission, and his fellow Commissioners, Kristine Svinicki, William Ostendorff, and Jeff Baran. Thank you for all being here today and we look forward to your testimony.

Our government should not make policy based on energy sources that the market favors at any given time. It is our job to address our energy needs strategically and to work to create an environment where all forms of energy can compete. A robust energy portfolio is the best path to a secure energy future. I believe that nuclear energy is a critical component of that portfolio.

The Commission plays an important role in assuring nuclear energy's success. Nuclear energy must continue its strong safety record, but regulations need to ensure safety without placing undue burdens on the industry. We must move forward on long-term waste storage, and the Commission must be prepared to advance new and innovative nuclear technologies.

I look forward to your thoughts on all of these subjects and many more. And I would also ask that witnesses to please ensure that for the hearing record, questions for the record, and any supporting information requested by the subcommittee be delivered in its 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. With that I will turn to my Ranking Member, Ms. Kaptur, for her opening statement.

Ms. KAPTUR. Thank you, Mr. Chairman, very much. Thank you, Chairman Burns, and Commissioners Baran and Svinicki and Ostendorff. Thank you so very much for being here today and for the important work that you do for our country.

Nuclear energy is a critical component of our nation's all-of-the-above energy strategy, and I think we are united as a committee on that. To meet this need we currently rely on an aging fleet of nuclear power generation facilities with an average age of 34 years. Many have already outlived their initial 40 year licenses and with others quickly approaching it.

We know also that safety is paramount. One in three Americans live within 50 miles of a nuclear power plant. So you have serious work in your portfolios. As a member who represents one such facility, the Davis-Besse Nuclear Power Plant in Oak Harbor, Ohio, our region is keenly aware of the need to strike a balance between the jobs and economic opportunity these facilities support in the surrounding region. But we need to ensure the highest level of oversight and security to protect local people and communities.

Unfortunately, our region has experienced three incidents with the potential for great calamity if oversight and regulation are not handled properly. Design flaws in the past and lax oversight brought our region within three-quarters of an inch from disaster.

I am interested in hearing more about your plans for relicensing and continuing operations at these facilities while maintaining the utmost attention to safety. The NRC faces additional security concerns in addressing spent fuel storage and eventual disposal. The current approach is far from ideal. I think we can all agree on that. In the absence of real forward motion on Yucca Mountain or another site, our nation has no long-term solution to this pressing challenge. More than $10 billion has been spent on Yucca, yet America has nothing to show for that investment.

The government has to live up to its responsibility to provide for the eventual safe disposal of commercial spent fuel that is currently stored at these sites, and I look forward to your thoughts on how we can meet this obligation. And as we discussed in the past, I have a particular interest in the training of personnel who work in nuclear power facilities and would be very grateful for additional insight you could provide us on how we make sure that is done in the most excellent way for the current generation and the next.

Thank you so very much, Mr. Chairman, and we look forward to your testimony.

Mr. SIMPSON. Thank you. Mr. Burns?

Mr. BURNS. Good morning and thank you, Chairman Simpson and Ranking Member Kaptur. My colleagues and I appreciate the opportunity to appear before you today to discuss the NRC's fiscal year 2016 budget request.

NRC, as you know, is an independent federal agency established to license and regulate the nation's civilian use of radioactive material and nuclear facilities, to ensure adequate protection of the public health and safety, to promote the common defense and security, and to protect the environment. The resources that we are requesting for fiscal year 2016 will allow the NRC to continue to ensure the safe and secure use of material and facilities in the United States.

In addition to the agency's routine regulatory and oversight activities, the fiscal year 2016 budget is expected to include and will cover continuing work in the licensing and construction of new reactors, the continued implementation of lessons learned from the accident at the Fukushima Daiichi Power Plant in Japan in 2011, and preparation for licensing of small modular reactors.

The NRC readily acknowledges that it is in a changing environment. Since 2001 the agency grew significantly to enhance security and incident response and to prepare for the projected growth in the use of nuclear power in the U.S. That forecast in growth has

been adjusted downward in response to changes in the nuclear industry. And as is appropriate, we are being scrutinized by our stakeholders and the Congress for our responsible use of resources. The Congress has charged the NRC with a critical mission to ensure public health and safety and the common defense and security, and we can never lose sight of that mission. Still we can and should maintain our focus on that mission while also taking a responsible and hard look at whether we are effectively using our resources.

Our fiscal year 2016 budget reflects the NRC's efforts to demonstrate its responsiveness to the current environment in which we find ourselves. Continuing with trends that began in 2014, the 2016 budget request reflects a reduction in both dollars and staff from budget proposals in recent years. But it will still provide for the necessary resources in our view to carry out our mission.

As required by law, the fiscal year 2016 budget request provides for 90 percent fee recovery, less the amounts appropriated for certain specific activities. As such, approximately $910 million of the fiscal year 2016 budget request will be recovered from fees assessed against NRC licensees. Our proposed fee rule for the current fiscal year, 2015, which was published for public comment yesterday on March 23, includes estimates for reductions in the overall licensing annual and hourly fees.

Another key step the NRC is taking to prepare for changes in its environment is Project Aim 2020. The project was initiated in June 2014 to enhance our ability to plan and execute our mission while adapting in a timely and effective manner to our dynamic environment. After gathering perspectives from internal and external stakeholders to forecast future workload and the operating environment in 2020, the staff recommended to the Commission a number of measures designed to transform the agency over the next 5 years to improve our effectiveness, our efficiency, and our agility. The staff's report was provided to the Commission on January 30 of this year, and the Commission considers this to be an important part of the dialogue about the future of the NRC. We want to be timely in acting on the report, but we also want to do so deliberately and smartly. And although the NRC recognizes the need for adaptation and change, we are also keenly aware that any major organizational change if not done wisely can have a detrimental effect on our mission and on the morale of our employees. We have a critical mission and some of the most dedicated and knowledgeable employees in the federal government.

One final initiative I would mention is the Commission's focus on the past few years on its rulemaking process in order to understand and, if possible, reduce the cumulative effects of regulation. We are continuing to engage our stakeholders on this issue and will receive further recommendations from our staff for additional improvements this spring.

In sum, we are cognizant of our changing environment and we are committing to taking a hard look at ourselves in order to assure that we are prepared for the future.

This concludes my formal testimony on the fiscal year 2016 budget request. Again, on behalf of the Commission, I thank you for the opportunity to appear before you. I look forward to working with

you to advance our important safety and security mission. I am pleased to answer any questions you have. Thank you very much.

Mr. SIMPSON. Thank you. Do any other Commissioners have opening statements you would like to make? Ms. Svinicki?

Ms. SVINICKI. Thank you, Chairman Simpson and Ranking Member Kaptur, for the opportunity to appear before you today. The Commission's Chairman, Stephen Burns, in his statement on behalf of the Commission has provided an overview of the agency's budget request as well as a description of some key agency accomplishments and challenges in carrying out the NRC's important work.

The NRC continues to implement safety-significant lessons learned from the Fukushima accident in accordance with established agency processes and procedures while also maintaining our focus on ensuring the safe operation of nuclear facilities and the safe use of nuclear materials across the country. The current period of implementation of Fukushima-related regulatory actions, which is a set of complex, interrelated actions lasting several years, will require discipline and focus from the NRC staff as they review and process an extremely high volume of regulatory submittals and inspect the implementation of these requirements at licensee sites. At the same time the agency will be carrying out a set of complex rulemaking activities related to Fukushima actions. In short, very demanding work continues before us.

Concurrent with this, the NRC is undertaking a comprehensive initiative to improve agency budget formulation, budget implementation, and program execution; in other words, an effort to sharpen our delivery of the basics. This is truly a homegrown initiative involving the efforts and feedback of many hundreds of individual NRC employees who have demonstrated strong ownership of its core elements. These elements are—rightsizing the agency, streamlining agency processes to use resources more wisely, improving timeliness in regulatory decision making, and promoting a more unified agency purpose through agency-wide priority setting. We look forward to reflecting progress on these fronts in future budget submittals to you.

I appreciate the opportunity to appear today and look forward to your questions. Thank you.

Mr. SIMPSON. Mr. Ostendorff.

Mr. OSTENDORFF. Good morning, Chairman Simpson and Ranking Member Kaptur. The Chairman has already provided an overview of NRC's budget, the changing environment, and steps we are taking to improve the operations of the NRC through Project Aim.

I am in complete alignment with his testimony. I do want to expand just a bit upon the status of post-Fukushima safety enhancements.

Along with Commissioner Svinicki, I have been involved in all the Commission's decision making related to what safety changes we should require as a result of the operating experience from a tragic earthquake and tsunami in Japan 4 years ago. Looking back over the actions NRC has taken over these past 4 years as a result of Fukushima lessons learned, I firmly believe the agency has acted on a foundational basis of science and engineering. We have appro-

priately given highest priority to Tier 1 items associated with greatest safety significance.

I will not go into any details, but will make two very brief comments. First, as a career nuclear submarine officer, I spent 16 out of my 26 years in the Navy operating submarine reactor plants. I am confident based on that experience of the NRC's safety actions post-Fukushima.

The second is as I compare our safety actions to that of the broader international community, I am convinced that the NRC and the United States industry continue to be world leaders in nuclear safety. I had a chance just last week to visit the industry's Regional Response Center in Phoenix. I believe Commissioner Svinicki was there with Commissioner Fuketa from the Japanese agency just the week before. I think those steps we have seen in the industry and the regulatory body have been significant, but perhaps not widely published.

In closing I appreciate the chance to be here today and I look forward to your questions.

Mr. SIMPSON. Thank you. Mr. Baran.

Mr. BARAN. Chairman Simpson, Ranking Member Kaptur, thank you for the opportunity to appear today before the subcommittee. It is a pleasure to be here with my colleagues to discuss NRC's fiscal year 2016 budget request and the work of the Commission.

First and foremost, NRC is focused on our mission of protecting public health and safety. Yet the agency faces a different environment than what was expected just a few years ago when substantial new reactor construction was anticipated and no licensees had yet announced plans to shut down any reactors.

To meet our responsibilities now and in the future, we need to enhance the efficiency, effectiveness, and agility of the agency. In order to avoid disrupting the agency's work, I think it is important to set a thoughtful trajectory to the appropriate resource and staffing levels over the next few years. We need to make sure that we do a good job matching resources to expected workload.

Before I joined the Commission, my colleagues had the foresight to initiate Project Aim, an internal working group tasked with looking at the changes NRC should make to prepare for the future. This is a valuable and timely effort. We are actively deliberating on the recommendations of the Project Aim team, and I expect that the Commission will approve some prudent actions in the near term.

While we work to increase the agency's efficiency and agility, we need to ensure that NRC also maintains its focus on its ongoing safety work. Currently, five new reactors are being built in the U.S. and five reactors recently ceased operations and are entering decommissioning. At the construction sites, NRC is conducting oversight to ensure that the new plants are built safely and in accordance with regulatory requirements. For the decommissioning plants, the agency reviews requests for exemptions from some of the requirements that apply to operating plants. Meanwhile, the NRC staff is beginning a rulemaking to take a fresh look at a number of decommissioning issues.

NRC is continuing to address post-Fukushima safety enhancements and lessons learned, as my colleagues indicated. Progress

has been made in several areas, but we recognize that more work remains to be done.

NRC also is responsible for having an efficient and effective licensing process for new designs and facilities. While NRC continues its work on pending applications for new reactors, we need to be ready to accept and review applications submitted for new technologies. We are expecting to receive the first application for a small modular reactor design next year in 2016. NRC already is reviewing an application for a new production facility for medical isotopes and anticipates additional applications of this type in the future.

Thank you, and I look forward to your questions.

Mr. SIMPSON. Thank you all and first let me say I appreciate the work that you all do. This is both a challenging and a very important job for the future of this country and for nuclear safety, and I do appreciate the hard work that all of you do.

All of you I think, or almost all of you, mentioned in your statements Fukushima and the lessons learned there in trying to increase the safety in our reactors and so forth and our safety plants. We all talk about lessons learned. Can you give me some examples of what have we learned from Fukushima?

Mr. BURNS. Certainly, Mr. Chairman. I think one of the things that we learned actually built on a lesson I think we learned in terms of the agency's response after the 9/11 attacks, and that is having the availability of supplemental equipment that could be used to provide additional power or to assure essential systems were operational or could be put back in operation after an event. If you look at the Fukushima accident, the inability, particularly in units 1 through 4, to restore the electric diesel generators, that was one of the primary problems that led to additional problems. One of the things that we have done, and Commissioner Ostendorff mentioned, is reflected in these regional support centers, but also onsite centers at each of the facilities, is basically stockpiling of this additional equipment—pumps and valves, things like that—that might be needed in the event of a severe event.

So I would say perhaps that is the most significant lesson that we have learned in terms of making that availability of equipment, to cope with those unusual and rare events, being able to do that, that is probably the most important lesson. My colleagues might have something else to say.

Mr. SIMPSON. Kristine.

Ms. SVINICKI. Mr. Chairman, thank you for that question. Commissioner Ostendorff in his statement just now, which I had not heard until just now, made an important point, which is that if you look across the international nuclear community, you see tremendous coherency in terms of the set of near-term actions that we all are calling our lessons learned from Fukushima. And at bottom, it is really no more complicated that this—witnessing and experiencing something like the Fukushima accident I think challenged all countries with mature nuclear programs or those who are considering nuclear to really confront their assumptions about high-consequence, low-probability natural events. And so when Chairman Burns talks about further enhancing the set of equipment onsite to mitigate in these low-probability, high-consequence events,

as Commissioner Ostendorff pointed out, you see across nations that that was the immediate first step.

Now countries can also overreact. I am proud of the United States having from early days after the accident, President Obama stood outside the White House with our Chairman at the time, Chairman Jaczko, and he asked for assurances, for NRC to give assurance to the nation that nuclear power plants were safe. We did not shut all our plants down as Japan did. We did a quick look and as the safety regulator, we were able to tell the American people it was safe to continue operating plants, but that did not mean that there were not opportunities for enhancement. As we have prioritized those, those are under implementation and have been for some time.

So I think at bottom that is the core lesson learned.

Mr. OSTENDORFF. I want to chime in. I agree with everything that Chairman Burns and Commissioner Svinicki said. One thing, and Commissioner Svinicki and I went through this in great detail 4 years ago. I think one of the most significant steps decision-making wise NRC as a body went through was to look at the near-term taskforce, which our staff in a short, 90-day period, presented to the Commission in July of 2011. It had 12 recommendations with different subparts to that. This is a very thoughtful body of work, but two comments I would make, Chairman, in response to that report.

One, our level of knowledge has significantly increased over the last 4 years as we have gotten into details working in very collaborative engagement with industry to figure out what really makes sense here, where do we add value.

And the second piece I would say is we have been very thoughtful in saying we cannot do all this at one time nor should we try to. Let us take those high-priority action items and sometimes it takes a little bit longer than we thought it would, but we believe it has been important to get it done right the first time rather than get it done fast.

So I would just add those comments.

Mr. SIMPSON. Is industry in agreement with that?

Mr. OSTENDORFF. I believe so.

Mr. SIMPSON. Jeff.

Mr. BARAN. I think my colleagues have done a really good job covering this. But the only thing I would add—I think one of the important lessons learned that the near-term taskforce detected right away when they worked in the immediate aftermath of Fukushima is really the cliff-edge effect of flooding, which I do not know that was fully appreciated. So the plants there did pretty well in terms of the seismic event, the earthquake itself. But the flooding is what really knocked out the power and the ability to provide core cooling that was so essential.

And so I think one of the focuses that the NRC has had over the years before I arrived obviously was the work on flooding, the focus on flooding. There were walk-downs immediately after the event to check the status of defenses against flooding. And then there has been an effort ongoing to reevaluate the flooding hazards, to make sure that in the decades of the past since some of these plants were licensed, we make sure we really understand what are the poten-

tial flooding hazards in our plants, prepared to mitigate it with new equipment or to protect against it with any modifications that might be necessary.

So I think that is a key lesson learned that has been responded to significantly in what the NRC has done in the past few years.

Mr. SIMPSON. Thank you. It is my understanding that the Commission will work to develop and issue a supplemental environmental impact statement for Yucca Mountain, that noncontroversial subject, this year because the Department of Energy will not. Can you lay out for us the schedule to complete the EIS Supplemental? And as you do so, could you please highlight for us what responsibilities and activities the Commission will have to take on as a result of Department of Energy's decision to only provide an update to the 2009 technical report? And can you please tell us how much the Commission will need to spend in 2015 to address EIS Supplemental activities that the Department of Energy completed during the previous EIS process? Do you have sufficient funds to complete the Supplemental?

Mr. BURNS. The basic schedule, Mr. Chairman, is about 12 to 15 months, so perhaps about this time next year we would issue the Supplemental Statement. We do have the funding. You may have mentioned it. There is approximately $4 million left in the carryover funds the agency has. That would be sufficient to cover doing the Supplemental EIS as well as there are some other activities related, primarily the archiving of some of the documents, assuring the documentation on the overall, that we have on the overall application and review process are preserved appropriately. We have been preserving them but there are some others. Those are the steps. We can provide the details if you like. But that is essentially what we would do with that. And I am not sure whether I answered all of the set of your questions, but if I have to, I can try to supplement.

Mr. SIMPSON. That pretty much covers it. I have suggested in the past that we not, as this debate on Yucca Mountain went forward, that we not do anything to ruin that cave because we are going to need a cave that size to store all the study papers that have been done on Yucca Mountain; it is probably the most studied piece of earth on earth. In a report provided to the Committee in August 2014 the cost for the Commission to complete all the activities required to authorize construction at Yucca Mountain was estimated at $330 million. What could the Commission accomplish towards moving the Yucca construction license forward in 2016 and how much would you need to do that if you assume a willing, responsive applicant, and what would you need for the Department of Energy to do in 2016 to support those activities?

Mr. BURNS. As I say the approximate $330 million would be for activities with respect to the NRC's completion of its role. That primary thing beyond this step where I talked about the completion, the EIS, then we have the adjudicatory hearing which is provided for by law; there are close to 300 contentions in front of our licensing board. So much of it would go to that and then I think there are probably some supplemental staff activities if you got through the hearing process. And assuming a favorable decision, you would have some staff activities. My understanding is that I think some-

where in the order to $25–$30 million might be the amount for agency activities reflecting a resumption of the adjudication for the fiscal year 2016 period. Again I think if you have, from my perspective, a willing applicant—because again the significant step you are now in is an adjudication where you in normal terms you expect an advocate for the application, like you would in other types of licensing proceedings. Again because the NRC's role is as a licensing authority and the oversight of the application process.

Mr. SIMPSON. I showed you a coin that I had in my office the other day.

Mr. BURNS. Yes, you did.

Mr. SIMPSON. And it was from 2009. It was a nice coin that they minted. It was to commemorate the application of license for Yucca Mountain. I think that is going to be a historical coin at some point in time.

It is my understanding that Waste Control Specialists, a private company that provides waste treatment storage and disposal has announced their intent to apply for a license for the interim storage of used nuclear fuel by April 2016. In developing the fiscal year 2016 budget request did you estimate the resources that would be needed to process this license and were they included in this budget request?

Mr. BURNS. I believe that they are not in the request. That is my——

Mr. SIMPSON. Can you please discuss what activities were included in the budget for nuclear materials and waste safety? And if Congress does not include more than requested can you tell me that they requested activities will have priority over license applications that were not proposed as part of this request? In other words over WCS?

Mr. BURNS. Well, the activity that are in that part of our budget would reflect other ongoing activities with respect to licensing related to materials, oversight of existing fuel facilities and the like that are within that portion of the budget. I might need to get back to you unless one of my colleagues may want to——

Ms. SVINICKI. If my memory is correct the Waste Control Specialists alert to us for notification came a bit late in our budget formulation process. So we did not. It was not because of any intentional decision, but just because of that timing. We did not include funds explicitly for review or starting the review of such a storage facility application. I should mention that we have a well established regulatory framework for a spent fuel storage installation. It is 10 Code of Federal Regulations, Part 72. So we do not need to come up with a new framework for reviews such as this, and commensurate with that we would anticipate or our staff informs us that resource requirements in the first year would not be significant. I think if funds were not appropriated specifically to support the review our staff has informed the Commission that it would likely be possible to reallocate amongst funds. It is one of our larger budget lines so we should be able—I cannot make a commitment that it would take priority over other work. We would have to look at that, but we do think it could likely be accommodated.

Mr. SIMPSON. Okay.

Mr. OSTENDORFF. I will just add the estimate we received from our staff, Chairman Simpson, was about $3 million. If the application is full and complete and detailed enough—and we have had some experiences in the agency dealing with a similar application back in the 1990s with a private fuel storage facility of a similar nature that was proposed for the State of Utah.

Mr. BARAN. Just briefly to build off Commissioner Ostendorff's remarks, what the staff was telling us was that $3 million was what it probably cost for the safety and security review. You would also have to do an environmental impact statement which would be about $2 million. And their expectation is that process, the review process, would take about three years assuming no contentions were filed. In other words three years without the adjudicatory step. So $5 million over a three year period is their estimate right now without actually, of course, seeing the application.

Mr. SIMPSON. I have had people come to me and talk to me about deep bore hole storage. Have you guys done anything on that? Would they need a license? Obviously they would need a license. Is that a reality? I heard it mentioned just yesterday as a matter of fact.

Mr. BURNS. As far as I know as an agency we have not done anything with respect to the deep bore hole storage. If as you say, if it is an entity that we would have the responsibility to license we would prepare to do what we need to do in terms of the technical criteria and reviewing it. But, to date, as I understand, we have not.

Mr. SIMPSON. An interesting idea.

Ms. SVINICKI. I would just like to distinguish that where deep bore hole is discussed, it is typically a disposal option, not a storage option, so just making that distinguishable case.

Mr. SIMPSON. But it would still need licensing?

Ms. SVINICKI. Yes. It would. And I believe that DOE's Blue Ribbon Commission spoke to this technology option for disposal as something that was promising, but as the regulator we have not conducted any work on it.

Mr. SIMPSON. Okay. I don't know how this—and I just say this for whoever is listening—I don't know how this is going to work out in our budget and stuff. The House obviously believes that Yucca Mountain is the law of the land and we need to be following the laws that exist and we need to proceed down that line. The Senate has a provision that they have tried to implement relative to interim storage, and they have put that in their bill. And so far we have knocked them both out when we conference because as Senator Feinstein and I discussed it is either—it is not one or the other, it is both as far as the House is concerned if you are going to do those. And so I don't know how it is going to work out with the Senate this year. We all know that if Yucca Mountain were to open tomorrow that we would need additional storage beyond that to capacity anyway. So I have been supportive of moving forward with the pilot program and of moving forward with Yucca Mountain, but as I said that is kind of out of the technical area and into the politics area. So, Marcy.

Ms. KAPTUR. Thank you, Mr. Chairman. Chairman Burns, 14 commercial nuclear reactors will go through relicensing over the

next 10 years, and some of these are facing a checkered past of safety concerns. What assurances can you share that due diligence is being taken in the relicensing process and that there will be an emphasis on continued safe operations?

Mr. BURNS. Well, safety is at the heart of everything we do and the touchstone for our requirements, whether we are conducting inspections and oversight or doing undertaking our licensing responsibilities. The Commission's renewal process has been well established. There are about 75 units that have gone through the license renewal process already. License renewal focuses primarily on the aging effects and assuring that those are managed in the renewal term. Beyond just the license renewal we have ongoing oversight, particularly over the last 15 years or so. And partly from lessons learned from our own experience and looking at ourselves as well as the performance of licensees, we developed what we called the Reactor Oversight Process. That is intended to look at the various areas of not only operation but radiation safety and other types of performance, and from our inspection program assess the performance of licensees. So that is what I would call the primary focus in terms of integrating performance, assessing performance, and assuring that there is adequate oversight based on the results of inspections and reports of events and things like that at power plants.

Ms. KAPTUR. If you were to compare the variety of designs in the plants that you will be evaluating for relicensing, compared to a nation like France for example, how many different designs do we have in this country compared to others, and are you thinking about streamlining the number of plants that are out there in order to have more symmetry between what it is we are regulating?

Mr. BURNS. Well, I am not sure I know a particular number. There have been several major vendors within the United States that constructed or provided the design for power plants. For example, Westinghouse, General Electric Corporation, formerly Combustion Engineering Corporation, and Babcock and Wilcox. So there are those basic designs and there may have been variations in terms as they developed. Within France again I won't say there is a single design or one design, but basically my understanding is that the French having obtained the Westinghouse technology then basically adapted it. They have in effect a homegrown facility and essentially have used that design at most of the French installations. What we did in the United States is—and I think this was one of the lessons learned actually coming out of the Three Mile Island accident—was in looking at enhancing standardization. And one of the things that we did in terms of adopting the licensing process we are using now for new reactors is focusing on design certifications that then can be applied in different individual applications. And we have gone through in terms of certifying a number of designs, a Westinghouse design, a General Electric design for example. As I say there are policies, particularly in the '80s and on into the '90s, in terms of enhancing that standardization which I think has benefits to the industry, but it does have benefits I think for us in terms of our oversight and inspection.

Ms. KAPTUR. Does anyone else wish to comment because we have about 100 plants operating in the country? I guess with relicensing the question is can there be more standardization or is that an impossibility? Yes, I think both the Commissioners Svinicki and Ostendorff wish to comment. And I thank you both.

Ms. SVINICKI. Thank you. Speaking to your question about what assurance can the NRC give in terms of the safety of aging plants, I think a key assurance that NRC gives is that any emerging issue will not await a relicensing review, and Chairman Burns spoke to this a bit in his response. Many of the issues that have been encountered, concrete aging for ocean side plants in the northeastern United States, the material corrosion of the vessel head at Davis-Besse. These things do not await any review, the agency takes regulatory action immediately. So I would hope that would be an assurance to the public that we don't store up these issues and wait for any kind of relicensing or license renewal process.

I would draw a key distinction between France and the United States and it is that France has in essence one operator, Electricite de France, and therefore there is greater coherency and consistency among the program they have implemented across their country. And while some speak to a more homogenized power reactor fleet that France has as an advantage, and I am sure it does pose advantages, in the same way that the all of the above energy policy is intended to provide strength through diversity of supply, having diverse designs in the United States is viewed by many as a strength of the U.S. system if there should be some emergent, unpredicted phenomenon or aging management issue that would arise. If you have a diversity of plants you have a greater likelihood that it will not be problematic at all of them and essentially would not be emerging all at the same time. So there are two ways of looking at whether or not there is strength in resiliency and having the same plant built over and over again. That is just a perspective that some have.

Ms. KAPTUR. Of 100 plants in our country, if you could classify them by design, how many different designs do we have? I know it is not 100.

Ms. SVINICKI. It is not 100 designs, but what is interesting is because there are site specific adaptations and then there was knowledge gained over time evolving and improving the designs, candidly the answer many give is that there are 100 different plants. And that is the complexity of NRC's regulatory challenge. Even if the same design has been built it has probably been modified for each location. Now the significance of those adaptations and modifications varies, but I think if the French regulators come here they see a rather dazzling diversity in our fleet compared to their own.

Ms. KAPTUR. You know, the auto industry had to streamline and had to reduce the number of models. And it is still about the task of doing that. And when you have a lot of permutations and combinations, forgetting just that they are nuclear power plants, just mathematically you have more chances for error. Now where that balances, I don't know. I am just saying that I think it is something to really think about in the relicensing process. And looking forward how we use whatever power we have to streamline and to limit the possibility for error, and for mechanical failure and dif-

ferent things that happen inside these plants. I think Commissioner Ostendorff wanted to make a comment as well.

Mr. OSTENDORFF. Yes. Thank you. I wanted to maybe just piggyback on both the Chairman and Commissioner Svinicki's comments. I wanted to talk about just very quickly one program we have that I think gets to part of your concern and that is called a Component Design Basis Inspection Program. It is for our existing operating nuclear power plants. Every three years each of the nuclear power plants in the United States undergoes a five week inspection. That inspection is to look at is the pump that is supposed to pump water, pumping at the hundreds of thousands of gallons per minute it is designed to. Is the electrical distribution system functioning as it is designed to. So on top of some of the aging management concerns that have been alluded to by my colleagues, there is a very deep dive inspection done every three years at each power plant, looking at a focused area to ensure that we have a good understanding of the basic engineering operation and is that plant operating as designed. So I think to a certain extent one of your concerns comes from how do we know that these are safe with the various designs. That is one component we think is very important to our regulatory approach.

The second piece, and this is relating to Commissioner Svinicki's comments, I would say that yes, there are a number of different designs in the United States. At a high level we have pressurized water reactors and boiling water reactors. So two fundamental types of designs, but they are all water cooled. We are not talking about for our commercial power reactors—we don't have molten salt or the high temperature gas reactors, some other experimental designs. So they are in two fundamental families. But what we have seen over decades it that as industry and NRC have worked together to ensure that equipment upgrades are accomplished at these different design plants, we are seeing a convergence on some systems. I will use one example. Many of our systems have gone from analog to digital control systems for feed water control. So you will see a lot of commonality in digital feed water control installations at various nuclear power plants. Just as one example how there is a lot of commonality in upgrade features based on lessons learned and operating experience.

Ms. KAPTUR. Thank you for that. Commissioner Baran, did you want to add something here? You were shaking your head there.

Mr. BARAN. Sure. I agree with everything my colleagues have said. The only other thing I would mention is just as part of the response to Fukushima one of the requirements was that there be equipment on site and also in regional response centers to deal with situations where there was a loss of power at a plant. And one of the things I would mention in terms of standardization is all that equipment and all the connections for that equipment are standard across the country. So the generators, the pumps, those types of equipment. If there was anything that happened, a beyond design basis event, at a plant, an emergency situation, there is equipment that is going to be on site at that plant to deal with that in terms of mitigation, but you could take equipment from any other plant in the country or from the regional response centers, and it would all fit and work at every plant. And so that is a key

kind of standardization development that I think is directly relevant to safety.

Ms. KAPTUR. Chairman Burns, you happened to mention in one meeting that we had about the different ways in which equipment was colored for connections. Do you want to restate that for the record here in trying to standardize for ease of operation?

Mr. BURNS. Yes. What I discussed with you, I had recently visited the North Anna plant which is south of Washington between Fredericksburg and Richmond. And Dominion Power operates North Anna, was one of the lead plants in terms of doing what we call the FLEX equipment, this additional equipment to respond to the beyond design basis accidents, and what they did is a lot of the things that you would expect connections to, cabling or some sort of piping. They would be pumps and things like this. They would have in effect color coding. Color coded so the equipment that you would bring in when you look into the plant that it helps you recognize where you need to make the connections. And I think that is a very good, very smart way of doing things in terms of helping the people who are there, who are under duress because you have got this event going on. They want to make sure the plant is safe. I think it helps them in terms of getting the right things done.

Ms. KAPTUR. I hope that as you proceed in the relicensing process that these kinds of good practices, best practices are shared industry wide. I am sure that you are doing that, but I just want to encourage it in any way that I can having lived through three different incidents in the region that I represent. Anything we can do to streamline, anything we can do to promote safety as this relicensing occurs I think is a very good step.

In that regard, in your testimonies and comments here this morning the one word I have not seen is workforce development and training. And that is of concern to me. As you conduct your affairs what can you tell us about how the NRC engages and provides oversight for the training of nuclear power plant personnel? Not just the in plant operators, but the contract and the critical skills that most often are hired through these contracted relationships. I am talking particularly about plumbers and pipefitters, electricians, boilermakers, who are called in at different points, but they might not be full-time employees of that company. What can NRC do to recognize, engage, elevate the vital importance of these skilled trades people in the operation and repair of our nation's nuclear power endowment, or do you just leave that to somebody else? Or do you think about that training aspect and the regularity of how workers are trained?

Mr. BURNS. You know, I think we do think about it and it is reflected in the requirements that we expect licensees to meet in terms of conducting all of their operations. Now in terms of company personnel, but for contract, contract workers and I think as you and I were discussing, off and on outages where you come and do refurbishment, you may often have—use a contract workforce. And often that is—these are folks sometimes who may go around the country, go other places.

Part of that, the fundamentals go to, and it may not at first blush seem like it is about training, but I think it is, it is things like our quality assurance requirements, that say that in order to

conduct an activity in the plant, the safety-related activity, or other activity important to safety you need to understand what are the things you need to do.

You have to have personnel who are equipped and trained and understand what it is. The environment they are going into, what it is they are expected to do. You know, you may have a sheet that they need to sign off, so critical to that, is understanding that those requirements, and that is an expectation, and that is something, we in terms of our inspections that we audit, with respect to the conformance to those types of requirements.

So at a sort of general overview, I think maybe I will leave my answer there, and then my colleagues might have something they would like to add.

Ms. SVINICKI. If I may, Congresswoman. To the extent your question went to looking to the future and preparing for the workforce of the future. Maybe in the realm of encouraging not so much compelling, but I have engaged with a number of nuclear power plant operators in the United States when I visit their plants. I engage them on the topic of local vocational and technical community colleges, and what I am pleased to hear is that many of them have extensive cooperative programs with local vocational colleges.

I was, as Commissioner Ostendorff notes recently at the Palo Verde Plant out in Arizona, Maricopa County has a community college program. The plant is almost exclusively hiring and helps to design the curriculum for that vocational program. Again, this is welders and maintenance crafts people, trades people. They have worked with the community college to develop the curriculum.

And as a result they are hiring almost exclusively trades people that come out of that program, because they know that they will arrive on site with the right training to the high quality nuclear standards required. The same thing in Bay City, Texas, near the South Texas project. I actually visited the community college there, and engaged with students that are either summer hires, and hope eventually to work full time in various trades roles at nuclear power plants.And I do not kid myself that this was all philanthropy. Frankly, these plants need to have access to a pipeline of workers for the future. And so in their own interest, if nothing else, they have engaged with local trade schools to make sure that they have a pipeline of people who will be ready to do the job on day one.

Ms. KAPTUR. Well, first of all, I congratulate you for going to those institutions. And I would like to invite you to my region, and to meet the people that, three times, prevented catastrophe in our region. And to take a look at the pipeline through which they came in order to do their job, and to consider how we can learn from the matrix of entities that are out there producing this talent, and I think we can do a better job of linkages between those places that are training with those who are doing this incredibly difficult work. And I will be there myself if you come.

Ms. SVINICKI. Thank you. I will take you up on that.

Ms. KAPTUR. Because I think the NRC has something to learn, and to appreciate from what is being done in places like I represent. But I just wanted to point out the absence of that whole

focus on workforce in training in the testimony that was presented today. Thank you, Mr. Chairman. I know there are others waiting.

Mr. SIMPSON. Ms. Lowey.

Ms. LOWEY. Thank you very much, Mr. Chairman. I apologize for coming late. As the Chair knows we have several hearings all scheduled at the same time today. So thank you for being here.

My congressional district includes Indian Point, which houses one decommissioned, two nuclear power plants, owned and operated by Entergy, another country's spectra—another company's spectra has proposed the Algonquin Incremental Market expansion, which is called the AIM Project, which would expand a natural gas pipeline which transverses the Indian Point property.

This is of great concern to me and to many of my constituents, and I strongly believe that the NRC has not adequately investigated the risk nor responded substantively to the concerns that have been raised.

Why did the NRC rely on Entergy's hazards analysis instead of performing an independent analysis of risk and consequences of construction and operation of the AIM Project? That is the first question.

Mr. BURNS. Well, actually Congresswoman, the NRC did review the analysis, and did its own confirmatory analysis of the energy hazard analysis which they are required to submit to us.

Ms. LOWEY. But it was not an independent analysis of risk and consequences of construction and operation, was it?

Mr. BURNS. Well, it was an analysis by our staff. We are independent of the applicant or the licensee. So, from that standpoint I think we provided—our staff did do an analysis and documented that analysis in an inspection report, I think the end of last year, November last year.

Ms. LOWEY. Is this typical procedure, where you rely on the owner's analysis?

Mr. BURNS. Well we expect the owner—I think it is typical that we expect the licensee, who has ultimate responsibility—is responsible for safe operation on the site; we would expect the licensee to submit the analyses, and then we would review that, and reach our conclusions, whether it conformed to the analytical standards or the outcome. And from my understanding that is what the staff did.

Ms. LOWEY. Now, did the NRC evaluate the impact of drilling fluids used in the horizontal directional drilling for AIM on the spent fuel, rod pools located at Indian Point?

Mr. BURNS. My understanding is that the horizontal directional drilling is planned for that portion of the pipeline that runs under the Hudson River, and the Staff does not review or inspect how that drilling will be performed particularly in the river and that location is about a half-mile or so away from the site is a—or the spent fuel pool building, as I understand it.

The spent fuel pool buildings are seismically—qualified seismically designed, and the impact of drilling fluids would not have an impact as we understand it, on those structures. Underground drilling with drilling fluids would have to be very close in proximity to the spent fuel pool buildings in the protected area, for that to be of a safety concern to the agency.

Ms. LOWEY. Well, as I understand it, compared to AIM, there is a smaller pipeline with lower gas pressure near the Turkey Point Nuclear Power Plant, in Homestead, Florida. However, the NRC predicted a greater damage radius in Florida, than it did for AIM at Indian Point. Can you explain why? It does not make any sense.

Mr. BURNS. Well, at the Turkey Point, as I understand it, at the Turkey Point 6 and 7 application, the applicant evaluated the natural gas pipeline near the proposed units, the staff evaluated the potential effects in the same manner as it did for the AIM Project, and the resulting effects were lower Turkey Point due to the smaller sizes of pipeline.

What the applicant at Turkey Point did, is it submitted an analysis that used a very conservative assumption on, I think, on the confined explosion, and it resulted in a larger calculated distance for the pressure release, or pressure wave, than the NRC analysis.

Again, I think that at the core here, the applicant decided to use a very conservative analysis, we thought, using appropriate analyses that were acceptable. If they wanted to use a more conservative analysis they could, but in terms of the outcome, you know, we believe that both the Turkey Point situation and the Indian Point situation were satisfactory.

Ms. LOWEY. Well, another question. I do not understand why the NRC used the ALOHA Manual instead of the NRC regulatory guide 1.91, when it performed a sensitivity study and determined that a delayed closure of the pipeline's isolation valves after rupture would result in only a minimal increase in over-pressure, and heat flux at safety-related structures, systems and components at the plant. The ALOHA Model assumed an incident at the end of the pipeline. Why was a rupture in the middle of the pipeline not considered?

Mr. BURNS. Okay. Again, from my understanding and speaking with the NRC staff, the ALOHA Model calculates the release rate of gas based on the pipeline and its operating characteristics, and computes the resulting effects of a vapor cloud explosion. Jet fire heat flux, and cloud fire based on flammable concentration limits, and since an instantaneous explosion of the pipe rupture is not considered realistic and not computed by the ALOHA Model, the calculated release of gas from using that model was used to determine the amount of gas available for an instantaneous explosion.

Now, the evaluation of instantaneous explosion used in the Regulatory Guide, as opposed to the ALOHA Model, to compute, it is basically used to compute the TNT equivalent for determining the minimum safe distance, where the overpressure would be predicted to occur.

Ms. LOWEY. Well, that was puzzling to me. Does not Regulatory Guide 1.91 have provisions for jet flame, cloud fire and vapor cloud?

Mr. BURNS. Now, essentially, again, my understanding is that the Regulatory Guide 1.91 calculates minimum safe distance by evaluating potential explosion at the source based on a amount of explosives in terms of TNT and in terms of you having a certain amount of TNT at that particular point, and it uses that to evaluate for a potential explosion. There are not provisions in the Reg

Guide for vapor cloud explosion or this heat flux, jet flame or the cloud fire.

Ms. LOWEY. Why is that?

Mr. BURNS. I would have to get my staff to explain that more. Again, I think the idea is that the Reg Guide assumes there is an equivalent explosion to TNT, whatever the source of the explosion is. But we can certainly, for the record, provide you some more information or have the staff brief you or your staff on that issue.

Ms. LOWEY. Well, thank you for your comments. As you can see I have many people, including myself, that have real concerns about the proximity. And I hope we can follow up on that, and have an additional in-depth discussion. Thank you, Mr. Chairman.

Mr. SIMPSON. Thank you. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman. And good morning, everyone. It is great to be with you all. My first question is, can you provide an update on the operating approval process at Watts Bar Unit 2, please? And my follow-up question to that will be, when do you think we can expect to see Unit 2 reactor generating electricity?

Mr. BURNS. TVA has proposed a fuel load date, I think it is in about June this year. I expect to get a recommendation soon from our staff with respect to the licensing decision on Watts Bar 2, you know, assuming there are no issues identified, I think the nominal prediction is, again, assuming they receive the licenses after the final Commission review is toward the end of, for operation, toward the end of this year.

There may be a couple other matters that the Commission has to look at in terms of late contentions or something but that is what I understand the schedule to be.

Mr. FLEISCHMANN. Okay. And then for when it is generating electricity, do you think by the end of this year, is that what——

Mr. BURNS. Again, that depends also on what the Tennessee Valley Authority, plans are. I think some of their announced plans talk about the end of this year, or early next year.

Mr. FLEISCHMANN. Okay. Thank you. I want to turn to a topic that very important to me and I know very important to this entire Sub-Committee, the small modular reactors. They provide an opportunity for clean, reliable energy and this Sub-Committee has been strongly supportive of SMR development. I have got four questions.

How many SMR licenses do you expect to begin reviewing in fiscal year 2016, and was that workload included in the budget request?

Mr. BURNS. I believe we expect one application in 2016, and we did provide for that review in the budget.

Mr. FLEISCHMANN. Can the NRC provide and update of the licensing processing for the new scale of small modular reactor design? And it is my understanding that you are currently working with them at the pre-application stage?

Mr. BURNS. That is correct. And that is the application we expect in 2016.

Mr. FLEISCHMANN. Can you provide the Committee with the timeline for the NRC to complete its review and approval for design certification for the new scale, SMR?

Mr. BURNS. Yes. We can. If I could I would provide that for the record. I do not have it in my head at this point.

Mr. FLEISCHMANN. Fair enough. And we would ask you to do that. Does the NRC require additional funding to complete review of the design certification application for new scales SMR? What about other applications for advanced reactor design?

Mr. BURNS. At this point I do not believe that we require additional funding for that. We have tried to put in the 2016 budget what our expectations are. Some of those expectations are—those expectations reflect our communication with industry in terms of their plans. The same way we have some work with respect to advanced or next generation reactors, that we have on going, and I believe at the current level of activity, are covered within the budget request for 2016.

Mr. FLEISCHMANN. Okay, sir. Can you comment on creating a multinational certification process for future Generation 3 reactors such as SMRs, and Generation 4 type reactors?

Mr. BURNS. Yes. The United States participates, and the NRC is a participant in the Multinational Design Evaluation Program, which is—basically it is supported out of my former organization, the Nuclear Energy Agency, at the OECD in Paris. It was founded, and actually the U.S., among other European regulators, are the ones who founded that initiative, and it is a way of communicating with respect to approaches to design, learning from experience in the development, and implementation of new designs.

The step it has not gone so far as, and I think a step that is probably some time off, is an absolute international harmonization over particular design standards.

In other words, we are not at the point of, say, the airline industry, whereas if you build the aircraft in the United States it is recognized immediately in, say, France or Brazil, or vice versa.

I think we are some time off from that but, again, through this, MDEP, the Multinational Design Evaluation Program, I think there are good steps toward harmonization. Again, communication and learning from experience, and we continue to support that.

Mr. FLEISCHMANN. Well, as a follow up, and I thank you for your answer to that question. As a follow up to that, what are your views of these multinational applications going through country certifications simultaneously, rather than sequentially? And this would help to reduce cost and time to license new reactor designs. Is that correct, sir?

Mr. BURNS. Let me make sure I understand your question. If they went through simultaneously——

Mr. FLEISCHMANN. Simultaneously as opposed to sequentially.

Mr. BURNS. Potentially, the reason I say potentially is because in some circumstances, and we have seen this, and I think in our country, where, there has been great interest in terms of obtaining the U.S. design certification from the NRC because then that is viewed as an effective good housekeeping seal, that is then looked to by other countries in terms of their proceeding with implementation of those particular designs.

Again, to the extent that there is harmonization, I can see, you know, potential benefits. But again, each country, the responsibility under, for example, the Convention on Nuclear Safety is that each

country still needs to make its determination with respect to its regulatory regime whether it meets its safety requirements.

That said, you know, I would agree that, coming to greater harmonization, learning from the experience of others, not only our own country, but from others is a helpful thing.

Mr. FLEISCHMANN. Thank you very much. Appreciate you all. Mr. Chairman, I yield back.

Mr. SIMPSON. Mr. Fortenberry.

Mr. FORTENBERRY. Thank you, Mr. Chairman. Let me address an issue that is, I think should be in forefront of all of our minds. Where are we going in the 21st Century with regard nuclear technology, the proliferation, not only of the intellectual assets, to be able to derive power, but potential military applications.

And then you talked about not yet a harmonization of design standards, but not yet a harmonization of nonproliferation efforts either, some movement in that regard, but clearly with the tensions with Russia, a suspension of a lot of very good, older programs that have helped secure those material. That is where I want to start and specific question would be; in your work, what do you see as the greatest thread to nonproliferation, both domestically as well as internationally?

Mr. BURNS. I think from——

Mr. FORTENBERRY. Are these lines between commercial and military usage blurring?

Mr. BURNS. Well, I think you have always had the issues in terms of those lines.

Mr. FORTENBERRY. Yeah. Just because we create a line, does not mean there is a line.

Mr. BURNS. No. And I would draw on the experience, and in the United States, for example (NSG), has supported the effort of, say, the Nuclear Suppliers Group, in terms of looking at dual use technologies and assuring—getting high assurance that technology is used appropriately in civilian applications.

Mr. FORTENBERRY. Which has been very helpful, obviously as an entity outside formal regulatory authority to regulating this dynamic.

Mr. BURNS. Yes. But we also have as I said about the NSG, is essentially much like this Multinational Design Evaluation Program I spoke to. A cooperative effort of various states and various suppliers in the nonproliferation community, particularly through the IAEA. Within our own country we have, again, requirements with respect to export controls and export reviews.

We have responsibility in that area, as does the Department of Commerce and the Department of Energy. So I think those efforts—I think those are the efforts that are important in terms of a country-specific application and implementation.

Mr. FORTENBERRY. Is it enough?

Mr. BURNS. I think what we have today needs——

Mr. FORTENBERRY. What you have got going on, the technology is out of bottle, so to speak. The ability to do these things is widespread now, much more widespread, and will continue to grow. So that comes down to then, control of materials which, hopefully, will always be in the hands of nation states. In some places nation states, the whole concept is under threat and is collapsing.

So, again, it creates—we ought to constantly be reevaluating our framework here, which is going back decades to an era where we decided that we are going to have Atoms For Peace. There is going to be peaceful nuclear usages. And there is going to be a military dimension in our country that is an important component of our own deterrents from the use of military weapons.

Yet at the same time, again, lines of distinction are not as neat as they used to be and with enhanced capabilities through, again, the intellectual capabilities of doing this stuff, are we in front of that curve. We also have enhancement of, though interconnectedness with other countries to harmonize efforts as never before, but are we in front of it?

Mr. BURNS. I am not sure. I do not think I would say we are behind it. I think this is something we looked at, we learned from experience, we have learned from the information we have, that we receive, in terms of the nature of the threat that is out there.

We have requirements, as we are obligated to do in the United States under our treaty obligations with respect to material accounting and control.

Again, I think within our export policies and in terms of our implementation, I think those are effective. By the same token, I would not disagree that greater awareness and thinking about the context in which we are internationally, particularly since I started out as a young lawyer in the late 1970s, we are certainly more interconnected with respect to civilian nuclear technology, components come from all the world. e-Commerce is all over the world.

Mr. FORTENBERRY. Can we have a robust, full, and complete understanding of that inventory?

Mr. BURNS. The inventory? I think we can have a complete understanding or at least a robust understanding of inventory with respect to material within the United States. I think that is the objective. Do we know where every widget, component, et cetera, goes? Probably not.

Mr. FORTENBERRY. This begs the earlier point of what can we do better in this regard.

Mr. BURNS. We would probably say we can always do better, but again, I think we have a regime that in terms of looking at items that are, for example, dual use items, items that are controlled for export, that addresses the threat and addresses the national interest.

I think a lot of what we can do is make sure we are dedicated to implementing that and carrying through on it.

Mr. FORTENBERRY. I can come back, Mr. Chairman, if the time is up, or I can keep going, either way.

Mr. SIMPSON. How much longer do you have?

Mr. FORTENBERRY. One minute.

Mr. SIMPSON. Go ahead.

Mr. FORTENBERRY. Back to this issue of inventory of material, ultimately, again, a new architecture of non-proliferation, if we are going to continue down the same pathway and ensuring that commercial uses are not readily transferrable to military uses, and if we are going to clean up messes and identify prior material that has been out there and that is loose, and then secure that going

forward, does it not beg a construct that has all inventory counted everywhere?

Mr. BURNS. It is good to know where everything is. Again, I think within this country, we have pretty high standards, and I think we do that. This has been an issue certainly at the fall of the Soviet Union and efforts that were undertaken both on a bilateral and multilateral basis to address that, try to address those issues.

Again, I think that within our own country we have done pretty well.

Mr. OSTENDORFF. Can I add? I used to be the number two official of the National Nuclear Security Administration where all the DOE non-proliferation programs resided, and have been watching this area for a number of years, from my time in the military, my time working for the House Armed Services Committee, and then for the last five years, NRC.

I would say this Commission has been heavily engaged with the White House, Department of State, Department of Energy, the intelligence community, to ensure that we have proper situational awareness of where the materials are outside of our country.

I think with the advent of the Nunn-Lugar programs in the 1990s, there was a lot of stuff that was found 20 years ago that surprised a lot of people. I think our awareness today in 2015 is infinitely better than where it was 20 years ago.

We do not have authority as an agency to conduct our own assessments overseas, but we are fully plugged in with the interagency group and the intelligence community to have the awareness that I think is your concern.

Mr. FORTENBERRY. This is the key, because you are not going to be able to control the technology, the information technology, like we were able. It is the flow of material. That is the key if we are going to keep ourselves safe.

Thank you, Mr. Chairman.

Mr. SIMPSON. Mr. Valadao.

Mr. VALADAO. Thank you, Chairman. Thank you very much for coming out and spending some time with us as well.

The NRC is proposing to amend its regulations related to the medical use of by-product material. It has been suggested that the training requirements for physicians treating patients with therapeutic radiopharmaceuticals can vary widely, depending on the drug.

Is it currently the case or is the NRC proposing a rule that would make this the case? How does the NRC determine physician training requirements?

Mr. BURNS. I am sorry, Congressman. I may have to provide that for the record. I am not sure of the status. There was a rulemaking effort. I am not sure exactly of the status of where it is now. I will be happy to provide you the full information on that.

Mr. VALADAO. I will skip the next one on the same issue. The decommission sites, the U.S. Nuclear Regulatory Commission, NRC, held a public briefing on July 15, 2014 to give the Commission an overview of the nuclear power plant decommissioning process, status, and issues related to the four nuclear plants that recently entered decommissioning, including San Onofre nuclear plant, in my home state.

Chairman Burns, can you briefly describe the challenges of decommissioned plants and the public reaction, and do you expect additional plants to enter the decommissioning process in 2016?

Mr. BURNS. To answer the last question first, we do not expect additional plants in 2016. We have not been informed of that, recognizing there are some plants that some utilities may be evaluating because of some of the economic challenges that I think the chairman noted at the beginning.

What we are doing now, we have successfully gone through the decommissioning process with a number of facilities, and as you know, more recently we have had five facilities come into the decommissioning process.

One of the things the Commission has done is ask the staff to undertake a rulemaking to ensure that we have an effective and efficient process there. The way primarily we have gone through the process now often requires the utility or the licensee to ask for exemptions from our requirements, although that has been effective from the standpoint that we maintain health and safety, it is a bit cumbersome sometimes, and also in terms of the perceptions of the local community about what is going on, or sometimes it may not be as best communicated as it can be.

That is the thing we are looking at. Again, licensees, we have had a well established process for them in terms of what they need to address from a safety standpoint, security standpoint, and to work to those requirements.

As I say, we are working through the process now, and we hope to get a rule in a few years that would make it a little more effective and coherent.

Mr. VALADAO. Thank you. Thanks a lot, Chairman.

Mr. SIMPSON. Thank you. You are the first one that made the mistake of the NRCC. I thought about that all the time. The NRCC is the National Republican Congressional Committee. We get them confused all the time.

Let me delve in a little bit about the operations of the NRC itself. As you noted, the Commission has received the Project AIM Report and is in the process of reviewing recommendations. Although you are still reviewing the report, were you able to incorporate any of the Project AIM recommendations into the fiscal year 2016 budget request?

The report recommends that the NRC—brilliantly recommends—that it have the right number of people with the right skills at the right time. Easier said than done sometimes. The Commission must be staffed at a level that can respond to the needs of the nuclear industry but licensing fees should not make it harder for nuclear energy companies to compete.

I think most of you mentioned at one point during your testimony today about right sizing the agency. What exactly do you mean by "right sizing the agency," where is un-right sized now, and what needs to be done to address that, if you will.

Mr. BURNS. Yes. The particulars of the AIM Report were not the fiscal 2016 budget, given the timing. The report came out at about the time, I think, the budget was released or submitted to Congress.

The idea, I think, in the Commission in developing the 2016 budget was focused on are we concentrating our resources on the work that needs to be done, and that is both the importance of our safety oversight mission, safety and security oversight mission, and also in terms of the licensing work that is put on our plate.

Overall, it reflects a reduction in terms of the overall resources that are available in 2015 to 2016. It is looking at those areas where there is not as much a need for resources. Some of that area will be in the nuclear reactor area because of the number of applications is not what it was expected to be say six or seven years ago, as I noted in my statement.

Let me stop there. If there is something I did not answer in your set of questions, I would be happy to.

Mr. SIMPSON. Are there others who would like to comment on right sizing the agency and what exactly that means? Kristine?

Ms. SVINICKI. One of the things that the Commission is deliberating on now both in terms of embarking upon it and what form it might take is what is called a "rebaselining."

In our prior careers, many of us know if there is a major Government acquisition or long multi-year construction project, at some point, departments and agencies will rebaseline that project. It is to make sure that you have fundamental adherence to what you were trying to accomplish, you do not have a lot of mission creep, a lot of bells and whistles.

Rebaselining for NRC, if we pursue it, may take a form of looking at work in-house, work projections, truing that up to the world as we understand it now, and then deciding what skill sets and people you would need to have, and then creating the organizational agility to move those people to that work, perhaps with better performance than we have done to date.

We have seen some of the vectors in the external economy emerging for a number of years now, and we still find that we have bureaucratic obstacles to moving people to work that is needed.

I think to a person, we all feel like that should not be, so we are going to look organizationally at having a better understanding. I know it sounds so straightforward, and to me, "right sizing" means we probably think we are maybe a little larger than we need to be, to be real honest with you.

If we thought we were under-sized, we would not have asked for a budget flat or declining. By virtue of mathematics, I think you define "right sizing" to mean we need to perhaps trim down in some areas. We may have other skill sets that are critical and in shortage.

My understanding is the NRC has not rebaselined fundamentally, I think, in 15 years. I think an agency in my personal opinion can benefit from going back to just looking at the fundamentals every now and then and seeing if you are in alignment with the world as it exists, although we are still deliberating on a set of recommendations.

Mr. SIMPSON. I would agree with that. I would note that over the years, I have been very supportive of increased staffing that was necessary at the NRC or that we thought was going to be necessary, for example, for SMRs.

We wanted to make sure there was not delays in doing the license applications and stuff that we thought would be coming along because of insufficient staff. We have plussed up the staff in order to make sure they were available, and then we do not have the license applications that we originally thought maybe three or four years ago might come at this time.

They might be there in the future. We might need those personnel at the time.

It is a constantly changing environment, and the nuclear renaissance that we thought was going to be bigger than it currently is, we thought we would maybe have several more reactors that we would be licensing around the country than we currently do.

Rebaselining, right sizing, whatever you want to call it, I think is an appropriate thing to do.

How do you determine what your fees are going to be that you are going to charge the industry? Ninety percent of your budget comes from fees charged to industry; right?

Mr. BURNS. Correct.

Mr. SIMPSON. How do you determine what that is going to be?

Mr. BURNS. Ultimately, it is based on the final appropriation that we receive, and I believe in consultation, in terms of both the estimate of the types of applications that come in.

As you may recall, there are two types of fees. There is in effect a fee for service, for example. An applicant comes in and wants a license amendment or a new license. There is a fee paid there. Then there is in effect an annual fee that is imposed on operating power reactors.

Mr. SIMPSON. How much of that 90 percent is from fees that are charged because someone wants an application or an amendment or something like that? How much of it in the base out there that is charged to everybody?

Mr. BURNS. My CFO is telling me apparently it is about one-third related to applications, the so-called Part 170 fee, so that would mean about two-thirds are derived from the annual fee.

Mr. SIMPSON. A key outcome of the Project AIM recommendations is the development of an overhead structure that is well defined, reasonable, and acceptable to external stakeholders.

How have or will you involve stakeholders in the transformation of your budget process?

Mr. BURNS. What we have done through the AIM process, we have engaged stakeholders on that. I think we will continue to do that as we implement—I forecast, as Commissioner Svinicki says, we have not completed deliberations, but I think it may be safe to say to the extent where these things have impact on the stakeholders, I think it is important to engage them as we go forward, so that we understand what the concerns are and then in reaching some solution, we have something that is workable and effective.

Mr. SIMPSON. In your testimony, you mentioned that the Commission has recently received a benchmarking report looking at how the NRC fee practices compare with those of other regulatory agencies.

What has the NRC learned from this report, and how does the NRC fee practices compare, and how has this information been incorporated in the fiscal year 2015 rule fee?

Mr. BURNS. I think we are in the process of still getting the report. Apparently, we just received a draft report, and our CFO will be taking a look at it. I would imagine to the extent it is relevant, again, the rule that was published yesterday was a proposed rule, and I think to the extent that it helps us, from my standpoint, understand where we ought to be with the final rule, we would take that into consideration.

Mr. SIMPSON. I look forward to seeing how these changes are being implemented and how the Commission is working to do that.

I am a little concerned in the effort to streamline the rulemaking process. The NRC staff now spends significant resources on new rulemaking efforts—we talked about this yesterday—prior to obtaining Commission approval.

How is the need for a new rule determined? Is that a staff driven decision or is that a Commission driven decision?

Mr. BURNS. For the most part, Commission driven decisions. The staff, obviously, we rely on our staff from looking at things, like operating experience, industry requests, or the like, to identify areas where there might be a need for a new rule or modification of existing rules.

For most rulemaking actions, it requires Commission approval.

Mr. SIMPSON. At what stage does it require Commission approval?

Mr. BURNS. For the most part, it would require approval at the proposed stage.

Ms. SVINICKI. If I may bring to the subcommittee's attention something that I recently discovered. It occurred in 2006. I joined our Commission in 2008.

Once again, forecasting a strong nuclear renaissance in the United States, in 2006, the Commission undertook to delegate to the agency staff a significant set of what I call "front-end Commission approval and involvement steps" in looking at what rulemaking's would be embarked upon.

Again, I would expect that Commission in 2006 thought they were going to be facing a crushing agency workload related to having 28 new reactors under construction and the various things that were forecast in that time period, and they did not think it was sustainable for the Commission to be so involved in the early approval steps for new rulemaking activities before they were embarked upon.

These were steps such as requiring the staff submittal to the Commission of a rulemaking plan, requiring the submittal of early regulatory analyses. Again, these are precursors well in advance of a proposed rule stage.

The Commission delegated many of those activities to office directors and waived wholesale other requirements, such as—although the sound of this committee is a bit strange, we have a committee to review generic requirements, and it is a body made up of senior staff that looks across programs, and in some ways is looking at the cumulative impact of agency rulemaking activities. The requirement for review by that committee was waived and was left entirely discretionary to agency staff.

I think some of these steps, while I am sure well intentioned and probably well merited given what they predicted in 2006, were key

in involvement of the Commission, which in my view, has a unique opportunity to look across programs in the agency that office directors simply do not have that perspective.

As we look at having X number of rulemaking's, either active or inactive, ongoing, people throw around this number of 60 rulemaking's, I challenge myself as to whether that change in the Commission's involvement in 2006 perhaps had some impact to where we are today. I have not engaged my colleagues on this research I just discovered in the last couple of weeks. I was not aware this significant change had been made at that time.

I think again it is nearly 10 years later, is it worth the Commission maybe looking at that? Possibly. I hope to engage my colleagues on that.

Mr. SIMPSON. Commissioner Ostendorff.

Mr. OSTENDORFF. I would add to Commissioner Svinicki's comments to say in our current deliberations by the Commission on Project AIM, this is one specific aspect that I believe will be discussed and vetted, and I cannot predict the outcome in the context of the rebaselining of work effort mentioned by others.

Mr. SIMPSON. I am just curious. I am trying to get this in my head. If the staff is out there working in a particular area and they decide this is something we need to actually write a rule on, how far do they go before the Commission has to say yes, that is an area we need a rule written on? How much work and money is expended on looking at proposed rules before the Commission gets involved and says yes, proceed with that, or no, we do not need that? Where do you step in, at what point?

Mr. BURNS. Again——

Mr. SIMPSON. As you can tell, I am a little bit concerned about staff driven rules rather than Commission driven rules.

Mr. BURNS. Certainly. No, I understand that. As Commissioner Svinicki said or indicated, I was not particularly aware of some of the information in terms of this.

Again, as Commissioner Ostendorff said, I think this is something right for us to look at. The Commission can always step in. We have the responsibility. We have the ability to obtain—each Commissioner individually can obtain the information they want to carry out as they see fit their responsibilities.

We as a collegial body can reverse a direction on a particular thing, and I think the importance for us is even if we have a circumstance now where there may be some rulemaking activity that may be going on that does not formally come for the approval, we actually have the ability to do that and maintain awareness. We do get reports from our staff on various activities.

I think the responsibility rests with us in terms of obtaining that oversight and awareness of what is going on.

Mr. SIMPSON. Well, I will tell you what drives part of my concern I guess. When we on the one hand talk about right sizing the agency, which we talk about right sizing the agency. And on the other hand, we talk about rules being driven. I have been around long enough, both at state and federal level, to know that bureaucracies have a tendency to, when hands are idle, we think of things to do. And that concerns me to some degree, and I am just wondering how much of this thinking of things to do drives some of the rules,

if at all. I don't know. But I have heard concerns about the number of rules and so forth, and I am trying to drive at where is the Commission's responsibility versus how far can these go before the Commission actually gets involved? I know you can get involved at any stage along the way, but do you? And that is why I ask these set of questions. So it is an issue that we will continue to look at. Marcy.

Ms. KAPTUR. Thank you, Mr. Chairman. Chairman Burns, on the issue of the continued storage of spent nuclear fuel, the NRC determined that spent fuel could be safely stored on site well past the reactor's life span. I understand that there is a legal challenge to the NRC's waste confidence rule. Could you give us an update on the status of that challenge please?

Mr. BURNS. Certainly. The continued storage rule is really a, well, a continuation if you will of the Commission's previous waste confidence rule. The waste confidence rule of course dated from the early 1980s. The challenge, the petitioners who were challenging the agency's final rule now called continued storage, have filed for a petition for review in the Court of Appeals I believe here in the District of Columbia Circuit.

And my understanding is that the expectation is the briefing will be done before the court toward the latter part of this year. The general counsel is confirming my impression.

Ms. KAPTUR. What do you expect the challenger's argument will be in court?

Mr. BURNS. I haven't read the petitions for review, which are normally often very general or very cursory at this stage of the proceeding. Again, I think they will question the Commission's conclusions with respect to the outcome of the rule itself. I think the Commission's action was completed before I came onto the Commission in November. But having been involved in this rule as general counsel before and my experience with it, I think the staff has done a good job in terms of considering the various comments on the rule and establishing a firm basis for it. So we will put ourselves in front of the court and the process allows it to be.

Ms. KAPTUR. Should the court side with the challengers, what would be the impact to the rule and by extension to the operating plans?

Mr. BURNS. I wouldn't want to speculate too much because again, it depends on what the court says. There are circumstances which the court may say, you need to correct and effect, there might be some procedural issues you need to correct. But the court might say, we are not going to stay the agency's actions in other cases, and it could be the opposite. So I wouldn't want to speculate too much on that. Again, if the court thinks we need to do something else, again, I think we are confident that we have done a good job already. But if there is something we will do, we will address what the court tells us to do.

Ms. KAPTUR. Thank you. I am very impressed with this panel, Mr. Chairman. I think it is energized. It is informed, and I am really glad that you invited this number of people up. They seem quite awake and attuned to the challenges ahead. I just wanted to go back to an experience that I have had and share it with you, because you might be in a position to do something about it.

Commissioner Ostendorff, you having come from the military will maybe identify with what I am saying here. I view working in these plants as not just another job. And what has surprised me over the years in our region where we have had very serious challenges, those that actually helped both the company and the public, were never properly acknowledged. In the military, when you do something really exceptional you get a battle ribbon.

When you are part of a corps that has a brotherhood and sisterhood, your commander even has a special medal that is struck that he hands to special people that meets along the way. And I have been actually surprised and disappointed that we haven't done more to recognize these exceptional Americans. I don't think they even got a letter from the governor of the United States for preventing hazard in our region.

So I am just asking you, and I don't know who could actually do it, but you have how many staff that work at the NRC?

Mr. BURNS. About 3,700.

Ms. KAPTUR. Three thousand seven hundred people. There must be somebody there somewhere that cares about people who work in these plants, either directly or on contract, and could help us figure out when they do something great, like, they run into a plant that is at a critical moment and at risk to their own lives, they have done things that have stopped damage. My gosh, they should have a big medal, and they get nothing.

So I am just saying to you, if somebody could look at the workforce issue. I have invited Commissioner Svinicki out to our area, and you are all welcome, I want you to meet some of these people. And maybe as you go through these plants, by happenstance you bump into them. But they are remarkable. I couldn't do what they do. I don't have the muscular strength to do some of what they do and the training they go through. I just think that there should be something initiated that acknowledges their importance and recognizes it when they do something great. And I don't think we do that as a country at the NRC. And I don't know why we don't. If you don't have legislative authority to do it, let me know. But I think it could be done under the existing authorities that you have.

So all I am asking you to do is to think hard about where something remarkable has been done, to figure out a system of acknowledgement. I am not asking for any money. Maybe you would have to pay for a little patch they could sew on their uniform. For those that are contracted employees, who regularly go into some of these plants, they work so humbly. And they just don't get any recognition of a national nature and I think they deserve it.

So they are not military. They receive their own apprenticeship and journeymen's cards in the community that I represent. And I really respect them, and I think our federal government should to. Do you have a means to think about this within the NRC? Do you need a formal letter from me to ask you to think about how to identify some of these folks? Yes Commissioner Ostendorff?

Mr. OSTENDORFF. I appreciate it. I think all four commissioners here agree with the sentiment and the spirit behind your remarks and your question. Let us provide some feedback to you on this area if we may. I think that there are some industry representatives even in this hearing today. I do believe, from our experience

collectively, when we go to nuclear power plants we will see some indication that various licensees are providing some recognition to their employees. But I would like to have the opportunity to give you a more fulsome response and in addition, what else we might be able to do.

Ms. KAPTUR. Yeah, I really think some of these folks that helped us 25 years ago or more, they are still alive. The incident that occurred in 2003 I think it was, some of the workers who were contract workers ended up staying in motels where they moved from plant to plant, where nuclear particles were on their work clothes. I am going, is this really happening?

So I just think there is something missing in the way we treat the people. The worst example I have of how people have been treated in nuclear power plants is the example of under the former Soviet Union when Chernobyl occurred and workers were sent in with no protective. They were sent in to their deaths, right.

We don't have that situation here in this country. We have more respect for those who have these skills. But I just think that we need to regularize recognition. I don't know how one does that working with the private sector because these are private plants. But I think when workers who are contracted workers go into a facility that is having difficulty, their national government should care about them and should acknowledge that service to our country. And with the private sector, we need to figure out how to do that. And if you could tell me who to work with within the NRC, I will be your strongest advocate because they deserve a recognition that they never get.

So thank you for allowing me to put that on the record. I wanted to ask, on securing radiological material, the omnibus included direction that the NRC provide a report to the committees that evaluate the effectiveness of the requirements of 10CFR part 37 and determines whether such requirements are adequate to protect high risk radiological material. Has the NRC initiated this review, and can you speak to what you have found if you have or how you are implementing the requirements for radiological source licenses?

Mr. BURNS. Congress set the requirement basically to do a review after two years, and we will be prepared to do that. I am sure that we will take some steps before we reach the two year mark to get there. Part of the background on the requirement was to allow a period of time for implementation of this part 37 that addresses source security because there is a fairly new rule. And so we will do that. We are very conscientious about the requirement to do the review, and we will do so.

One of the things that the agency—part of the background of this too is a requirement that goes back to the Energy Policy Act of 2005 related to source security. And there is a periodic task force that the NRC and other sister agencies who have an interest in it participate in. And there was a report last year which concluded that there were essentially no gaps in domestic source security. But again, I think it is important for us to follow through on the language because we have a new rule. You want to understand from the experience with your implementation, is it doing what you tried to design it to do?

And so we will take that on in terms of doing the report within the next two years that was requested.

Ms. KAPTUR. Thank you. Mr. Chairman in closing, this will be my last comment, your leadership Chairman Burns is so important and every one of the commissioners. I have been impressed with every one of you this morning. And I have had to deal with the NRC now for over three decades. Without leadership being set at the top for a well managed organization, things happen downstream that are very dangerous.

And so I just encourage you to set the kind of leadership to revive the NRC and its multiple connections around the country, to managing this very important asset that exist within the United States of America. And I wish you well in your duties and to enliven your board, to keep your board engaged and make sure that the Commission does what it is chartered to do. And thank you very much for your testimony this morning.

Mr. BURNS. Thank you.

Mr. SIMPSON. Mr. Fortenberry.

Mr. FORTENBERRY. What is the future of the nuclear industry?

Mr. BURNS. Well, as the regulator, I am not sure that I am really the one to speak to that from——

Mr. FORTENBERRY. But you could look at the trajectory of the current dynamics, both here and internationally and give me a—since you are immersed in this world. It would be helpful to have your perspective on that.

Mr. BURNS. And again, I will perhaps take from my prior experience.

Mr. FORTENBERRY. I just looked at you. Anybody else can answer it if they want.

Mr. BURNS. Well, what you see, you see a very dynamic and concentrated building program in China and other interests in emerging, what we call emerging nuclear countries such as Vietnam. India, now that it is mostly back into the fold, has a vigorous program. So that is what you are seeing, and then the Gulf states as well. So that is what sort of picture you are seeing internationally. It is a cloudier picture in Europe, although you have the United Kingdom. And in Eastern Europe, a lot of interest in new nuclear development.

In the U.S. you have, again, a dynamic that between things like cheap natural gas, questions in terms of how the energy market is regulated or unregulated and things like that, that have led to the current lower interest in pursuing some of the applications we thought we might have a few years ago.

That said, as we recently had a hearing on the Detroit Edison, or as they are renamed, the Fermi 3 plant in Michigan, and there is also Dominion and its potential for North Anna 3. Both of those utilities have indicated to us they are interested in pursuing the combined licenses, partly as part of their future planning portfolio. They will defer a decision whether they will actually construct until the early 2020s, again, looking at energy markets, issues about carbon pricing and things like that. All of which are fairly much outside the NRC's regulatory regime.

Mr. FORTENBERRY. But in the race for commercial markets, who is leading that? You said it is very dynamic?

Mr. BURNS. Well, what I said is in China you have an extraordinary vigorous construction program. You have had US technology in terms of Westinghouse. They are building the AP1000, but the Chinese have also looked at interests in others, such as Areva designs and have built them, Areva, the French company. So again, you have U.S.-based marketing from the US based industry as well as other players in the market. The Russians are very vigorous in terms of their marketing strategies for their newer designs.

Mr. FORTENBERRY. So if we have got no harmonization of design standards, do we have harmonization of security initiatives? Not only in terms of actual commercial plant protection, but again, applying these lessons for the potential diversion of materials or accounting for materials.

Mr. BURNS. Well, in terms of the designs themselves, I think in terms of material accounting and control, that is not so much in the reactor design. That is in terms of the fuel and the types of fuels that are used. And again, I would say with respect to——

Mr. FORTENBERRY. I don't want to impose on things that are outside your purview, but again, sitting from where I sit, when you look across the spectrum of nuclear security issues, you operate within a certain set of parameters, ensuring that we have commercially licensed, safe use of radiological materials here. However, this has implications moving forward in a world of fast moving technology and new resource players with large capacity, to make us all think critically as to how again, back to your words, which I like, harmonization either of design, but certainly harmonization of commitments to material security as well as non-proliferation, is the key question. And you might occupy a sort of narrower seat in that bandwidth, and I understand that. So I won't put you in an awkward position.

But at the same time, in terms of all of us working strategically to ensure that your mission is met, these other questions loom very large as well, I would assume for you.

Mr. BURNS. Oh, yes, they certainly do. And again, in terms of us looking at designs, obviously in many instances we are looking at the design in the United States. But as I said, we have responsibilities with respect to potential export of design and export of particular equipment.

I think as Commissioner Ostendorff said earlier, we work well within the inter agency community in terms of those types of issues. And again, there are controls domestically, we have our safety, our security. We have safeguards, requirements, and again to the extent that we are involved in terms of approval of exports and export of technology, that is part of our responsibility. And also working with the inter agency community, particularly Department of Energy, Department of Commerce in some of these other areas.

Mr. FORTENBERRY. Thank you, Mr. Chairman.

Mr. SIMPSON. I thank you all for being here, Chairman Burns and Members of the Commission. Normally for the 12, 13 years, whatever it has been that I have been on this committee, whenever we have had the NRC testify, we have always had the chairman come up and give the budget requests and stuff. And I think it was important to have all the commissioners come up, so that we had a chance to get to know you and talk to you. And I know that you

don't all think the same thing. If you did, only one of you would be necessary.

But it is good for us to get a chance to know you a little better and talk to you about the important work that the NRC does because it is vitally important work. And it is very critical that the NRC maintain the credibility that currently, I think exists and has across the country, both for the public to know that we have safe, nuclear operating plants in this country and also for the regulated industry to know that you are working with them to make sure that we are not unduly driving the cost and making nuclear energy less competitive or anything like that.

So I appreciate the challenge that you face. We look forward to working with you and hearing about how you are implementing some of the rebaselining or whatever you want to call it and the rule making processes that you are going through and those types of things. So thank you all for being here today. Committee is adjourned.

QUESTIONS FOR THE RECORD
SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing on the 2016 Budget Request for the
Nuclear Regulatory Commission
Tuesday, March 24, 2015

NUCLEAR REGULATORY COMMISSION

LICENSE RENEWAL

Subcommittee. The NRC has established a license renewal process that will allow commercial power reactors to renew their licenses for an additional 20 years.

Is the NRC ready to process renewal applications when they are submitted? What activities and resources are included in this year's budget request to address license renewals?

It is my understanding that the NRC standard to complete the review of an initial license is 22 months. Since these applications will be for renewals, will the completion standard be shorter? If not, why?

What are the biggest challenges in approving subsequent license renewals?

Chairman Burns. Based on discussions with the nuclear industry, the staff expects the first application for subsequent license renewal to be submitted in 2018 or later. To support that timeline, NRC staff plan to issue the final guidance documents for subsequent license renewal in 2017. NRC's current regulations support the receipt and review of a subsequent license renewal application. The staff is continuing to develop guidance for subsequent license renewals. A key activity of this guidance development is a series of public meetings in which the NRC staff meets with stakeholders, including industry, to discuss technical issues relating to subsequent license renewal. These public meetings also enable staff to hear from stakeholders regarding potential issues related to an effective subsequent license renewal process. Staff anticipates that the regulatory and technical frameworks will be in place to accept and review applications for subsequent license renewal. The FY 2016 budget request includes 9.5 full time staff and $698K for completing these activities.

Once the NRC's process for reviewing initial license renewal applications (the first 20- year extensions) was well established, the NRC's expectation for time to complete the review and make a licensing decision was 22 months, assuming there were no hearings on the application. In establishing the key issues that must be addressed and satisfactory responses to these issues for the subsequent license renewal period (the second 20 year extension), the review and licensing decision may exceed 22 months for the first applications. The aging issues for the affected nuclear reactor components will have to be addressed either generically or on an individual plant basis.

The results of industry's research to address the major technical issues may not be available in time to meet the needs of the first applicants for subsequent license renewal. If the industry has not provided the generic technical basis to address these issues, the NRC will require applicants to address them on a plant-specific basis, which may require a longer review and approval time. Once the initial plant reviews are conducted for the subsequent license renewal period, the NRC will develop a time-based goal to complete the reviews of subsequent license renewal applications.

The biggest challenges for the NRC and the industry will be addressing the major technical issues for operation beyond 60 years. Based on the information extensively reviewed over the past several years (see NUREG-1925, Revision 2, "Research Activities, FY2012-FY2014"), the NRC staff currently considers the most significant technical issues challenging power reactor operation beyond 60 years to be:

- Management of the adverse effects of high neutron exposure on the reactor pressure vessel;

- Irradiation-assisted stress corrosion cracking of reactor internals and primary system components;

- Concrete and containment degradation; and

- Electrical cable qualification and condition assessment.

An understanding of the causes and control of degradation mechanisms is necessary to form the basis for developing aging management programs to ensure the functionality and safety margins of nuclear power plant systems, structures, and components remain intact. The resolution to these issues must provide reasonable assurance of safe operation of the systems, structures, and components in the scope of license renewal during the subsequent period of extended operation.

POST -FUKUSHIMA SAFETY ENHANCEMENTS

Subcommittee. Is has been four years now since the Fukushima accident. It is reassuring to hear of Commissioner Ostendorff's confidence in the safety of our nuclear power plants, particularly given his expertise in this area.

Could you please highlight for us some of the Near Term Task Force work that has been included in the fiscal year 2016 budget request?

What recommendations are being deferred into the future?

Commissioner Ostendorff. In July 2011, the NRC's Near-Term Task Force {NTIF) provided recommendations to enhance the safety of U.S. nuclear power plants in light of lessons learned from the Fukushima Dai-ichi accident These recommendations became the foundation of the NRC's post-Fukushima initiatives but have been shaped and advanced by many more of the agency's staff experts in the four years since the accident. The Commission approved a three-tiered prioritization of the recommendations, with Tier 1 recommendations being those that the staff determined should be started without unnecessary delay and for which sufficient resources, including availability of critical skill sets, existed. The most significant Fukushima-related work included in the fiscal year 2016 budget request is associated with implementation of these high-priority recommendations.

As an example of ongoing Tier 1 work, on March 12, 2012, the NRC issued an order requiring all U.S. nuclear power plants to implement strategies that will allow them to cope without their normal and emergency electrical power sources and without normal access to their ultimate heat sink for an indefinite period of time. These strategies must keep the reactor core and spent fuel pool cool, and protect the containment buildings that surround each reactor. The mitigation strategies include three phases that consist of: {1) the use of installed and protected equipment that is immediately available (e.g., batteries and steam-driven pumps), (2) additional portable equipment that is stored on-site, and (3) equipment that can be flown or trucked to the site from newly-established industry support centers. Licensees are currently in the process of implementing this order and nearly all safety enhancements will be in place by the end of 2016. Throughout fiscal year 2016, the NRC will be reviewing licensees' final integrated plans for compliance with the order, conducting site audits to evaluate and resolve open items, and preparing and issuing final safety evaluations. The NRC will also be conducting on- site inspections to verify licensee compliance with the order and finalizing programs necessary for long-

term oversight of licensees' mitigating strategies through, for example, inspection program enhancements and inspector training.

Throughout fiscal year 2016, the NRC will also continue work on the reevaluation of flooding and seismic hazards for U.S. nuclear power plants. As part of a March 12, 2012, request for information, the NRC required U.S. nuclear power plants to use present-day methods to reevaluate the seismic and flooding hazards that could impact their sites. These reevaluated hazards, if more severe than what the plant was originally designed for, will be used to further analyze the plant to determine if structures, systems, and components need to be upgraded to protect against the updated hazard. Examples of important activities in this area that will take place in fiscal year 2016 include continued review of licensees' seismic and flooding hazard analyses and resolution of any issues associated with those analyses, continued documentation of the results of the NRC staff's review of the hazards, and development and issuance of NRC staff assessments of interim actions taken in cases where reevaluated hazards are greater than the plant was originally designed to handle.

Examples of additional activities ongoing during fiscal year 2016 include review of licensees' integrated plans for compliance with the NRC's order requiring installation of reliable, severe accident capable hardened vents for boiling water reactors with Mark I and II type containments; continued development of two post-Fukushima rulemaking activities, one associated with mitigation of beyond-design-basis events and one associated with establishment of additional measures for containment protection and reduction of radiological releases during a severe accident; review and documentation of enhancements to spent fuel pool instrumentation; and emergency preparedness enhancements.

The Commission approved a prioritization strategy whereby each recommendation was assigned to one of three tiers. Tier 1 recommendations are discussed above. Tier 2 activities are those NTTF recommendations that could not be initiated in the near term due to factors that include the need for further technical. assessment and alignment, dependence on Tier 1 issues, or unavailability of critical skill sets. Tier 3 issues are those recommendations that require further study to support a regulatory action, have an associated shorter-term action that needs to be completed to inform the longer-term action, or are dependent on the availability of critical skill sets.

Tier 2 activities include the following:

- Improved capability to provide makeup water and cooling to spent fuel pools.

- Enhancements to address three aspects of emergency preparedness for multiunit reactor sites and loss of power events:

- Training and exercises (drills).

- Equipment, facilities, and related resources.

- Multi-unit dose assessment capability.

- Reevaluation of external hazards other than seismic and flooding.

Since developing initial plans for the Tier 2 recommendations in 2012, the NRC staff recognized that they could be completed more efficiently and effectively if addressed as part of one of the NRC's two ongoing post-Fukushima rulemaking initiatives. As such, enhancements to spent fuel pool makeup and cooling capability and the Tier 2 emergency preparedness activities are being completed earlier than they would have otherwise. The recommendation associated with reevaluation of other external hazards will be initiated once additional insights are gained from the seismic and flooding reevaluations.

With respect to Tier 3 activities, the staff developed initial plans for addressing these recommendations and has been completing related activities consistent with those plans. Tier 3 recommendations include the following:

- Reevaluation of the emergency planning zone size.

- Evaluation of the need to pre-stage potassium iodine beyond 10 miles.

- Evaluation of the need to expedite transfer of spent fuel from spent fuel pools to dry cask storage (complete).

- Assessment of improvements to reactor and containment instrumentation qualifications.

- Periodic confirmation of seismic and flood hazards.

- Evaluation of seismically-induced fires and floods.

- Consideration of the need for reliable hardened vents for containment designs other than Mark I and II boiling water reactor containments.

- Hydrogen control and mitigation inside and outside containment.

- Various additional emergency preparedness topics (beyond those described above).

- Enhancements to the NRC's Reactor Oversight Process based on post- Fukushima lessons learned initiatives.

- NRC staff training on severe accidents and severe accident mitigation measures.

The status of these activities can be found in the NRC staff's periodic updates to the Commission on lessons learned activities, with the most recent report available at:

http://pbadupws.nrc.gov/docs/ML1506/ML15069A568.pdf

In some instances, the staff has been able to complete these activities ahead of schedule. For example, in mid-2014, the NRC completed an evaluation of the need to expedite transfer of spent fuel to dry cask storage. This activity, which was prioritized as Tier 3, determined that the expedited transfer of spent fuel to dry cask storage would provide only a minor or limited safety benefit and its expected implementation costs would not be warranted. As such, the staff recommended that expedited transfer of spent fuel not be required. The Commission approved this recommendation.

POST-FUKUSHIMA ACTIVITIES IN JAPAN

Subcommittee. Does the NRC continue to provide assistance to Japan post-Fukushima? If so, how much is included in this year's budget request? Why doesn't Japan reimburse us for these activities?

Chairman Burns. The NRC exchanges mutually-beneficial nuclear safety and security technical information with its counterparts at the Nuclear Regulation Authority of Japan (NRA). Since the creation of NRA following the 2011 Fukushima Dai-ichi accident, the NRC has held semi-annual meetings with NRA to provide direction for collaborative activities between our two organizations. In recent years, NRC and NRA have prioritized cooperation on fire protection, internal flooding, emergency preparedness, regulatory research related to beyond design basis accidents, and decommissioning.

Since our cooperation with Japan is mutually-beneficial, the NRC does not seek reimbursement for these activities. However, NRC's budget request does include resources to support international cooperation with regulatory counterparts. No specific appropriations were included in this year's budget request for assistance to Japan.

CUMULATIVE EFFECTS OF REGULATIONS ON MEDICAL USE

Subcommittee. The cumulative effect of regulations can impose a cumbersome burden in any industry and the medical community is not exempt from this.

As you have revised your rulemaking processes, how have you involved medical and pharmaceutical stakeholders?

What actions, if any, have you taken to work with the FDA to reduce the cumulative effects of regulations across the government?

Chairman Burns. The NRC did not take specific steps to engage medical and pharmaceutical stakeholders when enhancing the rulemaking processes to address the Cumulative Effects of Regulation. The NRC has increased opportunities to receive input from all stakeholders both before and during the rulemaking process. NRC staff collects input from stakeholders and licensees about current rule implementation issues through licensing actions, inspections, attendance at professional meetings, and meetings with NRC's Advisory Committee on the Medical Use of Isotopes (ACMUI)

ACMUI is a 13 member advisory committee whose members include representatives of the medical and radiopharmacy community, specifically, a nuclear medicine physician, a nuclear cardiologist, a medical physicist in nuclear medicine unsealed byproduct material, a medical physicist in radiation therapy, a radiation safety officer, a nuclear pharmacist, two radiation oncologists, a patients' rights advocate, a FDA representative, an Agreement State representative, a health care administrator, and a diagnostic radiologist. If the input from any stakeholder indicates the need for rulemaking, potential rulemaking issues and ways to resolve the issues are collected for use in a User Need Memo requesting rulemaking. In addition, potential rulemakings issues are discussed in public ACMUI meetings. The ACMUI advises the NRC staff on policy and technical issues that arise in the regulation of the medical uses of radioactive material in diagnosis and therapy by commenting on changes to NRC regulations and guidance; evaluating certain non-routine uses of radioactive material; providing technical assistance in licensing, inspection, and enforcement cases; and bringing key issues to the attention of the Commission for appropriate action.

During the rulemaking process, we conduct public meetings and numerous outreach efforts with the medical and pharmaceutical industry and their professional societies. Some examples are NRC-initiated public meetings and staff outreach during meetings and conferences sponsored by the American Association of Physicists in Medicine, Health Physics Society, Society of Nuclear Medicine and Molecular Imaging, American Society for Radiation Oncology, American Brachytherapy Society, and Thyroid Cancer Survivors' Association. Staff gives presentations, sits on professional panels, and interacts with professional organizations and non-government organizations, seeking their input on proposed rule changes. All proposed rule or policy changes that affect the medical or radiopharmacy community are vetted through the ACMUI who give NRC staff recommendations on any rulemaking affecting the medical and radiopharmacy community.

The NRC and FDA have a Memorandum of Understanding, which is used to clarify each agency's respective role, foster better interactions, and coordinate sharing of information between existing NRC and FDA regulatory programs. Staff members in each agency provide day-to-day awareness and coordination on issues associated with products and uses of products regulated by both agencies. The NRC has a staff member designated as the FDA liaison, and an FDA representative is a member of the ACMUI. Although NRC and FDA both regulate radioactive drugs and medical devices containing byproduct material, our regulatory focuses are very different. For example, FDA approves radioactive drugs for research and marketing in the United States based on their safety and effectiveness for diagnostic and therapeutic purposes, but NRC regulates the manufacture, distribution, use, and disposal of these drugs with respect to occupational, public and patient radiation safety.

Subcommittee. This subcommittee has viewed education and workforce development initiatives proposed across the Department of Energy with a critical eye in recent years. Because education and workforce development are the core missions of other federal agencies, the Department must identify a specific workforce need in order to justify a workforce development program.

The Nuclear Energy Integrated University Program is one such program that the Committee has supported. It is necessary because of specific workforce shortfalls identified in the domestic nuclear energy sector. Unfortunately, this year continues the usual dance where the Administration zeroes it out in the budget request.

Can you briefly discuss the Integrated University Program and how that program ensures the pipeline of highly trained engineers and scientists?

Chairman Burns. In 2009, the Integrated University Program (IUP) was established between the Nuclear Regulatory Commission (NRC), Department of Energy, and National Nuclear Security Administration to support multi-year research projects that do not align with programmatic missions but are critical to maintaining nuclear engineering and science. The NRC's portion of the IUP provides grants to academic institutions to support education and training in nuclear science and engineering; to develop a workforce capable of supporting the design, construction, operation, and regulation of nuclear facilities; and to promote the safe handling of nuclear materials. It provides for scholarships, including scholarships to 2-year trade schools and community colleges, graduate fellowships, and faculty development opportunities. The program educates and trains the next generation of highly qualified engineers, scientists, and craft workers entering the nuclear-related workforce that will support the demands of the nuclear sector. The faculty development grants seek to attract and retain highly-qualified individuals in academic teaching careers. To date, through scholarships, fellowships, and faculty development, over 2300 students and 80 faculty members involved in nuclear engineering; health physics; radiochemistry; and related crafts, trades, and science disciplines, have received assistance through the NRC IUP. The NRC's required service agreement for students supported through its IUP serves as a pipeline to help ensure that these scholars and fellows work in science and engineering fields that benefit the nuclear and broader community, including national labs, universities, and the utility sector, while enhancing

the craft and trade sector necessary to build and preserve the Nation's nuclear workforce.

NRC FUTURE

Subcommittee. What do you see as the NRC's greatest challenge over the next ten years and what actions is the Commission taking now to address that challenge?

Chairman Burns. For forty years, the NRC has successfully met its safety, security, and safeguards mission and has met or surpassed agency performance measures, but adjustments are necessary for success in the future.

Since the terrorist attacks of 2001, the agency has grown significantly to enhance security and incident response and to prepare for projected growth in the use of nuclear power in the U.S. That forecast in growth has now been adjusted downward in response to changes in the nuclear industry resulting in fewer new nuclear power plants and earlier decommissioning of some of the existing plants. These adjustments, in turn, are prompting the NRC to adapt its structure, workforce, culture, and regulatory processes to achieve the agency's safety and security mission in an era of constrained resources.

The NRC must reposition itself to function as an effective and efficient regulator in this new environment, while retaining the capability to respond in an agile manner to a range of possible futures.

To accomplish this, the agency established Project Aim 2020 to identify opportunities to enhance the agency's ability to plan and execute its mission while adapting in a timely and effective manner to a dynamic environment. Earlier this year, the staff submitted its project report to the Commission with a number of proposed strategies grouped into people, planning, and process. The Commission is currently deliberating on the staff's recommendations and anticipated giving directions to the staff in the near future. Implementation of these strategies will support the agency's continuing effectiveness in accomplishing its essential mission.

CUMULATIVE EFFECT OF REGULATIONS

Subcommittee. The Committee is very concerned by the impact that the cumulative effects of regulations has on the nuclear industry's ability to compete in the energy market.

Can you explain in more detail the actions the Commission has taken to reduce this impact? What still needs to be done?

Chairman Burns. Although NRC's mission focuses on protecting public health and safety and the environment, the NRC understands that, under principles of good regulation, the NRC should achieve its regulatory objectives in a cost-effective manner, mitigating cumulative effects of regulation where possible. Consistent with Executive Order 13563, "Improving Regulation and Regulatory Review," issued on January 18, 2011, and guidance provided by the Office of Management and Budget memorandum, titled "Cumulative Effects of Regulation," issued on March 20, 2012, NRC's cumulative effects of regulation efforts examine ways in which the agency may be able to enhance the efficiency with which it carries out regulatory actions, as well as ways to mitigate the cumulative effect of regulatory activities on both the NRC and licensees. The NRC has held multiple public meetings to discuss the cumulative effects of regulation efforts for operating power reactor licensees. NRC has already implemented several rulemaking procedures that improve consideration of cumulative effects of regulation, including providing increased stakeholder interactions, publishing supporting guidance concurrent with rules, requesting specific comment on cumulative effects of regulation process improvements in proposed rules, and developing informed implementation timeframes. The rulemaking process enhancements to address cumulative effects of regulation have received positive feedback from external stakeholders.

NRC is evaluating additional options for addressing cumulative effects of regulation for power reactors through a risk-informed approach to the establishment of compliance and implementation dates or schedules for power reactor regulations. Depending upon what option is selected by the Commission, additional rulemaking actions, development of guidance, staff training, and changes to internal NRC procedures may be necessary.

STAKEHOLDER FEEDBACK

Subcommittee. You have indicated that the NRC has worked to engage stakeholders to understand their concerns, challenges, and limitations.

In your interaction with stakeholders, what have they indicated are the largest barriers to a more robust nuclear energy program in the United States? How can the NRC work with industry to address these challenges? What can Congress do?

Chairman Burns. Stakeholders for the large light water reactor community believe that the principal challenge within the control of the NRC continues to be the length of time it takes the NRC staff to complete its technical reviews of design certification and combined license applications. However, the delays in licensing review schedules have resulted from multiple factors that are not primarily attributable to the staff's technical review. These have included incomplete applications; delays by applicants in providing comprehensive responses to requests for additional information; design changes made by applicants near the end of the review process; resolution of emergent issues such as Fukushima; and the effects of sequestration.

The NRC continues to meet with its stakeholders through its normal regulatory process to identify policy or implementation challenges related to new reactor licensing and to resolve these challenges so that applicants and licensees clearly understand what is necessary to meet the NRC's regulations and the NRC can make its licensing determination in a timely manner.

For the non-light water reactor or advanced reactor community, stakeholders have asserted that the largest barrier within the NRC's area of responsibility is the desire for more specific regulations, review guidance, and acceptance criteria for their unique designs. NRC's regulations and regulatory structure set clear standards for ensuring public health and safety, security, and environmental protection. However, because the existing framework was formulated for existing light water reactor technology, stakeholders have expressed concern that certain requirements might not be easily adapted to non-light water reactor technologies, making it less clear how new applicants will demonstrate that their designs meet those fundamental objectives. Stakeholders have also asserted that the rigorous safety, security, and environmental reviews that are an essential part of NRC's

licensing reviews are overly burdensome and costly for small "start-up" companies.

NRC has been meeting with the non-light water reactor community to develop a good understanding of the technologies that are being proposed and of the obstacles that the industry feels are inhibiting its ability to move forward. NRC has engaged with the Department of Energy in a two-phase program to develop what are termed general design criteria that are appropriate for these advanced technologies. Additionally, NRC has engaged the international community, principally through the Nuclear Energy Agency, to gain insights from regulatory bodies that have licensed and operated non-light water reactor technologies or are planning to do so. Through these efforts, NRC is seeking to bring relevant international experience to bear on national efforts to develop appropriate regulations, regulatory structure, and acceptance criteria. Working with the international community, the Department of Energy, and domestic nuclear industry groups, the NRC is seeking to draw on broad and current experience as we move forward to address these new technologies.

The NRC continues to evaluate lessons being learned from implementation of the 10 CFR Part 52 licensing process and is working to ensure infrastructure is being put in place to efficiently review future applications with a continued emphasis on safety. There are no specific legislative actions recommended at this time.

QUESTIONS FROM MS. ROYBAL-ALLARD OF CALIFORNIA

SAN ONOFRE NUCLEAR GENERATING STATION

Ms. Roybal-Allard. The San Onofre Nuclear Generating Station, Units 2 and 3, are currently going through the decommissioning process in the state of California.

How will the $4.7 million increase in the President's Budget Request from Fiscal Year 2015 to 2016 support the safe decommissioning of this nuclear facility? What safety measures has the Commission considered in allowing for the continued use of the San Onofre spent fuel pools?

Chairman Burns. NRC budgets are designed to ensure decommissioning licensing and inspection activities are conducted in accordance with NRC policy at all sites undergoing decommissioning until the licenses are terminated. Although the NRC has requested a $4.7 million increase to the Decommissioning and Low Level Waste business line to support, among other activities, increased reactor decommissioning activities, this increase is offset by decreases in other areas of the NRC's budget. With respect to San Onofre, the NRC staff will continue to ensure that licensed activities, especially those required for the safe storage of nuclear fuel in the San Onofre spent fuel pools, are conducted safely in accordance with the reactor decommissioning inspection manual and inspection procedures for the reactor decommissioning program.

SEISMIC HAZARDS

Ms. Roybal-Allard. Millions of people live near major fault lines in the state of California. This is a big area of concern for many people on the West Coast.

Can you expand on how the Nuclear Regulatory Commission will re-evaluate seismic hazards at the Diablo Canyon Power Plant in California?

Chairman Burns. On March 12, 2012, the NRC requested that all nuclear power plant licensees reevaluate the seismic hazard at their sites, using current-day methods and guidance. At that time, the licensee for the Diablo Canyon Power Plant, Pacific Gas and Electric Company (PG&E), had ongoing seismic hazards investigations that were directed by California Assembly Bi111632. In response to the NRC request for information, PG&E continued to develop a detailed seismic hazard reevaluation for the Diablo Canyon site. This reevaluation considered the latest geological information, including the results of investigations directed by Assembly Bill 1623, and used methods and guidance that were approved by NRC. PG&E submitted its reevaluated seismic hazard assessment to NRC on March 11, 2015.

The NRC staff is conducting an initial review of the PG&E seismic hazard reevaluation. PG&E's submittal indicates that the reevaluated seismic hazard exceeds the Diablo Canyon licensing-basis earthquake (called the Safe Shut-down Earthquake). Because PG&E indicated that the reevaluated hazard exceeds the Diablo Canyon licensing basis, PG&E submitted an interim evaluation to demonstrate that the plant can safely cope with the higher seismic hazard while additional risk evaluations are completed. This interim evaluation is based on results from the Long-term Seismic Program (LTSP) at Diablo Canyon, which NRC has previously reviewed and accepted for safety decisions. The NRC will complete its review of the interim evaluation in the next 30 days. NRC will take appropriate regulatory action, at any time, if it questions the ability of the Diablo Canyon plant to safely cope with the reevaluated seismic hazard. Currently, NRC does not have an immediate safety concern based on available information. In the initial review, the NRC staff also will determine the priority and schedule for completion of any additional risk analyses that are warranted for the Diablo Canyon plant.

After the initial safety review, the NRC staff will conduct a more in-depth review of the PG&E seismic hazard reevaluation. NRC will issue a staff assessment report that documents the results of the review, which is anticipated to take approximately 18 months to complete. In addition, the NRC staff will thoroughly review the additional seismic risk analyses that will use the results of the reevaluated hazard assessment to analyze the impact of the new hazard information on the plant. Once these reviews are completed, NRC will determine if additional regulatory action is necessary to assure plant safety for the reevaluated seismic hazards.

TUESDAY, MARCH 17, 2015.

U.S. DEPARTMENT OF ENERGY, APPLIED ENERGY FUNDING

WITNESSES

FRANKLIN ORR, UNDER SECRETARY FOR SCIENCE AND ENERGY
DAVID DANIELSON, ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY
JOHN KOTEK, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR NUCLEAR ENERGY
CHRISTOPHER SMITH, ASSISTANT SECRETARY FOR FOSSIL ENERGY
PATRICIA HOFFMAN, ASSISTANT SECRETARY FOR ELECTRICITY DELIVERY AND ENERGY RELIABILITY

Mr. SIMPSON. The hearing will come to order.

I would like to welcome our witnesses: Dr. Franklin Orr, Under Secretary for Science and Energy; Dr. David Danielson, Assistant Secretary for Energy Efficiency and Renewable Energy; John Kotek, Principal Deputy Assistant Secretary for Nuclear Energy; Pat Hoffman, Assistant Secretary for Electricity Delivery and Energy Reliability; and Christopher Smith, Assistant Secretary for Fossil Energy. Big panel this morning.

In 2012, the President unveiled an all-of-the-above energy strategy that sought to develop every source of American-made energy. Over the years, we have come to realize that this all-of-the-above approach really means a prioritization of renewable energy research and development at the expense of nuclear and fossil energy accounts.

Together, your programs account for almost $4.5 billion of the Department's budget request for fiscal year 2016. As in previous years, half of this request is for the Office of Energy Efficiency and Renewable Energy.

I agree that an all-of-the-above approach should fund research in new energy sources, but we also need to ensure that we are efficiently and effectively using our existing sources. Last year, fossil and nuclear energy sources provided about 85 percent of all electricity produced in this country. Just increasing the production efficiency by 1 percent of any fossil or nuclear energy source would have a tremendous effect on net electricity generation. A true all-of-the-above approach would not make these sources the lowest priority of the Department of Energy.

Each of you has an important role in managing and developing the future of these diverse energy sources. I look forward to hearing how your vision supports a true all-of-the-above approach and continues to make investments in our energy future.

Please ensure that the hearing record, questions for the record, and any supporting information requested by the subcommittee are delivered in the 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.

Mr. SIMPSON. With that, I will turn to Ranking Member Kaptur for her opening statement.

[The information follows:]

Chairman Mike Simpson
Subcommittee on Energy and Water Development and Related Agencies, House Committee on Appropriations

FY 2016 Budget Hearing: Department of Energy's Applied Energy accounts
March 17, 2015
Opening Statement As Prepared

The hearing will come to order.

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With that, I'll turn to Ranking Member Kaptur for her opening statement.

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Ms. KAPTUR. Thank you, Mr. Chairman, very much.

Good morning, Dr. Danielson.

Mr. DANIELSON. Good morning.

Ms. KAPTUR. Welcome back.

And, Dr. Orr, Secretary Smith and Hoffman and also Mr. Kotek, so glad to have you all here today. America just keeps producing this incredible talent that you represent, and that bodes well for the future. Thank you for all being here today to present to our subcommittee your 2016 program requests.

It is no secret that United States reliance on foreign energy imports presents a significant strategic threat as well as drain on our economy of jobs and productivity. Last year, America turned a corner, producing more energy than we imported. The President's—I should mention, imported energy remains America's number-one category of trade deficit. Your offices deserve a great deal of credit for your accomplishments.

And I just want to put on the record some numbers so we have the big frame in which we are operating. For 2014, our overall trade deficit as a country in every category was up 6 percent, over half a trillion dollars, $505 billion. That was up from 2013, when our trade deficit for $476 billion. Yet domestic energy and the boom here at home with natural gas kept the deficit in check—gas and additional oil. Oil costs, at the same time, plunged, but U.S. production by fracking has reduced our dependence somewhat.

2014 petroleum imports fell 9.6 percent to $334.1 billion, and that was the lowest we have seen since 2009. And U.S. petroleum exports actually went up 5.9 percent to $45.7 billion.

Nonetheless, as a country, in the energy realm we sustained a $289 billion deficit last year, and that translates into lost jobs in our country—if you calculate 5,000 jobs for every billion dollars of trade deficit, of 1,445,000 jobs just in 2014 alone.

We must push forward even harder to meet the energy demands of a new era with an all-of-the-above clean and innovative energy strategy. And you are all about that.

You all have exciting jobs in inventing the future, and the applied Offices of Energy Efficiency and Renewable Energy, Nuclear Energy, Fossil Energy, and the Office of Electricity provide important resources that the American people need to success at home and abroad. And the gap is huge still.

Secretary Smith, the work you and your predecessors did to help develop the new drilling technology spurred a revival of American oil and gas production. That resource helps meet America's strategic challenges while domestically creating jobs and advancing our economy. You don't get enough credit for that.

Our renewable energy installations are growing their share of the generation market, and innovation will propel them forward. We must strive for full-price parity while supporting domestic manufacturing.

Energy conservation: Energy efficiency presents a huge opportunity for our country, and it is heartening to see American business and both in the public and private sectors rise to the occasion. It makes good business sense, c-e-n-t-s as well as s-e-n-s-e.

Buildings and vehicles are becoming increasingly efficient beyond where we ever imagined. And targeting the biggest energy users,

like the steel industry, the auto industry, the glass industries—all of which, by the way, I represent—and America's industrial heartland and focusing additional attention there can yield real results.

The Advanced Manufacturing Office has an important role to play in developing energy-saving processes that will help drive down costs for producers and ultimately consumers, and it is a win-win for everyone.

The energy innovation championed by your offices holds the key to unlock the full potential of America's modern energy economy. And we look forward to hearing your goals for advancing our Nation to a place where she is more sustainable here at home, diversified, and—very important to me—self-reliant.

Thank you, Mr. Chairman. I look forward to the testimony.

Mr. SIMPSON. Thank you.

And, again, welcome to all of you.

It is good to see you again, John.

Mr. KOTEK. Thank you.

Mr. SIMPSON. As I understand it, Dr. Orr is going to give an opening statement and that any other opening statements will be included in the record and so forth.

So, Dr. Orr, the floor is yours.

Mr. ORR. Thank you very much, Chairman Simpson, Ranking Member Kaptur, and members of the subcommittee. Thanks for the opportunity to appear before you today to talk about the Department of Energy's applied energy budget for fiscal year 2016.

As both of you observed, we are in the midst of an American energy renaissance, and the good news is that there is no shortage of primary energy resources—wind, sun, fossil, nuclear—that we can put to work to supply our energy needs.

But the question we have to face carefully over time is how we take advantage of them. And this is really a central message of human ingenuity—how we supply energy services by using some primary energy resource to make something like electricity or transportation services, services that we all take, I think, for granted but also are woven through every aspect of human societies. We need to apply our ingenuity to supply those services safely, cleanly, reliably, and economically, and thereby enhance the Nation's energy security while mitigating carbon emissions and other impacts.

So DOE is charged with advancing the all-of-the-above strategy to enable the transition to a low-carbon economy through innovative, lower-cost, clean energy technologies. And we employee the expertise and capabilities of 17 national labs, 13 of which are under the part of DOE that I am supposed to look after, and they have tremendous expertise and ability to influence and help us do what we do.

As Under Secretary for Science and Energy, my job is to try to coordinate the Department of Energy's scientific research efforts with applied energy research and development, including by enhancing the productive links among all the science and energy programs. And we will reassemble this afternoon, I think, to talk about the science programs, so we actually will get a chance to see where we stand on that. The fiscal year 2016 science and energy budget request reflects our attempt to make those links and our attempts to make them stronger.

The Department's total science and energy request, which also includes the Loan Programs Office and ARPA–E and the Energy Information Administration request, is $10.7 billion, about $1.4 billion above the fiscal year 2015 enacted level. For the applied energy portion of our science and energy portfolio, the fiscal year 2016 budget is $4.76 billion, an increase of $1.06 billion over the fiscal year 2015 enacted level.

Before I talk a bit about the applied energy programs' budgets, I will note that my colleagues are here to join me, as was observed earlier, and I am very grateful that they are here because I am pretty new at this. And I am fully aware that the actual knowledge sits on either side of me, and they will be called into action for sure as we go forward.

In the energy efficiency and renewable energy area, which you can think of as three distinct offices, the budget request continues a diverse suite of sector investments in sustainable transportation—that is $793 million; renewable power technologies at $645 million; and development of manufacturing technologies and enhanced energy efficiency in our homes, buildings, and industries at $1.03 billion.

A key highlight in this office is its advanced manufacturing work. The budget request for that area includes $404 million to fully fund two new clean energy manufacturing institutes, and then it continues funding for four institutes.

In nuclear energy, DOE proposes $908 million, $74 million above the fiscal year 2015 enacted level, to continue supporting the pursuit of several new concepts and nuclear reactor designs, including increased funding for licensing technical support for development of small modular reactors.

For the Office of Fossil Energy, the Department requests $842 million to continue development of carbon capture, utilization, and storage technologies for coal plants and research to improve the performance of the natural gas infrastructure. We have made a commitment to coal and natural gas in concert with new carbon capture use and sequestration tax credits in the administration's POWER Plus initiative to harness our domestic fossil resources in an environmentally prudent manner.

The Office of Electricity Delivery and Energy Reliability is working hard to accelerate the modernization of the Nation's grid. To carry out this work, the fiscal year 2016 budget request proposes $270 million to support research and development activities, cybersecurity work, and grant programs to develop and update energy assurance plans for States, localities, and tribes.

The request also includes $20 million for a fifth energy program in my office, the Office of Indian Energy Policy and Programs, which works to address the fundamental challenges to broad clean energy deployment on tribal lands. The request also includes $11 million for a new Tribal Indian Energy Loan Guarantee Program that leverages our department's Loan Programs Office to help improve access to capital for energy products in Indian country.

So the Department's all-of-the-above applied energy portfolio is quite widespread, and, as I mentioned before, my office is working to try to increase the productive links amongst these programs to

increase their efficiency and to coordinate on some of the big shared challenges that we have to face.

So one significant way to do this is through the crosscutting initiatives that we introduced in the fiscal year 2015 budget. So the fiscal year 2016 request includes just over $1.2 billion in crosscutting research and development across six initiatives: exascale computing; grid modernization; subsurface technology and engineering; supercritical carbon dioxide power generation technology; cybersecurity; and new for this year, the energy-water nexus.

So the applied programs are involved in five of these crosscuts, so let me say a word about each of them to give you an idea of how that works.

So we are starting here with the grid modernization crosscut, which is focused on providing tools to set the Nation on a cost-effective path to the flexible, secure grid of the future. Investment in a modernized grid is a critical component of energy and economic security, and, through this crosscut, we are focusing the efforts of our experts across the relevant offices on this particular challenge.

The subsurface technology and engineering crosscut is focused on a fundamental objective: mastery of the subsurface. Specifically, adaptive control technologies that can control where fluids go, where they flow in the subsurface, can have a transformative effect on a host of subsurface applications, ranging from carbon and nuclear waste storage to responsible geothermal and hydrocarbon extraction.

The supercritical technology crosscut is aimed at working to mature a supercritical CO_2 technology that could improve efficiency of electric power generation and harness that in a way that would reduce costs and reduce the footprint of the equipment required. The crosscut team is working towards a pilot-scale facility to evaluate just how transformative this technology can be over a range of operating conditions that would apply to a wide range of thermal energy sources.

For increased coordination on cybersecurity, DOE requests $306 million to fund the cybersecurity crosscut. Cybersecurity is increasingly important in today's modern age, and DOE is working to protect its cyber assets as well as to strengthen the security of the national grid.

And, finally, I will mention the energy-water nexus crosscut. It is new in our fiscal year 2016 budget request. Water use is absolutely fundamental to electric power generation. Some 40 percent of the withdrawals of water that come through the system are associated with cooling and electric power generation. And through data modeling and analysis as well as targeted technology development, this new initiative positions DOE to support the Nation's transition to more resilient energy-water systems.

And before I finish here, let me say a word about one more initiative my office is overseeing that cuts across all the Department's applied energy programs as well as the Office of Science. This is the Quadrennial Technology Review.

The purpose of this effort is to inform the future of the Department's science and applied energy research portfolio by examining the state of existing and emerging energy technologies and by identifying the most promising research and development opportunities

across those technologies. It is meant to give us a picture of where we are and where it makes sense to go in the research effort going forward.

The release of that report is planned for the summer, and I will look forward to briefing the committee and other Members of Congress when that review is complete.

So let me conclude by saying that the Department of Energy is pursuing an all-of-the-above approach to build a portfolio of advanced energy technologies that will lead us to a low-carbon economy. And, in doing so, a key aspect we are focused on is fostering increased coordination and efficiency throughout the science and energy enterprise.

I and my colleagues here would be pleased to answer your questions on how the fiscal year 2016 budget supports those efforts and our effort to use the funds efficiently and effectively. Thank you very much.

Mr. SIMPSON. Thank you.

[The information follows:]

Testimony of Under Secretary for Science and Energy Franklin Orr
U.S. Department of Energy
Before the
Appropriations Subcommittee on Energy and Water Development
U.S. House of Representatives
March 17th

Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the Department of Energy's (DOE) Budget Request for the applied energy programs in fiscal year (FY) 2016. I appreciate the opportunity to discuss how the Request advances the Department's mission to research, develop, demonstrate and deploy clean energy technologies.

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

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

The Science and Energy Challenge

The use of energy is woven through every aspect of modern societies. We rely on the conversion of energy resources into services that fuel our nation's households and businesses, transportation sector, manufacturing, and the economy as a whole.

Today we are in the middle of an American energy renaissance. There is no shortage of primary energy resources in the United States, and we are poised to take full advantage of them. These include renewable sources from the sun, wind, and water; thermal energy within the earth's upper crust; fossil fuels; and nuclear resources. The question we face is how to convert them to

energy services—how we apply our ingenuity to supply those services safely, reliably, and economically. In doing this, we must also work to harness energy in ways that are environmentally sound.

The President has directed Federal agencies to work towards a low carbon economy through his Climate Action Plan. More recently, he has made a historic commitment to reduce the United States' greenhouse gas emissions by 26-28 percent by the year 2025. To make these reductions a reality, we need to use all the greenhouse gas reduction technologies in our toolkit, and we must also invent new ones and develop them to be economically practical.

Through DOE, the American people support over 30,000 experts across the Department's Science and Energy missions to carry out the research, development, demonstration and deployment that will serve as a foundation for a low carbon economy. When the Secretary joined the Department almost two years ago, one of the first things he did was restructure it to create an Under Secretary for Science *and* Energy. He did this to more closely integrate the Office of Science with the applied energy offices focused on energy efficiency and renewables, fossil, nuclear and electricity delivery.

As Under Secretary, my job is to coordinate our scientific research efforts with the applied energy Research and Development (R&D) that will lead the nation to a low carbon future. Fundamental science underpins everything we do in the energy sector, and the world of energy applications is rich with opportunity to put the science to work, and also for energy applications to illuminate the opportunities for science that could have game-changing impact. My office is working to enhance the productive links among the science and energy programs as we build and execute the Department's research, development, demonstration and deployment activities. The FY 2016 Science and Energy Budget Request reflects these links.

Overview of the FY16 Science and Energy Budget Request

The FY 2016 Budget Request for the Department of Energy's science and energy programs supports the President's all-of-the-above energy strategy. The Department is investing across the innovation chain—from basic scientific and discovery research to the demonstration and deployment of energy technologies. The National Laboratories are key contributors to this work, providing the Nation with strategic scientific and technological capabilities. The applied energy programs are focused on innovating across a diverse portfolio of clean energy technologies to enhance economic competitiveness and secure America's long-term energy security and infrastructure. The Budget Request also continues to implement the President's Climate Action Plan through the development and deployment of clean energy technologies that reduce carbon pollution.

The $10.7 billion science and energy Budget Request in FY 2016, $1.4 billion above the FY 2015 Enacted level, supports DOE's missions of enabling the transition to a clean energy future with low-cost, all-of-the-above energy technologies; supporting a secure, modern, and resilient

energy infrastructure; and providing the backbone for discovery and innovation, especially in the physical sciences, for America's future prosperity.

The FY 2016 Budget Request across the Department of Energy's applied energy portfolio is $4.76 billion. This funding will support important advances in fossil energy, energy efficiency and renewable energy, grid modernization, cyber security, nuclear energy, and Indian energy policy and programs while increasing funding for new initiatives and priorities.

I will briefly provide an overview of the Science and Energy program budget requests. The Assistant Secretaries will provide more detail on their specific program budget requests in each of their written testimonies.

Highlights of the Energy Efficiency and Renewable Energy FY 2016 Budget Request

DOE's Energy Efficiency and Renewable Energy program provides research, development, demonstration and deployment funding to foster advances in sustainable transportation, renewable power, and energy efficiency. Across the nation today, a renewable revolution is occurring, and the Department of Energy is working to further accelerate the deployment of clean energy technologies.

The FY 2016 Budget Request proposes $2.72 billion—$809 million above the FY 2015 Enacted level—to continue a diverse suite of sustained investment in sustainable transportation technologies ($793 million), renewable power technologies ($645 million), and development of manufacturing technologies and enhanced energy efficiency in our homes, buildings and industries ($1.03 billion).

EERE's renewable power efforts include programs in wind, water, geothermal, and solar energy. As an example of this work, EERE's solar program is focused on further accelerating the rapid downward trend in solar energy costs. Just four years into our SunShot Initiative's 10 year goal of achieving cost parity for utility scale solar, we are two thirds of the way there. The FY 2016 Budget Request includes robust funding for solar photovoltaic R&D and efforts to cut non-hardware "soft costs" in half. Not only is this industry creating clean energy for Americans to use in their homes, businesses, and even their cars, but it currently provides jobs to nearly 174,000 solar workers across all 50 states.

Regarding sustainable transportation, the nation's vehicle fleets are now lighter, more efficient, and less dependent on oil than ever before, and the budget request invests in technologies that will accelerate those trends as well as progress on vehicle electrification and biofuels. The FY 2016 Budget Request supports aggressive vehicle technology goals through continued R&D on lightweight materials performance, advanced power electronics, and battery storage, as well as funding a SuperTruck II initiative to improve freight hauling efficiency, pursuit of drop-in biofuels, and automotive fuel cells.

EERE's energy efficiency efforts include work to advance energy performance in buildings, homes, and advanced manufacturing processes. As an example of this work, in addition to

providing continued support for the four planned and existing Clean Energy Manufacturing Institutes, the FY 2016 Budget Request fully funds the deployment of two additional Institutes and supports high-impact R&D on critical materials.

Highlights of the Nuclear Energy FY 2016 Budget Request

Nuclear power provides over 60% of the Nation's non-greenhouse-gas-emitting electric power generation, and it is worth noting that the Nation's first new nuclear plant this century will come online in the near future. In the last year, the Office of Nuclear Energy has successfully completed the first 5-year program at the Consortium for Advanced Simulation of Light Water Reactors nuclear modeling Hub at the Oak Ridge National Laboratory and has initiated a second award for design and licensing support of a small modular nuclear reactor with advanced safety features. To build on these successes, the FY 2016 Budget Request increases funding for Nuclear Energy to increase safety and extend the life of the current commercial fleet, as well as to invest in new reactor technologies for a low-carbon, clean energy future.

In the FY 2016 Budget Request, DOE proposes $908 million ($74 million above the FY 2015 Enacted level) to continue supporting the pursuit of several new concepts in nuclear reactor design. The FY 2016 Budget Request also continues to lay the groundwork for full implementation of the Administration's Strategy for the Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste released in January 2013, providing $108 million for research, development, and integrated waste management system activities in the areas of transportation, storage, disposal, and consent-based siting. Finally, the Request supports development and qualification of accident tolerant fuel concepts as well as critical safeguards and security upgrades at the Idaho National Laboratory.

Highlights of the Fossil Energy FY 2016 Budget Request

Research undertaken through the Fossil Energy program is a key component of environmentally-sound development of the Nation's domestic fossil resource wealth. Last year, the DOE achieved an important milestone of 9 million tons total of CO_2 stored in geologic reservoirs, and will reach the 10 million ton mark this summer. In addition, the DOE-supported and world's largest post-combustion carbon capture project, the Petra Nova Project at NRGEnergy's WA Parish generating station in Thompsons, TX, reached financial close and began construction.

Building on the many Recovery Act-funded demonstration projects and the fossil energy loan guarantee solicitation issued a year ago by the DOE Loan Programs Office, the FY 2016 Budget Request increases funding for transformational carbon capture and storage technologies relevant to coal and natural gas. For the Office of Fossil Energy, the Department is requesting $842 million—the majority of which ($560 million) is dedicated to fossil energy research and development.

The FY 2016 Budget Request also supports collaborative R&D efforts through the Multiagency Unconventional Oil and Natural Gas initiative joint research program with the Department of

Interior and the Environmental Protection Agency. These joint efforts leverage the impact of research funding by the agencies and avoids duplication.

The FY 2016 Budget Request proposes $15 million in funding to develop and demonstrate technologies to identify, measure, and reduce methane leaks from midstream natural gas infrastructure and $10 million to improve quantification of methane leaks for inclusion in the national Greenhouse Gas Inventory, both key parts of the Administration's initiative to reduce fugitive methane emissions.

Even with expanding domestic energy supply, it is important that the United States maintain a healthy reserve to protect against unexpected supply disruptions, so this Request supports full operational readiness and drawdown capability of the Strategic Petroleum Reserve, as well as continued inventory maintenance of the Northeast Home Heating Oil Reserve.

Highlights of the Electricity Delivery and Energy Reliability FY 2016 Budget Request

A modern electric grid is essential to sustaining economic growth, supporting clean energy, and maintaining our energy security. With aging infrastructure and a rapidly changing energy landscape, it is vital that the Nation's power grid be modernized to ensure that consumers have access to reliable, secure, and clean energy. The Department of Energy is working hard to advance the technology innovation and institutional support and alignment needed to enable a grid of the future that is cleaner and more reliable, resilient and secure.

Even as the grid becomes "smarter" and more advanced, devices and technologies are deployed across the country to improve the reliability and efficiency of the system, reduce the frequency and duration of outages, and help consumers better manage their electricity use, more work is needed. As the Nation makes important progress towards our clean energy goals through expanded renewable energy generation, it is increasingly critical to build a flexible grid that effectively integrates variable and distributed renewables and is adapted to more active consumer participation. Sustained investments in the development, demonstration, and deployment of advanced technologies, such as energy storage, that will further enhance the stability, resiliency, and reliability of the grid are crucial. Last May, with cost-share funding provided by the Office of Electricity Delivery and Energy Reliability, Southern California Edison constructed and installed equipment for a prototype 8 megawatt/32 megawatt-hour battery storage plant for wind integration in Tehachapi, CA—one of the world's largest battery storage systems to date.

To continue DOE's important work to enable modernization of our Nation's grid, the FY 2016 Budget Request supports foundational technology and tool development. Through targeted investments in advanced distribution management systems, energy storage, microgrids, and synchrophasor applications, to name a few, DOE can help develop technology options for the electricity sector to strengthen regional and local infrastructure and markets, help communities become more resilient, and improve grid services overall.

The FY 2016 Budget Request proposes $270 million, $123 million above the FY 2015 Enacted level, to support a smart, resilient electric grid for the 21st century and fund critical emergency

response and grid security capabilities, including grant programs to develop and update energy assurance plans for states, localities and tribes, and a new effort to support state and multi-state electricity reliability.

A major challenge the Nation must address is the grid's vulnerability to cyber-attack. The Request includes $52 million for R&D to strengthen protection of critical energy infrastructure against cyber threats. The FY 2016 Budget Request provides special focus on tool development for cybersecurity incident management, and establishes a virtual platform for advanced digital forensics analysis for the energy sector.

Highlights of the Office of Indian Energy Policy and Programs FY 2016 Budget Request

Fundamental challenges to broad clean energy deployment still exist in tribal lands and communities. To help address these challenges, the Department requests $20 million—$4 million above the FY 2015 Enacted level, to support DOE's partnership with the Department of the Interior to address the need for clean, sustainable energy systems on Indian lands. This Budget Request continues the program's deployment focus through an expanded grant program and continued technical assistance efforts.

In addition, the FY 2016 Budget Request includes $11 million for a new Tribal Indian Energy Loan Guarantee Program that would help tribes invest in small and medium sized generation projects. This program would leverage the underwriting infrastructure in the DOE's Loan Programs Office, to help improve access to capital for energy projects in Indian country. The Loan Programs Office is the Department's key financing arm, which works with private companies and lenders to mitigate the financing risks associated with clean energy projects.

Crosscutting Budget Initiatives

One of the ways the Department is increasing the productive links between the science and energy programs is through the budget crosscuts the Department introduced in the last budget cycle.

Building on the success of last year's crosscutting proposals, my office is continuing to bring together subject matter experts across our programs to overcome overarching challenges. The crosscuts embody the improved agency-wide coordination the Secretary envisioned when he created the Office of the Under Secretary for Science and Energy as part of the Department's FY 2013 reorganization.

Taking an enterprise-wide approach to research efforts will improve outcomes and avoid redundancy between program offices. The FY 2016 Request includes just over $1.2 billion in crosscutting research and development across six initiatives: exascale computing; grid modernization; subsurface technology and engineering; supercritical carbon dioxide technology; cybersecurity; and the energy-water nexus.

Five of these initiatives were established in FY 2015, and they have evolved and matured as their coordination resulted in high-impact proposals in the FY 2016 Budget Request. I'll first detail the five crosscuts my office is continuing in the FY 2016 Request and then describe the one addition—the energy-water nexus crosscut.

Exascale Computing: Enables U.S. leadership in the next generation of high performance computing

Since the beginning of the digital era, the Federal government has made pivotal investments in high performance computing (HPC) at critical times when market progress was stagnating. HPC technology is at another turning point where fundamental innovations in hardware and software architectures are necessary to drive future advances in computing performance. Committed U.S. leadership in HPC is a critical contributor to our competitiveness in science, national defense, and energy innovation as well as the commercial computing market. Equally important, a robust domestic industry contributes to our nation's security by helping avoid unacceptable cyber-security and computer supply chain risks.

For these reasons, DOE is proposing $272.6 million for the Exascale Computing crosscut initiative funded through the Office of Science and the National Nuclear Security Administration. A significant investment by the Federal government involving strong leadership from DOE, in close coordination with government, national laboratories, industry, and academia is required to address this national challenge. The Exascale Computing crosscut initiative focuses on three pillars: foundational research, development and deployment activities; application development to take full advantage of the emerging exascale hardware and software technologies; and platform deployment to prepare for and acquire two or more exascale computers. Funding for the first two pillars is included in the FY 2016 Budget Request.

Grid Modernization: Provides tools to set the Nation on a cost-effective path to the grid of the future

The reliability and functioning of the Nation's electricity grid is often taken for granted. Whereas rolling blackouts are the norm in many developing countries, U.S. customers have historically benefitted from highly reliable and affordable power transported through long-lived transmission and distribution infrastructure and built on a foundation of safe and secure centralized power generation. Our extensive and resilient power grid has fueled the Nation's growth engine and long been an exemplar for other countries. Access to electricity is such a fundamental enabler for the economy that the National Academy of Engineering named electrification the greatest engineering achievement of the 20th century.

The FY 2016 Request includes $356 million for the Grid Modernization crosscut initiative, which draws from the work in the Office of Electricity Delivery and Energy Reliability. This funding supports strategic investments by DOE in foundational technology development, enhanced security capabilities, and greater institutional support and stakeholder engagement, which will provide tools necessary for the evolution to the grid of the future. Investment is

critical now as the energy system is being transformed by increased distributed renewable energy generation, interactive demand side technologies, and the need to ensure resiliency against more frequent and intense weather events, as well as cyber and physical attacks.

Subsurface Technology and Engineering: Advances a new era of capabilities across a range of energy applications

Subsurface energy resources provide more than 80 percent of total U.S. energy needs today. Next generation advances in subsurface technologies may enable greater access to renewable geothermal energy and safer and more environmentally sustainable development of domestic oil and natural gas supplies, as well as potentially provide hundreds of years of safe storage capacity for carbon dioxide and opportunities for environmentally responsible management and disposal of energy waste streams. Thus, discovering and effectively harnessing subsurface resources while mitigating impacts of their development and use are critical pieces of the Nation's energy strategy.

DOE's FY 2016 Budget Request includes $244 million for the Subsurface Technology and Engineering crosscut initiative. The subsurface crosscut, SubTER, will address identified challenges in the subsurface through highly focused and coordinated research in wellbore integrity, stress state and induced seismicity, permeability manipulation, and new subsurface signals to ensure enhanced energy security, material impact on climate change via CO_2 sequestration, and significantly mitigated environmental impacts from energy-related activities and operations.

Supercritical CO_2 Technology: Synchronizes R&D activities around a collective technology demonstration opportunity

Steam based power cycles are used for approximately 80 percent of the world's electricity generation. Power generation cycles based on supercritical carbon dioxide (sCO_2) as the working fluid, instead of steam, have the potential for significantly higher thermal efficiencies (upwards of 50 percent improvement) with smaller physical footprint and lower capital cost than state of the art steam-based power cycles. The supercritical carbon dioxide power generation cycle also has the potential to eliminate the need for water required to cool traditional power plants and a directly fired supercritical CO_2 cycle could have significant cost reduction benefits for carbon capture and storage. This technology therefore could have transformative applications in power generation through coal, nuclear energy, geothermal energy, and concentrated solar power.

There is broad industry interest in partnering with DOE to demonstrate the sCO_2 power cycle due to the unique features of sCO_2; the potential for lower capital cost and the compounding performance benefits from a more efficient cycle; as well as the resulting efficiency gains in balance of plant requirements, fuel use, emissions, and water use.

The FY 2016 Budget Request proposes $43.6 million for the sCO_2 crosscut initiative. This initiative is structured around a common objective to establish a 10 MWe scale Supercritical

Transformational Electric Power (STEP) pilot scale facility for evaluating power cycle and component performance over a range of operating conditions. Demonstrating favorable performance at this scale is the next step required to address technical issues, reduce risk, and mature this promising technology.

Cybersecurity: Protecting the DOE enterprise and improving cybersecurity in the energy sector

The Department of Energy is engaged in cyber-related activities to protect the DOE enterprise, including government-owned, contractor-operated sites, from a range of cyber threats that can adversely impact mission capabilities; and to improve cybersecurity in the electric power and the oil and natural gas subsectors.

Strengthening cybersecurity to protect the DOE enterprise requires bolstering the Department's cybersecurity functional capabilities to identify, protect, detect, respond, and recover from the increasing incidence of cyber-attacks.

To this end, the Department has established a Cybersecurity crosscut to strengthen the coordination of budget activities related to cybersecurity so that cybersecurity is managed based on strategic priorities. DOE requests $306 million to fund this Cybersecurity crosscut initiative in FY 2016. DOE has also established an internal Cyber Council to serve as the principal forum for coordinating cyber-related activities across the Department and for consideration of cyber-related issues requiring decisions by DOE senior leadership.

Under the Presidential Policy Directive on Critical Infrastructure Security and Resilience (PPD-21), DOE is the Sector-Specific Agency for the energy sector and has a number of responsibilities, including the following: 1) collaborating with infrastructure owners and operators to strengthen the security and resilience of critical infrastructure; 2) serving as the day-to-day Federal interface for the prioritization and coordination of sector-specific activities; 3) carrying out incident management responsibilities consistent with statutory authority and other appropriate policies; and 4) providing technical assistance to the energy sector to identify vulnerabilities and help mitigate incidents, as appropriate.

Energy–Water Nexus: Creating more resilient and efficient energy-water systems

The energy-water nexus crosscut initiative is new in our FY 2016 Budget Request.

Water and energy systems are interdependent. Water is used in all phases of electricity generation and energy production, accounting for over 40 percent of total water withdrawals and over five percent of total water consumption. Conversely, energy is required to extract, convey, and deliver water of appropriate quality for diverse human uses, and then again to treat wastewaters before return to the environment; this accounts for 3 percent of total electricity consumption. Current trends are increasing the urgency to address the energy-water nexus in an integrated way. Precipitation and temperature patterns, U.S. population growth and regional

migration trends, and the introduction of new technologies could shift water and energy demands.

Building on DOE's report on Challenges and Opportunities in the Energy-Water Nexus, published in June 2014, the Department proposes a $38 million program in FY 2016 that involves five DOE organizations. This effort comprises a coordinated set of cross-program initiatives that 1) builds and deploys DOE modeling and analysis to improve understanding and inform decision-making for a broad range of users; 2) strategically targets crosscutting technology RDD&D opportunities within the system of water and energy flows; and 3) is informed and supported by focused policy analysis and outreach and stakeholder engagement. Taken as an integrated whole, these investments position DOE to contribute strongly to the Nation's transition to more resilient energy-water systems.

Additional Avenues for Increased Coordination Across Science and Energy

Funding proposed through crosscuts ultimately resides within DOE's existing programs, but my office is coordinating execution as well. One avenue for doing this is through our newly established National Laboratory Consortia. For example, the Grid Modernization Laboratory Consortium has set up a framework to integrate the shared efforts under the leadership of three headquarters programs—the Office of Energy Efficiency and Renewable Energy, the Office of Electricity Delivery and Energy Reliability, and the Office of Energy Policy and Systems Analysis—and the experts at the national laboratories. Following the creation of the Grid Modernization Laboratory Consortium, the Department has now established one in Subsurface Engineering.

In addition, the Science and Energy programs are hard at work drafting the 2015 Quadrennial Technology Review. This rigorous review will examine where the technological capabilities and overall outlook stand on the most promising research, development, demonstration and deployment opportunities across the range of technologies that will address the nation's energy needs in the years to come. I look forward to briefing Congress when the review is complete.

Conclusion

The Department of Energy is focused on implementing the President's all-of-the-above energy strategy to lead the nation to a secure, low carbon future. The technologies the Department is researching, developing, demonstrating and deploying will become the portfolio of energy technology options in the decades to come that will help meet our greenhouse gas emissions reduction targets.

Statement of
Patricia Hoffman
Assistant Secretary for
Electricity Delivery and Energy Reliability
U.S. Department of Energy
Before the
United States House of Representatives
Appropriations Subcommittee on
Energy and Water Development
March 17, 2015

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) 2016 budget for the Department of Energy's Office of Electricity Delivery and Energy Reliability.

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

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

A modern electricity grid is vital to the Nation's security, economy and modern way of life, providing the foundation for essential services that Americans rely on every day. Whether it's flipping a switch when entering a dark room, withdrawing money from an ATM, pumping gas, or doing any of the other tasks that make up modern life, Americans expect to be able to go about their daily lives without thinking about whether the power is flowing.

The Nation's power grid, however, is aging and faces a future for which it was not designed. Four critical challenges are rapidly re-defining the energy landscape:

- Changes in demand are being driven by population growth, the adoption of more energy efficient technologies, dynamic economic conditions, and broader electrification, including

possible mass-markets for electric vehicles. Consumers have adopted energy efficient end-use technologies that interact differently with the grid than traditional loads. At the same time, our dependence on electricity has increased.

- Changes are occurring in the supply mix and the location of the Nation's portfolio of generation sources. Electricity generation is shifting from relatively few large central station plants to many smaller generators. Much of the new generation depends on the sun or wind and is variable, requiring a system that can adapt to changes in supply.
- Increasing variability and uncertainty on both the supply and demand sides, driven by factors such as the integration of variable renewables and more active participation by consumers, are making managing the grid progressively more challenging.
- Challenges to the reliability and security of the electric infrastructure from more frequent and intense extreme weather events, cyber and physical attacks, and interdependencies with natural gas, liquid fuels, and water systems are growing.

In order for the electric grid to successfully meet these challenges, this essential infrastructure must be modernized.

Our mission is 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 the energy supply. We lead the Department's efforts to strengthen, transform, and improve our energy infrastructure so that consumers have access to reliable, secure, and clean sources of energy. The goal for the future grid is to provide a platform that delivers reliable, affordable, and clean electricity to consumers where they want it, when they want it, and how they want it.

To accomplish this vital mission, we work closely with private industry and Federal, state, local, and tribal governments on a variety of initiatives to modernize the electric grid and enhance key characteristics of the U.S. electric transmission and distribution systems, which include:

- Reliability – consistent and dependable delivery of high quality power;
- Flexibility – the ability to accommodate changing supply and demand patterns and new technologies;
- Efficiency – low losses in electricity delivery and more optimal use of system assets;
- Resiliency – the ability to withstand and quickly recover from disruptions and maintain critical function;
- Affordability – more optimal deployment of assets to meet system needs and minimize costs;
- Security – the ability to protect system assets and critical functions from all hazards; and
- Minimal environmental footprint – grid system designs that reduce total environmental impact of grid components and connected systems.

Improvements to all of these operational capabilities, together with end-to-end protection from manmade and natural threats, are necessary for a modern and reliable grid.

Our FY 2016 budget request makes critical investments that support the Administration's all-of-the-above energy strategy, which calls for developing a balanced portfolio of America's energy resources, giving consumers more options to save money and reduce energy use, and promoting

the creation of innovative technologies to move the Nation closer to a secure and independent energy future.

This request is part of the Department's Grid Modernization Crosscutting Initiative, a coordinated program of activities to help set the Nation on a cost-effective path to a reliable, integrated, secure, and affordable grid system. The Initiative will build on past successes and current activities. Aspirational goals, such as reducing the economic losses of power outages by ten percent over the next ten years, will guide future activities, with appropriate metrics used to measure progress.

Much of the increase in our budget request is due to investments in three priority areas.

- Protecting the Nation's critical energy infrastructure from all hazards is a critical element of the mission of this office. Recognizing that many authorities and actions depend upon the states, the request includes $35.5 million to provide grants to state, tribal, and local governments to update energy assurance plans to address infrastructure resilience, as well as $27.5 million to provide grants to states and multi-state entities to address electricity transmission, storage, and distribution reliability. These grants, under the new State Energy Reliability and Assurance Grants program, account for about half of the increase over FY 2015.
- The $10 million Transformer Resilience and Advanced Components program will address unique challenges facing large power transformers and other critical grid components. Specifically, these investments will better characterize the risks to transformers from electromagnetic pulses, following up on a key recommendation from the Electromagnetic Pulse Commission, and support research and development into advanced high-voltage equipment.
- Cybersecurity for the energy sector is one of the Nation's most serious infrastructure protection issues, and it remains a priority in FY 2016. Our budget request further broadens our capabilities to protect against and mitigate cyber threats to the energy infrastructure. Intelligence reports indicate that cyber adversaries are becoming increasingly sophisticated and better financed. Cybersecurity practices must address not only the threats and vulnerabilities of traditional information systems, but also issues unique to the energy sector. The $6.0 million increase for the Cybersecurity for Energy Delivery Systems program includes funding to establish a virtual collaborative environment for conducting real-time advanced digital forensics cybersecurity analysis. In addition, our cybersecurity program will be a key component of the Department's Cybersecurity crosscutting initiative.

With the growing dependence of our economy on electricity and the economic and personal losses from electricity outages due to severe weather becoming greater, building in resiliency has assumed an even greater degree of urgency. Power outages resulting from extreme weather events disrupt lives and cost the economy billions of dollars. The impact of events such as Superstorm Sandy, the vulnerabilities of our communities, and the critical importance of coordinated preparation, response, and recovery become increasingly clear with each new severe weather event.

This budget request supports the President's Climate Action Plan which offers a strategy for steady, responsible actions to prepare the Nation for the impacts of climate change, including

building stronger and safer communities. A resilient energy infrastructure that can recover quickly from a severe weather event is critical for climate adaptation.

As we witness the transformation of our Nation's electric grid, the Office of Electricity Delivery and Energy Reliability continues to drive electric grid modernization and resiliency. The American Recovery and Reinvestment Act of 2009 invested $4.5 billion and leveraged almost $5 billion of private sector matching funds to begin modernizing America's aging energy infrastructure. The Smart Grid Investment Grant and Smart Grid Demonstration Programs were important first steps in accelerating the Nation's transition to a smarter, stronger, and more efficient and reliable electric system. The Recovery Act funding enabled the deployment of a wide range of advanced devices and technologies now being used across the country to improve the reliability and efficiency of the system, help consumers better manage their electricity use, and better recover from disruptions and return to normal operations.

Our FY 2016 budget request invests in activities that will build on the successes of the Recovery Act-funded technology deployments, help communities become more resilient to extreme weather events, and help anticipate the growing challenges and changing dynamics in which the energy system will operate. The Smart Grid program will invest $14.6 million to develop an integrated operating system at the distribution level and an innovative market-based control system to better manage large numbers of distributed generators. To further support our resiliency work, we will also invest in microgrids and cost-effective solutions that will help strengthen infrastructure. In addition, we are developing a capability to estimate the risk of energy system disruptions, thus improving our ability to prepare for and respond to extreme weather and other threats to the system.

OE's FY 2016 budget request prioritizes activities that increase the resiliency, reliability, and security of the Nation's power grid through working closely with the energy sector and state, local, and tribal partners to take a systems-level approach to grid modernization, strengthen the distribution system, and increase protection of the energy infrastructure.

HIGHLIGHTS OF THE FY 2016 REQUEST

At $270.1 million, the FY 2016 budget request reflects a $123.1 million increase over the FY 2015 enacted appropriation, demonstrating the priority that the Administration places on OE's role in strengthening the energy infrastructure and modernizing the grid. This budget request emphasizes investments that increase the reliability and resiliency of the electric grid, including managing risk, strengthening the distribution system, and providing tools that will help states and local partners improve the resiliency of their communities. These priorities are reflected in the following highlights.

Strengthening Cybersecurity of the Energy Infrastructure

Strengthening protection of the critical energy infrastructure against an increasingly active and sophisticated threat of cyber attack is vital to the Nation's energy and economic security. There are a number of challenges unique to energy system cybersecurity, including protecting legacy devices that were installed before cyber threats existed. Another challenge is that most cybersecurity solutions developed for IT systems are not appropriate for the control systems utilized in the energy sector, which must assure real-time delivery of energy. Innovative solutions designed to meet the unique requirements of high-reliability energy delivery systems

are urgently needed to ensure the transformation of the Nation's power grid to meet future needs for economic growth. At the same time, it is crucial that these solutions not interfere with the critical function of the energy delivery devices they are meant to protect. Effective solutions must be based on industry best practices, sound risk management processes, and improved situational awareness.

Recognizing that security for energy delivery systems is most effective when it is built into the system from the very beginning, we have worked closely with the electricity sector for over a decade to improve protection and resiliency of the grid. Since 2010, we have invested more than $150 million in cybersecurity research, development, and demonstration projects led by industry, universities, and national labs. As a result of these investments, 20 new technologies are now being used to further advance the resilience of the Nation's energy delivery systems. For example, in January, the Oak Ridge National Laboratory announced the licensing of its Hyperion software, which helps detect software that has been maliciously altered.

The Office of Electricity Delivery and Energy Reliability is working to accelerate innovative research and development over the longer term, while also addressing the immediate need for information sharing and response capabilities. All of our cybersecurity activities align with the *Roadmap for Energy Delivery Control Systems Cybersecurity* vision of having resilient energy delivery systems that are designed, installed, operated, and maintained to survive a cyber incident while sustaining critical functions.

The FY 2016 budget request for the Cybersecurity for Energy Delivery Systems (CEDS) program provides $52.0 million to expand and accelerate our efforts to enhance the reliability and resiliency of the Nation's energy infrastructure by reducing the risk of energy disruptions due to cyber attacks. Our focus in FY 2016 falls into four areas:

- Accelerate information-sharing to enhance situational awareness in the electricity and oil and natural gas sectors;
- Expand implementation of the Cybersecurity Capability Maturity Models and Risk Management Process for the electricity and the oil and natural gas sectors;
- Continue investing in research to develop cutting-edge cybersecurity technologies and tools; and
- Exercise and refine the energy sector's cyber incident response capabilities.

Enhancing the Resilience of Large Power Transformers

To ensure a reliable and resilient power system, grid components must be designed and built to withstand the impact of lightning strikes, extreme weather events, space weather events and other natural disasters, electrical disturbances, accidents, equipment failures, and attacks. Building on earlier work funded by OE's Infrastructure Security and Energy Restoration program to monitor and analyze the impacts of ground-induced currents on the electric infrastructure, the new Transformer Resilience and Advanced Components program will advance our understanding of risks associated with geomagnetic disturbances and electromagnetic pulses and their impact on large power transformers and other critical components.

Strengthening the Reliability, Resiliency, and Efficiency of the Electricity Distribution System

Transforming the way electricity is distributed by developing new tools, technologies, and approaches will help improve the reliability, resiliency, and efficiency of the grid, and can help to manage electricity costs. The distribution system is where the factors driving change in electricity converge, presenting both opportunities and challenges. Advanced information and communication technologies are creating opportunities for utilities to leverage huge volumes of data for improved operational efficiency and integration of system assets in new ways. At the same time, falling costs of distributed energy resources, electric vehicles, and demand-side management technologies mean that utility distribution systems must accommodate increased deployment of these technologies. Consumers also expect more in terms of being able to control and manage their energy usage.

This budget request builds upon these trends by including funds for the development of an Advanced Distribution Management System that enables the integration of a full suite of distribution management applications. This development will fundamentally change the way that a utility operates, allowing disparate, manual processes to be integrated into real-time and near-real-time data and automated processes. Based on specifications and requirements to be developed jointly with utilities, this integrated platform will allow information to flow among applications across the utility enterprise, enabling enhanced visibility and controllability of system assets. The new capabilities will provide greater visibility and control required to integrate large amounts of renewables in a safe and effective manner and will allow utilities to use assets more efficiently during restorations and enable more choices for consumers while also maintaining affordable electricity rates.

Smart Grid investments in FY 2016 will also fund a new control paradigm that allows utilities to balance supply and demand at all levels of the grid by actively seeking participation of customer-owned and third-party assets in grid services through competitive market forces of supply and demand. Also known as transactive control, the combination of market-based control signals with electric distribution operations will create value to both consumers and utilities by allowing customers to fully participate in grid operations while also significantly increasing the system flexibility needed for integrating renewables and moving closer to a clean energy future.

Working with the States to Institutionalize Best Practices and Provide Tools Needed to Help Communities Become More Resilient and Adaptive

States have significant jurisdiction over the electricity system and are test beds for the transformation of the electric power system. In FY 2016, a new Grants for Electricity Transmission, Storage, and Distribution Reliability program will help state, local, regional, and tribal entities advance and integrate electricity reliability, efficiency, renewable energy, environmental protection and climate resiliency planning and actions.

The Federal Government can play a vital role in helping states and local governments by building and maintaining preparedness and assurance capabilities. Building on our successes and lessons learned with previous work in energy assurance across the states and U.S. territories, the new Grants for Energy Assurance program will provide grants for state, local, and tribal governments to update their energy assurance plans; conduct testing, training, and exercises; and ensure that plans and assessments are shared. The assurance grants will improve awardee

capacities to identify the potential for energy disruptions, quantify the impacts of those disruptions, and develop comprehensive plans for responding to the disruptions and to mitigate the threat of future disruptions. The goal of the program is to achieve a robust, secure, and reliable energy infrastructure that is better able to withstand catastrophic events, restore services rapidly in the event of any disaster, and minimize future vulnerabilities.

DETAILED ELEMENTS OF THE FY 2016 REQUEST

Our budget request supports investments in three key priority areas.

- We will increase the resiliency and security of the Nation's energy infrastructure with activities such as our work on cybersecurity and the preparedness exercises we conduct with our partners in government and industry.
- We will develop tools and technologies that measure, analyze, and control the grid of the future.
- We will establish the State Energy Reliability and Assurance Grants program to strengthen our partnerships with states, localities, regions, and tribes and help give them the tools they need for grid transformation.

GRID SECURITY AND RESILIENCE

Cybersecurity for Energy Delivery Systems

Within CEDS, continued support of cybersecurity research and development to ensure a sustainable pipeline of innovation remains a priority in FY 2016. At the same time, we are increasing our efforts to help the energy sector improve its cybersecurity posture at the organizational and process levels through expansion of tools such as the Cybersecurity Capability Maturity Model (C2M2). C2M2, launched in 2012 as part of an Administration initiative led by the Department of Energy and developed with the Department of Homeland Security, industry, and other stakeholders, helps organizations measure and improve their cybersecurity capabilities, informs their cybersecurity investment decisions, and encourages the adoption of best practices. The C2M2 model has helped organizations in the electricity and, since FY 2014, the oil and natural gas sectors to evaluate, prioritize, and improve their cybersecurity capabilities using a common set of industry practices.

CEDS supports the Cybersecurity Risk Information Sharing Program (CRISP), which started as a small OE-funded pilot and transitioned in FY 2014 to a private-sector program primarily managed by the Electricity Sector Information Sharing and Analysis Center within the North American Electric Reliability Corporation. CRISP facilitates the timely bi-directional sharing of classified and unclassified threat information and develops and deploys situational awareness tools to enhance the sector's ability to identify and mitigate threats and coordinate the protection of critical infrastructure. In FY 2016, we will continue to perform classified analytics and reporting in CRISP and will issue a competitive solicitation to identify and fund commercially available technologies and services that can be incorporated into CRISP via operational pilots designed to enhance all aspects of the program.

The ability to detect and mitigate the malicious activity is critical. In FY 2016, CEDS will conduct a competitive solicitation to establish a virtual collaborative environment for conducting real-time advanced digital forensics analysis for the energy sector. This virtual environment will allow analysts to safely inspect malware, vulnerabilities, and advanced threats across multiple stages and different vectors and test mitigations. This environment will be implemented over a two-year timeframe, after which it will transition to the private sector where it will become self-sustaining.

Transformer Resilience and Advanced Components

The Transformer Resilience and Advanced Components (TRAC) program grows out of activities formerly conducted in the Infrastructure Security and Energy Restoration (ISER) program. TRAC addresses the unique challenges facing large power transformers and other critical components of the electric grid.

Large power transformers are one of the most critical components of the grid. A single damaged large power transformer could disrupt power to a half million homes. Moreover, these large custom machines can take up to two years to manufacture and deliver. Geomagnetic disturbances (GMD), electromagnetic pulses (EMP), and other physical stressors can degrade or damage these vital assets. The risks, however, are not well understood.

The $10 million request for TRAC will expand upon previous work to monitor and analyze impacts of ground-induced currents on the electric infrastructure. This will include modeling and testing of transformers to evaluate vulnerabilities and alternative approaches to mitigate the risks from ground-induced currents. The request will also support research and development of power electronics systems that provide new capabilities to mitigate risks and provide advanced capabilities demanded by the future grid.

Infrastructure Security and Energy Restoration

As the Sector-Specific Agency for Energy, under the Department of Homeland Security's National Infrastructure Protection Plan, we work closely with Federal agencies, state and local governments, and industry to protect against and mitigate threats on the energy infrastructure caused by natural disasters, deliberate attacks, or even human error. DOE is also the lead agency for Emergency Support Function 12—also known as ESF-12—for Energy, when activated by the Federal Emergency Management Agency under the Stafford Disaster Relief and Emergency Assistance Act.

In the event of an emergency, we provide situational awareness, coordinate the response among Federal, state, and local agencies, and help facilitate the restoration of energy systems. When activated by FEMA, our team of specialized energy-infrastructure responders can be quickly activated and deployed to the event's location. These ESF-12 responders provide situational assessments, facilitate clear and consistent communication with other deployed responders, provide subject matter expertise to help with restoration, and identify where the Federal government can engage in restoration efforts. ISER was activated for five events during the 2014 storm season and deployed 33 field responders across these activations.

Our tactical analysis and situational awareness efforts inform the public, senior government officials, and Congress on energy infrastructure status and provide leadership and technical

guidance on issues impacting the energy sector. These system assurance efforts minimize adverse impacts to electricity, oil, and natural gas operations and strengthen national security through inter-agency coordination.

Ongoing emergency preparedness efforts include maintaining a proactive preparedness and readiness posture, as well as promoting information sharing and communication of best practices for hardening and resilience of energy systems.

The $14.0 million request for ISER will develop advanced mitigation solutions for hardening energy infrastructure against all hazards and increase the breadth and number of energy emergency preparedness exercises. Processes and procedures must be stressed and proven through testing, training, and exercises across all levels of government and industry in order to ensure planning and coordination practices are effective. The request also supports the DOE Response and Operations Center for an operational environment with the technology, methods, and tools to enable analysts to time, monitor, simulate, and track energy disruptions in real time.

TECHNOLOGY INNOVATION

Smart Grid Research and Development

Transforming the way in which electricity is distributed by developing new tools, technologies and approaches will help improve the reliability, resiliency, and efficiency of the grid, and can help to manage electricity costs. Advanced distribution systems that use microgrids and other smart grid technologies will be crucial to next-generation electric distribution systems. I am proud to mention that a microgrid design for NJ TransitGrid, developed through a technology transfer partnership with the State of New Jersey and Sandia National Laboratory in the aftermath of Hurricane Sandy, is now being built under a competitive grant by the Federal Transit Administration.

The $30.0 million request for the Smart Grid program expands our investment in transforming electric distribution systems through the development of new tools, innovative grid technologies, and advanced concepts. The FY 2016 request includes a new investment to develop an Advanced Distribution Management System (ADMS). This will be an open source integrated software platform supporting a full suite of distribution management applications, such as voltage and frequency regulation; fault location, isolation, and service restoration; dispatching assets; and routing service crews. This platform, based on specifications developed jointly with utilities, will allow information flow among applications across the entire utility enterprise, enabling enhanced visibility and controllability of system assets. We will also explore new applications that can leverage the increased types and volume of available system data to enhance observability and controllability needed to integrate large amounts of distributed generation (e.g., from renewables) in a safe and effective manner, enable greater consumer power choices, and maintain affordable electricity rates.

The Smart Grid program will also explore market-based controls in FY 2016. Market-based controls create value for both utilities and customers using competitive market forces of supply and demand. Utilities would be better able to balance supply and demand at all levels of the grid while also allowing consumers to actively participate in grid operations. Consumers would be able to determine their flexibility on power usage based on the cost of power—for instance, during hours when power is cheaper they may want their HVAC to pre-heat or cool their house

and at other times to restrict HVAC usage, or, if they have rooftop solar power and storage batteries, at some price point they may choose to charge their batteries and at another to discharge power to sell back to the grid. Ultimately, an aggregate price/power flexibility curve across all customers would be available to utilities, which could then find the right price point to balance supply and demand. FY 2016 market-based control signal activities include developing simulation tools and test cases, and validating tools using test cases developed under the Recovery Act. Approaches developed by researchers and industry will be evaluated for controllability, stability, and effectiveness.

Microgrids, which are localized grids that can disconnect from the broader electric grid to operate autonomously and help mitigate grid disturbances to strengthen grid resilience, remain an important focus in FY 2016. We saw the important role microgrids can play in resiliency during Superstorm Sandy, when hospital, university, and building facilities equipped with microgrids were able to provide essential power to critical loads during week-long grid outages. Microgrid R&D will focus on activities needed to achieve the DOE 2020 microgrid performance targets and meet resiliency objectives defined by individual communities. We plan to have a funding opportunity announcement during FY 2016 for networked microgrids.

Another priority of Smart Grid in FY 2016 is on R&D for a resilient distribution grid. The R&D program plan will be finalized in June 2015, with input from stakeholders. The program plan has a goal of achieving a twenty percent reduction in the economic impact of loss of load resulting from extreme weather events. Our planned activities in FY 2016 include implementing partnership projects with industry on cost-effective hardening measures and developing two decision analysis tools with national labs. One tool will target utilities designing a resilient electric distribution grid, and the other will target utility operators interested in optimizing their response during system restoration and recovery.

Clean Energy Transmission and Reliability

The Clean Energy Transmission and Reliability (CETR) program improves energy system planning and operations through research, development, and demonstration of measurement, modeling, and control technologies for the grid and through risk assessment of interconnected energy infrastructure systems. CETR disseminates its results to industry partners and state- and Federal-level stakeholders. The $40.0 million request for CETR supports three subprograms: Transmission Reliability, Advanced Modeling Grid Research, and Energy Systems Risk and Predictive Capability.

CETR's Transmission Reliability subprogram develops advanced monitoring applications for the grid that give transmission system operators real-time information to improve system operations, reliability, and efficiency. Prior investments by the Transmission Reliability subprogram resulted in the deployment of devices to measure the conditions of the grid and the systems to synchronize and collect these high-resolution measurements. The data from these systems provide operators with wide area visibility and situational awareness, allowing them to foresee and respond to potentially destabilizing events, thus improving reliability, reducing the number and extent of blackouts, and speeding power restoration. Past program investments have resulted in a continent-wide measurement system and improvements in the measurement devices. In FY 2016, the $18.0 million request supports developing and deploying synchrophasor-based software applications that improve reliability through real-time high-resolution measurements

and allow operators to identify and react to incipient equipment failures, physical attacks, and geomagnetic disturbance events.

Advanced Modeling Grid Research (AMGR) focuses on modeling, computational, and mathematical advancements as the foundation for energy management systems for operators to plan, monitor, and control the increasingly dynamic, uncertain, and complex electric system. AMGR's research innovations increase the electric system's operational efficiency, improve reliability and resilience, and support visibility and control across electricity transmission and distribution systems. Advanced models transform real-time data into actionable information, assessing not only "what is happening" but also "what could happen." Accurate and validated models are a critical enabler of system transformation by applying real-time situational awareness and measurement-based autonomous control. When a disruption occurs, model-based decision support tools are essential to identify opportunities for operational flexibility and help guide operators along a path to quick recovery. The FY 2016 request of $15.0 million supports a competitive solicitation to accelerate the transition of mathematics research and prototype models developed over the past several years by the program into industry-relevant applications, as well as to expand mathematics and computational research to include uncertainty quantification, model formulation and reduction, and system controls.

The Energy Systems Risk and Predictive Capability (ESRPC) subprogram develops independent and objective risk assessments of energy infrastructure systems and supply chains. Recent efforts include an energy risk and reliability assessment for Super Bowl XLIX in January 2015 and a pilot study on the effect of sea level rise on energy infrastructure in Houston, Los Angeles, Miami, and New York City. A predictive capability to better understand potential impacts to energy infrastructure will help in near- and long-term planning and response, enable improved prioritization of infrastructure improvements to improve resilience and security, and reduce vulnerabilities. The budget request of $7.0 million supports connecting and integrating research from the Transmission Reliability and AMGR subprograms into ESRPC assessments, further developing analytic tools to estimate seasonal and regional energy system risks, and expanding the sea level rise study to Boston, Mobile/Pascagoula, Norfolk, and Philadelphia.

Energy Storage

Energy storage is a necessary and vital component of the future electrical grid, providing a critical buffer between electrical generation and demand. To provide this buffer, the Energy Storage program is focused on the development, demonstration, and deployment of advanced energy storage technologies that will enhance the stability, resiliency, and reliability of the future electric grid while enabling increased deployment of variable renewable energy resources such as wind and solar power. The program is aligned with the 2013 DOE Grid Storage Strategy and focused on developing cost-competitive technologies, validating reliability and safety, establishing an equitable regulatory environment, and promoting acceptance by industry.

Our FY 2016 request of $21.0 million supports work on materials and device research, demonstrations, and cost-benefit analysis. Developing alternative battery chemistries will increase the potential to develop safer and more cost effective storage solutions. Efforts on energy storage safety, including a new quarterly Energy Storage Safety Forum for the storage community, will be expanded to improve acceptance and accelerate the deployment of storage. Energy storage reliability will be further developed with a stakeholder workshop and research to

improve operating lifetimes of energy storage systems. New co-funded efforts with state and regional entities on energy storage demonstrations to quantify storage performance and develop valuation tools for utilities and regulators under a wide variety of applications will be initiated.

Advances in all these areas will be vital in the progress towards commercially sustainable deployment of energy storage solutions to enable a more stable, resilient, and reliable electrical grid with increased deployment of variable renewable energy resources.

INSTITUTIONAL SUPPORT AND ALIGNMENT

State Energy Reliability and Assurance Grants

The Nation's energy infrastructure is undergoing a sweeping transformation including growth in distributed generation resources such as renewables, internet-enabled demand response technologies, increasing electric vehicle deployments, dramatic expansion in natural gas production and use, and integration of energy storage. These changes are placing increasing demands on the energy grid. To assist states, localities, regions, and tribal entities in meeting these challenges, this budget request includes $63.0 million for State Energy Reliability and Assurance Grants. This funding is divided into two separate grant programs:

- $27.5 million is requested for Grants for Electricity Transmission, Storage, and Distribution Reliability. These grants help the states design energy markets and policies that will address system interdependencies and support integrating increasing levels of renewable energy generation into the grid.
- $35.5 million is requested for Grants for State Energy Assurance. These grants will help state and local governments build and maintain their preparedness capabilities through energy assurance planning and the testing, training, and exercising of plans that address the range of complexities that can arise during energy disruptions such as shortages of delivered fuels and impacts on interdependent sectors such as telecommunications and health.

National Electricity Delivery

Beyond advances in grid security, resiliency, and technologies, the electric industry must respond to several emerging challenges that arise from grid transformation. A changing electric generation mix, replacing aging infrastructure (transmission, storage, distribution, and generation), and updating communication networks, are some challenges that we face. Other challenges include accommodating new end-use technologies such as distributed resources, planning for increased interdependencies between natural gas, water and electricity systems, and addressing business models that manage these challenges in providing reliable and affordable electricity service. All of this must be balanced against the need for cost control, physical security and cybersecurity, improved or sustained reliability and resiliency, and flexibility to deal with market uncertainties and a changing climate.

States, regions, and tribal entities may lack sufficient expertise to make decisions on often complicated electricity policy issues. Traditional utility or state boundaries may not be conducive to regional thinking among stakeholders, but transmission lines, demand response, and planning activities are inherently regional in nature. With a requested $7.5 million for the National Electricity Delivery program in FY 2016, OE continues to provide technical assistance to states,

tribes, and regions on their electricity policies, programs, and market mechanisms to help identify approaches that encourage the development and deployment of reliable and affordable electricity infrastructure, whether generation, transmission, storage, distribution, or demand side electricity resources. Our intent through this work is to support strengthening these individual systems, which, in turn, strengthens the entire electricity infrastructure.

In addition to technical assistance, OE will facilitate grid modernization by strengthening the long-term integrated system reliability modeling and analytical tools available to states and others. Decision-making by state, regional, and local entities will be better informed by understanding the range of potential futures and their impacts before decisions are made. These tools will also help manage the complexity of the grid and the additional complexities associated with interdependent infrastructures such as electricity and gas, as well as energy and water. The capability to analyze infrastructure requirements on a range of potential futures is critical as it helps quantify the long-term benefits and costs of constructing long-lived assets, which markets may not adequately signal.

The FY 2016 request also supports efforts to facilitate timely construction and efficient operations of electric transmission capacity. OE plays important roles at the Federal level, authorizing the export of electricity, issuing permits for the construction of transmission infrastructure across international borders, and conducting a triennial national transmission congestion study to draw attention to areas of the country where transmission congestion is a significant concern.

OE also coordinates Federal permitting of transmission infrastructure for new transmission projects involving Federal lands, pursuant to section 216(h) of the Federal Power Act. The request builds on the progress made to achieve multi-agency recognition of an Integrated Interagency Pre-Application (IIP) process for transmission projects requiring Federal authorizations, as required by a June 7, 2013 Presidential Memorandum and in support of section 216(h). Successful IIP process implementation will improve coordination among project proponents and Federal agencies prior to formal application submission, leading to more complete applications and more efficient Federal permitting timelines.

PROGRAM DIRECTION

The FY 2016 budget request includes $32.6 million for Program Direction, which supports Federal staff providing executive management, programmatic oversight, and critical technical and administrative support necessary for the effective implementation of the OE program. The request funds 128 full time equivalents in FY 2016, based primarily in Headquarters and at the National Energy Technology Laboratory in West Virginia.

CONCLUSION

OE's FY 2016 budget request of $270.1 million will give our team the tools and resources that they need to maintain steady, sustained progress towards modernization of the Nation's electricity system. OE's strategy supports and is aligned with the President's all-of-the-above energy strategy. This vision—with an eye on both the present and the future—is crucial, as we work to meet the challenges that are rapidly redefining U.S. energy landscape and the Nation's power grid.

The United States has reached an important juncture in the evolution of how electricity is delivered to consumers. As America's population continues to grow and the world becomes increasingly digitized and complex, consumers must have access to reliable, secure, and clean sources of energy to meet the demands and challenges of living in a modern, vibrant society. As the Nation and the world continue changing, the Nation's power grid must also change and adapt to climate change, the diversity and uncertainty of future energy demands and generation portfolios, and growing threats.

OE's FY 2016 budget request invests in activities that will allow us to address these ongoing challenges and continue moving the Nation towards a more resilient and secure energy future.

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

Statement of John Kotek
Principal Deputy Assistant Secretary for Nuclear Energy
U.S. Department of Energy
Before the
Subcommittee on Energy and Water Development, and Related Agencies
Committee on Appropriations
U.S. House of Representatives

FY 2016 Appropriations Hearing
March 17, 2015

Chairman Simpson, Ranking Member Kaptur and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the President's fiscal year 2016 budget request for the Office of Nuclear Energy (NE) at the Department of Energy.

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

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

Nuclear energy continues to be an important part of President Obama's "all-of-the-above" energy strategy for a sustainable, secure, and clean energy future. Nuclear energy must continue to play a pivotal role to achieve the Administration's goal of reducing carbon emissions by 26-28 percent by 2025. As Secretary Moniz stated during the International Atomic Energy Agency's General Conference last September, "Strong global action is needed to reduce greenhouse gas emissions and address their impacts on climate and development. Smart climate policies can drive cleaner growth, resulting in a range of economic and social benefits... If most nuclear power plants are retired at 60 years, we will see many retirements starting in 2030. We will need

to know within a decade how new nuclear energy sources can play a major part in the clean energy solution."

There are five new nuclear reactors currently under construction in the United States, the first in more than 30 years. The first of these expected to enter service will be the second unit at TVA's Watts Bar site, which is scheduled to begin loading fuel this summer and begin commercial operation later this year. The other four reactors, in Georgia and South Carolina, are of the next-generation advanced reactor AP1000 design, possessing enhanced passive safety features and improved operational performance. Last February, the Department of Energy's Loan Programs Office announced that two of the owners of Plant Vogtle received a $6.5 billion loan guarantee to support construction of the Vogtle facility. Together, these newly constructed units will provide enough reliable, zero-carbon, baseload electricity to power three million homes in the Southeastern United States.

In spite of the optimism surrounding the construction of these new plants, challenges remain with the 99 reactors in our existing fleet. Aging and market forces have placed additional economic pressures on some of these units. Our Light Water Reactor Sustainability program ensures the continued safe and economic operation of the current fleet. This program focuses on extending the operating lifetimes of current plants beyond 60 years and generating near-term benefits by making further improvements in their productivity.

A high priority of the Department has been to accelerate the timelines for the commercialization and deployment of small modular reactor technologies through the SMR Licensing Technical Support program. SMRs have the potential to achieve lower upfront capital cost, modular power additions, and simpler, predictable and faster construction than other designs. The Department believes strongly that SMRs can promote American competitiveness, create manufacturing jobs here at home, and reduce CO_2 emissions through clean, safe, and reliable nuclear power. Furthermore, SMRs could re-invigorate design and construction infrastructure for the nuclear sector and lay the foundation for the advanced reactor concepts of the future.

Additionally, we look to the future and strive to develop advanced computing capabilities that serve as virtual versions of existing, operating nuclear reactors. In January, the Department renewed funding for the Consortium for the Advanced Simulation of Light Water Reactors (CASL), an Energy Innovation Hub established in 2010. Over the next five years, CASL researchers will focus on extending the modeling and simulation tools built during its first phase to include additional nuclear reactor designs, including small modular reactors. In coordination with CASL, the Nuclear Energy Advanced Modeling and Simulation (NEAMS) program will address high impact problems in accident tolerant fuels and steam generator vibrations.

Over the last two decades, nuclear energy has provided nearly 20 percent of the Nation's electrical generation and remains the largest contributor of non-greenhouse gas-emitting electricity in the United States. In order to continue to use this this carbon-free energy supply, we

must overcome the challenge of managing our nation's nuclear waste and used nuclear fuel. With the Administration's 2013 *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* as our foundation, NE is undertaking activities within its existing authority to lay the ground work for implementation of transportation, storage, and disposal of nuclear waste through a phased, adaptive, and consent-based approach.

The President's fiscal year 2016 budget requests $907.6 million for the Office of Nuclear Energy.

OFFICE OF NUCLEAR ENERGY PROGRAMS

NE Funding for DOE Crosscutting Initiatives - $62.266 million

The FY 2016 Budget Request expands the crosscutting initiatives introduced in the FY 2015 Budget Request. The Department's crosscuts effectively and efficiently address the United States' energy, environmental, and national security challenges. Each crosscut, designed to advance key technology areas that have multiple energy resource applications, reflects a comprehensive and integrated plan of work to optimize programmatic objectives by efficiently allocating resources.

Supercritical CO_2 - $8 million

The supercritical carbon dioxide (sCO_2) based power generation effort is a technology-focused crosscutting initiative that will facilitate industry's transition to realize power cycles based on sCO_2 as the working fluid. A unique aspect of this conversion technology is that it can be used by nuclear, solar, and fossil energy plants to improve energy generation efficiency. As a result, this continues to be a collaborative DOE project among the Offices of Fossil Energy (FE), Energy Efficiency and Renewable Energy (EERE), and Nuclear Energy to further develop the technology by establishing a cost shared pre-commercial pilot demonstration, while continuing to leverage the technical expertise and capabilities of the national laboratories.

Building on industry outreach and focused research and development (R&D) efforts in FY 2015, the major thrusts of the crosscut in FY 2016 are a coordinated R&D effort in high temperature technology development/component validation, and the Supercritical Transformational Electric Power Generation (STEP) initiative to design, construct and operate a 10-MW pilot test bed. Demonstrating and developing this power cycle has the potential to revolutionize electric power generation for fossil, concentrating solar, geothermal, nuclear and waste heat recovery applications in a way that is cleaner and more efficient, and which reduces cost.

Subsurface Engineering - $39.5 million

DOE's Subsurface Technology and Engineering R&D crosscut, SubTER, aims to address identified challenges in the subsurface through highly focused and coordinated research in Wellbore Integrity, Stress State and Induced Seismicity, Permeability Manipulation, and New Subsurface Signals to ensure enhanced energy security, material impact on climate change via CO_2 sequestration, and significantly mitigated environmental impacts from energy related activities and operations. NE is contributing to this crosscut with its field test to support R&D on the concept of waste disposal in deep boreholes and its R&D on characterization and performance of generic mined geologic repository media.

Cybersecurity - $14.466 million

The DOE is engaged in three categories of cyber-related activities: protecting the DOE enterprise from a range of cyber threats that can adversely impact mission capabilities; bolstering the U.S. Government's capabilities to address cyber threats; and, improving cybersecurity in the electric power subsector and the oil and natural gas subsector. The Cybersecurity crosscut supports central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center (JC3) for incident response and the implementation of Department-wide Identity Credential and Access Management (ICAM).

SMR Licensing Technical Support – $62.5 million

The development of safe, clean, affordable nuclear power options is a key element of the Department of Energy's Office of Nuclear Energy (DOE-NE) Nuclear Energy Research and Development Roadmap. As a part of this strategy, accelerating the timelines for the commercialization and deployment of small modular reactor (SMR) technologies through the SMR Licensing Technical Support (LTS) program has been a high priority of the Department. The program supports first-of-a-kind costs associated with design certification and licensing activities for SMR designs through cost-shared arrangements with industry partners (industry contributions are a minimum of 50% of the cost). If industry chooses to widely deploy these technologies in the U.S., SMRs could help meet the Nation's economic, energy security, and climate change goals. The goal of the program is to provide financial risk reduction to the industry first-movers to accelerate the design development, certification, and licensing of the safest, most economical SMR technologies. The Department's cooperative agreements awarded under this program support the domestic development of these innovative nuclear technologies, thereby strengthening American manufacturing capabilities and the associated nuclear supply chain, improving the domestic job outlook, and creating important export opportunities for the U.S.

The Department also believes that exercising of SMR-specific site permitting and licensing methodologies and processes is an important aspect in the development of commercialization potential of SMR technologies. The Department's FY 2016 Budget Request allows for ongoing recipients and an electricity provider partnered with NuScale to receive funding for site permitting and related licensing activities within existing program funding amounts. In FY 2016, the SMR LTS program management will also consider additional analytical efforts that may be able to provide value to the overall program goals within the current program budget.

Supercritical Transformational Electric Power Research and Development - $5.0 million

The Supercritical Transformational Electric Power Research and Development (STEP R&D) initiative is a collaborative Department of Energy (DOE) project to develop and scale up advanced Supercritical Carbon Dioxide (sCO_2) Brayton cycle energy conversion technology to facilitate commercial development.

The FY 2015 Omnibus directed the Department to engage with the appropriate stakeholders to gather information with the goal of developing an effective solicitation for a public-private cost-shared sCO_2 demonstration program. In FY 2016, NE activities will support the solicitation, evaluation and competitive award(s) for the STEP pilot scale demonstration facility, which will be funded and directed primarily by FE because the near-term deployment and potential market applications for commercial sCO_2 power cycles are primarily in the fossil energy area. Both FY 2015 and FY 2016 activities in this budget element will be coordinated and fully integrated through the Department's sCO_2 Crosscut, involving the Offices of Fossil Energy (FE), Energy Efficiency and Renewable Energy (EERE), and Nuclear Energy.

Reactor Concepts Research, Development and Demonstration - $108.1 million

The Reactor Concepts Research, Development and Demonstration (RD&D) program develops new and advanced reactor designs and technologies to further the state of reactor technology, to improve its competitiveness, and to help advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs. Program activities are designed to address technical, cost, safety and security issues associated with advanced reactor technologies, such as fast reactors using liquid metal coolants and high temperature reactors using helium or liquid salt coolants. Additionally, Reactor Concepts RD&D will conduct R&D on advanced technologies that improve the reliability, sustain the safety, and extend the life of the current light water reactor (LWR) fleet.

Light Water Reactor Sustainability - $33.275 million

The Light Water Reactor Sustainability (LWRS) subprogram is focusing research on material aging issues where research results will help support subsequent license renewal applications expected from industry around 2018. Activities in the Reactor Safety Technologies area are addressing opportunities to enhance the safety profile of the domestic reactor fleet by examining lessons learned from the Fukushima Daiichi accident. These include evaluation of instrumentation needs to better monitor and manage accident conditions, improved modeling of accident progression, and preparation and planning efforts in support of eventual examination of the damaged reactors.

Advanced Reactor Technologies - $74.865 million

The Advanced Reactor Technologies (ART) subprogram will continue R&D on advanced reactor technologies and will support work on generic topics that can apply to various advanced reactor concepts. This program focuses on efforts in the following areas: advanced reactor coolants, safety and technology for advanced reactors, advanced energy conversion, advanced instrumentation and controls, collaboration with the Nuclear Regulatory Commission (NRC) on the development of an advanced reactor licensing framework, liquid metal reactor component testing, TRISO fuel and graphite material qualification, advanced materials development and codification, completion of the exploratory planning study for an advanced text/demonstration reactor, continued international collaborations, and cost-shared industry-R&D collaborations. Research results from this program are expected to help reduce design and construction costs, contribute data to the technical bases for the operation of safety systems, improve proliferation resistance, and provide critical insights to help solve key feasibility and performance challenges.

Fuel Cycle Research and Development - $217.76 million

The Fuel Cycle Research and Development (FCR&D) program conducts generic R&D and generic non-R&D activities related to used nuclear fuel (UNF), nuclear waste management and disposal issues. The program also conducts R&D on advanced sustainable fuel cycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, enhance safety, and limit proliferation risk. In addition, the program is laying the ground work for implementation of the Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (*Strategy*). The program employs a long-term, science-based approach to foster innovative, transformational technology solutions to achieve this mission. Advancements in fuel cycle technologies and solutions support the enhanced availability, affordability, safety, and security of nuclear-generated electricity in the U.S.

An effective, long-term nuclear waste management program requires the restructuring of the current funding arrangement. The Administration recommends the new funding arrangement

include the following elements: ongoing discretionary appropriations; access to annual fee collections provided in legislation, either through their reclassification from mandatory to discretionary, or as a direct mandatory appropriation; and eventual access to the balance or "corpus" of the Nuclear Waste Fund. The FY 2016 Budget Request includes a proposal to implement such reform. Discretionary appropriations are included for the duration of this effort. These funds would support expenses that are regular and recurring, such as program management costs, which include administrative expenses, salaries and benefits, studies, and regulatory interactions. In FY 2016, these funds will be for ongoing studies and outreach efforts associated with transportation and storage through the UNFD's integrated waste management system subprogram. Mandatory appropriations in addition to the discretionary funding are proposed to be provided annually starting in FY 2019 to fund the balance of the annual program costs.

Material Recovery and Waste Form Development - $35.3 million

The Material Recovery and Waste Form Development (MRWFD) subprogram's primary mission is to develop advanced material recovery as well as advanced waste form development technologies that could improve current fuel cycle performance and enable a sustainable fuel cycle with minimal processing, waste generation, and potential for material diversion. MRWFD continues to apply the expertise and technical capabilities gained over the years to a broader range of applications. In addition to separations, MRWFD provides solutions for environmental remediation, national security missions, as well as civilian nuclear applications.

The Joint Fuel Cycle Studies (JFCS) effort/project is a key activity within MRWFD. In collaboration with the Republic of Korea, the JFCS is assessing the technical and economic feasibility and nonproliferation acceptability of electrochemical recycling and other options for managing UNF. JFCS is a ten-year effort that is divided into three phases. In FY 2016, the JFCS will be in its second phase, which is the determination of reliable integrated process operation with used LWR fuel.

Advanced Fuels - $48.7 million

The development of improved and advanced nuclear fuels is a major objective for existing light water reactors (LWR) and future sustainable fuel-cycle options. Advanced Fuels is pursuing two major paths: 1) the development of next generation LWR fuels with enhanced performance and accident tolerance, and 2) the development of transmutation fuels with enhanced proliferation resistance and resource utilization over the long term. The Advanced Fuels subprogram sustains core development and experimental capabilities that support the nuclear reactor technologies described in the Reactor Concepts Research, Development, and Demonstration program.
In FY 2016, the program continues to support accident tolerant fuel (ATF) and clad concepts R&D. This includes fuel fabrication and testing involving irradiations in DOE's Advanced Test

Reactor (ATR) and foreign reactors (Halden), steam environments, furnaces, and mechanical property testing. These feasibility and assessment activities also include establishing modeling capabilities for these new concepts, using existing models as the bases for development; as well as studies of impacts on economics, the fuel cycle, operations, safety, and the environment. These evaluations will inform decisions about future activities in this subprogram. The Department also plans to establish the capability for pressurized loop testing in the ATR and transient testing in the Transient Reactor Test Facility (TREAT), both at the Idaho National Laboratory (INL).

A major activity in 2016 will be the "downselection/prioritization" of the industrial accident tolerant fuel concepts that will be pursued in the next phase of the program; leading up to the irradiation of a lead fuel rod or fuel assembly in a commercial power reactor. The Department will also continue the long-term development of transmutation fuel that includes irradiations, enhanced material testing capability enhancement, associated model development, and coordination with the NE nuclear model and instrument development programs.

Systems Analysis and Integration - $11.2 million

The Systems Analysis and Integration subprogram provides the critical capability needed to analyze complex fuel cycle system options, assess overall performance under various scenarios, and improve understanding of the interdependencies between various subsystems and associated technologies. The objective is to develop and implement analysis processes and tools, and perform integrated fuel cycle evaluations that help inform the decision makers on the overall FCR&D priorities and program direction. In addition, information gleaned from these processes will provide valuable insights into how to best integrate activities through R&D efforts with common fuel cycle goals.

Materials Protection, Accounting and Control Technology - $8.6 million

The Materials Protection, Accounting and Control Technology (MPACT) subprogram develops the technologies and analysis tools to support the next generation of nuclear materials management and safeguards for future U.S. nuclear fuel cycles. It also includes assessing vulnerabilities and security of the consolidated storage of used nuclear fuel, and managing and minimizing proliferation and terrorism risk. Addressing the energy security needs of the country will require innovative approaches to materials control and accounting to ensure that nuclear material is not misused, diverted, or stolen.

NE works closely with the National Nuclear Security Administration (NNSA), the Department of State, and the Nuclear Regulatory Commission (NRC) on issues related to nuclear nonproliferation. NNSA has broad responsibilities in international nonproliferation and security

matters for the present and into the future. MPACT is focused on R&D as it relates to potential future fuel cycle facilities in the U.S.

Used Nuclear Fuel Disposition - $108.36 million

The Used Nuclear Fuel Disposition subprogram is organized into three distinct elements: R&D to identify alternatives and conduct scientific research and technology development to enable storage, transportation, and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles; activities that lay the groundwork for an integrated waste management system with specific emphasis on development of a consolidated storage facility and associated transportation; and activities associated with exploring potential alternative disposal options for some DOE-managed high-level radioactive waste and spent nuclear fuel. The FY 2016 Budget supports the following activities: a field test to support R&D on the concept of waste disposal in deep boreholes in crystalline basement rock and R&D on characterization and performance of generic mined geologic repository media and concepts for disposal of high-level radioactive waste and used nuclear fuel.

Fuel Resources - $5.6 million

The Fuel Resources subprogram supports activities that will assure economic nuclear fuel resources remain available. The program will evaluate nuclear fuel resources and develop economic means of extracting uranium from seawater. A key objective is to develop advanced adsorbent materials that can simultaneously enhance uranium sorption capacity, selectivity, kinetics, and materials durability; thereby, reducing the development costs and uncertainties.

Nuclear Energy Enabling Technologies - $86.387 million

The Nuclear Energy Enabling Technologies (NEET) program sponsors R&D and strategic infrastructure investments to develop innovative and crosscutting nuclear energy technologies. This program also makes a strong investment in modeling and simulation efforts to bring 30 years of improved computational and material science to reactor and fuel system simulation. The results will provide researchers, designers, and operators with advanced tools to better understand the behavior of nuclear energy systems; thereby improving safety, economics, and efficiency. Additionally, the program provides access to unique nuclear energy research capabilities through its nuclear science user facilities. NE Traineeships is a new subprogram under NEET that will address workforce needs in the field of radiochemistry. The capabilities developed through NEET will advance the state of nuclear technology, improving its competitiveness, and promoting continued contribution to meeting our Nation's energy and environmental challenges.

As in previous years, NE dedicates up to twenty percent of R&D dollars to the Nuclear Energy University Program (NEUP) to develop the next generation of leaders in America's nuclear workforce. NEUP supports work scopes addressing the full range of NE R&D activities with specific emphasis on technical areas best suited for university-based R&D including important aspects of fuel cycle and reactor development, as well as mission supporting transformative research.

Crosscutting Technology Development - $15.343 million

The Crosscutting Technology Development (CTD) subprogram competitively awards high-priority R&D to universities, national laboratories, and industry, leading to the development of innovative solutions to unique and crosscutting nuclear energy challenges. Additionally, NEET CTD strategically invests in competitive, nuclear energy-related infrastructure enhancement at national laboratories; ensuring researchers have access to state-of-the-art R&D capabilities. The subprogram leads the coordination with NE's other R&D programs to ensure that developed technologies and capabilities are part of an integrated system offering the potential of revolutionary improvement in safety, performance, reliability, economics, and proliferation risk reduction.

Nuclear Energy Advanced Modeling and Simulation - $23.612 million

NEAMS provides a complex set of computational simulation tools, in support of NE programs, such as the Advanced Reactor Technologies and Fuel Cycle R&D programs. NEAMS engages scientists and engineers in developing state-of-the-art, multi-scale models of material properties and advanced computational simulation tools for simulations of nuclear energy systems. NEAMS is developing a computational ToolKit which is comprised of both reactor and fuel systems analysis capabilities that can be exercised either coupled or independently, depending on the needs of the end user. Computational tools developed under the NEAMS program define the state-of-the-art in nuclear simulation and are currently being used by over 60 organizations, both domestically and abroad.

Energy Innovation Hub for Modeling and Simulation - $24.3 million

The Energy Innovation Hub for Modeling and Simulation (Hub) is developing a virtual reactor model of an actual Westinghouse-designed, pressurized water reactor (PWR), owned and operated by the Tennessee Valley Authority-owned (TVA), to simulate reactor behavior. Once completed, engineers will use this virtual model to improve the safety and economics of reactor operations by simulating proposed solutions to manage reactor power production increases and reactor life and license extensions. The combination of data gained from the virtual model and

the physical reactor will be used to resolve technology issues that have challenged nuclear energy development. The Oak Ridge National Laboratory (ORNL) is leading a consortium (CASL – Consortium for Advanced Simulation of Light Water Reactors) of national labs, universities, and industry partners to manage Hub execution.
During FY 2015, the Hub was renewed for a second five-year phase.

In FY2016, the Hub will add new capabilities to the virtual reactor that will allow its coupled thermal-hydraulics, neutronics, fuels performance, and chemistry tools to address performance and safety issues for Pressurized Water (PWR) and Boiling Water (BWR) reactors, as well as SMRs. In addition, the Hub will expand its partnership to include other reactor technology vendors and electric utilities. Plans include conducting cost-shared deployment tests that would install virtual reactor tools on industry computers. Information obtained from these tests will provide an improved understanding of industry-defined issues that currently limit the energy output of their reactors.

Nuclear Science User Facilities (NSUF) – $21.132 million

The request renames the National Scientific User Facility subprogram to the Nuclear Science User Facilities (NSUF) to better align with the focus of the subprogram and to recognize that it is comprised of multiple facilities spread across multiple national laboratories, universities and industry. The NSUF represents a "prototype laboratory for the future," promoting the use of unique nuclear research facilities and encouraging active university, industry, and laboratory collaboration in relevant nuclear scientific research. The NSUF, through competitive solicitations, provides a mechanism for research organizations to collaborate, conduct experiments and post-experiment analysis, and utilize high performance computing at facilities not normally accessible to these organizations.
The Idaho National Laboratory Advanced Test Reactor (ATR) and post-irradiation examination (PIE) facilities at the Center for Advanced Energy Studies and Materials and Fuels Complex are available as user facilities. Additionally, research reactors at Oak Ridge National Laboratory, Massachusetts Institute of Technology, North Carolina State University, the Advanced Photon Source beam line capabilities at the Illinois Institute of Technology, irradiation experiment design and fabrication capabilities at Pacific Northwest National Laboratory, hot cells and fabrication capabilities at Westinghouse, and examination facilities at the Universities of Wisconsin, Michigan, California-Berkeley, Purdue, and Nevada-Las Vegas are partnered with the NSUF, bringing additional user facilities to the research community. Since its designation as a user facility in 2007, the NSUF has awarded 109 experiments to 22 universities and 4 laboratories.

Nuclear Energy Traineeships - $2 million

The Office of Nuclear Energy has mission-specific/mission-critical workforce needs in the area of radiochemistry. Given that the current radiochemistry workforce is approaching the age for retirement, the U.S. is faced with a growing demand for the education and training of scientists in radiochemistry. The DOE national laboratories are also losing capability due to retirement of a substantial number of their "core" groups of radiochemists and nuclear chemists. The nation will need radiochemistry expertise for decades to come in order to support its energy and security interests, and most importantly, to maintain global leadership in the next generation of safe nuclear energy technology from both a national security and an environmental perspective.

Radiological Facilities Management - $6.8 million

Radiological Facilities Management (RFM) provides support for radiological facilities not on Department of Energy (DOE) property. In FY 2016, the Department is requesting funding only for the Research Reactor Infrastructure (RRI) subprogram. RRI supports the continued operation of U.S. research reactors by providing research reactor fuel services and maintenance of fuel fabrication equipment.

In FY 2016, in support of its mission and objectives, the RRI subprogram will provide project management, technical support, quality engineering and inspection, and nuclear material support to 25 reactors located at 24 U.S. universities. Major program deliverables will be to procure new plate fuel elements and ship them to universities, and also to ship used plate and TRIGA reactor fuel elements from universities to DOE used fuel receipt facilities. In addition, work will continue on initiatives that evaluate alternatives to the current TRIGA reactor fuel sole supply source.

Idaho Facilities Management - $211.826 million

The mission of the Idaho Facilities Management (IFM) program is to manage the planning, acquisition, operation, maintenance, and disposition of the Office of Nuclear Energy owned facilities and capabilities at the Idaho National Laboratory (INL). The IFM program maintains Department of Energy (DOE) mission-supporting facilities and capabilities at the INL in a safe, compliant status to support the Department's nuclear energy research, testing of naval reactor fuels and reactor core components, and a diverse range of national security technology programs that support the National Nuclear Security Administration (NNSA) and other federal agencies such as the Department of Homeland Security in the areas of critical infrastructure protection, nuclear nonproliferation, and incident response.

The IFM program enables long-term nuclear R&D activities by providing the expertise, facilities, equipment, and nuclear materials necessary to conduct a wide array of experimental activities in a safe and compliant manner. The Advanced Test Reactor (ATR) provides unique

irradiation capability to further nuclear fuel and reactor component research in support of advanced nuclear reactor design activities. The Materials and Fuels Complex (MFC) contains a comprehensive range of fuel and experiment fabrication, and pre- and post-irradiation examination capabilities used to assess material and fuel characteristics, and performance in varying reactor environments. A number of facilities at the Idaho Nuclear Technology and Engineering Center (INTEC) are utilized to support material consolidation and storage at the Material Security Consolidation Facility (CPP-651), fuel cycle research and development, and National and Homeland Security (N&HS) activities. The Research and Education Campus is home to a diverse range of research capabilities and facilities; supporting research in nuclear energy as well as N&HS, energy, and the environment.

In FY 2016, the Department is proceeding with pre-critical decision (CD)-2 design activities for the Sample Preparation Laboratory (SPL) at the INL to satisfy core requirements of the mission need under the Advanced Post Irradiation Examination (APIE) Capabilities Project. The scaled down alternative of the APIE Capabilities Project will provide a new functionally focused laboratory with a smaller footprint at a reduced cost, which, when coupled with existing facilities and recapitalization efforts, will fulfill near-term APIE capabilities needed to improve understanding of nuclear fuels and material performance. Additionally, the Department will invest in major power distribution infrastructure refurbishments at the INL, including, but not limited to, the replacement of the Supervisory Control and Data Acquisition (SCADA) system, replacement of power-lines and transformers, and the replacement of multiple site substations that are near or have exceeded their lifecycle. Finally, reestablishing a transient testing capability at the Transient Reactor Test (TREAT) Facility at the INL will enable the NE R&D programs to understand fuel performance phenomenology at the milli-second to second time scales, as well as provide a capability to screen advanced fuel concepts, including accident tolerant fuels, which allows for early identification of the limits of fuel performance.

Idaho Sitewide Safeguards and Security - $126.161 million

The Idaho Sitewide Safeguards and Security (S&S) program supports the Idaho National Laboratory (INL) complex nuclear facility infrastructure and enables the Office of Nuclear Energy to conduct R&D in support of multiple program missions. The S&S program funds physical and cyber security activities for the INL, providing protection of the Department's nuclear materials, classified and unclassified matter, government property, personnel and other vital assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts that may cause adverse impacts on our national security; program continuity; or the health and safety of employees, the public, or the environment.

In FY2016, the S&S program will continue to sustain program functionality at the level necessary to assure high confidence in the protection of INL assets and a high degree of customer service by maintaining effective staffing levels, proactive preventative and corrective maintenance programs, and a robust cyber security program. The FY 2016 request will focus on

implementing infrastructure investments, capital improvements, emerging technology investments and enhanced cyber security program capabilities to adequately secure site assets.

In FY2016, funding supports increased S&S program scope in the following areas: Completing critical physical security infrastructure investments required to maintain an S&S program consistent with Departmental requirements and ensure adequate protection levels; such as upgrading the perimeter intrusion detection and assessment system and central alarm system at the Materials and Fuels Complex (MFC). Additionally, implementing enhanced external penetration capabilities and data protection resources to monitor and mitigate risks for INL Cloud services. Finally, the additional funding establishes an INL Industrial Control Systems cyber security program to ensure protection of critical infrastructure systems vital to operations at the INL.

International Nuclear Energy Cooperation - $3.0 million

International Nuclear Energy Cooperation's (INEC) mission is to serve as the Department's overall lead for all international activities related to civilian nuclear energy, including analysis, development, and implementation of international civilian nuclear energy policy and coordination and integration of the Office of Nuclear Energy's international nuclear technical activities. These activities support international bilateral and multilateral engagement and civil nuclear energy R&D activities with countries having an established or planned civilian nuclear power sector.

INEC provides the Department the ability to meet growing demands for engagement with international partners on civil nuclear policy, RD&D, and related activities. INEC engages both bilaterally and multilaterally to support broader U.S. policy and commercial goals related to the safe and secure deployment of nuclear energy globally and allow more effective integration of NE international R&D and policy interests, including increasing proliferation resistance of new and existing technologies.

Program Direction - $80 million

Program Direction provides the federal staffing resources and associated costs required to support the overall direction and execution of the Office of Nuclear Energy programs. NE has staff located in multiple locations: Washington, D.C., the Idaho Operations Office, the Oak Ridge Operations Office, and the Nevada Site Office. The Idaho Operations Office funding supports what is a fully functional service center for NE, as well as other Department of Energy offices. Activities within the site office support function include execution of headquarters directed procurements, supplemental support for any unforeseen actions, as well as maintenance to federal buildings.

In addition to appropriated funds, NE also manages approximately $140.0 million dollars annually from other activities including: Strategic Partnerships Program and reimbursable funding from the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD). The Program Direction request reflects NE's continued effort to optimize support for its federal workforce, while continuing to improve efficiency and cost-effectiveness; and ensure the expert federal management and oversight of NE mission activities.

Written Statement of

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

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

March 17, 2015

INTRODUCTION

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

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

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

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

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

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

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

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

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

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

EERE INVESTMENT APPROACH AND RETURN ON INVESTMENT

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

Investment Prioritization

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

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

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

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

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

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

Investment Strategies

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

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

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

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

Return on Investment

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

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

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

EERE PROGRAMS, ACCOMPLISHMENTS, AND FY 2016 BUDGET REQUEST

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

Sustainable Transportation Portfolio ($793 Million)

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

Sustainable Transportation Accomplishments

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

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

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

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

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

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

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

Program Description and FY 2016 Budget Highlights

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

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

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

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

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

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

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

Renewable Power Portfolio ($645 Million)

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

Renewable Power Accomplishments

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

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

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

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

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

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

Program Description and FY 2016 Budget Highlights

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

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

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

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

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

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

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

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

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

Energy Efficiency Portfolio ($1,030 Million)

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

Energy Efficiency Accomplishments

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

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

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

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

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

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

Program Description and FY 2016 Budget Highlights

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

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

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

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

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

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

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

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

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

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

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

ADVANCING U.S. MANUFACTURING COMPETITIVENESS

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

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

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

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

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

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

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

DOE CROSS-CUTTING INITIATIVES

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

Grid Modernization Initiative

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

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

Subsurface Technology and Engineering Initiative

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

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

EERE OPERATIONAL EXCELLENCE AND ORGANIZATIONAL IMPROVEMENTS

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

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

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

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

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

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

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

Protecting Taxpayer-funded Intellectual Property

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

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

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

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

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

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

CONCLUSION

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

Mr. SIMPSON. Let me ask you just a general question first. The price of energy, in whichever form it is, has a great impact on other forms of energy. Natural gas is making nuclear energy less competitive and every other form of energy less competitive. And, as you know, our economy kind of goes, rightfully so, to whichever is the cheapest form of energy production.

What I am really concerned about is reliability. Because prices of various forms of energy, whether it is wind, solar, natural gas, oil, nuclear, whatever, will go up and down.

Mr. ORR. Yep.

Mr. SIMPSON. How does that affect your department and where you put your resources as you are looking at the future of energy development in this country?

Mr. ORR. So you are absolutely right that energy prices are commodities. They are hard to predict—well, if asked about this, I usually say that the price will go up and then go down but not necessarily in that order.

Mr. SIMPSON. Yeah.

Mr. ORR. But the real goal of the Department of Energy and really the Nation as a whole, I think, is to have a well-diversified portfolio of energy resources in the mix and energy conversion methods that give us the flexibility to adapt to those price changes as they happen.

I don't discount the markets as important. They are fundamentally important to this. But we also want to make sure that we don't have all our eggs in any one basket. And I think that means that we need a long-term view that makes sure that the well-diversified portfolio is there, and that means investing across the spectrum of energy technologies in the way that we have been trying to do.

The Department is really aimed at supplying the fundamental idea flow into the marketplace that will, over time, affect the prices of all those conversions, in addition to responding to the commodity prices. So I think the important issue is that we not react too much to short-term price fluctuations.

If you remember back to the mid-1980s, when the price of oil went down, for a period we paid less attention to investing in research for the future than we should have, and so we don't want to do that again. We really need to make sure that we build a diverse and capable portfolio for the future.

Mr. SIMPSON. Well, I appreciate that, because one of the concerns is that while natural gas is cheap and so forth, I don't expect it to stay that way forever. While the outlook looks good right now, the reality is, as Dr. Danielson and I were talking yesterday, the price of solar has been coming down——

Mr. ORR. Yep.

Mr. SIMPSON [continuing]. And we still need to do research. Same thing with nuclear and——

Mr. ORR. Uh-huh.

Mr. SIMPSON [continuing]. Other commodities that we work on. And we shouldn't de-emphasize those because of the current situation that we are in.

Mr. ORR. Uh-huh. And I would observe also that using energy efficiently across the full portfolio, as you observed at the beginning,

is an important way we can make sure that everything we do is more efficient and, therefore, more cost-effective.

Mr. SIMPSON. Dr. Orr and Mr. Kotek, I would like to take a few minutes to talk about the Department's nuclear energy program. What is your vision for the strategy of moving forward DOE's nuclear energy program, its research and development activities, and DOE's assets across the enterprise?

Mr. KOTEK. Would you like to start?

Mr. ORR. Well, I would say that we believe fully that there needs to be a nuclear energy component in the Nation's energy mix. And we are committed, through both the research for advanced reactors and things like small modular reactors and so on, to contribute in an important way to that future.

I would actually like to ask John to fill you in on some of the details of what is in the budget.

Mr. KOTEK. Yep. Thank you very much.

As I look at any program budget, you know, I think the overall program categories are right. I mean, we have work going on to extend the safe operating lives of today's reactors. We have work going on to develop multiple pathways for new deployments, including small modular reactors, which could be a great opportunity for both, you know, domestic and export markets. We have research going on on alternative fuel cycles and alternative, you know—and disposal methods on the back end. And then we have some crosscutting things, workforce development, computational capabilities, and then, of course, the research infrastructure, which of course I am very familiar with, at our lead lab in Idaho and elsewhere.

So a question I have is, you know, what is the right vector going forward and what are the right areas of emphasis. And so what we are trying to do is we are trying to draw on the best ideas across the nuclear industry and beyond. So you may be familiar, earlier this month we had a series of workshops across the country involving our labs, universities, industry, and others to really give us input that is going to help guide those future investments. And so I am looking forward to receiving that synthesized input to help us guide our programmatic directions and budget requests in fiscal 2017 and beyond.

Mr. SIMPSON. Thank you.

Dr. Orr and Mr. Smith, last year's omnibus included direction to develop—and you guys don't mind if I have a cold and keep coughing and all that kind of stuff.

Mr. ORR. Oh, that is all right.

Mr. SIMPSON. But last year's omnibus included direction to develop a comprehensive program plan and research and development roadmap for the Office of Fossil Energy.

I know it is too early to ask for the specifics, but I want to get a broad sense of your vision for this roadmap development. And what is your vision for the fossil energy, and where will the biggest technological advancement opportunities exist?

Mr. ORR. Chris, why don't you just dive right in on that?

Mr. SMITH. Well, thank you, Mr. Chairman, for the question.

First of all, I would emphasize that I think we have a very robust request this year for the Office of Fossil Energy, a total re-

quest of $842 million for this year, which is an increase over the fiscal year 2015 omnibus bill. So we think that this is a very important part of the strategy, and it is a key component of the technologies that are going to provide power and energy in the future.

In terms of the request, there is an increase for carbon capture. We think this is going to be an important part of what we are working on throughout this fiscal year and going forward.

There is also an increase in the request for natural gas technologies. There we are going to be focused on environmental sustainability and safety of producing oil and natural gas. We feel that one of the most important components of our R&D program, in terms of a government role, is to give communities the confidence and the assurance that we have good science that is quantifying things that people are concerned about in terms of production technologies and that we can develop and deliver these molecules safely, get them out of formations and get them to the burner tip and to power plants, where they can provide energy for our economies.

So those are our two broad programs, the coal program and the oil and natural gas program. We think both of them are really important in terms of diversity of energy supply, reducing our reliance on imports, and ensuring that we are looking at reliability and the benefits we can provide for our economy.

Mr. SIMPSON. Thank you.

Ms. Hoffman, this year's budget request contains a proposal for two new grant programs aimed at assisting the States with electrical reliability planning programs and formula grants to update energy assistance assurance plans.

Can you discuss how the proposal came about? Are the proposals intended as multiyear programs? And will these grants go out under the same formula as previous grants?

Ms. HOFFMAN. Thank you very much.

I appreciate the question because the interface and the dialogue with States are an extremely important issue as we move forward for grid modernization and looking at energy security of the electric grid.

Both of these programs were to address specific conversations and dialogues that need to occur at the State level, the first for the energy reliability programs. These programs are looked to be competitive programs where it will be an ongoing program in support of reliability investments. So how do we really keep the State engaged in very tough conversations that have to occur between the utility planners and the States and the policymakers for grid modernization?

The second effort is energy assurance plans. These plans, we are looking at grants to the States. This program would probably be updated every—request to have these plans updated maybe every third year.

The intent of this program is to really go after having the States have a good situational awareness of their energy assets and how these assets are changing over time so they can really look at the availability in an emergency. For example, you look at Hurricane Sandy—where was the availability of gasoline in the New York area? Or as you look at maybe an earthquake or other sort of events—what assets do you have to rely upon? Those must be up-

dated on a regular basis so that the State energy offices and the State constituents really understand what the options are in an emergency.

Those are the two goals of the program—what we hope to achieve. It is an important effort as we look at assurance in the future.

Mr. SIMPSON. Thank you.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman.

Dr. Orr, I listened carefully to what you said about the water-energy nexus, and I am very interested in comments from yourself and the other panelists on this topic.

Could you summarize some of the key findings of your report—I read this summary—and tell us how they are influencing your program?

Mr. ORR. Uh-huh.

Ms. KAPTUR. And let me just say, as a representative of several large cities, places like Cleveland, Lorain, Toledo, in the industrial heartland, I am wondering if your focus in the energy-water nexus is merely on energy-producing plants and their water-draw or if your program includes thinking about how to help some of our older cities deal with their power needs related to their water and their sewage treatment.

I am interested in your—I read the summary. I didn't read the whole report——

Mr. ORR. Yeah.

Ms. KAPTUR [continuing]. But I——

Mr. ORR. You can be forgiven for not reading that.

Ms. KAPTUR. Okay.

Mr. ORR. Yeah. So——

Ms. KAPTUR. So, in any case, you know, the question is, what are your findings? What is some of the direction, and would it include a look at both sides of that?

Mr. ORR. Yes, indeed. And the reason that this is a crosscut is because there is exactly that interlocked use.

So part of the effort—we will actually talk about this again this afternoon in the hearing, because part of this involves our science program, in building much more detailed and careful models of how water flows through the whole system. But there is also emphasis on specific work of using nontraditional waters, both to provide energy and to be treated in such a way that they can have beneficial uses, and that can include the whole water treatment area.

And then, of course, there is the whole question of the sustainable, low-energy water utilities that will allow us to increase energy efficiency and perhaps energy recovery for water and wastewater treatment.

So it is an attempt to focus the efforts of the Department of Energy, which, you know, we are involved in a lot of water use through energy generation, but also to recognize that it is linked to all kinds of other things that we do through agriculture and everything else. So cities are certainly an important part of that, and I anticipate that that will cover both of those areas.

Ms. KAPTUR. With the intensive interest of the Federal Government in the 17 Western States—and I can understand the water-

shortage challenges that many places face. I don't represent that part of America, but I wanted to just put on your screen some of the cities and the—going through some of the water plants and sewage treatment plants in the district that I represent, and the efforts that they are trying to make, very slowly, too slowly, to produce power on site, to try to reduce their energy footprint. Many of these facilities are over 50 years old.

So I just wanted you to see that——

Mr. ORR. Uh-huh.

Ms. KAPTUR [continuing]. Particularly in these heavy manufacturing regions, where there has been—two-thirds of the jobs have been lost, and yet they have these antiquated systems that they are dealing with. And they could use some of your expertise as you think through how you are going to structure the energy and water nexus.

Mr. ORR. Yeah. One component, I should have said the first time around, of this would be enhanced technical assistance and R&D related to a variety of the areas that you just mentioned. We could talk more about that if that would be helpful.

Ms. KAPTUR. If you just look at this panel, you see people from Gary, Indiana; Los Angeles; Cleveland; Toledo. I mean, so I think that there would be a great deal of interest in that, though I can't speak directly for my colleagues on that.

Does anyone else wish to comment on that energy-water nexus? Anyone else on the panel?

Mr. DANIELSON. I can add a little bit about some of the work that we have in the fiscal year 2016 budget in this area.

One area that the Under Secretary mentioned is the importance of developing more sophisticated models to actually understand the water-energy system in the United States. And so, through our Water Power Program, we are investing some funds in developing new models for how to manage water power systems in a more effective way. And those will be integrated with other models that will be a more comprehensive set of models around energy-water use in the country.

In the area of technologies for producing more freshwater, our geothermal program is proposing a research and development effort to use low-grade geothermal waste heat to make freshwater. There is a project we have today on an exciting technology called forward osmosis being done at Idaho National Laboratory, which is a technology that presents a lot of opportunity there for taking low-grade geothermal waste heat and producing freshwater.

And then, finally, we have an effort in our Advanced Manufacturing Office, about a $4 million effort, on sustainable water utilities. Our water processing infrastructure uses a lot of energy, and a lot of energy comes into those systems. We are going to be doing research and development and technical assistance with water utilities to help them lower their energy footprint and also find ways to convert waste into energy that they can use on site to lower their energy costs.

Ms. KAPTUR. I am glad you said that latter point, because, though I can't direct what you do, I can talk and suggest ideas, that you look at the United States in terms of its watersheds and

that the watersheds of the West are very different than the watersheds of the Great Lakes, let's say.

Mr. ORR. Indeed.

Ms. KAPTUR. And if you look at our watersheds and what is happening in the Midwest, in the Great Lakes region, with drainage and the large amounts of freshwater, and you look at the facilities that treat the water or treat the sewage, we have large amounts of organics that are associated with processing on site. They are like big mixing bowls, right? And we have a problem throughout the Great Lakes with water runoff that is polluted with manures from agriculture and so forth.

But if one starts thinking about these big mixing bowls and the way of reprocessing that regional waste, that organic waste, in a manner that produces heat, let's say, or produces power, that kind of thinking is not really going on, because people aren't thinking about the watershed. They are just involved in their own little operation, whatever it might be.

But your kind of technical assistance to regions like that could really be important to unleash the creativity and innovation that is possible on those sites that have had multibillion dollars of investment over the years but they don't view power as part of their mandate. So I just think this is a really important initiative.

And I have one other question in the first round, and then we will move to others.

To your knowledge, Dr. Orr, is the Department of Energy effectively engaged in some manner in assisting Europe and Ukraine to meet their strategic energy challenges as they grapple with Russian aggressiveness rooted in Russia's energy relationships with Western Europe and now the invasion of Ukraine? Is the Department of Energy aggressively involved in any kind of effort to try to help Europe reposition——

Mr. ORR. Uh-huh. So——

Ms. KAPTUR [continuing]. From an energy standpoint?

Mr. ORR. [continuing]. We, of course, are in more or less constant contact with energy colleagues around the world. The Secretary has participated in a series of clean energy ministerials, for example, that have some relationship to the issues you mention. And I know that there is effort in thinking about the questions of natural gas availability in Ukraine.

I am too new to the program to know for sure any details of that, and I don't know whether—maybe I will ask Chris Smith to jump in on that.

Mr. SMITH. Well, thank you, Dr. Orr.

So I will make a couple of points on the ways that the Office of Fossil Energy has been directly engaged.

So, as Dr. Orr mentioned, this is a—you know, it is a long-term challenge. It is multifactorial. There are a lot of moving parts here.

Over the long term, we have been engaged with our partners throughout Europe to help take the lessons that we have learned here in the United States with regards to development and production of unconventional oil and gas resources and try to transfer some of that knowledge, some of that information to some of our allies and trading partners in Europe.

A couple years ago, predating this effort, I traveled with one of my colleagues from the State Department and engaged in an IEA engagement that was putting together what they called at the time the golden rule, sort of a golden age of gas, that was an attempt to take the lessons learned in the United States and establish a playing field in Europe, in terms of thinking about shale gas extraction.

It is those types of long-term collaborations that are critical. So, as Dr. Orr mentioned, in the immediate term, we do have teams that have been working with our allies and trading partners to think about planning, to think about contingency planning, some things that we do well here in the United States. But, also, over the long term, there are a lot of issues around development of infrastructure, around putting in place smart rules, around commonsense regulation to make sure that infrastructure can be built safely and that resources can be developed prudently. And that is the type of collaboration that we have had to have over the long term and over the short term.

Ms. KAPTUR. Thank you very much.

For the record, I would like to ask if maybe Dr. Orr could, or by letter, develop a reply to that question a little bit further, focused in at least three areas. One is the possibility—I represent the largest coal-shipping port on the Great Lakes. It may be cost-prohibitive to ship coal from our full committee chairman's district in Kentucky through the Port of Toledo to Ukraine, which is the shortest distance, by the way, from the United States to the ports of Northern Europe. But I have asked myself the question, if they use that coal, it would actually be better coal than they have in Ukraine, so it would lower the carbon footprint. Is that possible?

Number two, small-package nuclear. Could we do something quickly to help some of the countries that are involved adjust?

And, thirdly, LNG. Can we do anything on export quickly? Not 5 years from now, but quickly. Are there short-term energy initiatives that we could undertake to help that situation, which is being lived in real time right now. I would very much appreciate that.

Mr. ORR. Yeah, we will be happy to do that for you.

Ms. KAPTUR. Thank you.

Mr. SIMPSON. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman.

And, Dr. Orr, I want to welcome your entire panel. I really appreciate you all being here before us today. I work very closely with many of you all, and I appreciate each and every one of you all's commitment to our Nation's energy needs. This is a critical area for, I think, discussion, not only for my constituents, I think, but for the whole Nation as we move forward.

I have a few questions. Last Thursday, I had the privilege again of visiting the Oak Ridge National Lab's Manufacturing Demonstration Facility with Deputy Secretary Liz Sherwood-Randall. We saw the world's largest polymer 3D printer being installed and watched as manufacturing parts were being printed. I wish the full committee could visit this amazing facility that last year made the world's first printed car.

Dr. Danielson, we have been there together, as well. Our subcommittee's investment in these programs will help foster innovation and promote U.S. leadership.

My first question is for you, Dr. Danielson: How does advanced manufacturing connect to EERE core research programs that you divided into sustainable transportation, renewable energy, and energy efficiency, sir?

Mr. DANIELSON. Thank you, Congressman. And we have been very excited to see the work that has come out of the Manufacturing Demonstration Facility at Oak Ridge. It is a model for what we want to see with our advanced-manufacturing-oriented efforts going forward, and with the manufacturing innovation institutes, as well.

One thing I will point out is that we are in a pretty exciting and unique time as it relates to manufacturing competitiveness in the country. The low energy prices mentioned are a result of some early great work done by the Fossil Energy department here. We are seeing significant increases in labor rates overseas. And we are also seeing a whole suite of new advanced manufacturing technologies emerge, especially here in the United States, that have the potential to give us a competitive advantage.

And so what our focus has been, in our Advanced Manufacturing Office, which is a significant focus in this budget request, is we are looking to invest in those advanced platform, foundational manufacturing technologies that will apply to a wide variety of the technologies within our sustainable transportation offices, renewable electricity, and end-use efficiency.

To give you an example, in the additive manufacturing area, we are seeing opportunities not only in sustainable transportation for more efficient engines, but we are also seeing it be applied more broadly in the building technologies office, as well. Just recently, Oak Ridge National Lab is leading an effort to put out an open call for America's best innovators' ideas that Oak Ridge will then go, and within a short period of months using 3D printing, prototype those advanced technologies and show what they can do.

And so we are seeing some exciting synergies amongst the Advanced Manufacturing Office's capabilities, resulting in end-use innovation in the various sectors that we invest in in energy.

Mr. FLEISCHMANN. Thank you, sir.

This question is for either Dr. Orr or for Dr. Danielson. Can you please tell me how the Advanced Manufacturing Office might benefit other technology programs, such as the vehicle technologies program and the Carbon Fiber Test Facility at ORNL or the building technologies program, any of those three?

Mr. ORR. Well, let me give you a brief answer, and then Dave can help out.

The good thing about these fundamental changes—additive manufacturing, the 3D printing is an example of that—is that there are many applications that kind of cut across. They are fundamentally enabling for more efficient, lower materials requirements, lower cost, and much faster prototyping. And all of those things can find applications in lots and lots and lots of ways.

So we have good examples and good applications to start with, but they should have much broader impact.

Mr. DANIELSON. And I would add that although this additive manufacturing capability, for example, was initially funded out of the Advanced Manufacturing Office, we are seeing the Vehicle Technologies Office engage on this with the 3D-printed car technology that you just talked about, in addition to the automotive industry using 3D printing as a way to much more quickly and cheaply develop new molds so that they can lower tooling costs for manufacturing.

We have also seen the first ever 3D-printed packaging and heat sinks around advanced power electronics between the Vehicle Technologies Office and the Advanced Manufacturing Office work at Oak Ridge.

And we are also seeing, as I mentioned in the building technologies area, all kinds of opportunities that are just emerging as we get these offices engaged with the capability, including advanced new nozzles that can enable much more efficient heating, ventilation, and air-conditioning units.

Mr. FLEISCHMANN. Thank you.

For several years now, it has taken congressional direction to fund the nuclear infrastructure at the Oak Ridge National Laboratory. The hot cells are essential capabilities that serve multiple missions for the United States Government, yet they lack an institutional steward.

The Office of Science has provided a portion of the funding needed in this budget request, but support for these facilities is still not evident in the fiscal 2016 request for the Office of Nuclear Energy despite direction from Congress to work jointly with the Office of Science on this issue.

Mr. Kotek, I was pleased to see in the fiscal 2016 budget proposal that the Office of Science, for the first time, is providing partial funding for the nuclear infrastructure at Oak Ridge National Lab. This funding, while an important step, only partially covers the operating costs. What do you see as your role to ensure full funding for these multi-program facilities?

Mr. KOTEK. Thank you for the question.

It was my understanding that the transfer of responsibility to the Office of Science was to be for the complete responsibility. And so I will go back and work with the folks in the Office of Science to understand what their plans are, and maybe there will be an opportunity to ask them about that later. But at least my understanding for this budget request was that was to be moved over entirely into their office.

Mr. FLEISCHMANN. Okay. Thank you.

Mr. Kotek, I would like to discuss the Modeling and Simulation Energy Innovation Hub funded with your office.

The hub's primary task is to create a computer model that simulates a reactor. What has the hub accomplished? How far along is this model? And how is it being used?

Mr. KOTEK. Thank you very much for the question.

The model is being used, you know, fairly widely by industry to understand a range of issues that can occur within nuclear reactor types. And, as you may know, we have several different reactor types that are currently in use.

And so what we have started with is the simulation of a pressurized water reactor, a certain type of reactor that is commonly in use. As we look and go forward, what we are looking to do is take that capability and use it to help us examine certain phenomena in other reactor types, so boiling-water reactors and even small modular reactors.

So it is something we expect to see broadly applicable by the time we are done with this second 5-year term.

Mr. ORR. And could I just add to that that, in building these models, they look at the underlying physics of the details of the fuel rods and bundles, of how the fluids flow around them, and building better descriptions of those than to have applications kind of throughout the nuclear enterprise but, actually, more broadly in other kinds of power plant applications, as well.

So the knowledge base that is applied in that specific area will have much broader application.

Mr. KOTEK. Absolutely.

Mr. FLEISCHMANN. Thank you, gentlemen.

As a followup to that, I have two questions.

One of the unique features of the hub is its management structure. It is comprised of a consortium of national labs, universities, and industry partners.

Can you talk about the successes and lessons learned from this approach? And how does each of the different partners contribute to the hub success?

Mr. ORR. Well, as you know, there has been some experimentation in the way we have done the hubs in a variety of places. The ones that have been very successful—and I would cite the battery hub led out of Argonne as another example of those, and the Oak Ridge effort—have started with a capable organization leading it, so a group that is used to managing complicated enterprises. It needs a good leader, a person who is in charge who really is in charge and who has the technical chops to deal with all the players.

It needs to have the right range of expertise of people contributing to it. And because of the way these things have been selected in a competitive proposal kind of environment, there is a real test as the teams have to assemble and make the argument that they are well enough equipped to do that.

And then they need to keep focused, to keep their eyes on the ball as they work through. The fact that they have funding for a finite time has a way of focusing the intention of all of the participants on really making progress that can matter.

So each of the problems is a little bit different, so you have to adapt those ideas in the right place, but I think we have seen enough examples of very successful hubs that we can see how to do that going forward.

Mr. FLEISCHMANN. And one final question: Can you describe how the Office of Nuclear Energy's other research activities into advanced modeling and simulation complement the activities of the hub?

Mr. KOTEK. Certainly.

So we have had work underway under our NEAMS Program, the Nuclear Energy Advanced Modeling Simulation Program, that de-

velops specific codes looking at what they call high-impact problems. So there is integration between the two activities, but the CASL hub is focused on, you know, sort of this broader request of reactor modeling. The NEAMS Program is looking more at specific issues, so what they call high-impact problems, all right? So looking at, for example, the question of understanding tube vibration within a steam generator. That is a specific thing that we would dive into under that program to, sort of, you know, in part, build off of what we are doing through the CASL effort.

Mr. FLEISCHMANN. Okay.

Thank you all.

Mr. Chairman, I yield back.

Mr. SIMPSON. Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman.

And welcome, all of you. Good to see all of you.

And, Dr. Danielson, good seeing you too.

Dr. Danielson, this year's budget request proposes a significant increase for Clean Energy Manufacturing Innovation, or CEMI, institutes as part of the White House initiative to revitalize American manufacturing, including establishment of two new CEMI institutes.

This committee has been very supportive of the Advanced Manufacturing Program within the Office of Energy Efficiency and Renewable Energy. And in the Cromnibus for fiscal year 2015, the committee included the Revitalize American Manufacturing and Innovation Act, or the RAMI, to authorize a National Network for Manufacturing Innovation.

But I know some folks, at least in my district, are a little confused by the way the budget request rolls out these centers, because they expected that the RAMI authorization to reprogram $250 million would mean a more rapid expansion of the program, whereas the budget request seeks appropriations for the centers and goes about the establishment of the nationwide network more slowly than they envisioned.

So can you explain to us how your vision, to the extent you can, the administration's vision for rolling out the network? And can you give us an update on how the existing institutes are working out right now?

Mr. DANIELSON. Yes. Thank you, Congressman.

The National Network for Manufacturing Innovation is an interagency effort across Department of Commerce, Department of Energy, Department of Defense, and a number of other agencies.

The vision is to build a national network of innovation centers that will allow the United States to tap into those emerging advanced manufacturing technologies that are just around the corner, that we think, if the United States can assert leadership, will establish us as a major player and make us a magnet for the manufacturing jobs of the future.

The Department of Energy's request would support four ongoing institutes that would already exist going into fiscal year 2016 and would fund two fully front-funded new institutes at $70 million each. This would be in addition to the Department of Commerce putting forward in their budget a proposal to do two new institutes, I believe, the Department of Defense looking to do one new insti-

tute, and the U.S. Department of Agriculture doing one more institute, as well.

The RAMI bill you are talking about, I think, authorized transfer authority, but that is not an authority that we are planning to use in fiscal year 2015 or 2016.

Mr. HONDA. So with the RAMI project in mind, how would that go about becoming realized?

Mr. DANIELSON. The institutes that I just spoke of are in the budget request this year. And, in my office alone, this budget requests support for six total institutes in addition to the institutes that I mentioned that the other agencies will be putting forward.

Mr. HONDA. Okay.

Mr. DANIELSON. But I would be happy to take that question for the record to give you a little more clarity on the interagency strategy around NNMI.

Mr. HONDA. It would be really helpful for me. Thank you.

Mr. DANIELSON. Okay.

Mr. HONDA. The SunShot Initiative, access to solar for lower-income folks—2016 marked the halfway point of the President's SunShot Initiative to make solar-power costs competitive without subsidies by 2020. Can you update the subcommittee on where we stand in achieving that goal?

And, as I understand it, we are currently 70 percent of the way towards achieving the goal of reducing the cost of solar-energy technologies. It is the halfway mark, and we are more than halfway there, yet the request increases the solar-energy budget by almost 50 percent.

This may be a stupid question, but can you explain the challenges that remain to be overcome and how these justify the increase, which I am not unhappy about, in your budget request?

Mr. DANIELSON. Thank you, Congressman. You and I visited SunPower manufacturing——

Mr. HONDA. Right.

Mr. DANIELSON [continuing]. Facility in your district, which I think is a great example of some of the momentum that we are building in the United States around solar manufacturing.

We have made significant progress since 2010 when we kicked off the SunShot Initiative—and that was in 2010—with the goal by 2020 of achieving directly cost-competitive solar without subsidies.

When we are here, about 40 to 50 percent of the way through that decade-long initiative, I would say we are about 50 to 60 percent of the way to the goal. And we have seen significant reductions in module prices, but we still have a lot of work to do. We are at about 70 cents per watt on modules, and we need to get another 40 percent reduction, down to about 50 cents per watt, for direct cost-competitiveness.

We really have three major thrusts within the program that are becoming more urgent as we approach this SunShot goal. The first is innovation in modules for much more efficient modules, low-cost modules, and modules that can give the United States a competitive advantage as it relates to manufacturing.

And I will note that last year was a great year for solar manufacturing in the U.S.—an announcement of 2 gigawatts of new capacity that will come on line, which is doubling the U.S. solar manu-

facturing capacity, including a gigawatt-scale plant to be built up in Buffalo, New York, that is based on technology that we originally funded, in addition to DOE-funded technologies scaling up in Michigan and Oregon.

Mr. DANIELSON. Secondly, in addition to the technology innovation on modules, we have a major focus on grid integration, which is part of the grid modernization initiative that has been put forward. Whereas we get more and more cost-effective distributed solar power, we are going from having maybe thousands of centralized power plants that need to be controlled to potentially millions of distributed power plants—small solar power plants, that need to be integrated into the grid in a reliable, resilient fashion. So we are looking at things like control strategies, control of energy storage behind the meter, smart inverters that can sense what the grid needs and adjust what is being put back.

Finally, one of the sticky cost points with solar is on what we have called soft costs, which includes things like permitting, customer acquisition, financing costs, and a number of other areas. We are also investing in an increased way in attacking those finance costs by working with industry partners to streamline documentation, and are working with a number of jurisdictions around the country to develop technology solutions to dramatically reduce the red tape and the permitting time and cost associated with solar, as well.

Mr. HONDA. It sounds like it is a good investment, that we could drive this thing forward more quickly.

Something I brought up in our hearing with Secretary Moniz is my desire to do more in the way of helping low-income families gain access to solar energy so that they can reap the benefits of reduced energy bills that are currently largely enjoyed by more affluent Americans.

Can you tell us a bit about what the Department is doing to improve access to solar for all Americans?

Mr. DANIELSON. Yes. Thank you very much.

You know, one of the important programs that is under my purview is the Weatherization Assistance Program.

Mr. HONDA. Right.

Mr. DANIELSON. It is a program that, since 1976, more than 7 million low-income families have had retrofits of their homes to enable up to, on average, about $400 a year of energy savings, in addition to making these homes actually comfortable and warm in winter and things like that.

Solar thermal is a measure that is currently on the weatherization approval list, so that is a technology that is available to low-income families to be able to access solar energy to heat their homes and cut their energy costs, as one example.

Mr. HONDA. For the chair, if I may ask another question?

The budget request for weatherization assistance, again, includes two initiatives: the $50 million for competitively selected products to demonstrate financing models that would support the retrofit of low-income and multifamily buildings; and second was $20 million for certain local communities to develop economic development roadmaps in achieving the clean energy goals.

Can you provide us more details about this proposal? And would it be through the States or directly to the project recipients? And what sort of financing models are you currently considering for this program? And what criteria would you use to make an award?

This sounds like this new proposal represents your vision for the future of weatherization, and that would be an activity that would supplant the existing form of grants, grant programs. Are there comments you can make on that?

Mr. DANIELSON. Yes. Thanks for that question.

Those are two important new initiatives we put forward under the Weatherization Assistance Program within the 2016 request.

The first you mentioned was the multifamily program——

Mr. HONDA. Yeah.

Mr. DANIELSON [continuing]. And the challenge there is that, with the Weatherization Assistance Program today, a disproportionate number of the retrofits occur on single-family homes relative to the number of multifamily homes there are. And so this program is meant to competitively try out new programs that would unlock private capital to allow the multifamily side of the equation to have a significantly larger number of retrofits.

One example of a program that could enable that are PACE programs, as you know—that is Property Assessed Clean Energy—which allows financing to be repaid through municipal taxes however we would put this out for the best ideas that the Nation's finance community would have to put forward.

And then on the local energy program, under the Recovery Act, we were able to establish partnerships with municipalities and cities directly through the EECBG program, Energy Efficiency Community Block Grants, and we found that to be incredibly productive. We ended up successfully retrofitting more than 700 million square feet of buildings through that program.

And since the Recovery Act has sunsetted, we don't have a direct mechanism to engage on innovative clean energy policy development and deployment program development with localities. This program would put forward the first time we would be working directly with those localities on innovative programs to help them lower their energy bills and their carbon footprint.

Ms. KAPTUR. Would the gentleman yield at some point?

Mr. HONDA. Yeah.

Ms. KAPTUR. I just wanted to follow on Congressman Honda's excellent questioning here on this differential between single-family units versus multifamily units.

I am going to throw in a third perspective here, and that is, as the program is developed, think about neighborhoods that both single-family and multifamily are located in certain neighborhoods. And what is not happening at the local level, in my opinion, is that the systemic energy needs of a given neighborhood are not thought through initially because of the way the program functions.

So, for example—and I will just take historic preservation neighborhoods, which tend to be located in the older parts the cities——

Mr. HONDA. Sure.

Ms. KAPTUR [continuing]. All right? And because of the historic preservation tax credits and all the other things that attend to them, what is happening is that the private sector is reluctant to

invest for different reasons, but the houses leak energy because they are not allowed to put in windows that actually save energy because that violates some historic preservation code.

And, from a market standpoint, over time, these neighborhoods aren't going to make it. I hate to be that bold in saying that, but there has to be an energy perspective that takes in the neighborhood.

In some of the neighborhoods I am talking about and have visited, there is waste heat from big industrial plants that sit in the same neighborhood. There are landfills that leach methane that could be put into an energy grid for that neighborhood. But nobody is thinking big enough. They are thinking at the unit level or at the apartment level. But it is not—it can't be a successful strategy.

So I just would urge you to think about a footprint that includes a neighborhood and—for instance, on a landfill, if you could put up solar panels, let's say, and help to move power into one of these older neighborhoods, wow, what you could do for those communities. But nobody is thinking at a systemic level.

So I just thank you for yielding. I just wanted to put that on the record.

Mr. HONDA. Yeah. Well, that would give a more comprehensive carbon footprint kind of an impact, if we do that. And I think historical designations is a problem also, so I think that is what you are talking about, that third point on the soft cost challenges that we need to look at. So perhaps we can figure out how we could work through that problem.

My last piece on the weatherization was——

Mr. SIMPSON. Quickly.

Mr. HONDA. Yes. Thank you, Mr. Chairman.

The inclusion of solar in the weatherization program, because it is not part of the program. How can we work together where we can include solar in the weatherization program so it would impact also more temperate parts of country rather than just the high-impact neighborhoods, parts of our country?

Mr. DANIELSON. Thank you, Congressman. I would actually like to follow up with you directly on that specific issue.

As I mentioned, I know that solar thermal is on the weatherization approved list. And I do want to dig in to determine where we are in terms of photovoltaics and getting it onto that weatherization approved list.

Mr. HONDA. Thank you so much, Mr. Chairman.

Mr. SIMPSON. Mr. Fortenberry.

Mr. FORTENBERRY. Thank you, Mr. Chairman.

Thank you all for coming today.

This is an important discussion for a variety of reasons, one of which, though, that we do not consider is that the externalities of traditional energy production—we talk about those not being embedded into the cost fully, in terms of environmental impact, but there are other considerations, as well, such as entanglement in foreign affairs, that make a compelling case that we should, as quickly as possible, as is feasible, have a market-driven policy to move toward sustainable energy, a more robust sustainable energy dynamic in our country, using renewables, that is undergirded by public policies that help correct or advance certain distortions that

the market can't take of by itself. So, market-driven, certain public policies that assist that, in order for us to bridge to, again, a more robust integration of renewables into our portfolio.

So what you do is important in a very broad sense. And I think the growing awareness of this in the country is real. The growing demand for it is real. The innovation in the marketplace in terms of reducing cost and making it competitive is real. And those are all good dynamics.

In this regard, my question follows up a bit on what you just spoke with Mr. Honda about, but I would like just a broad overview of the current status of the wind/solar energy industries, battery technology, as well as the opportunity for homeowners to build out their own distributed energy systems.

Now, one of the difficulties that utilities have—and it is very understandable—is they are carrying legacy cost from 40 years. And 40 years ago, they were told, "Build out your energy systems, delivering as much power as you can, as cheaply as possible, for economic development reasons." Now they are being told, "Conserve as much power as you can, and integrate a renewable portfolio, but, yeah, you still have to pay your bills." So they are caught in this difficult transition period.

So the more that we can, again, creatively recognize the legacy difficulty but have smart, market-driven policies that actually encourage the fullness of the development of renewables that meet a growing market demand, that meet the interest of American consumers, and that do untangle us from some of the externality problems that really are hard to quantify in terms of traditional energy production, particularly in foreign affairs—dependence on Middle Eastern oil, for instance—I think it provides the justification legitimacy not only for this conversation but for certain expenditures.

So I am with you in spirit. We just need to, obviously, make sure we are using the taxpayer dollar wisely, not investing in things that, again, are foolhardy from a market perspective. But, nonetheless, when there are market dynamics that are broken or have gaps or are too long-term to be of benefit to fix this short-term problem of real externality costs, we need to move in those directions aggressively.

Home-based distributed energy production using wind and solar, geothermal potentially, I think is one way to do that. But give me an overview of the status of these opportunities, if you will.

Mr. ORR. Maybe I will start, and then Dave can——

Mr. FORTENBERRY. And I also want to save time for a modular nuclear discussion.

Mr. ORR. We can do that.

Mr. FORTENBERRY. Okay.

Mr. ORR. So there is actually a common thread among some of the comments here, and that is that we really need to be thinking about the way we supply energy services as a set of interlocked, complex systems.

And part of that is the technology part, and I have to say that all of us engineers amongst us are probably happiest in that part of the sandbox. But part of it is the market structures and the policy arena.

The market structures are changing as the mix of distributed and central generation changes over time. My own personal opinion is that we are not evolving to a system with no central generation; we are just evolving toward one with a lot more distributed generation——

Mr. FORTENBERRY. Well, the two can be complementary, I think.

Mr. ORR. Indeed.

Mr. FORTENBERRY. And I think we are living with the residual of some——

Mr. ORR. Yeah.

Mr. FORTENBERRY [continuing]. Tension, but that is giving way to a more realistic future of complementarity, I think.

Mr. ORR. Yeah. I——

Mr. FORTENBERRY. And that ought to be the goal.

Mr. ORR. I agree with that.

But the market structure was put together with the central model in mind, and so, therefore, there has to be some evolution. It is deeply connected to the whole grid modernization part of it, and it is regulated in a relatively complex way across the country.

So this is a problem, I think——

Mr. FORTENBERRY. If I could interject right quick, I liked the phrase—I think you said it, Dr. Danielson— "the soft cost of implementing solar." There a variety of soft costs here that may not make sense, but because of the legacy of complexities——

Mr. ORR. Yep.

Mr. FORTENBERRY [continuing]. Particularly a regulatory model that is diverse, that creates this.

Mr. ORR. That is a good way to say it.

So that gives us a real challenge, and it is one that we can participate in in a very big way but don't control entirely because so much of this is regulated at the State and local level. So I——

Mr. FORTENBERRY. But where are we in terms of a timeline to get to—I just laid out a certain set of goals.

Mr. ORR. Uh-huh.

Mr. FORTENBERRY. In terms of reaching those goals, what are we looking at?

Mr. ORR. I think we are actually relatively early days in figuring out the details of that.

Pat, maybe you are the right one to—Pat Hoffman has been engaged in a series of conversations with utilities and grid operators and others, various stakeholders, as we think about these market strictures going forward.

Ms. HOFFMAN. It is an important discussion, and it is also a challenging discussion, as you appropriately brought up, in that we know that the grid is evolving, and I think we need to really create a set of parameters where we can have a transparent conversation on how the grid should evolve but allow for the incorporation of distributed energy resources and technologies at the customer level.

What we are actually looking at is how do we merge both of those capabilities, having a strong distribution system but also allowing customers to advance with on-site generation technology.

Mr. FORTENBERRY. Okay. So that is the academics. So where are we in terms of realistic implementation of this?

Ms. HOFFMAN. So we——

Mr. FORTENBERRY. Are there templates/models out there? And then where is the front end of the curve?

Ms. HOFFMAN. So we——

Mr. FORTENBERRY. I am sorry to cut you off. Our time is so limited. I just want to kind of get to the core of the problem.

Ms. HOFFMAN. We have done several different demonstration programs where we looked at pilot projects where we have integrated solar with storage on the distribution system. We have our project in Vermont that brought 2 megawatts of solar with energy storage at an optimized distribution level. We——

Mr. FORTENBERRY. At competitive market rates? Or does it—there is a deep capital subsidy there, I would assume.

Ms. HOFFMAN. The purpose was to increase the resiliency of the electric grid. So there was a value of having increased resiliency. The whole purpose of that was to support an emergency response facility at a local school, which they needed additional reliability. So you are going to have to—there is a lot of——

Mr. FORTENBERRY. There is a value beyond the market. I understand.

Ms. HOFFMAN. There is a value beyond that. So there is progress being made.

Mr. FORTENBERRY. I think you understand what I am driving at. Let's just take a typical homeowner who has this desire to place themselves in a smart grid situation, where they create on a typical city lot a distributed energy mechanism, backed up perhaps by a centralized utility structure, but maybe even put themselves in a position to make money, if you will, through small-scale wind, small-scale solar, some implementation of geothermal.

A back-of-the-envelope analysis by me would suggest that that is a $30,000 to $50,000 upfront cost based upon a probable $3,000 utility bill a month, something like that. Is that a fair assessment of where we are?

Mr. ORR. Gosh, the actual dollar numbers depend hugely on where you are in the country and what the——

Mr. FORTENBERRY. I get that. But in terms of an average, a basic template model——

Mr. ORR. But I can give you an example. I mean, I am one of those people, in my previous reincarnation, living in California, I actually make more electric power using a PV system than I use, but, you know, I need those grid services because my solar cells don't generate electricity at night. And so I should have to pay for that portion of the grid services.

I think the California model has not yet quite gotten there in recognizing the balance of those costs. But I think utilities and—we all realize that we have to do this. So it is a really important conversation going forward, and it has to have all the stakeholders present in it.

Ms. HOFFMAN. So, two things.

We need to create a market and a distribution system that allows for better valuing of services. One of the things is how do you price differently at the distribution system. But, also, it is the conversation with the States, going back to the reliability conversation

earlier, of how important it is to have that dialogue for grid modernization and how we are going to lead the evolution to that.

Mr. FORTENBERRY. Are we 30 years out? Five years out? Ten years out? Depends on the segment of this you are looking at?

Mr. ORR. Okay, so now I am going to engage in rank speculation.

Thirty is too long. We will have made big progress. I would say we will have made quite significant progress over the next 5 but will not have solved every problem that——

Mr. FORTENBERRY. Okay. Thank you.

Mr. ORR. That is my guess.

Mr. FORTENBERRY. Right quick, the status of battery technology in the market, as well as small modular reactors?

Mr. ORR. Yeah. So who wants to—batteries here quickly. Small modular here.

Mr. DANIELSON. Thank you, Congressman. And if we don't get to it, we will take for the record your questions on wind and solar, as well.

Mr. FORTENBERRY. Okay.

Mr. DANIELSON. On batteries, we have seen tremendous cost reduction in the last few years. In 2008, we were at around $1,000 per kilowatt-hour. A kilowatt-hour can take you 3 or 4 miles in an electric vehicle or can interact with the grid. Today, we have prototype cells that are working and showing that, if we took those into manufacturing, it would be about $300 per kilowatt-hour. So we have seen a 70 percent reduction there.

Most of the production we are seeing in batteries is in the electric vehicle space right now. But we have significant capacity in this Nation. About 20 percent of global capacity for battery production is in the United States now.

And then the other forms of grid storage particularly lithium ion batteries, which is what my office invests in, like flow batteries or other low-cost storage methods, are under the purview of the Office of Electricity and Pat Hoffman.

Ms. HOFFMAN. So, with respect to flow batteries, there has been a significant reduction in flow battery costs. We have achieved about $350 per kilowatt-hour. And what we are going after is to continue to drive that cost down because we know the value that energy storage brings in integrating all those pieces of grid assets.

Mr. KOTEK. And then on the small modular reactor piece, we as a department had engaged in cost-shared arrangements with two companies to try and bring forward designs to the—for design certification. One of those companies had made a corporate decision to reduce their funding, so we are not investing in that one anymore, but the other company is in fact moving forward. Hope to have the design certification application to the Nuclear Regulatory Commission within the next 2 years.

And then there are other companies, you know, that we are not working with that are also developing——

Mr. FORTENBERRY. Are there other countries investing in this technology heavily?

Mr. KOTEK. Yeah.

Mr. FORTENBERRY. Who?

Mr. KOTEK. We certainly have seen the Japanese with designs. China has had several interesting reactor concepts that I think

could fit into SMR space. And there are probably others, as well, but those are the ones I know the most about.

Mr. FORTENBERRY. Thank you, Mr. Chairman.

Mr. SIMPSON. Mr.—Ms. Herrera Beutler.

Ms. HERRERA BEUTLER. I get that a lot. That is why I have two names, because then it is like, two names, it has to be a girl, right?

Thank you all. Thank you, Mr. Chairman.

I have a couple questions. And it is interesting, I think most of them will probably be directed at you, Dr. Danielson, as it relates to renewables.

And so my district in southwest Washington runs along the Columbia River out to the Pacific, so you can guess my interest. The Columbia River Basin generates, according to PNNL, about 30 gigawatts of power and over 40 percent of U.S. hydroelectric generation. And I think our future challenge is going to be improve the current system, as we are having to renew the generation capacity in our dams, and still protect our wild salmon runs, still make sure our tribal treaty obligations are met—which we are doing well right now, by the way.

Our salmon runs are at record numbers. Now we are trying to deal with the sea lions that are eating these amazing salmon that we as ratepayers in the region worked very hard to make sure are there. So it is an interesting dynamic. Nonetheless, it is a good problem to have.

And I appreciate your ongoing support of hydroelectric technologies. I am concerned that—I am not sure, and hopefully you can speak to this, that the Department has put enough emphasis on next-gen hydro technologies.

Because, you know, we hear all this talk about solar and wind, and Dr. Orr spoke to the need for firming our grid. And we have a lot of wind in our area, we have a lot of different renewables, but here is an amazing carbonless source of energy that—you know, we have a lot of lofty goals on the West Coast of people driving electric cars up and down I–5. We are going to need that—unless you only want to drive when the wind blows, we are going to need this firming power. And it is carbonless.

So I guess what I would like to hear is the plan for next-gen hydro and what you see 30 years from now. Why are we picking 30 years?

Mr. DANIELSON. Thanks for that question.

The hydropower part of our portfolio is becoming an increasingly important part of the portfolio for the reasons that you mentioned. And our work in looking at where we could take hydro for the Nation has really focused, first and foremost, in the last couple years on determining how much resource is out there in the next-gen opportunities.

We have about 78 gigawatts, including a lot on the Columbia River Gorge. And we have done resource assessments that show that, if you look at existing unpowered dams around the country that don't have any power being generated from them, we could get another 12 gigawatts or so.

We did a very comprehensive study on what we call new stream reach development that would be very low-impact, smaller, not-large-impoundment kind of development. And when you exclude a

number of resources for various reasons, it gets you to about 65 gigawatts.

And those are reasonably conservative estimates. We think that, with the right technology, the right new technologies and approaches, that we could double hydropower. And we have a vision to potentially do that around 2030.

The big technology challenges that we see are, with these large impoundments, you make these very large generators that are one-off. They are actually designed for the application. And so you actually get an economy of scale from how big the equipment is. But when you start looking at these smaller opportunities, we need to develop modular technologies that can benefit from manufacturing economies of scale.

And so that is a big focus for us, developing common platforms, modular new technologies that will be cost-effective, in addition to developing new approaches to the civil works of redirecting the water that are much more cost-effective, as well.

Ms. HERRERA BEUTLER. Very good. I appreciate that.

I think we may stay with you, although it might jump over.

So we have talked about an abundance of different types of technology. And I missed the first part; I assume we talked about fossil fuels. I wanted to switch a little bit to timber.

Timber is prevalent in my district. In fact, the woody biomass from our forest—and I am not talking about clear-cutting. Let's go on record. I am not talking about clear-cutting. I am not talking about chipping whole Douglas firs. I am not talking about cutting down old growth. The amount of foliage and dead and dying timber that hits the floor that creates fuel for catastrophic wildfires, I am talking about that stuff, the woody biomass that we could—really, it is a twofer. You could keep our forests cleaner and more healthy and possibly generate energy.

And I know that there are small-scale projects, but I wanted to see if there were any—we have had some challenges in the D.C. Area with explaining, kind of, the lifecycle of a tree to some folks who work in cubicles. I have invited a lot of people out to come tour our region, tour our forests. We love it. We don't want to get rid of our forests. We want to help take care of them, have them take care of the families, and, in turn, utilize and conserve and do the best job we possibly can in using some of this woody biomass, as a great example.

I wanted to see if there were any projects or anything taking place at your level in this area.

Mr. DANIELSON. Yeah. One exciting project I would point to is, through a partnership with the Department of Defense under the Defense Production Act, we are funding a pioneering project to turn waste wood into jet fuel, hydrocarbon jet fuel, using gasification technology.

And with the DOD and the commercial aviation sector having interest in the off-take, these projects actually have off-take agreements with companies like Southwest Airlines and other companies.

That is a 10-million-gallon-per-year plant——

Ms. HERRERA BEUTLER. So——

Mr. DANIELSON. Yes, go ahead.

Ms. HERRERA BEUTLER. So can I add to that? Because this is one of the things I wanted to bring up.

Is it true that they are prohibited from using the woody biomass off the Federal floors in Washington State and that has to be poplar-grown biomass? Or someone is growing plantations to meet that—because I love the idea, and when I first heard about this, I was ecstatic. Because, hey, we could reduce our catastrophic forest fires. And then I was told it is specifically prohibiting the use of the woody mass, the biomass on our Federal floors.

Mr. DANIELSON. I am not familiar with that specific issue, but I ould like to take the question for the record to follow up.

Ms. HERRERA BEUTLER. I would love to.

Mr. DANIELSON. Our national laboratories bid a pretty definitive study on how much biomass could be sustainably harvested while not affecting food or other industries. And it was about a billion tons a year of biomass, which could displace about a third of our oil usage.

Within that report, we would have a number on biomass from sustainable forestry, and I would like to take that for the record and follow up and get you the right number.

Ms. HERRERA BEUTLER. I would like to. Because I was thrilled when I heard about this. So let's run that one down.

Mr. DANIELSON. We will.

Ms. HERRERA BEUTLER. And that, Mr. Chairman—I guess, just in parting, I wanted to make sure that, as we are talking about modernization, keep those of us in the Northwest in your conversations and relationship as you move forward.

Mr. ORR. Indeed.

Ms. HERRERA BEUTLER. That was, I guess, my parting shot. Thank you.

Mr. SIMPSON. Thank you.

Dr. Orr and Mr. Kotek, this year's request eliminates funding for the Integrated University Program, which supports nuclear energy engineering students with fellowships and scholarships and proposes a new account, the Nuclear Energy Traineeship, which supports students in the radiochemistry field of nuclear science.

This subcommittee has tried to broaden this focus over the years by supporting programs to ensure the next generation of nuclear scientists and engineers across all fields of nuclear science. Why does the request specifically target students in radiochemistry instead of what the committee has been trying to do?

And what other fields of study within the nuclear science are there that face a growing demand and an aging workforce? And can you assess the current state of nuclear science at the university level and where else support can occur?

Mr. ORR. I will ask John to take that.

Mr. KOTEK. Yeah. Thank you, Mr. Chairman.

So, specifically on the traineeships first, so we have identified radiochemistry as one of those areas where there aren't a lot of programs, there aren't a lot of students coming in. It is something we need in the laboratories as we look at separations technology, for example. So we are trying to focus on that.

Looking forward for other traineeships, there are other areas. For example, some folks in the industry point to the need for seis-

mic experts as another area that might be ripe for a traineeship-type program. So we are working internally right now to identify are there other specific areas where it would be important for us to bring a proposal for a traineeship program forward.

Looking more broadly at the university support piece, one of the things that our office does in the nuclear energy program is we involve universities very heavily in each of the research areas that we have going. So, in this budget and in past budgets, we have had $50-million-plus going for university-based nuclear research programs. So we have an opportunity there for people who are pursuing whether it is bachelor's, master's, Ph.D. To work on challenges that are directly relevant to our program.

So that has been the way that we have been supporting university-based nuclear engineering science education over the last couple of years.

Mr. SIMPSON. I was—well, let me ask you, how close do you work with the NRC on this?

Because several years ago—and I was asking Taunja when it was, because she has been here about as long as I have. I think it was when Mr. Hobson was chairman. I was wondering if it was when Visclosky was chairman. But we were a little PO'd at the Department and their lack of moving forward on a nuclear education and training program. We took it all and gave it to the NRC because they wanted it and they said they would do a good job, and apparently they are doing a good job.

How closely do you work with them on this issue? Because having the workforce in the future is going to be a big issue. I mean, not only in radiochemistry and other things, but just having nuclear-trained welders is a big issue.

Mr. KOTEK. Do you want me to take that one?

Mr. ORR. Go ahead.

Mr. KOTEK. Thank you, Mr. Chairman.

So we are working with the NRC. For example, I believe it was this committee asked for a report looking at workforce issues next year and asked the NRC to take the lead on that. So my staff is working with the NRC now to be responsive to that request. I have to say I am not familiar with the details of those discussions thus far, so——

Mr. SIMPSON. Okay.

Mr. KOTEK [continuing]. We will be in a position to follow up with you on that.

Mr. SIMPSON. As long as you are aware of it——

Mr. KOTEK. I am aware.

Mr. SIMPSON [continuing]. And this committee's desire to make sure that we have the trained nuclear experts in the future when that time comes.

Mr. KOTEK. Thank you.

Mr. SIMPSON. Mr. Kotek, the request for the Advanced Reactor Concepts program decreases funding from last year's level of $23 million to account—or decreases it by $23 million to account for a transfer made from the Nuclear Energy Enabling Technologies program. The transfer concerns studies on hybrid energy systems performed in concert with EERE.

It is difficult to view the difference in funding with the transfer, and I wanted to dig a little deeper. Can you explain why these funds were moved and describe the work your office performed with Secretary Danielson?

And the transfer placed funds within the crosscutting technologies account of the Nuclear Energy Enabling Technologies program. Do you have plans to collaborate with EERE on future studies?

Mr. KOTEK. Yeah, certainly. I think there are several of us who can talk about the—certainly, the supercritical CO_2 project. And that involves the——

Mr. SIMPSON. Right.

Mr. KOTEK [continuing]. Fossil Energy Office, as well. But that——

Mr. SIMPSON. You were the lead agency on that previously, but under this budget it is proposed to be——

Mr. KOTEK. Yeah. Now it is in the Fossil Energy——

Mr. ORR. Maybe I could just say a word, and then maybe Chris will chime in, as well.

The good news about that technology option is that, if we can solve all the issues that have to be solved, it has application across a variety of areas. The nuclear area is one, but geothermal is another, and coal and even potentially natural gas all could be the thermal energy resource that gets turned into electric power.

The judgment in looking at where the potential for earliest applications might be, it seemed likeliest to us that the coal applications had the greatest potential for early application. But the problems that we have to solve are really common across all of those areas, so it made sense to move that program over but to keep the nuclear energy group connected to it so that we work on the problems that they are interested in at the same time.

Mr. SIMPSON. Okay.

Mr. SMITH. I will just add very briefly that the fiscal year 2015 omnibus bill specifically pointed out that cycles above 500 degrees was the area in which you get the greatest benefit from supercritical CO_2. Those primarily lie in fossil applications, and so that is one of the drivers behind some of the observations that Dr. Orr has made.

So this shift is consistent with the language that we saw in the 2015 omnibus bill.

Mr. SIMPSON. Okay.

Any others?

Mr. DANIELSON. On the specific issue of the collaboration between nuclear and EERE on hybrid energy systems, in fiscal year 2015 we got $2 million at EERE that we are going to be investing into analysis to identify and develop a multiyear research agenda that next year we would be putting forward the best ideas that have come out of our analysis and roadmapping. The vision being thinking of nuclear heat and renewable heat or electricity in also a refinery context. What is the best use of that primary energy? Do you build an industrial park that can make hydrogen or use the heat for industrial processes?

We are in the, kind of, ideation and discovery phase of that this year. And in 2016 and then in 2017, I would expect we would come forward with a research agenda.

Mr. SIMPSON. Okay.

Mr. KOTEK. And then, Mr. Chairman, just specifically on the nuclear energy applications, back looking at the supercritical CO_2 question, we have some funds in our request for a collaborative effort across our offices. And then we have I think it is $3.3 million in the request to look at specific issues associated with coupling one of those energy systems to the back end of a nuclear reactor. So we are making sure we keep active in both areas.

Mr. SIMPSON. I will never criticize you for working across and between different offices. In fact, I have said we need more of that in the future.

Mr. ORR. Yeah. The good news is that I have a very good team of colleagues here interested in doing exactly that.

Mr. SIMPSON. Good.

Mr. Kotek, the Advanced Test Reactor at the Idaho National Lab serves as an important role for the health of our nuclear Navy as well as for civilian nuclear energy research and development. The ATR is an old reactor but is still going strong day-in and day-out.

What is the general health of the reactor, and has it been adequately funded to provide maintenance and upgrade necessary for it to last? And what projects and upgrades to the ATR are still outstanding that were not funded in this year's budget request?

Mr. KOTEK. Thank you, Mr. Chairman. I can answer that.

Generally, right now, the ATR is an essential piece of equipment for us. And, of course, when I was at DOE Idaho, we spent a lot of time focused on maintaining the safe long-term operation of that facility. And let's face it, machines like that are not cheap to replace and may not be replaceable, and so we are really committed to ensuring the long-term safe operation of that facility.

What we have done is we have asked the contractor to start by looking at just that question: What are those investments we need to make to ensure the long-term health of the facility? They have created a report that has been submitted to my office and the Office of Naval Reactors.

The Office of Naval Reactors and my staff are going to sit down here, I think next month, to talk through, okay, how do we ensure that these funding requirements are met going forward. So that is something that is going to be——

Mr. SIMPSON. So you will discuss the share of——

Mr. KOTEK. Yeah, how we do that going forward.

Mr. SIMPSON [continuing]. How much Naval Reactors pays for it and how much civilian pays for it——

Mr. KOTEK. Yeah.

Mr. SIMPSON [continuing]. And so forth?

Mr. KOTEK. Right.

Mr. SIMPSON. Okay.

Mr. KOTEK. And we have been making investments, for example, in the uninterruptible power supply system out there. So there are things we have been trying to do each year through the budget to ensure the long-term safe operation of the facility, and that will remain a focus of ours.

Mr. SIMPSON. This year's budget request includes an additional $22 million for the Idaho safeguards and securities, which provides critical security operations for the Idaho National Lab. I understand those additional funds will finally allow you to support protective forces staffing levels consistent with the approved site protection plan and also to address the backlog of physical security systems.

Can you discuss how this request supports the Idaho National Lab? And what will be the biggest cost drivers of the Idaho National Lab security infrastructure moving forward?

Mr. KOTEK. Yes, Mr. Chairman. And you correctly point out that part of it is manpower-driven. So we are adding staff in 2015, and so we will have a full year of costs for those people in 2016. So that is part of the reason for the increase.

We also need to make some improvements at the Materials and Fuels Complex to the PIDAS, the intrusion detection system, and to the central alarm system there. So that is a part of it.

And then there is another piece that is tied to cybersecurity.

So those are the big drivers for the increases here.

Mr. SIMPSON. Okay. Thank you.

And, Ms. Hoffman, we talked about this a little bit yesterday, and so I would like to just have it for the record. I have been reading several books, or maybe not several, but a few books on the threat to our grid and the infrastructure of our grid from EMPs and solar flares, those kind of things. And maybe that is dangerous to read those books, I don't know, but it is a potential risk out there.

And we discussed this yesterday and what are we doing as a Federal Government and why aren't the private utilities that own this infrastructure more concerned about it. And do you want to get into that discussion a little bit?

Ms. HOFFMAN. Sure. Thank you very much.

You have brought up a set of emerging challenges that are facing the electric grid. EMP, as we have discussed, is an emerging challenge. We know that threat actors are getting more sophisticated on the cybersecurity side as well as on the physical security side.

And what we really need to do, as we look at grid modernization and evolution in securing the grid, is put into perspective what are some of the near-term challenges that we have to address now within the electric infrastructure—hardening, mitigation, continuous monitoring—and then provide some joint public-private partnership in some of the riskier areas, some of the things that are a little bit beyond the ability of the utilities to truly understand the impact and consequences and the magnitude of the threat in those areas.

The public-private partnership with utilities, I think, will be one that will help address some of those advancing threats.

Mr. SIMPSON. Thank you.

I have one more question I will ask before I let the others go.

Dr. Danielson, as someone who came from ARPA–E, you are well aware of the successes that an active project management approach has created within the program. EERE has had its share of management difficulties in the past, and I want to give you an opportunity to explain how you have changed some of EERE's manage-

ment problems and implemented a strategic plan for EERE's future successes. Can you talk us through the effort you have made to improve the office and why you felt you needed to make these changes?

In order of implementing an active project management approach to programs, there must be mechanisms in place to track progress and terminate projects that are underperforming. What mechanisms are you using so that you can cancel underperforming projects and reclaim unspent funds? And what have been the results of your project management implementations?

Mr. DANIELSON. Thank you, Mr. Chairman.

You know, we have put in place a number of important new mechanisms under the active project management banner.

One thing we are doing across the whole portfolio is every 2 years we get an external set of experts to provide peer review, commentary, and scoring on our whole portfolio to give us a feel for which projects are having the greatest impact and which are potentially not providing the impact for the taxpayer.

And then we put in place this active project management approach. We are no longer doing grants. We are only doing cooperative agreements, which allows us to have a much more substantial interaction with our performers.

And we are also putting in place annual go/no-go milestones, where when performers are not able to hit those and don't show promise to deliver value on the taxpayer investment, we terminate or redirect those projects. And since we have implemented this over the last year and a half or so, more than 68 projects and more than $100 million has been redirected from projects that we thought weren't performing to the standard that we would expect into more high-impact projects.

Those are the kind of things we are putting in place in order to make sure that our performers are delivering as much value for the taxpayer investment as possible.

Mr. SIMPSON. Thank you.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman.

Secretary Hoffman, I wanted to ask you, do you maintain a ranking at the Department relative to States and their leadership in grid modernization?

You mentioned Vermont earlier in your testimony. If I were to ask you, where does Ohio rank in terms of grid modernization, where would it rank compared to Vermont, for example?

Ms. HOFFMAN. So I don't have a ranking with respect to States in comparison of grid modernization. Each State is developing differently with respect to how the grid is evolving, based on whether they participate in a market like PJM's market or whether they are in a vertically integrated area.

But I will tell you that the basic principles of what we are trying to drive is better situational awareness through the deployment of sensors on the system and the ability of the grid to integrate distributed energy resources but provide improved reliability.

I don't have a ranking that I could give for one State to another State with respect to how well they are doing because each State has its own goals and objectives.

Ms. KAPTUR. Hmm. Does that serve the national interest?

Ms. HOFFMAN. It is part of, unfortunately, the infrastructure of the United States where the grid has evolved differently and whether you are in a competitive market region in the United States or in a noncompetitive market, you know, a bilateral-agreement part of the United States grid. It is part of a structure we have that is making grid modernization very challenging, and it is making the urgency of having the conversation at a national level even more important so we can make sure that States such as Ohio interface very well with Pennsylvania, and we look at the seams issues that are occurring between grid operators.

So it is imperative that we look at grid modernization holistically as a national effort. And then, as the States make decisions—New York is doing their revitalization of the energy, a vision in New York, how all those pieces fit together.

Ms. KAPTUR. Well, I would think—I can't make you do anything, but I would urge you to think about how one would measure State performance so we could make a judgment as Members. That would be very helpful to Members like myself.

Mr. Chairman, you concur there?

Mr. SIMPSON. You can make them do that, yeah.

Ms. KAPTUR. All right. I like that idea. It gives us policy direction, and that is very helpful to us.

So I thank you. I thank you for answering that question.

I had another question on weatherization money, and that is—perhaps, Dr. Danielson, you can answer this. Do you know if all that money is disbursed to the States? Or is a percentage of it able to be awarded to consortia eligible to operationalize the funding? Is it all to the States?

Mr. DANIELSON. Yes, we have about 56 State-like entities that then distribute it to about 8,000 sub-entities all around the country that are already well defined today.

Ms. KAPTUR. All right.

I was going to move to Under Secretary Orr next.

On March 4, the Department issued a $12.5 million funding opportunity announcement for a new technical track under the U.S.-China Clean Energy Research Center and to promote collaborative efforts to help ensure energy, water, and environmental security.

My question really is, if that whole effort exists with China but I wanted a similar effort for Europe, Ukraine, would new legislative authority be required for that, to get the Department to put as heavy a focus on Europe and Ukraine as it is currently on China? Do you know if new legislative authority is required for that, or do you have it under existing authority?

Mr. ORR. I do not know the answer to that question, and I will be happy to take it for the record and get back to you.

Ms. KAPTUR. All right. I thank you very much.

I wanted to ask follow-on questions on solar manufacturing.

Dr. Danielson, you could tell us how we are doing in the area of solar? And what led manufacturing of solar to shift so dramatically overseas? And what is your plan for increasing manufacturing efforts here in the United States?

Mr. DANIELSON. Thank you for that question.

As you know, I think it was maybe 20 years ago, when the solar market was relatively small, we had the majority of the cell and module manufacturing here in the United States, but over the last 5 or 6 years, especially a couple years ago, significant government investments in China, both from the Federal level and from the regional level, provided subsidies for the industry to scale there. That drove a lot of cost reduction, but it also made for a difficult environment for U.S. manufacturers. There have been trade cases that Commerce has put forward that were informed by some of our analysis around the basic cost structure of U.S. manufacturing versus Chinese manufacturing.

In addition to that, the growth of the market here which has occurred in recent years has begun to drive—that in addition to the advanced technologies we have been funding over the last 10, 15 years is resulting in a solar comeback that I mentioned earlier, with a doubling of capacity expected by 2017. That is cell and module capacity.

That includes First Solar expanding in Ohio, a company that we funded the basic technology at the National Renewable Energy Lab decades ago——

Ms. KAPTUR. 1987 forward.

Mr. DANIELSON. That is right.

Ms. KAPTUR. I was here—I was there.

Mr. DANIELSON. It is a truly differentiated technology and a great American success story.

And then, in upstate New York, SolarCity has acquired a company that had advanced silicon solar high-efficiency technology called Silevo that we had supported in its early days of research and development to put a gigawatt-scale factory.

And we are also seeing—I mentioned the expansion of Suniva, which is a high-efficiency solar company that spun out of a lot of our early R&D at Georgia Tech, is now expanding its new plant, 250 megawatts, in Michigan, creating more than 300 jobs.

And then SolarWorld in Oregon is expanding its production, as well.

One thing I want to point out is that just looking at the cell and module manufacturing market share doesn't show the whole picture. And so what you find is that, even when a very large fracture of modules are being made in—cell and modules—in China, oftentimes the really high-value component materials like films that can prevent water from getting in or other high-value components like micro-inverters are being manufactured in the United States. And so, if you look at the full value chain, which is something we are beginning to track much more carefully, the United States has been doing a lot better than the cell and module numbers would indicate.

And so I would say that we are seeing a strong comeback in the United States because of advanced technology innovation and growing market demand here in the United States.

Ms. KAPTUR. I wanted to say to the chairman, I don't know if you represent one of these companies, but it is so unbelievable to, in one's lifetime, see a technology come forward and to be a part of the founding, meeting the founders and scientists that are involved locally, who are reaching for something that is—they can't see ex-

actly where it is going. And to actually be part of the invention process and then to see a company created and then, all of a sudden, hundreds of jobs and then thousands of jobs, it is unbelievable. I am just—I feel very fortunate—and to see a new technology.

And I want to do everything I can as a Member to continue helping them grow. Obviously, I support the budget in this regard. It doesn't seem like enough, with all the trade problems and the counterfeiting and the intellectual property and all the others pieces. But I just—it is unbelievable what this is providing the world with. So, obviously, I support your efforts here and always look for ideas for how to be more supportive. And I thank you for your leadership.

Just to put on the record, one of the companies that Dr. Danielson mentioned is hiring several hundred more people in the State of Ohio, where, of course, we need more jobs, but they are hiring three times that many in Malaysia. And I am glad—I am glad that they are expanding globally, but I say to myself, how do I get more of those jobs in Ohio? If you were elected by constituents in Ohio, you would ask yourself the same question. And I see this happening, and I want more of that production to be in the United States.

How is it, Doctor, that Buffalo—I guess they are getting a utility-size field built in the State of New York? Is that true?

Mr. DANIELSON. They are actually building a gigawatt-scale-per-year manufacturing facility.

Ms. KAPTUR. Oh, a manufacturing facility.

Mr. DANIELSON. It is about the number of solar modules that will be produced a year.

Ms. KAPTUR. Okay. So that is manufacturing. All right.

I want to completely change direction here for a second. On coal, I was very happy to see the President's budget include investing in coal communities. And those that are heavily impacted by what is happening in that industry—I know the chairman of our full committee in interested in this.

Does this also include a focus on communities and places where coal-fired utilities have closed down, or just where coal is mined?

Because I have to believe Ohio would be at the top of the list of States where coal-fired utilities have shut down. And in my own area, for example, the loss of coal-fired utility production has borne down very heavily on school systems that can't adjust that quickly.

And I am wondering if the program will include technical assistance to help these kinds of communities adjust more quickly to new energy production or if you will just let them languish out at sea.

Mr. SMITH. Well, thank you for the question. So you are referring to the POWER Plus plan——

Ms. KAPTUR. Yes.

Mr. SMITH [continuing]. Which, actually, is not part of the Office of Fossil Energy. It is not——

Ms. KAPTUR. Oh.

Mr. SMITH [continuing]. A plan that is managed by our department, but it is part of this budget that was released by the President. That does have a focus on both communities in which coal is produced and also communities where coal is being utilized in power plants.

So there is a number of factors to that program. I would be happy to answer for the record or provide more information on the POWER Plus plan, but that isn't part of my research and development budget.

Ms. KAPTUR. Do you think you have nothing to offer them, then? I notice they have the Appalachian Regional Commission as a part of it, the Department of Labor. But, technically speaking, your division doesn't really have anything to contribute to that?

Mr. SMITH. We don't manage the budget. We certainly have a lot to contribute in terms of understanding the playing field, understanding what technologies are being developed, understanding the future of ensuring that all parts of domestically produced energy are part of the clean energy economy of the future.

So we do work with all those agencies that are working at rolling out those plans, but, again, that is not part of our appropriated budget.

Ms. KAPTUR. Does anyone else on the panel wish to comment on this? No?

Okay. Let me switch to biofuels for a second from algae.

Dr. Danielson, a new focus was charged to the Algae and Advanced Feedstocks Program after major barriers to algal biofuel commercialization were identified in public workshops held by your office in 2014. Can you briefly explain what those barriers are and how this affected the program's focus? And, also, what is the future viability of algal biofuel commercialization?

I come from Lake Erie, where algal blooms were the reason for the shutdown of a major water system at Toledo for 3 days to people. Over a half a million people were impacted. Algal blooms, lots of algae is a problem for us. Can we turn it into a opportunity?

Mr. DANIELSON. Algae is an important part of our long-term biofuels roadmap. Our research, development, and demonstration focus in our biofuels program is on converting sustainably produced biomass into drop-in hydrocarbons—bio gasoline, bio jet, biodiesel, actual diesel fuel. And we are looking at a number of different pathways today. Some of them will work; some of them ultimately won't get to market.

However, because of the variety of feedstocks we have in the country, we also are going to need a number of pathways in the end, regardless, to get to the kind of production goals that will make a difference. We have biochemical, using biology or organisms to convert material into fuels. And we also have thermochemical approaches, which basically borrow from the oil and gas industry and the gasification industry to burn and then break down and reconstitute fuels.

The 2017-to-2022 timeframe is when we expect those fuels to begin to be cost-competitive. But we see algae as potentially being a much greater scale, because you can grow algae in a lot of different places.

Ms. KAPTUR. Well, Lake Erie knows how to do that real well.

Mr. DANIELSON. Right. It is a longer-term pathway, but it could scale much larger in terms of its volume. 2025-plus is the timeframe.

The big challenge we have seen is it is costly to grow the algae in ponds or in photobioreactors, and so there is a lot of research

being put into making that more productive, increasing the amount of the conversion efficiency of algae, essentially, of sunlight and CO_2 into oil in their bodies. Secondly, you have to actually dry them, which costs you energy. And then you have to basically cut open the algae body and get the oil out, and you have to process the oil.

We have been, over the last few years, tackling many of those challenges. One thing I am excited to let you know about is that the Pacific Northwest National Laboratory has developed a new approach called hydrothermal liquefaction, just in the last couple of years, where you use catalysts to take the whole wet algae soup or bodies and convert that into hydrocarbon-like material, which could be much more cost-effective much more quickly. That is being commercialized by a company called Genifuel at the pilot scale today.

And so I think we are making a lot of progress on algae, and we have had some recent breakthroughs that might even pull that roadmap up a little bit.

Ms. KAPTUR. How do I get some of that expertise or at least have a briefing of what is happening in the algal markets and focus it on the Great Lakes and all of our challenges with algae, which are significant? How do we find the experts to kind of home in on what is happening there?

Mr. DANIELSON. Within my office and within the national laboratories, we have a tremendous set of expertise. And we would be happy to come and brief you at any time.

Ms. KAPTUR. All right.

Thank you, Mr. Chairman. Thank you.

Mr. SIMPSON. If we could, Mr. Valadao has arrived, and I would like to give him a chance.

Mr. Valadao.

Mr. VALADAO. Thank you, Mr. Chairman.

And I apologize for being a little late. They like to schedule all these committees at the same time. Appreciate all of you taking some time for me today, or for us today.

But I wanted to touch a little bit on cybersecurity, and my question is for Ms. Hoffman.

The energy sector's critical infrastructure has been subjected to a dramatic increase in focused cyber attacks in recent years. Your office has the responsibility of protecting the electricity grid and other energy infrastructure against the ever-present threats of a cyber attack.

Can you talk us through the state of the energy sector's cybersecurity? What are the existing capabilities? Who are the bad actors? And how do energy control systems differ from normal IT systems in the event of a cyber incident?

I have some more questions after that, so——

Ms. HOFFMAN. Thank you. There were a lot of questions involved in that. I appreciate it. Cybersecurity is an important topic, and I think we all need to engage in that topic in a very transparent way.

For cybersecurity, we have developed a strategy with industry that includes, first of all, engagement with the CEOs. We know we need to make a change and a difference, whether we are talking grid modernization or cybersecurity, but it takes leadership within

the industry to make that change. So we have been engaging directly with the CEOs to understand, number one, where the cybersecurity issues are, where the threats are, and where the opportunities are for mitigation and response.

In our strategy, we have been working with the Electricity Sector Information Sharing and Analysis Center we created in partnership with NERC, an information-sharing center, because, first of all, you need to figure out what is happening on the system and to be able to share that information with the grid operators. So they have over 1,900 NERC members of that system, of that information-sharing collaboration, and now they are also bringing forth other entities that participate in the electric grid as part of that information-sharing and analysis center.

What we have also been doing is developing tools. These tools identify where some of the vulnerabilities are on the system but also what is actually happening on the system. Everybody said, oh, I am concerned about cybersecurity. But the unknown was really driving some frustration, I would say, from Congress and from other folks on exactly how secure are we. So now what we have developed is a set of tools where the grid operators are taking a harder look at their system and being able to understand in greater detail what is happening from that perspective.

With respect to the actors, they are all over the place. Utility operators get probes every day. They get probes on their IT and their OT systems. And, really, the difference is information technology is what runs your business systems. It is what is in your computer as you look at your computer that is sitting on your desktop. The operational, or OT systems are really looking at controls of devices within the electric grid. So things that take action are what OT system are.

And there is a greater concern over a bad actor being able to get into the operational technology system and being able to have it take action. Our research program, which is $52 million, is really focused on how do we develop technologies to protect the operational environment within the electric grid.

Mr. VALADAO. Is our infrastructure currently capable of surviving a major cyber incident while sustaining critical functions?

And, again, I know this is back to that same question of who are the bad actors, but what are the tools that we see bad actors using here in the future to come after our infrastructure?

Ms. HOFFMAN. Our goal is to have the electric grid survive an attack while it is going on within this sector. The tools and most of the common technologies or capabilities that the bad actors are using are malware that is for sale on the Internet. They are looking at spear phishing and whale phishing, going after passwords and codes.

And so it is everything that you are seeing in other sectors, you are seeing the same thing that is occurring in the electric sector. And so we need to continue to develop solution sets to mitigate that.

Mr. VALADAO. As far as developing technology at speed of computers—I mean, we are always talking about the next fastest computer—how much of a role does the speed of a computer play on a person's ability to hack our system?

Ms. HOFFMAN. I think it is the networking and speed of the computer, its accessibility, that is in addition to how fast.

So, from a speed-of-a-computer point of view, the electric grid has fixed communication, so in some ways there is an advantage within the electric grid compared to other sectors, because we actually can look at what is being asked from one point to another point, what action is being taken, so we understand that a little better.

But timeliness of sharing of the information, for machine-to-machine sharing of information, is absolutely critical if we are going to stay ahead of the bad actors.

Mr. VALADAO. All right.

And how can this committee be helpful in providing you the resources you need to develop and implement new technologies to keep our energy infrastructure secure?

Ms. HOFFMAN. Support of the 2016 request would be first and foremost what I would ask, but also to continue to support the strategy which we are developing.

And the strategy really has several components to it. It is understanding what is happening on the system. It is building the information-sharing capabilities, the ability to protect the information but be able to share the information between the Federal Government and grid operators; then the ability to develop mitigating solutions, new technologies.

And what we are requesting in the 2016 budget includes forensics capabilities, where as a new piece of malware is discovered—and there is always some new, attack vector that is coming out—we want to be able to analyze it quickly, have the industry be the first to be able to say, this is how we are going to respond to it.

Mr. VALADAO. All right. Well, thank you.

Thank you, Mr. Chair.

Mr. SIMPSON. Thank you.

Ms. Kaptur, did you have anything else?

Ms. KAPTUR. I do.

Mr. SIMPSON. Okay. Go ahead.

Ms. KAPTUR. Thank you, Mr. Chairman.

I wanted to ask Under Secretary Orr or Dr. Danielson, the national labs are a tremendous asset, particularly to those regions of the country lucky enough to have one. How do we leverage the labs to provide benefit to those areas of our country where that expertise is not on site, particularly those areas like my own where over half of the manufacturing jobs have been lost for various reasons—to outsourcing, to technology—and they have no labs on site?

What can be done to adjust and identify those regions that have had serious economic dislocation?

Mr. ORR. Well, it is obviously an important question. The labs are national labs because their focus is national. So, for example, you are not so far from Argonne National Lab, which has very wide-ranging capabilities across the energy space and has expertise that applies every bit as much in Ohio as it does in Illinois. And our goal really is to try to make sure that we make available the expertise that exists in the national labs, really to work on problems across the whole country.

The Secretary has taken action in recent times to build a much more strategic relationship amongst the national labs. At a meeting recently of the national labs' directors commission, there was a long discussion of how do we take the abilities of these national labs to do emergency response in their own areas and surrounding States and make that capability available to folks that might need it, that it is really an opportunity to use that expertise across the area.

In the technology transition, technology transfer area, all of these labs work with companies that can be anywhere in the country. So we try very hard not to make them only be of parochial interest in a particular area but to supply their expertise to the Nation as a whole.

Ms. KAPTUR. I am glad to hear that, Under Secretary.

I am going to send you a map of where in our country we have had this job washout. Maybe it already exists at the Department of Energy. And then I think it would be very interesting for you then to see where the labs are located and to think about connectivity——

Mr. ORR. Uh-huh.

Ms. KAPTUR [continuing]. In a more direct way.

I wanted to ask a question. Mr. Smith, in the last several budget requests, the administration has reduced funding for technologies that increase the efficiency of coal-powered plants. Could you please tell us what your office is doing to increase coal utilization and the efficiency of our existing power plants?

Mr. SMITH. Thank you very much for the question.

So, indeed, as we have looked at prioritization for the budget for the Office of Clean Coal, we prioritized on two lines, which has been R&D on capture technologies to capture CO_2 and technologies for long-term safe storage, either in saline aquifers or in enhanced oil recovery applications. So those are the two areas in which we have focused in terms of our budget request.

We do still have requests in the areas of efficiency, of control systems, of materials for supercritical processes. So we do still do research and development, and we still have, as part of this request, lines that look at efficiencies of plants, using less fuel in plants, which also has the benefit of making them more efficient, more effective, more cost-effective, and reducing emissions.

But, again, you know, as we look at our prioritization, we have focused most of our efforts on the challenge of reducing the cost of capturing CO_2 and understanding issues around long-term storage, either in saline aquifers or in enhanced oil recovery applications.

Ms. KAPTUR. Thank you.

I will look forward to your reply, also, on the letter I requested on three energy options for Europe and Ukraine and the role of coal in all of that.

Mr. SMITH. Indeed, we will have some thoughts on that.

Ms. KAPTUR. Thank you.

Dr. Orr and Dr. Danielson, I wanted to ask you about clean energy manufacturing. And as part of the White House's initiative on manufacturing, there were the first CEMI institutes funded in 2012, and I am wondering if you have had time to assess their progress.

How has the program enhanced U.S. competitiveness in clean energy? And do you think that their goal of being self-sustaining within 5 years is realistic?

Mr. ORR. So let me say a word, too, and then Dave can follow up.

But there is always a bit of an induction period as you get these things going. And so the earliest ones have only been in action for a pretty short time, so I think it is too early to have a quantitative, you know, impact kind of assessment.

But we can already see that there is substantial potential for impact. The additive manufacturing work that we talked about, the—Dave will say more in a moment about the new Wide Band Gap Semiconductor Institute. All of those have potential for really very large impact. And we are committed to making sure that they are managed well to do exactly that.

Dave.

Mr. DANIELSON. Yes.

As Under Secretary Orr said earlier, we have done a few experiments in these new consortium models in recent years, and I think we have learned a lot as an organization. And Under Secretary Orr pointed out some of the key things around a very strong, well-qualified leader, very well-defined goals, active project management with empowerment. Those kinds of principles have really permeated into the way we are structuring our consortia going forward.

And in terms of the manufacturing innovation institutes, the first one that we funded directly out of appropriations on our own is led by North Carolina State University on next-generation power electronics. It just got up and running at the very beginning of the year. We have a great leader in place, General Nick Justice, who was the head of Army Research, Development, and Engineering Command prior to joining us in this leadership role.

But what gives me confidence that these are going to be successful is what I have seen with our prototype manufacturing innovation institutes the Manufacturing Demonstration Facility at Oak Ridge National Lab and, in some sense, the Critical Materials Institute out of Ames, Iowa. And we have seen great results in both of those consortia.

In the Manufacturing Demonstration Facility, we mentioned that we saw partnership between Cincinnati Inc. in Ohio, an equipment manufacturer, and Local Motors, an innovative company in Arizona, resulting in within 6 months start to finish the first-ever 3D-printed car, so a pioneering innovation result.

And, at the same time, we are seeing that Manufacturing Demonstration Facility around 3D printing is a magnet for new manufacturing and jobs. A Canadian company called CVMR that produces advanced metal powders moved its headquarters—they announced just last week they are moving their headquarters from Toronto to Oak Ridge, Tennessee, where they are investing more than $300 million in manufacturing, and they are going to create more than 600 jobs.

We have seen similar commercially relevant innovation in the Critical Materials Institute, as well, with three technologies al-

ready in the first year and a half getting into the hands of industry for testing.

I think that we have learned a lot about how to run these things and how to structure them. Although we are just beginning with the manufacturing innovation institutes, I think if we are going to achieve what we have done with the MDF and with the Critical Materials Institute, we are going to see some tremendous impacts for the Nation.

Ms. KAPTUR. Do those critical materials include strategic metals?

Mr. DANIELSON. Absolutely.

The major issue with the Critical Materials Institute, which is one of the energy innovation hubs, is to diversify supply of critical materials to replace or eliminate the need for them, and to recycle them better. We have already developed a new technology that can separate out rare earths from each other twice as efficiently as has been done historically, which could reduce the size and cost of a separations plant by more than a factor of two.

We have also seen major innovations in efficient lighting phosphors that have rare earths in them. We have developed technologies through the institute that virtually eliminate those rare earths while providing the same performance. And those are in the hands of industry, going through rigorous testing, just a year and a half into that institute.

Ms. KAPTUR. My last questions relate to vehicle technologies, especially natural gas and the potential for natural gas vehicles. Are there major barriers to deployment, Dr. Danielson?

And then the SuperTruck program, any update you can provide us on that?

And then, in terms of offshore wind, your sense of the technological landscape of offshore wind projects in the country? How do we stack up compared to our global competition?

Mr. DANIELSON. Thank you for those questions.

On the natural gas vehicles front, we are putting forward in fiscal year 2015, dual-fuel engine research, including heavy-duty vehicles that could be powered by both diesel and natural gas, and the innovation that is required to make those more cost-competitive.

There is a lot of interest in the industry to move to natural gas because of the cost benefits, of course. But this year, for the first time, we are putting forward a research agenda topic on natural gas storage, which is one of the major long poles in the tent in terms of making compressed natural gas vehicles directly cost-competitive.

That is an area where RPE had made some pioneering investments about 3 years ago. And we are putting forward a $10 million program to try to take some of those technologies to the point where they can be put out into the market.

SuperTruck, as you know, is a very successful program. It was actually a $130 million program that invested in four integrated teams with the goal of developing Class 8 demonstration semi trucks that would achieve 50 percent improvements in fuel economy, through engine innovation, aerodynamics and all kinds of different innovations. And one of our teams has already achieved a more than 70 percent improvement in efficiency through the SuperTruck program.

Because of the success of the program, we are putting forward in this budget a $40 million SuperTruck 2 program that would be able to fund two integrated teams to go to a 100 percent or a doubling of efficiency versus the 2009 baseline.

And on offshore wind, one thing that is very interesting about the United States is we have a very different resource base than they have in Europe, where most of the deployment has been to date, in addition to Japan and other countries. We have quite a bit of deepwater. So we actually have about 4,000 gigawatts of resource within 50 miles of the coast, which is four times the peak power utilization of the country. About 60 percent of that is in deepwater, however, where you can't actually fix the offshore wind to the bottom, so you have to do floating wind turbine technologies.

Also, on the East Coast, where you are faced with hurricane conditions that aren't present in Europe and other places, we need innovation to allow us to have stronger, more robust technology.

And, as you know, in the Great Lakes, which present another interesting resource base for offshore wind, we have unique issues around ice formation, and we need technologies that can break the ice and can shed ice from the blades and also deal with ice creeping into the base of the technology.

And so we have a huge resource base, a great opportunity, but there are some unique technology challenges that we are addressing and that need to be overcome in order to establish a cost-competitive U.S.-based offshore wind industry.

Ms. KAPTUR. Thank you all very much. A tremendous panel this morning.

Thank you, Mr. Chairman.

Mr. SIMPSON. Thank you.

And thank you all for the work you do. Thank you for being here today.

We will see you, I guess, this afternoon, Dr. Orr.

Mr. ORR. You will.

Mr. SIMPSON. But thank you for your testimony. And the offices that you run are very, very important to the future of this country, so I appreciate it. Thank you.

Hearing adjourned.

QUESTIONS – SUBCOMMITTEE SET

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing
Applied Energy
DOE FY 2016 Budget Hearing

Tuesday, March 17, 2015

ENERGY EFFICIENCY AND RENEWABLE ENERGY

ENERGY SYSTEMS INTEGRATION FACILITY AT NREL

Subcommittee. Dr. Danielson, your programs fund activities at many of the national laboratories, but you have one lab specifically devoted to energy efficiency and renewable energy programs—the National Renewable Energy Laboratory [NREL, *pronounced n-rehl*].

The Energy Systems Integration Facility (ESIF) was a considerable investment at the NREL to overcome the challenges associated with distributed energy systems and the integration of renewable energy technologies into the electricity grid.

Can you describe some of the types of research being done at ESIF and how this fits into current market trends?

Dr. Danielson. Commissioned in September 2013, ESIF is the Nation's first facility that can conduct integrated megawatt-scale research and development of the components and strategies needed to safely move clean energy technologies onto the electrical grid at the speed and scale required to meet national goals. It is a state-of-the-art facility designed for testing, simulation, data analysis, engineering, and evaluation techniques for integrated technologies, and has already brought in over 50 outside partners with projects valued at over $13M since the opening of the facility.

This exceptional national resource supports scientists and engineers from the private and public sectors conducting critical research, development, testing, and validation. The efforts at ESIF will directly benefit equipment providers, utilities, public utility commissions, legislative bodies, and other entities working to modernize the Nation's electricity grid and related infrastructure.

One example of ESIF's valuable work in addressing current market trends is a partnership in Hawaii that resulted in lifting a moratorium on the interconnection of some PV systems on the island of Oahu. Along with states like California and New Jersey, Hawaii leads the nation in the penetration of residential rooftop solar photovoltaic (PV) systems, approximately 346 MW of distributed solar technologies on 48,000 rooftops. As a result, Hawaii is also at the forefront of the integration challenges associated with high solar PV penetration levels, which have resulted in

large interconnection queues where PV systems are no longer being connected to the grid in a timely fashion.

To address this challenge, the Energy Department's National Renewable Energy Laboratory (NREL) and SolarCity entered into a cooperative research agreement to address the operational issues associated with large amounts of distributed solar energy on electrical grids, including collaboration with the Hawaiian Electric Companies (HECO), to analyze high penetration solar scenarios using advanced modeling and inverter testing at ESIF.

Preliminary work demonstrated the ability of advanced power inverters to mitigate the potential challenges associated with high penetration of solar PV on distribution grids. As a result, HECO has now indicated it will expedite the installations of solar PV systems if the systems are installed with advanced inverters that meet stricter requirements—they must be designed to prevent rapid voltage spikes, and must be able to "ride through" possible unstable frequency and voltage conditions during emergencies. Under these conditions, HECO has agreed to clear all but 250 of the 2,750 systems in queue by April 2015, with the remainder being cleared by December 2015. This outcome - fostered by ESIF - addresses a major issue faced by the State of Hawaii in meeting its clean energy goals and paves the way for other States and utilities to work cooperatively to do the same.

Subcommittee. The high performance computing facilities and some of the other research equipment have experienced a tremendous amount of demand that's resulted in a backlog of waiting experiments. Was this demand anticipated? How do you prioritize research?

Dr. Danielson. The Energy Systems Integration Facility (ESIF) has been very successful at providing value to EERE offices, industry, and other external stakeholders. Currently, the computational science center at ESIF is fully subscribed and demand for computer time is increasing as new users are requesting to work at ESIF. Completing the three-year start-up of ESIF, the FY 2016 Budget includes an additional $6 million, relative to the FY 2015 Enacted funding level of $30 million, to support the expansion of equipment and NREL staff to further the research capability of ESIF. The increase will support investments in high performance computing (HPC), allowing for a near doubling of NREL's current HPC capacity to about 2.2 petaflops. The Budget also includes additional funding to provide 1

megawatt of additional PV simulation and expand the Research Electrical Distribution Bus (REDB) to enable conducting more than one experiment at a time on the electrical grid simulation system.

Generally, research using both the HPC and the other research equipment is prioritized first for requests from EERE. For example, approximately 84% of the capacity of the HPC is currently used by EERE. The remaining capacity is used for other DOE offices, work for others (WFO), and lab-directed research and development (LDRD). NREL has also done an excellent job developing partnerships with industry and other stakeholders, and has developed over 50 partners over the life of the facility with many more on the horizon.

Subcommittee. Does this facility overlap with any other facilities in the DOE complex?

Dr. Danielson. ESIF is the nation's first facility that can conduct integrated megawatt-scale research and development of the components and strategies needed to safely move clean energy technologies onto the electrical grid at the speed and scale required to meet national goals.

Before deciding to move forward with ESIF, the Department performed an analysis of potential alternatives that covered facilities across the country, including those in DOE National Laboratories, universities, research laboratories, and utilities.

As a result of this study of existing capabilities, it was determined that no existing facilities combined large-scale testing and evaluation capabilities, hardware-in-the-loop testing and large-scale simulation and visualization techniques. The ability to test components and subsystems, as well as complete integrated systems, is essential to mitigating the risks of commercialization and deployment of technologies in order to accelerate the speed of testing, integrated systems testing/simulation and "plug – and – play" testing bays. A flexible design to accommodate new technologies is key.

ESIF serves as the hub for EERE grid integration activities and is providing unique research and development opportunities for utilities, advanced clean energy technology manufacturers, and system integrators that together will help reshape the energy system of the 21st century.

ADVANCED MANUFACTURING PROGRAM

CRITICAL MATERIALS HUB AT AMES LAB, IOWA

Subcommittee. Dr. Danielson, the Critical Materials Institute at Ames Lab was the fifth Energy Innovation Hub launched by the Department, with the aim to develop technologies that make better use of – or eliminate the need for – materials subject to supply disruptions. This initiative was meant to explore 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.

The Hub aims to develop three technologies adopted by U.S. companies: one to diversify and expand production, one to reduce wastes, and one to develop substitutes.

Can you talk us through how work at the Hub is proceeding? Are they meeting their milestones in developing these technologies, and can you explain to us the type of work they're considering?

Dr. Danielson. The mission of the Critical Materials Institute (CMI) is to eliminate materials criticality as an impediment to the commercialization of clean energy technologies of today and tomorrow. CMI's goal is to develop technologies to diversify the domestic supply of critical materials, to develop substitutes to critical materials, and to drive recycling of critical materials. To help ensure CMI meets these goals, each of the Institute's technical projects has developed a set of milestones and a technology roadmap with Go/No-Go decisions. External experts from industry, academia, and Federal agencies are engaged in annual peer reviews of CMI to evaluate its progress. CMI is currently meeting the majority of its stated milestones.

Since beginning operations in June 2013, CMI investment has already spurred 28 invention disclosures and several patent applications. CMI has made significant progress towards its goal of having supported technologies adopted by U.S. companies. One example of a technology moving towards industry adoption is the development of new phosphors for lighting applications. A team of scientists from industry, Lawrence Livermore National Laboratory, and Oak Ridge National Laboratory has developed

substitute materials for rare earth-based lighting phosphors. The materials developed by the team are currently undergoing testing by industry.

Another example is the development of cerium-aluminum alloys for use in transportation applications. Aluminum is widely used in transportation but has limited applicability for high temperature uses in engine parts. At the same time, many rare earth mines produce large amounts of cerium, which is the least expensive rare earth element. Fundamental research has shown alloys of cerium and aluminum can show improved performance over traditional alloys, although casting the alloy has been a challenge. CMI is working with industry researchers to explore novel routes, such as additive manufacturing, to cast engine parts from this promising alloy material.

A third promising technology is the fast recovery of rare earth magnets from hard drives. Hard disk drives are a major consumer of rare earth permanent magnets. More than 1 billion hard disk drives are manufactured each year. Approximately 50% of these drives are deployed to data centers, which turn over a third of their hard drive population each year. A limiting factor in recovery of the magnets from end-of-life drives is that traditional disassembly is difficult and time consuming. CMI researchers have developed a process to remove the magnet intact from the hard drive, while recovering the circuit board, integrated circuits, and other valuable materials in a fraction of that time.

Subcommittee. Critical materials is an important topic that several other agencies are also exploring. I believe ARPA-E has funded some work in this field, along with the Office of Science. As the body overseeing the Hub, how is it collaborating with these other DOE programs? Is there any duplicative research?

Dr. Danielson. DOE's investment in critical materials research will help ensure clean energy technologies will be invented and manufactured in America. These efforts are coordinated across the Department and relevant program offices to maximize taxpayer investment and avoid unnecessary duplication, for example by including multiple relevant DOE offices in critical materials planning discussions and ongoing project evaluations.

Several entities within the Department contribute to the critical materials R&D effort. These include the Basic Energy Sciences program in the Office of Science, which supports broad-based, fundamental materials research; the

Advanced Research Projects Agency - Energy, which invests in high-potential, high-impact energy technologies that are likely too early for private-sector investment; and the Office of Energy Efficiency and Renewable Energy, which supports research related to critical materials for clean energy applications specifically through the Vehicle Technologies Office, Wind Power Technologies Office, the Solar Energy Technologies Office, the Geothermal Technologies Office, and the Advanced Manufacturing Office (AMO), which oversees CMI.

Like entities across the Department, CMI takes its stewardship of taxpayer resources seriously and has taken steps to avoid duplication and maximize taxpayer investment. For example, during the initial development of CMI project milestones and project scopes, offices across the Department were consulted to avoid any unnecessary duplication. Today, CMI continues to regularly coordinate to avoid duplication. For example, staff from relevant DOE programs are invited to participate in the annual peer reviews of CMI, the most recent of which was held in Ames, Iowa, in March 2015. CMI also coordinates directly with EERE programs on specific projects to avoid duplication. For example, for one project, technology managers from the Geothermal Technologies Office met with AMO to ensure investment in activities to explore recovery of rare earth elements and strategic minerals from geothermal brines were complimentary and not duplicative of efforts within CMI. In addition, CMI and AMO regularly engage with various agencies across the federal government on CMI progress and activities.

BATTERIES

BATTERIES: UPDATE ON TECHNOLOGY LANDSCAPE

Subcommittee. Dr. Danielson, many different offices at the Department are conducting research into batteries and their supporting technologies, ranging from materials research at the Office of Science to more incremental research in your office. And of course, all of these are focused on cars, storage for energy on the power grid, and other energy-related applications.

Can you update us on the landscape of battery technologies? What's being used in electric cars, what does tomorrow's battery look like, and what does the next decade's battery look like?

Dr. Danielson. Within the Department of Energy, four program offices – Basic Energy Sciences, ARPA-E, the Office of Electricity Delivery and Energy Reliability (OE), and the Office of Energy Efficiency and Renewable Energy (EERE) – cover a continuum of battery research, development, and deployment activities. Each program's activities complement one another but their respective end goals are very different.

•Basic Energy Sciences seeks to generate fundamental scientific knowledge and discover novel materials.

•EERE focuses applied research and development (R&D), as well as demonstration of advanced batteries for hybrid and plug-in electric vehicle applications.

•ARPA-E focuses on very high-risk but potentially very high-reward technologies for both transportation and grid storage that could potentially transform how we use and store energy.

•The Office of Electricity Delivery and Energy Reliability focuses on technologies that can store a large amount of energy and deliver very high power for the electricity grid.

EERE's Vehicle Technologies Office (VTO) supports energy storage research to meet all major vehicle applications, including 12-volt start/stop systems for conventional vehicles, power assist hybrid vehicles, plug-in

hybrid vehicles, and battery electric vehicles and is working on all of the major lithium-ion technologies noted above. VTO funds R&D to develop next-generation battery technology (like silicon based anodes and high capacity cathodes to improve lithium-ion batteries by offering two to ten times the storage capacity of today's materials). In contrast, the Office of Science's Energy Storage Hub (Joint Center for Energy Storage Research, or JCESR) supports research on energy storage systems explicitly "beyond" lithium-ion that promise even greater energy storage capacity and potentially lower costs. This research, which examines technologies such as magnesium ion batteries and novel flow batteries, comes with much higher risk levels and significantly longer timeframes to commercialization. Relative to the energy use sectors addressed, VTO supports energy storage R&D for vehicle applications only, while JCESR investigates energy storage materials for both vehicles and grid storage. VTO focuses on applied research of issues that directly impact battery life, performance, cost, and safety. JCESR focuses on basic science and includes investigation of fundamental issues impeding the advancement of high energy storage materials.

Other DOE offices are pursuing energy storage research as well. For grid energy storage and voltage regulation, OE conducts research on redox flow batteries, such as those using vanadium redox chemistry, as well as other energy storage technologies including flywheels and compressed air energy storage. In addition, ARPA-E has had several programs for transformational energy storage research targeting technology gaps for both transportation and grid applications, high-risk concepts and aggressive delivery times. For example, the ARPA-E's Advanced Management and Protection of Energy-storage Devices (AMPED) supports 19 research projects whose goal is to reduce "overhead capacity" and "balance of system" by developing novel sensing, control, and system technologies for superior management of current battery systems. Current vehicle batteries possess a large overhead capacity for performance and lifetime warranty, but this adds additional weight, volume, and cost to the battery system.

To ensure coordination of battery research activities across multiple offices, DOE created a "Battery Tech Team," which meets regularly to brief staff on activities; leverage resources, expertise, and project results to the greatest extent possible; and ensure that future plans are well coordinated. In addition, in September 2012 the Government Accountability Office (GAO) found no duplication of effort after a comprehensive assessment of initiatives within the Department and across the Federal Government,

[reference GAO report entitled, "BATTERIES AND ENERGY STORAGE: Federal Initiatives Supported Similar Technologies and Goals but Had Key Differences" (GAO-12-842)]. GAO's report notes there is the potential for duplication, but the Department and other agencies are undertaking activities that are "consistent with practices that GAO has previously reported can help enhance coordination such as agreeing on roles and responsibilities."

Today's battery technologies can be grouped into two major types: nickel-metal-hydride chemistries and lithium-ion chemistries. Nickel-metal-hydride technologies are typically used in the transportation sector in hybrid vehicles. The current trend is for these to be displaced in the battery market by lithium-ion batteries, which are currently the battery of choice for plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). There are many variations of lithium-ion batteries that offer slight differences in performance characteristics (voltage per cell, energy density, and power density). Individual automakers have chosen different chemistries for their electric-drive vehicle (EDV) products based on these performance characteristics, as described below, and all of which are a variation of lithium-ion technology.

•Nickel-cobalt-aluminum stabilized chemistries (NCA) are being used in electric vehicles and hybrid vehicles on the market today.

•Manganese-spinel and nickel-manganese-cobalt chemistries are being used in electric vehicles and hybrid vehicles on the market today. .

•Lithium-iron-phosphate chemistries are good candidates for 12-volt start/stop hybrids that are expected to enter the market in increasing numbers, as they can provide an efficiency improvement of up to 10%.

•Lithium titanate manganese-spinel chemistries are also good candidates for start/stop hybrids.

In general, vehicle batteries nearing commercialization will likely use lithium-ion chemistries. These future batteries will benefit from R&D focused on lowering cost, with incremental improvements in performance and safety. For example, VTO-supported R&D improved the energy density, durability, and power capability of first generation lithium-ion battery chemistry used in the Chevy Volt. These innovations, along with GM's cell and pack design optimization efforts, enabled the automaker to reduce the

cell count by a third but give the consumer an additional 10 miles of electric range (to be available in the second-generation Volt for sale late in 2015).

Lithium-ion batteries in the next decade will have more extensive changes. It is expected that these batteries will replace the current carbon anode with a silicon alloy anode that will enable a threefold increase in anode storage capacity. This anode will be coupled with a lithium-rich high voltage, high capacity cathode using technology (developed at Argonne National Laboratory) that will also help increase total battery capacity.

In the long term, work is progressing to move toward metallic lithium as the anode and sulfur or oxygen as the cathode. This approach will increase the energy density of these new batteries by three or four times relative to advanced lithium-ion technologies and will make use of common and relatively low-cost materials (oxygen and sulfur). Solid state lithium battery chemistries using ceramic electrolytes will also be a critical technology to be pursued in this timeframe.

Subcommittee. Can you match those technologies up to the different DOE offices? Which is Science working on, which is ARPA-E working on, which is the power grid research office tackling, and which is your office focusing on?

Dr. Danielson. EERE's Vehicle Technologies Office (VTO) supports energy storage research to meet all major vehicle applications, including 12-volt start/stop systems for conventional vehicles, power assist hybrid vehicles, plug-in hybrid vehicles, and battery electric vehicles and is working on all of the major lithium-ion technologies noted above. VTO funds research and development to develop next-generation battery technology (like silicon based anodes and high capacity cathodes to improve lithium-ion batteries by offering two to ten times the storage capacity of today's materials). In contrast, the Office of Science's Energy Storage Hub (Joint Center for Energy Storage Research, or JCESR) supports research on energy storage systems explicitly "beyond" lithium-ion that promise even greater energy storage capacity and potentially lower costs. This research, which examines technologies such as magnesium ion batteries and novel flow batteries, comes with much higher risk levels and significantly longer timeframes to commercialization. Relative to the energy use sectors addressed, VTO supports energy storage R&D for vehicle applications only, while JCESR investigates energy storage materials for both vehicles and

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To support the coordination of battery research activities across multiple offices, DOE created a "Battery Tech Team," which meets regularly to brief staff on activities; leverage resources, expertise, and project results to the greatest extent possible; and ensure that future plans are well coordinated.

BIOENERGY TECHNOLOGIES

DEFENSE PRODUCTION ACT INITIATIVE

Subcommittee. Dr. Orr, this year's budget request includes $45 million, the same as last year's enacted level and the last year of funding, to support a Navy initiative to produce hydrocarbon jet and diesel biofuels for military use.

How much do you expect this total initiative to cost, what is the timeline to complete this activity, and ultimately what rewards will these federal investments return for us?

Dr. Orr. With Congress' support, the Department of Energy (DOE), along with the Departments of Defense (DoD) and Agriculture (USDA), received the authority in FY 2014 and FY 2015 to support Defense Production Act (DPA) activities to accelerate the development of cost-competitive advanced alternative fuels for both the military and commercial transportation sectors. $45 million was appropriated by Congress in FY 2014 and FY 2015 to contribute towards DOE's commitment. If the FY 2016 request is appropriated, the DOE funding would amount to a total of $140M (there was a DOE contribution of $5M in FY 2011 for administrative purposes), $30M below the original commitment of $170M. FY 2016 is intended to be the final year of the DPA funding request. Three projects have been selected and are in the design phase to construct commercial scale biorefineries that will produce renewable jet and diesel fuel.

Research and investment in drop-in fuels supports BETO's mission to catalyze a domestic capability to produce cost-competitive renewable fuels from non-food biomass resources. The partnership with DoD and USDA represents a strong alliance in the development of biofuels. The Navy represents a significant early market adopter for biofuels, and the commercialization of drop-in biofuels that meet military specifications (JP-5, JP-8, F-76) will make a large impact on the Nation's energy security. In addition to strengthening our national security by helping our military avoid oil supply vulnerabilities and rising fuel cost volatility, the civil aviation, maritime, trucking, and rail sectors could substantially benefit from the development of these drop-in biofuels.

BUILDING TECHNOLOGIES

DUPLICATION OF EFFORTS

Subcommittee. Dr. Danielson, one of the largest increases in the Building Technologies program is to expand retrofitting activities within the Residential Buildings Integration subprogram. Although this account does not fund retrofitting of new and existing homes, the Home Performance with Energy Star program does facilitate communication networks and technical support for weatherization efforts across the country.

How does this effort tie into the energy retrofitting activities funded in the Weatherization program?

How do you ensure that a duplication of efforts is avoided?

Dr. Danielson. The Weatherization Assistance Program (WAP) mission is to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety. By retrofitting residential buildings, WAP reduces the cost of low-income household energy bills, which are a disproportionately higher share of household expenditures relative to higher income households.

Through formula grants, WAP helps support the largest and one of the most technically advanced networks of residential energy retrofit providers in the country, providing a foundation for related services funded by other Federal and non-Federal sources as well. Funds are allocated on a statutory formula basis and awarded to a single agency within each State, Washington, DC, and U.S. territories, to increase the energy efficiency of homes occupied by families with household incomes of 200 percent or less of the poverty guidelines updated periodically in the Federal Register by the U.S. Department of Health and Human Services under the authority of 42 U.S.C. 9902(2). These agencies, in turn, contract with approximately 800 Community Action Agencies and local governmental and nonprofit agencies, providing jobs and delivering weatherization services to low-income families in every geographic area of the country.

On the other hand, the Building Technologies Office's (BTO's) Home Performance with ENERGY STAR (HPwES) program provides

homeowners with resources to identify trusted contractors that can help them understand their home's energy use, as well as identify home improvements that increase energy performance and improve comfort. Participating contractors can recommend and perform energy improvements, such as installing air sealing, insulation that can fix drafty and uncomfortable rooms, and high efficiency heating and cooling equipment. With HPwES, it is the homeowner who pays for the energy efficiency upgrade rather than the federal government.

While there are important differences in the activities that WAP and BTO undertake, areas of cooperation between these programs include the review of the standard work specifications developed by WAP and their applicability to HPwES, the use of the assessment tool for multi-family buildings, and the use of WAP training facilities for HPwES technicians.

In addition, WAP and the BTO coordinate on a regular basis to ensure that there is no duplication of effort, and work to leverage program capabilities to ensure that tax payers' dollars are wisely spent.

VEHICLE TECHNOLOGIES

VEHICLE TECHNOLOGIES DEPLOYMENT PROJECTS

Subcommittee. Dr. Danielson, this year's request includes $25 million to initiate up to 5 "Alternative Fuel Vehicle Community Partner" projects that would accelerate the introduction of and adoption of commercially-available advanced vehicle technologies. The budget request is short on detail and I want to take a few moments to understand what this deployment would entail.

The budget request makes no mention of the kinds of communities that would be eligible for these awards. Can you outline your vision for this program and describe what these eligible communities look like?

Dr. Danielson. The fiscal year (FY) 2016 Budget Request for VTO maintains robust support for a broad portfolio of advanced vehicle technologies for passenger and commercial on-road vehicles to improve the Nation's energy security, reduce carbon pollution, and strengthen U.S. global economic competitiveness.

The Alternative Fuel Vehicle Community Partner projects are expected to accelerate the adoption of commercially-available technologies to reduce U.S. dependence on petroleum, increase local fuel diversification, increase awareness, and promote the adoption of clean transportation technologies by other communities by collecting and sharing data and developing best practices. Awarded through an open and competitive funding opportunity, this effort would emphasize partnerships between state and local governments and the private sector and provide Federal matching funds for cost-shared projects.

DOE intends to select projects led by public-private partnerships with the greatest potential and most significant commitments toward creating locally-based deployment/demonstration communities for alternative fuels and plug-in electric vehicles. Selection criteria would be based on the strength of the partnership and its ability to create an environment for an effective launch of alternative fuel and electric vehicles, as demonstrated through the commitment of partners, ability to significantly leverage Federal funds, strength of the business case, and plans – as well as the team's ability – to ensure project sustainability beyond the expenditure of Federal funds. In

addition, selected projects would have the capability to capture and report data, success stories, case study examples, and lessons learned from local experiences, thereby fostering repeatability in other communities across the country.

Eligible recipients are anticipated to be public-private partnerships that bring together local, regional, or state government agencies; private or nonprofit entities; and private businesses/industry. Although any entity can propose, strong locally-based governmental participation would be required.

SUPER TRUCK II INITIATIVE

This year's budget request proposes $40 million for the second iteration of the Super Truck program, which aims to improve the freight hauling efficiency of heavy duty trucks by 100 percent by 2020. The budget request comptemplates fully funding 2 awards.

Subcommittee. Dr. Danielson, 2016 represents the final year of the Super Truck program and the start of the Super Truck II program to improve engine and freight haul efficiency of heavy duty trucks.

What were the lessons learned in the first iteration of the Super Truck program and how has that informed this second round of competitive awards?

How many iterations of the Super Truck program do you expect we will see as we head towards the goal of increasing the efficiency of these trucks by 2020?

Dr. Danielson. Two of the four SuperTruck I teams (Cummins/Peterbilt and Daimler Truck North America) have already demonstrated tractor-trailer class 8 long-haul vehicles that exceed the 50% freight efficiency improvement goal and achieve a fuel economy of more than 10 miles per gallon (vs. conventional class 8 combination vehicles that average 5-6 miles per gallon). Both teams pursued a variety of technologies, including some with a positive business case for near-term commercialization and immediate uptake into the market, and others with potential to be commercialized over the mid- to long-term. The two remaining teams (Volvo and Navistar) are also on track to meet or exceed the goals as they complete their work in the coming year.

The positive results from SuperTruck I and feedback from the participating industry teams have informed the development of SuperTruck II plans, which will focus on the development and demonstration of a suite of technologies to improve freight hauling efficiency by 100% compared to a 2009 baseline vehicle – with greater emphasis on validating technology cost-effectiveness and market viability. SuperTruck II will also incorporate demonstration of technology applicability to class 8 regional-haul vehicles as well. Improving the efficiency of regional haul trucks is becoming more important as fleets shift to daycabs to accommodate shorter hauls.

Technologies that will be pursued in SuperTruck II include, but are not limited to, cost-effective waste heat recovery, advanced high-efficiency combustion processes and emission control systems, and further reduction of weight and aerodynamic drag. Hybridization of class 8 vehicles was shown to not be cost-effective in SuperTruck I, and as such, industry teams may choose not to pursue this technology in SuperTruck II.

The fiscal year (FY) 2016 request of $40 million for SuperTruck II is expected to fund two competitively-awarded cost-shared projects (fully-funded projects in the year they are awarded).

WIND ENERGY

OFFSHORE WIND ASSESSMENT

Subcommittee. Dr. Danielson, the Wind Energy program has been focusing a majority of its efforts for many years on an offshore wind demonstration project. If timelines go according to plan, the next two years will complete the design and engineering phases of these demonstration projects. If these projects are successful, it will provide important evidence to global and domestic markets that offshore wind can be viable in the U.S. While no current offshore projects exist in the U.S. there are many currently operating and planned projects overseas.

First, will you give us an update on the awards you have made and their progress toward an actual demonstration project?

Dr. Danielson. The three DOE-supported advanced offshore wind demonstration projects include awards to Dominion Virginia Power of Virginia, Fishermen's Energy of New Jersey, and Principle Power off Coos Bay, Oregon.

Dominion Virginia Power plans to install two 6-megawatt direct-drive wind turbines 26 miles off the coast of Virginia Beach, Virginia. Dominion will use a domestically-produced twisted jacket foundation and incorporate hurricane-resilient design features to ensure that offshore wind facilities placed in hurricane-prone waters are reliable, safe, and cost-effective.

To simplify and shorten the leasing process for these turbines, Dominion has been pursuing a research lease instead of a commercial lease. On December 1, 2014, the Bureau of Ocean Energy Management (BOEM) announced the publication of its Environmental Assessment of proposed wind energy-related research activities off the coast of Virginia. Because the research lease must be held by a government entity or university, Dominion's research lease is held with Virginia's Department of Mines, Minerals and Energy (DMME), with Dominion as the project operator. The research lease with DMME and BOEM was signed on March 24, 2015, and Dominion executed an operator agreement with DMME for the project.

Fishermen's Energy of New Jersey plans to install up to six wind turbines with a total capacity of at least 20 megawatts in state waters approximately

three miles off the coast of Atlantic City, New Jersey. Fishermen's Energy Atlantic City Windfarm will demonstrate the use of a domestically-produced twisted jacket foundation that is easier to manufacture and install than traditional foundations and test advanced wind farm control systems to increase the energy output of the plant, helping drive down the cost of energy produced by the offshore wind system. Fishermen's has completed their public meetings required for NEPA and submitted amendments to their permits that account for the final project design. The New Jersey Board of Public Utilities (BPU) rejected Fishermen's Offshore Renewable Energy Credit proposal in November 2014 which has caused project delays. Fishermen's filed a case with the New Jersey Appellate Court to overturn the BPU's decision. The court heard arguments in March and is expected to rule shortly.

Principle Power plans to install a wind farm that will have a capacity of up to 20 megawatts of electricity approximately 18 miles off the coast of Coos Bay, Oregon, demonstrating the use of domestically-developed semi-submersible floating foundations. Floating installations have the potential to harness the more than 60% of U.S. offshore wind resources that are found in deep water. Principle Power and project developer Deepwater Wind are working on completing their permitting activities and securing a power purchase agreement.

Demonstration projects are divided into five Budget Periods in total. The demonstrations are currently in Budget Period 2. The milestones for Budget Period 2 include completion of 100% front-end engineering design, completion of detailed installation methods, completion of NEPA processes, and completion of all necessary grid interconnection requirements.

Subcommittee. Can you explain how this demonstration project fits into the marketplace?

Dr. Danielson. DOE is focused on meeting two critical objectives with respect to offshore wind: reducing the cost of energy through technology development and demonstration, and reducing deployment timelines and uncertainties. These are the objectives of the DOE and Department of the Interior (DOI) National Offshore Wind Strategy. DOE's Offshore Wind Advanced Technology Demonstration Projects support advanced, first-of-a-kind technologies that have the potential to reduce the costs of offshore wind and reduce barriers in the U.S. market for offshore wind technology. These

projects will give the offshore wind industry the opportunity to evaluate technology solutions aimed at reducing costs and addressing challenges unique to U.S. conditions such as deep water and hurricanes. For example, the twisted jacket bottom-fixed foundations that are being demonstrated off Virginia Beach and the Atlantic Coast are easier to construct and install than traditional offshore wind foundations, which reduces costs. These bottom-fixed foundations also include hurricane ride-through systems suitable for the hurricane regions of the East Coast.

DOE's offshore investments also help reduce market barriers by creating regulatory pathways for offshore wind and providing lessons learned for future projects. For example, in collaboration with DOI, DOE's offshore demonstration projects are generating efficient permitting processes so that these projects may be completed in just five years, from initial development to generating power to the grid. This is more than three years shorter than the timelines that other non-DOE supported offshore wind projects have experienced. Reducing timelines represents a large savings in development costs for offshore wind projects and reduces uncertainties for investors and developers. DOE investments may also indirectly grow the domestic supply chain, encourage domestic manufacturing, and help develop a specialized maritime labor force.

Subcommittee. Can you describe the technological landscape of offshore wind projects in other countries? Who is excelling in this field, and how does the U.S. stack up?

Dr. Danielson. Europe is ahead of the U.S. in commercial deployment of offshore wind, and both Europe and Japan have advanced offshore wind demonstration programs that are similar to DOE's program.

Europe, with higher electricity prices than the U.S. and shallower water, currently has the most offshore wind deployed, and is the leader in the offshore wind industry. All of the offshore wind installations in Europe have been bottom fixed, with the exception of the Statoil Hywind and Principle Power WindFloat demonstration projects deployed off of Norway and Portugal, respectively. Additionally, Europe is excelling in the design of advanced large offshore wind turbines, pushing turbines into the 6-MW and beyond range.

Japan has deployed several demonstration scale offshore wind projects, ranging from one to eight turbines. Japan is also developing commercial floating offshore wind platforms and deployed its first floating offshore wind platform as well as a first-of-kind floating substation in late 2013. Two additional floating platforms—another semi-submersible and an advanced spar—supporting 7-MW turbines are expected to be deployed at the Fukushima site in 2015.

The Department is supporting the development of three offshore wind projects with a goal of being operational by the end of 2017. Through these demonstrations, the United States stands to more effectively compete in the international offshore wind industry. There are several key differences between the research, development, and demonstration challenges facing U.S. offshore wind deployment and international activity in this industry; the U.S. offshore wind industry must address more diverse weather conditions, including hurricanes, and greater water depths than found in other regions. The United States is one of the leaders in advanced offshore foundation designs for both bottom-fixed and floating foundations, with a number of global innovations coming from U.S. companies. Seabed characteristics are also different in the United States, requiring different technological solutions for fixed-bottom systems. Current monopile technology that is regularly deployed in Europe may not be economical in the United States due to the combination of larger turbines and weaker U.S. marine soil conditions. Thus, supporting offshore wind technology demonstrations in different regions across the United States is one goal of the Department's offshore demonstration strategy, and one distinguishing factor from the majority of research performed by other countries to make offshore wind commercially viable.

GEOTHERMAL

GEOTHERMAL CROSSCUT EFFORTS

Subcommittee. Estimates of potential geothermal production represent an important, untapped resource for renewable energy generation. Innovative technologies addressing efficient solutions for geothermal exploration and development were highlighted this year in the Department's "Subsurface Engineering Crosscut."

Dr. Orr and Dr. Danielson, can you take a moment to describe EERE's efforts within this crosscut as they relate to geothermal technologies?

Dr. Orr. The Department of Energy (DOE) established the Subsurface Technology and Engineering Research, Development, and Demonstration (SubTER) Tech Team as an integrated platform across DOE subsurface interests to address crosscutting grand challenges associated with the use of the subsurface for energy extraction and storage purposes.

The goal of the SubTER crosscut is to efficiently pursue the grand challenges in the subsurface through highly focused and coordinated research, with the overarching goal of promoting "Subsurface Control for a Safe and Effective Energy Future." This critically important area is central to enhanced environmental protection, increased domestic energy production and supply, and effective and quantifiable risk mitigation. The pathway for pursuing this goal is to advance select technologies that provide for effective, adaptive and safe control of fractures and fluid flow; to this end, the SubTER crosscut focuses on four pillars of research: wellbore integrity, subsurface stress and induced seismicity, permeability manipulation and subsurface signals.

Geothermal Technologies supports this crosscut by targeting research in subsurface stress and induced seismicity, permeability manipulation, and new subsurface signals. Specifically, DOE expects that the FY 2016 request of $71 million within the SubTER crosscut will support activities to develop and implement seismic response simulations and risk models; develop new techniques for remotely characterizing and monitoring fluid flow in the subsurface; and advance state-of-the-art imaging technologies for subsurface interrogation to accurately image fractures. A key ongoing subsurface-related R&D effort is the Frontier Observatory for Geothermal Research

(FORGE), a dedicated EGS field laboratory where novel technologies and techniques will be tested, with a primary focus on EGS optimization and validation.

Subcommittee. What is the potential for enhanced geothermal systems, and how close are we to realizing it?

Dr. Orr. Enhanced Geothermal Systems (EGS) are engineered reservoirs, created where there is hot rock but little to no natural permeability or fluid saturation present in the subsurface. To develop an EGS reservoir, fluid is injected into the subsurface at low to moderate pressures under a safe, controlled, environmentally responsible and well-engineered stimulation process, causing pre-existing fractures or weaknesses in the rock fabric to open. The pressure increase causes displacements along existing fracture planes and zones of subsurface heterogeneity, which results in increased permeability and allows fluid to circulate throughout the rock. Production wells then transport this hot fluid to the surface where electricity can be generated. In the long term, continued EGS success would enable the utilization of an enormous, geographically diverse energy resource, potentially on the order of 100+ GW.

Between 2011 and 2015, the Office had three major successes within its EGS demonstration portfolio, including the first-ever EGS project in the U.S. to be connected to the grid (Desert Peak, Nevada). The Frontier Observatory for Research in Geothermal Energy (FORGE) — a dedicated EGS field laboratory where novel technologies and techniques will be tested—intends to build upon those successes and is a critical piece in our strategy of substantively advancing EGS within an aggressive timeframe and on a replicable scale. FORGE intends to further validate and optimize EGS technology, and bring it closer to commercial scale. FORGE expects to achieve this by supporting cutting-edge EGS research, drilling and testing to be conducted at this site.

ELECTRICITY DELIVERY AND ENERGY RELIABILITY

THE FUTURE OF THE ELECTRIC GRID

In December, the Office of Electricity Delivery and Energy Reliability hosted regional workshops and a national summit to create a report outlining an industry-driven vision of the grid in 2030.

Subcommittee. Ms. Hoffman, the electricity industry is experiencing many changes on a scale perhaps not witnessed since the creation of the grid more than 100 years ago. The technological advances and our digital economy demand a grid that is more resilient in the face of extreme weather events and more reliable in faster response times when outages do occur. The Office of Electricity Delivery and Energy Reliability partnered with the GridWise Alliance to host regional workshops and a national summit aimed at creating an industry-driven vision of the grid in 2030.

What is the future vision of the electric grid and what is the Department doing to enable the grid to become more resilient and reliable?

Ms. Hoffman. Today's grid, where power flows typically from central station power plants in one direction, will be different from the grid of the future, where two-way power flow will be common on not just long distance, high voltage transmission line but also on the local electricity distribution network. A whole range of new emerging communication/IT, generation, storage, and end-use technologies are making this possible. Taken together, all these technologies open up new avenues for promoting reliable, affordable clean electricity. To do this, the grid of the future will have to allow and rely on an increasingly wide mix of resources, including central station as well as distributed generation (some of it variable in nature), energy storage, and responsive load. A highly integrated yet distributed architecture, with appropriate attention to cybersecurity, physical attacks, and resiliency, will be needed. Above all, the future grid needs to build on our legacy system without compromising safety, reliability, security, and affordability.

To enable the grid to become more resilient and reliable, DOE's activities are in two main areas: for the near-term, conduct a collection of grid security and resiliency activities, and in the longer term, work with the private sector to conduct research and development on technology innovations.

For near-term grid security and resiliency activities, DOE's work is in: cybersecurity, such as helping fund new technologies now being used to further advance the resilience of the Nation's energy delivery systems; working with industry on transportation solutions for critical power transformer replacements during emergencies; and delivering emergency response services, such as the activations for five severe weather events during the 2014 storm season in which DOE's Energy Response Team deployed a total of 33 field responders across these activations. Related work provides states, Federal agencies, and industry with independent and objective risk assessments of energy infrastructure systems and supply chains.

For the longer-term, DOE's work in research and development of technology innovations to help make the grid more secure and resilient is focused on developing tools and technologies that measure, analyze, predict, and control the grid of the future. This work includes enabling high-resolution, wide-area measurement of the electricity system through the joint past deployment with industry of over 1,600 grid phasor measurement units and supporting technologies, giving grid operators wide area visibility and situational awareness to foresee potentially destabilizing events, improving reliability, reducing the number and spread of blackouts, and facilitating faster restoration, as well as better enabling integration of growing variable wind and solar generation. Other longer-term R&D work includes development of advanced grid planning tools that the private sector can commercialize to address the increased dynamics, uncertainty, and complexity of the evolving future grid, as well as work on distribution-level smart grid, microgrids, and electricity storage.

Subcommittee. What are the biggest challenges facing the grid today?

Ms. Hoffman. One of the biggest challenges facing the grid is continuing to deliver reliable, affordable, and increasingly clean electricity and related energy services to customers, while at the same time modernizing the to handle a fast changing mix of central station and emerging distributed generation resources and end-use resources, and ensuring physical security and cybersecurity. Much of the change is being driven by a wide set of new and emerging technologies at both the transmission and distribution levels, which together provide both challenges and opportunities to delivering service to customers and the U.S. economy. Thus the future grid needs to be flexible and adaptable, since no one can predict exactly what the future of

the power sector will look like due to the technical and policy changes underway. Change may sometimes be needed in business models and regulatory approaches to sustain grid investment and continued grid modernization now underway, while at the same time allowing for innovation in both technologies and market structures. Some more specific examples of challenges include integrating new variable generation (wind and solar) while some traditional forms of generation that previously provided reliability services for various reasons are being retired; designing and equipping local distribution networks handle two-way flows of electricity; using the IT and communication revolution at many more parts of the grid; better valuating new services and technologies and their impact on grid operations; and implementing uniform and interoperable standards for new and emerging grid and end-use technologies that can enable innovation and better operations, such as the USB standard has done for personal IT like smart phones, laptops, and related personal devices.

TRANSFORMER RESILIENCY

Subcommittee. Ms. Hoffman, the budget request proposes $10 million to create a new program within the Office of Electricity Delivery and Energy Reliability called Transformer Resilience and Advanced Components. The resilience of the grid is critically important to protect against geomagnetic and electromagnetic pulses. The main feature of this new program is a proposal that the Office of Electricity Delivery and Energy Reliability will work with NASA, NOAA, USGS, NIST, and the National Science Foundation to examine transformer failure mechanisms.

Is there currently a plan for this inter-agency working group? Have the other agencies proposed similar funding increases for transformer resiliency or would the Office of Electricity Delivery and Energy Reliability provide all the funding?

Ms. Hoffman. The Transformer Resilience and Advanced Components program will leverage the expertise available at partner agencies, such as National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, U.S. Geological Survey, National Institute of Standards and Technology, and the National Science Foundation, to inform multi-physics modeling (integrating aspects such as thermal, mechanical, electrical, and magnetics) of transformer failure mechanisms, which include geomagnetic disturbances and electromagnetic pulses. There is currently no plan to formalize an inter-agency working group outside of existing communication channels. Due to the critical role transformers play in the electricity delivery system, the Office of Electricity Delivery and Energy Reliability will provide the funding for examining failure mechanisms in order to improve transformer resilience.

EMERGENCY RESPONSE RELATED TO EXTREME EVENTS

Subcommittee. Ms. Hoffman, last year's budget request included a new Operational Energy and Resilience program. The proposal consisted of, in part, a strategic operations center at the Department's headquarters to coordinate emergency response during an extreme event that affects the electricity grid. Given the experience of the Northeast in the wake of Superstorm Sandy, this seemed like it might be a good idea. In fact, I believe it was a priority for the Secretary. The FY 2015 appropriation included direction that $8 million of the funding for the Office of Electricity should be used to support the construction of the Operations Center.

I understand that the Department is not honoring the direction in the explanatory statement for this item and is now considering integrating the Operations Center for emergency response into the existing DOE Operations Center.

Ms. Hoffman. We are moving forward to build-out an Energy Resilience Operation Center (E-ROC) capability at the Department of Energy (DOE). The Department is currently taking a detailed look at the best and most efficient way to construct this emergency management capability. This includes considering the exact location within DOE's headquarters building, as well as any infrastructure overlap and complementary functionalities that might exist with other emergency response programs within DOE.

Subcommittee. Can you explain to me why the Department is changing course on this Operations Center, with no coordination with Congress I might add, after your own request was supported in the conference agreement?

Ms. Hoffman. The Department is currently taking a detailed look at the best and most efficient way to build out this emergency management capability.

Subcommittee. When are we to expect a path forward?

Ms. Hoffman. We will certainly inform you of the path forward as soon as it is determined.

NUCLEAR ENERGY

RESEARCH AND DEVELOPMENT

ADVANCED REACTOR CONCEPTS FUNDING TRANSFER

Subcommittee. Mr. Kotek, the request for the Advanced Reactor Concepts program decreases funding from last year's level by $23 million to account for a transfer made to the Nuclear Energy Enabling Technologies program. The transfer concerns studies on hybrid energy systems performed in concert with EERE. It's difficult to view the difference in funding with the transfer and I wanted to dig a little deeper.

Can you explain why these funds were moved and describe the work your office performed with Secretary Danielson?

Mr. Kotek. Hybrid energy study funds were moved to Nuclear Energy Enabling Technologies because the hybrid energy study work was viewed to be a crosscutting technology having applicability to nearer term light water reactor use as well as longer term advanced reactor technologies. The hybrid energy study was initially funded within Advanced Reactor Technologies due to its previous development of hydrogen production technologies coupled to high temperature gas cooled reactors. The study we are conducting with EERE includes market analysis, development of economic assessment tools, and region-specific case studies, and creation of a hybrid energy technology development roadmap.

Subcommittee. The transfer placed funds within the Crosscutting Technologies account of the Nuclear Energy Enabling Technologies program. Do you have plans to collaborate with EERE on future studies?

Mr. Kotek. The Office of Nuclear Energy views the hybrid energy study work to be important to future utilization of clean energy sources on the grid and plans to continue to collaborate with EERE.

NUCLEAR ENERGY INFRASTRUCTURE AND SECURITY

IDAHO SAFEGUARDS AND SECURITY

Subcommittee. Mr. Kotek, this year's budget request includes an additional $22 million for Idaho Safeguards and Security, which provides critical security operations for Idaho National Lab. I understand those additional funds will finally allow you to support protective force staffing levels consistent with the approved site protection plan, and also to address the backlog of physical security systems.

Can you discuss how this request supports Idaho National Lab?

Mr. Kotek. The FY 2016 request for Idaho Safeguards and Security (S&S) provides a stable funding level for both physical and cyber security activities at the INL necessary to conduct research, development, and training activities for nuclear energy and national security programs. These programs require access to nuclear materials and sensitive information to further missions in the areas of advanced reactor and fuels development, nuclear forensics, nonproliferation, first-responder training, and critical infrastructure protection.

In recent years, several factors have impacted Idaho S&S, resulting in the loss of key physical and cyber security staff, including protective force personnel, and deferral of refurbishment of physical and cyber security infrastructure. The FY 2016 request not only stabilizes the security workforce, it provides funds to address the replacement or refurbishment of major physical security systems which are beyond useful life and establishes additional cyber security capabilities to protect against dynamic, evolving threats.

Subcommittee. What will be the biggest cost drivers of Idaho National Lab's security infrastructure moving forward?

Mr. Kotek. The extent of new and evolving Department physical and cyber security requirements will have the largest impact on INL security infrastructure needs in the future. The Office of Nuclear Energy (NE) and the INL will continue to work with Departmental organizations as new policies are put in place to develop implementation plans that balance

infrastructure investments against research program needs to ensure risk-informed, performance-based approaches are pursued.

FOSSIL ENERGY

NATURAL GAS DEMONSTRATION PROJECT

Subcommittee. Mr. Smith, the previous two budget requests proposed a $25 million natural gas demonstration project to be funded within the Carbon Capture account of the Coal program. No funds were requested this year towards this specific project, however, within the Carbon Capture program there is an explanation that an increase of funds will be used to support efforts to deliver on this same natural gas demonstration project.

Can you explain how funds will support a demonstration in the absence of any enacted funds for this specific line item?

Mr. Smith. DOE's FY2016 funding request for post-combustion capture will continue to focus considerable efforts on developing second generation and transformational carbon capture and storage (CCS) technologies for coal fired power systems but it will also leverage the portfolio to conduct additional tests on existing and future R&D field test units using flue gas from a natural gas power system. These tests will address specific natural gas-related carbon capture issues such as higher oxygen (O2) content and lower carbon dioxide (CO2) concentration in flue gas, and higher flow rates of flue gas. Most R&D will also address shared challenges for both coal and natural gas such as energy penalty, capital and operations costs, and plant integration. The results of these tests will be used to mature the technologies for carbon capture and lay the groundwork for a future demonstration for natural gas applications.

Subcommittee. Since this project specifically focuses on carbon capture from natural gas, it seems that a more proper fit for these activities would be within the Natural Gas Technologies program. Can you explain the decision to include this funding within the coal program? If funding were included for this demonstration project, would you object to re-locating this activity to the Natural Gas program?

Mr. Smith. Programmatic categorization by fossil fuel type has become an inaccurate representation of the areas of expertise that have been built within the Office of Fossil Energy's research, development, and demonstration (RD&D) portfolio. In general, coal and natural gas power plants have more in common regarding environmental controls of air

emission than with issues related to natural gas and coal resource production. Placing this activity in the Coal Program leverages the existing knowledge and RD&D portfolio associated with power generation systems and capture technologies needed to implement this activity. The advanced technologies and processes to capture carbon dioxide (CO2) from natural gas power plants are similar to those already being developed by the Coal Program for coal fired power plants. Keeping this activity in the Coal Program is the most efficient use of Government funds and reduces the amount of time to address technology solutions for natural gas power plants.

HYDRAULIC FRACTURING RESEARCH

Subcommittee. In last year's omnibus appropriations bill, funds provided towards the joint hydraulic fracturing research effort involving the Department of Energy, the Environmental Protection Agency, and the U.S. Geological Survey were held back pending submission of an interagency research plan. That plan was submitted last July but, unfortunately, provided little detail on the milestones, objectives, and out-year costs of the collaborative study. To rectify this, the Committee again directed a detailed research plan to outline the specifics of this joint effort.

Dr. Orr and Mr. Smith, can you update the Committee on efforts to create this new research plan?

Dr. Orr. Currently, discussions among the agencies are ongoing. Weekly committee meetings are being held to develop a response to the language in the explanatory statement. This effort was initiated in January when a workshop was held by the multi-agency steering committee and its technical subcommittee. The development of the research strategy that was delivered to Congress in July was very helpful in coordinating the research efforts of the three agencies.

Subcommittee. Are the other agencies contributing at the same level as the Department? If the other agencies provide little or no funding for this effort, how does this impact the collaborative effort moving forward?

Dr. Orr. In FY 2016, DOE requested $16 million, USGS requested $19 million, and EPA requested $12 million. Each agency implements their portion of the research effort within their respective core competencies, strengths, and roles. Research results are broadly shared with all agencies.

NATURAL GAS EMISSIONS QUANTIFICATION

Subcommittee. Mr. Smith, the Natural Gas program within your office is requesting a new program this year to quantify natural gas emissions from existing natural gas infrastructure. The request states this program will work with the Environmental Protection Agency to ensure that data is compatible with the national Greenhouse Gas Inventory.

The Environmental Protection Agency has also announced plans to improve their reporting and quantification of emissions from natural gas production infrastructure. How does your office's proposal differ from EPA's current and planned efforts?

Did your Office consult with EPA prior to proposing this request?

Mr. Smith. Yes. The program concept and the budget request were discussed with EPA's Office of Air and Radiation to enhance our collective understanding of emissions from natural gas systems. DOE and EPA are coordinating research efforts to maximize the use of Government funds related to emission quantification while ensuring results can benefit both Agencies.

DOE research program is focused on prioritization and collection of field measurement data based on actual emissions to ensure the quality and representativeness of emissions data to guide cost-effective technology solutions within the DOE Oil and Natural Gas RD&D Programs to reduce methane emissions. The DOE effort is also unique by focusing on regionally-differentiated samples of both routine emission (emission that occur under normal operating practices) and non-routine emissions (emissions that occur due to human or mechanical failure that recent studies indicate to be of low frequency but the primary contributor to total emissions). The DOE program is not duplicative of EPA's ongoing emissions quantification work.

CRUDE OIL SHIPMENTS

The Energy Information Administration has requested an increase of $14 million from 2015 to $131 million. In part, this increase is to improve data collection on movements of crude by rail. In the past the Department has also done minor work looking at the relative explosive tendencies of different grades and mixtures of crude oil. Two recent articles on the issue follow at the end of this question set.

Subcommittee. Dr. Orr, the recent train derailment in West Virginia has once again focused attention on the relative merits of moving oil by pipeline or rail. Recent reports by the AP and the Washington Post among others have detailed some of the issues.

While I know much of the issue is one of transportation standards, does the Department of Energy have an appropriate role in either data collection or research and development that could improve our understanding of the technical issues?

Dr. Orr. Yes. DOE is developing a science-based understanding of outstanding questions associated with the production, treatment, and transportation of various types of crude oils, including Bakken crude oil. In support of that effort, DOE, in collaboration with the Pipeline and Hazardous Materials Safety Administration (PHMSA), asked Sandia National Laboratories to prepare the study that was released on Tuesday, March 24: Literature Survey of Crude Oil Properties Relevant to Handling and Fire Safety in Transport. In addition, the EIA has stood up new data that begins to quantify how much crude oil is being transported from producing areas to different regions of the U.S. by rail.

The Sandia report is a compilation and summary of some of the available literature and data pertaining to the chemical and physical properties of tight crude oils. It represents the most comprehensive survey of existing, publicly held literature on tight oils completed to date, but it is important to note that the report does not include data and information held by industry and private companies. The report does, however, provide a better understanding of what is known and not known about the properties of this type of crude oil.

DOE, in cooperation with the Department of Transportation and other relevant agencies, is determining what knowledge gaps remain that might be able to be answered with additional research.

The EIA, for its part, is seeking to substantially improve upon its initial release of crude-by-rail data. These efforts include improving data collection and analytic methodologies, working with key external stakeholders, and looking towards expanding the energy commodities, such as ethanol, to be included in crude-by-rail metrics to be reported by the agency.

ADDITIONAL QFRS

THE HONORABLE CHUCK FLEISCHMANN

QUESTION REGARDING WASTE TO ENERGY

Mr. Fleischmann. Last year, Babcock and Wilcox completed a $600 million, 95-megawatt waste-to-energy plant in Florida. The plant is co-located with a 1980's era 65-megawatt waste plant already on the site. Together, the plant will consume more than 1.7 million tons of landfill waste a year, producing enough electricity to power 85,000 homes while providing 200 local jobs in the area. This was the first waste-to-energy plant built in the US in the last 20 years. Waste-to-energy plants reduce landfilling, recycle valuable metals, have CO2 emissions equal or lower than natural gas plants, produced no methane emissions, and produce low emissions of other pollutants. At the same time, these plants provide reliable, dispatchable baseload generating capacity.

What role do you see for waste-to-energy in the nation's changing fuel mix?

Is the Department taking any actions to support waste-to-energy as a reliable, alternative source of baseload generation capacity?

Dr. Orr. The EPA estimates that the U.S. generates approximately 250 million tons of trash annually, roughly 45% of which is recovered via recycling, composting, and energy production. The remaining 138 million tons that are currently landfilled represent potential for about 1.4 quadrillion BTUs annually. Additionally, approximately 30 TWh, just less than 1% of U.S. electricity consumption, is present as chemical energy in municipal wastewaters. Substantial additional resources are also available from animal manure, food waste, and industrial organic waste streams. The technologies for generating electric power from most of these feedstocks are commercially mature. BETO's R&D emphasis is on producing biofuels and bioproducts from these waste streams, potentially converting more of the inherent energy to productive use.

The FY 2016 request from EERE's Bioenergy Technologies Office (BETO) contains $5M within the Conversion subprogram to directly address barriers to utilization of wet wastes (including biosolids) as a feedstock for conversion to fuels and chemicals, identified in FY 2014 and FY 2015

stakeholder workshops. Dry waste, such as the organic, non-recyclable fraction of MSW is already a key component of the advanced feedstock supply system R&D and strategy for formulating economical, consistent biorefinery feedstocks. In addition, there are other instances within the overall program in which waste as a feedstock is applicable. For example, BETO's Demonstration portfolio includes projects that utilize MSW, such as the INEO integrated biorefinery. Wet wastes will be included as a potential feedstock for the planned pilot- and demonstration-scale funding opportunity in FY 2016.

In FY 2015, BETO intends to conduct three workshops to identify barriers to using waste for energy and will specifically examine the use of wet wastes for the production of biofuel intermediates that can be converted to fuels and chemicals. In FY 2016, BETO plans to conduct thorough market analyses and resource assessments to ascertain where the best opportunities are for future potential R&D activities in this area.

THE HONORABLE MICHAEL HONDA

NNMI

Mr. Honda. What is the Administration's plan for the NNMI and reasoning behind the strategy not to utilize the $250 million in reprogramming authority that the Revitalize American Manufacturing and Innovation Act included in the CROmnibus?

Dr. Orr. The Administration's FY16 Budget Request asks Congress to support more than $350 million in additional discretionary funds across four agencies – through the Departments of Energy, Defense, Commerce and Agriculture – to launch seven new institutes as part of the interagency National Network for Manufacturing Innovation (NNMI). Two of these new Institutes would be supported through the Department of Energy, pending the availability of funds. The Administration's Budget also requests appropriations to continue supporting the commitments made to nine Institutes already funded, including four Institutes at the Department of Energy. The Revitalize American Manufacturing and Innovation Act language provided authorization to transfer funds but does not require it. To promote efficiency and effectiveness and ensure funding is used for the activities it is appropriated for, funding for mission-related institutes should be requested by and appropriated to the agencies that will run them, which is how the NNMI institute funding structure is laid out in the FY16 Budget.

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

BIOFUELS

Mr. Honda. EERE has demonstrated strong leadership in developing large, multidisciplinary projects that advance the needs of US companies.

In the current climate with low oil prices, is DOE planning to expand support for production of value-added chemicals that will bring down the cost of biofuels?

Will DOE consider supporting a large biomanufacturing institute to support R&D that will quickly drive down the cost of fuels?

Dr. Orr. DOE intends to initiate a new funding opportunity announcement (FOA) that will identify, evaluate, and select applications proposing technology development plans for the manufacturing of drop-in hydrocarbon biofuels, bio-products, or intermediates in a pilot- or demonstration-scale integrated biorefinery (IBR). This effort would expand support for the production of value-added chemicals that will help to bring down the cost of biofuels. Scale-up and validation of these process technologies is essential to enable the industry to reduce the risks of building future pioneer- and commercial-scale manufacturing facilities. In addition, BETO is planning a FOA in FY 2016 to solicit consortia of industry, academia, and national laboratory members to address R&D barriers to production of high-value chemicals and materials from biomass that simultaneously enable biofuel production. BETO Plans to include investigation of functional equivalents to chemicals currently produced from fossil sources whose production from biomass may hold promise for significant greenhouse gas reductions.

Through FOAs, DOE frequently invites consortia as well as private sector or public sector-led applicants to support R&D that will drive down the cost of biofuels. DOE is currently in discussions with USDA on how to leverage investments in the bioenergy space to enable biomanufacturing in the United States.

BIOSOLIDS

Mr. Honda. Why has DOE failed to comply with congressional directives to diversify its bioenergy technology program and address the production of energy from municipally derived biosolids?

Dr. Orr. DOE continues to invest in a wide variety of bioenergy pathways, including municipally derived biosolids. The FY 2016 BETO request includes $5M for R&D on biosolids and similar renewables, which the DOE terms as "wet wastes." Funding would continue existing lab work on the conversion of wet waste streams to high-value bioproduct precursors. It would also allow the continuation of market analysis and resource assessment activities initiated in FY 2015, and support the development of a wet waste-to-energy roadmap in FY 2016.

Additionally, biosolids and biogases were included as two of the many important and eligible feedstocks in the EERE FY 2014 funding opportunity announcement "Biological and Chemical Upgrading for Advanced Biofuels and Products" (DE-FOA-0001085). Under this solicitation, DOE awarded two projects totaling $5M in federal funds that use waste-derived biogas methane to produce high-value chemical intermediates. Such biogas can be produced from anaerobic digestion of biosolids, and DOE is also funding an innovative project to increase the methane content of biogas produced in this way.

Furthermore, in FY 2014, the Conversion Technologies program conducted a Request for Information (RFI) to identify priority areas and barriers. Priority areas that emerged from this RFI included the need to manage variable feedstocks; assess spatially resolved resources; improve microbial consortia for processing biosolids and other waste streams; and determine opportunities to improve biosolids treatment. To address these priority areas, BETO is conducting three wet waste-to-energy workshops in FY 2015, the last one in collaboration with both the Environmental Protection Agency (EPA) and the National Science Foundation (NSF). The outputs from these workshops will inform the FY 2016 road-mapping activities.

DOE is keenly aware that other Federal agencies such as the U.S. Department of Agriculture, National Science Foundation, and the Environmental Protection Agency, share interest in waste-to-energy efforts. Interagency coordination is a key component of developing a unique value

proposition for DOE, while fully leveraging the capabilities and investments of sister agencies and external partners.

TUESDAY, MARCH 17, 2015.

DEPARTMENT OF ENERGY, OFFICE OF SCIENCE

WITNESSES

FRANKLIN ORR, UNDER SECRETARY, SCIENCE AND ENERGY, DEPARTMENT OF ENERGY

PATRICIA H. DEHMER, ACTING DIRECTOR, OFFICE OF SCIENCE, DEPARTMENT OF ENERGY

Mr. SIMPSON. The hearing will come to order. I would like to welcome our witnesses, Dr. Franklin Orr, Under Secretary for Science and Energy.

Welcome back this afternoon.

And Dr. Pat Dehmer, the Acting Director for the Department of Energy's Office of Science.

Dr. Orr and Dr. Dehmer, the budget request provides $5.3 billion for the Office of Science, a 5 percent increase over last year's level. The Office of Science is the single largest supporter of basic research in the United States and its activities have resulted in some of the important scientific breakthroughs of the 20th century. In the past, these breakthroughs occurred almost entirely at facilities in the United States. However, as the scale and complexity of the experiments increased, so did the costs of building new facilities.

Cutting-edge science, now more than ever, is reliant on multibillion-dollar facilities that few, if any, countries are willing to support alone. Ensuring that our taxpayer dollars are contributed to the breakthroughs that enhance American competitiveness within this international context is just one of the challenges you need to address. The balance between optimal operation of our current facilities and constructing new ones is another.

While the budget request avoids choosing between these activities by providing increases for both, the reality is that the current fiscal climate does require some tough decisions. I look forward to discussing with you both how the Office of Science will make these hard choices and continue to ensure our country's leadership in the scientific community.

Dr. Dehmer, 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.

Mr. SIMPSON. Members who have additional questions for the record will have until close of business tomorrow to provide them to the subcommittee's office.

Mr. Simpson. With that, I will turn to my ranking member, Ms. Kaptur, for her opening statement.

Ms. KAPTUR. Thank you, Mr. Chairman very much.

Good afternoon again, Dr. Orr and Dr. Dehmer. Thank you so much for being here today. Your work represents America's intelligence at work and inventing a better future for us all. The budget that you manage represents the largest federal sponsor of research in the physical sciences. That is an incredible responsibility.

The United States is known and respected around the world as a leader in innovation, and scientific research continues to yield important discoveries that change the way we live and work, from

cell phones to high-yield crops to biotech medicines. We look forward to your thoughts today on some of the discoveries that you see on the horizon, as well as how we can support innovation in the public sphere. How can America harness the work of our best and brightest to drive domestic growth and make American energy science the best in the world, including assuring our high-productivity manufacturing sector remains globally competitive?

While the value of funding scientific and other research is well established, federal resources remain limited and the return to sequestration levels will limit budgets even further. Research especially in science can provide enormous value, but it is a long-term and sometimes indirect investment, just like raising a child, that is too easily sacrificed for short-term concerns.

It would also be helpful to hear from you about the long-term consequences of this kind of underinvesting in science and research. The American people should understand the tradeoffs that our Nation is faced with in the name of budgetary scarcity. Scientific exploration can sometimes provide opportunities for immediate benefit. In certain cases, tools and equipment designed for research can be applied to manufacturing processes to increase efficiency or improve product quality. Advanced devices and computers can help advance our understanding of basic science and can help companies find solutions to challenging technological hurdles when they are locked in fierce competition with global competitors.

With this in mind, I want to touch briefly on the national labs, which are rightly viewed as a national asset. Coming from an area without a national lab, as most members do, I continue to wrestle with how the labs can play a transformational role for organizations beyond their boundaries and help jump-start innovation and opportunity in several sectors of our economy, including American manufacturing. Please share your thoughts on this and other topics. And I look forward to your insight, as do we all.

Thank you so much for the time, Mr. Chairman.

Mr. SIMPSON. Thank you.

Dr. Orr, I believe you are going to give the opening statement, right?

Mr. ORR. I am, and then Dr. Dehmer will follow with some more details.

Mr. SIMPSON. Okay.

Mr. ORR. So I would like to thank you, Mr. Chairman, and Ranking Member Kaptur and members of the subcommittee. It is a pleasure to be back with you today. I would like to compliment the committee on its energy efficiency with requiring only one trip over here all the way from DOE, so I saved some fuel there.

It is good to have the opportunity to appear here today to talk about the Office of Science budget request for Fiscal Year 2016. As you heard me say earlier this morning, DOE is charged with advancing an all-of-the-above energy strategy to enable the transition to a low-carbon economy, and the fundamental science effort that we will talk about today underpins every aspect of that. It permeates all of what we do.

As Under Secretary for Science and Energy, my job is to coordinate the Department of Energy's scientific research efforts with the applied energy research and development efforts and to work on

enhancing the productive links among the various programs, recognizing that they each bring something to the party that is unique to them and we need to support both the links and the fundamental parts as well.

The Office of Science delivers important scientific discoveries and tools that transform our understanding of nature and advance the energy, economic, and national security of the United States, and it does this through two principal thrusts. One is the direct support for scientific research, and then there is also direct support for the development, construction, and operation of unique open-access scientific user facilities.

I will give you a brief overview of the budget, and then the person with real knowledge, sitting to my left, will provide more details, and then together we will try to answer your questions.

The Department's total science and energy budget request for fiscal year 2016 is $10.7 billion. That is $1.4 billion above the fiscal year 2015 enacted level. And this includes $5.34 billion for the Office of Science, and that is $272 million above the fiscal year 2015 enacted level. And it is aimed at continuing to lead basic research in the physical sciences and to develop and operate cutting-edge scientific user facilities, while strengthening the connection between advances in fundamental science and technology innovation.

In addition to maintaining the operation of 10 national labs, the request includes increased funding for our Advanced Scientific Computing Research program, the operation of the Department's user facilities and support to design and build new facilities, and additional funds to create new Energy Frontier Research Centers, while continuing to support the 32 centers funded last June.

So those of you who were here this morning heard me say that a key way of increasing productive links amongst the various programs is through budget crosscuts. So the science programs are very much involved in these crosscuts as well. You may recall that the crosscut request is $1.2 billion across six initiatives, and four of those are ones in which the Office of Science participates actively. So let me talk a little bit about those in this setting.

I will start with the exascale computing crosscut. Investments in exascale computing are critical to maintain U.S. competitiveness and leadership in science, national defense, and energy innovation. The Exascale Initiative puts us on a path to achieve computing speeds 100 to 1,000 times faster than today's leading supercomputers. But it is much more than just speed, and I am almost certain we will come back to this in the discussion period afterwards, because it really is an absolutely fundamental underpinning to what we want to accomplish in almost every area.

Second is the cybersecurity crosscut, for which DOE requests $306 million. We talked about that a fair amount in the previous discussion and we will again, because it is absolutely important. It is increasingly important in today's modern age, and DOE is working to protect its cyber assets, and in particular Science's laboratory infrastructure. The national labs are crown jewels, and we want them to be safe and secure, even as they carry on the good science for which they are so well known.

The subsurface technology and engineering crosscut is focused on a fundamental objective, mastery of the subsurface through adapt-

ive control technologies, and Science supports this effort through its fundamental research and expertise in areas such as subsurface chemistry and complex fluid flows.

And finally, I will mention the energy-water nexus crosscut, again a topic of discussion this morning. This is new in the fiscal year 2016 budget request. Water use is fundamental to electric power generation, and the Office of Science provides the key underpinning for this crosscut through an $11.8 million investment in data modeling and analysis of complex energy-water system dynamics. Coupled with targeted technology development by the energy programs, this new initiative positions DOE to support the Nation's transition to more resilient energy-water systems.

And before I close and turn things over to Dr. Dehmer, I will say a word about one more initiative, and that is the Quadrennial Technology Review, which involves the Applied Programs as well as the Office of Science. The urpose of that review is to inform the future of our science and applied research, at least as far as it deals with energy applications. It examines the state of existing and emerging energy technologies and identifies the most promising research and development opportunities across those technologies. And the science of course is a fundamental enabling activity across that, so it is an important component of the report. It is due this summer, and I will look forward to coming back to talk about that when the opportunity arises.

So as several have observed, DOE's science program is the largest federal sponsor of basic research in the physical sciences, and therefore it plays a key role in advancing our understanding of nature and advancing the energy, economic, and national security of the United States. And it is something that I can say that, as a relative newcomer, that we should all be very proud of what has been accomplished in the past and what we can do in the future.

And I would be pleased to answer your questions when the turn for that comes. So thank you very much.

[The information follows:]

Testimony of Under Secretary for Science and Energy Franklin Orr
U.S. Department of Energy
Before the
Appropriations Subcommittee on Energy and Water Development
U.S. House of Representatives
March 17th

Chairman Simpson, Ranking Member Kaptur, and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the Department of Energy's (DOE) Budget Request for the Office of Science in fiscal year (FY) 2016. I appreciate the opportunity to discuss how the Budget Request advances the Department's mission in delivering fundamental scientific research.

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

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

The Science and Energy Challenge

The use of energy is woven through every aspect of modern societies. We rely on the conversion of energy resources into services that fuel our nation's households and businesses, transportation sector, manufacturing, and the economy as a whole.

Today we are in the middle of an American energy renaissance. There is no shortage of primary energy resources in the United States, and we are poised to take full advantage of them. These include renewable sources from the sun, wind, and water; thermal energy within the earth's upper crust; fossil fuels; and nuclear resources. The question we face is how to convert them to energy services—how we apply our ingenuity to supply those services safely, reliably, and economically. In doing this, we must also work to harness energy in ways that are environmentally sound.

President Obama has directed Federal agencies to work towards a low carbon economy through his Climate Action Plan. More recently, he has made a historic commitment to reduce the United States' greenhouse gas emissions by 26-28 percent by the year 2025. To make these reductions a reality, we need to use all the greenhouse gas reduction technologies in our toolkit, and we must also invent new ones and develop them to be economically practical.

Through DOE, American people support over 30,000 experts across the Department's Science and Energy missions to carry out the research, development, demonstration and deployment that will serve as a foundation for a low carbon economy. When the Energy Secretary joined the Department almost two years ago, one of the first things he did was restructure it to create an Under Secretary for Science *and* Energy. He did this to more closely integrate the Office of Science with the applied energy offices focused on energy efficiency and renewables, fossil, nuclear and electricity delivery.

As Under Secretary, my job is to coordinate our scientific research efforts with the applied energy research and development that will lead the nation to a low carbon future. Fundamental science underpins everything we do in the energy sector, and the world of energy applications is rich with opportunity to put the science to work, and also for energy applications to illuminate the opportunities for science that could have game-changing impact. My office is working to foster productive links among the science and energy programs as we build and execute the Department's research, development, demonstration and deployment activities. The FY2016 Science and Energy Budget Request reflects these links.

Overview of the FY 2016 Science and Energy Budget Request

The FY 2016 Budget Request for the Department of Energy's science and energy programs supports the President's all-of-the-above energy strategy. The Department is investing across the innovation chain—from basic scientific and discovery research to the demonstration and deployment of energy technologies. The National Laboratories are key contributors to this work, providing the Nation with strategic scientific and technological capabilities. The applied energy programs are focused on innovating across a diverse portfolio of clean energy technologies to enhance economic competitiveness and secure America's long-term energy security and

infrastructure. The Budget Request also continues to implement the President's Climate Action Plan through the development and deployment of clean energy technologies that reduce carbon pollution.

The $10.7 billion science and energy Budget Request in FY 2016, $1.4 billion above the FY 2015 Enacted level, supports DOE's missions of enabling the transition to a clean energy future with low-cost, all-of-the-above energy technologies; supporting a secure, modern, and resilient energy infrastructure; and providing the backbone for discovery and innovation, especially in the physical sciences, for America's future prosperity.

I will briefly provide an overview of the Office of Science budget request. The acting Director of the Office of Science will provide more detail in her testimony.

Highlights of the Science FY 2016 Budget Request

The Office of Science delivers scientific discoveries and tools to transform our understanding of nature and advance the energy, economic, and national security of the United States. It accomplishes this through two principal thrusts: direct support of scientific research and direct support of the development, construction, and operation of unique, open-access scientific user facilities. In carrying out these missions, the Office of Science is the largest federal sponsor of basic research in the physical sciences, supporting 22,000 researchers at 17 National Laboratories and more than 300 universities.

In addition to sustaining operation of 10 National Laboratories and several user facilities, the Office of Science had several accomplishments in FY 2014. The Department completed construction on schedule and within budget on several facilities—the National Synchrotron Light Source II at Brookhaven National Laboratory, the 12 GeV Upgrade of the Continuous Electron Beam Accelerator Facility at Thomas Jefferson National Accelerator Laboratory, the Numi Off-axis electron neutrino (ν_e) Appearance (NOvA) project led by Fermilab, and the National Spherical Torus Experiment at Princeton Plasma Physics Laboratory with commissioning underway.

These facilities allow for fundamental scientific research and discovery that enable advances for industries of all sectors to benefit from. For example, last year a research team mapped the structure of a protein within a living cell using the Linac Coherent Light Source at SLAC National Accelerator Laboratory. DOE-funded university research also led to the development of a new class of polymer-based flexible electronics for solar cells and medical applications.

To continue to promote the nation's scientific capabilities, the FY 2016 Budget Request includes $5.34 billion for the Office of Science—$272 million above the FY 2015 enacted level. These funds will allow DOE to continue to lead basic research in the physical sciences and develop and

operate cutting-edge scientific user facilities while strengthening the connection between advances in fundamental science and technology innovation.

The Budget Request includes a significant funding increase in our Advanced Scientific Computing Research program to support new high performance computing technologies on the road to capable exascale computing. This investment will help maintain America's leadership in energy, biosciences, materials sciences, climate science and chemistry, areas in which new doors will be opened with the availability of next-generation computation capabilities that are 200-400 times faster than today's premier systems. This effort is closely coordinated with the National Nuclear Security Administration, which is using supercomputing to maintain our nuclear deterrent and support nonproliferation and counterterrorism.

Underpinning our ability to be world leaders in scientific research is the world's largest collection of scientific user facilities operated by a single organization in the world. Each year, they are used by 31,000 researchers. The FY 2016 Budget Request funds operation of these facilities and supports design work and construction at a number of new facilities. The Office of Science has a positive track record of completing large projects on time and on budget.

In June last year, DOE awarded $100 million to fund 32 Energy Frontier Research Centers, which bring together interdisciplinary science teams to work together in a particular area—ranging from solar energy and biosciences to carbon capture and sequestration. These centers have already had an outsized impact in terms of scientific discovery and the FY 2016 Budget Request increases funding to create new research centers and continue to fund those in operation now.

Crosscutting Budget Initiatives

One of the ways the Department is increasing the productive links between the science and energy programs is through the budget crosscuts the Department introduced in the last budget cycle.

Building on the success of last year's crosscutting proposals, my office is continuing to bring together subject matter experts across our programs to overcome overarching challenges. The crosscuts embody the improved agency-wide coordination the Secretary envisioned when he created the Office of the Under Secretary for Science and Energy as part of the Department's FY 2013 reorganization.

Taking an enterprise-wide approach to research efforts will improve outcomes and avoid redundancy between program offices. The FY 2016 Budget Request includes just over $1.2 billion in crosscutting research and development across six initiatives: cybersecurity; the energy-

water nexus; exascale computing; grid modernization; subsurface science, technology and engineering; and supercritical carbon dioxide electric power generation technology.

Five of these initiatives were established in FY 2015, and they have evolved and matured as their coordination resulted in high-impact proposals in the FY 2016 Budget Request. The sixth, on the energy-water nexus, is a new proposal in the FY 2016 budget request.

The Office of Science is participating in four of these crosscut initiatives. I will first detail the three crosscuts the Office of Science is continuing to participate in: cybersecurity; exascale computing; and subsurface technology and engineering, and then the one additional crosscut we introduced in the FY16 Budget Request on the energy-water nexus.

Cybersecurity: Protecting the DOE enterprise and improving cybersecurity in the energy sector

The Department of Energy is engaged in cyber-related activities to protect the DOE enterprise, including government-owned, contractor-operated sites, from a range of cyber threats that can adversely impact mission capabilities; and activities to improve cybersecurity in the electric power subsector and the oil and natural gas subsector. Strengthening cybersecurity to protect the DOE enterprise requires bolstering the Department's cybersecurity functional capabilities to identify, protect, detect, respond, and recover from the increasing incidence of cyber-attacks.

To this end, the Department has established a Cybersecurity crosscut to strengthen the coordination of budget activities related to cybersecurity so that cybersecurity is managed based on strategic priorities. The DOE Budget requests $306 million to fund this Cybersecurity Crosscut initiative in FY 2016. DOE has also established an internal Cyber Council to serve as the principal forum for coordinating cyber-related activities across the Department and for consideration of cyber-related issues requiring decisions by DOE senior leadership.

Under the Presidential Policy Directive on Critical Infrastructure Security and Resilience (PPD-21), DOE is the Sector Specific Agency for the energy sector and has a number of responsibilities, including the following: 1) collaborating with infrastructure owners and operators to strengthen the security and resilience of critical infrastructure; 2) serving as the day-to-day Federal interface for the prioritization and coordination of sector-specific activities; 3) carrying out incident management responsibilities consistent with statutory authority and other appropriate policies; and 4) providing technical assistance to the energy sector to identify vulnerabilities and help mitigate incidents, as appropriate.

Exascale Computing: Enabling U.S. leadership in the next generation of high performance computing

Since the beginning of the digital era, the U.S. Federal government has made pivotal investments in high performance computing (HPC) at critical times when market progress was stagnating. HPC technology is at another turning point where fundamental innovations in hardware and software architectures are necessary to drive future advances in computing performance. Committed U.S. leadership in HPC is a critical contributor to our competitiveness in science, national defense, and energy innovation as well as the commercial computing market. Equally important, a robust domestic industry contributes to our nation's security by helping avoid unacceptable cyber-security and computer supply chain risks.

For these reasons, DOE is proposing $272.6 million for the Exascale Computing crosscut initiative funded through the Office of Science and the National Nuclear Security Administration. A significant investment by the Federal government involving strong leadership from DOE, in close coordination with government, national laboratories, industry, and academia is required to address this national challenge. The Exascale Computing crosscut initiative focuses on three pillars: foundational research, development and deployment activities; application development to take full advantage of the emerging exascale hardware and software technologies; and platform deployment to prepare for and acquire two or more exascale computers. Funding for the first two pillars is included in the FY 2016 Budget Request.

Subsurface Technology and Engineering: Advancing a new era of capabilities across a range of energy applications

Subsurface energy resources provide more than 80 percent of total U.S. energy needs today. Next generation advances in subsurface technologies may enable greater access to renewable geothermal energy and safer and more environmentally sustainable development of domestic natural gas supplies, as well as potentially provide hundreds of years of safe storage capacity for carbon dioxide and opportunities for environmentally responsible management and disposal of energy waste streams. Thus, discovering and effectively harnessing subsurface resources while mitigating impacts of their development and use are critical pieces of the Nation's energy strategy.

DOE's FY 2016 Budget Request includes $244 million for the Subsurface Technology and Engineering crosscutting initiative. The subsurface crosscut, SubTER, will address identified challenges in the subsurface through highly focused and coordinated research in wellbore integrity, stress state and induced seismicity, permeability manipulation, and new subsurface signals to ensure enhanced energy security, material impact on climate change via CO_2

sequestration, and significantly mitigated environmental impacts from energy-related activities and operations.

Energy-Water Nexus: Creating more resilient and efficient energy-water systems

The energy-water nexus crosscut initiative is new in our FY 2016 request.

Water and energy systems are interdependent. Water is used in all phases of electricity generation and energy production, accounting for over 40 percent of total water withdrawals and over five percent of total water consumption. Conversely, energy is required to extract, convey, and deliver water of appropriate quality for diverse human uses, and then again to treat wastewaters before return to the environment; this accounts for three percent of total electricity consumption. Current trends are increasing the urgency to address the energy-water nexus in an integrated way. Precipitation and temperature patterns, U.S. population growth and regional migration trends, and the introduction of new technologies could shift water and energy demands.

Building on DOE's report on Challenges and Opportunities in the Energy-Water Nexus, published in June 2014, the Department proposes a $38M program in FY 2016 Budget Request that involves six DOE organizations. This effort comprises a coordinated set of cross-program initiatives that 1) builds and deploys DOE modeling and analysis to improve understanding and inform decision-making for a broad range of users; 2) strategically targets crosscutting technology RDD&D opportunities within the system of water and energy flows; and 3) is informed and supported by focused policy analysis and outreach and stakeholder engagement. Taken as an integrated whole, these investments position DOE to contribute strongly to the Nation's transition to more resilient energy-water systems.

Additional Avenues for Increased Coordination Across Science and Energy

Funding proposed through the crosscuts ultimately resides within DOE's existing programs, but my office is coordinating execution as well.

In addition, the Science and Energy program offices as well as laboratory staff are hard at work drafting the 2015 Quadrennial Technology Review. This rigorous review will examine where the technological capabilities and overall outlook stand on the most promising research, development, demonstration and deployment opportunities across the range of technologies that will address the nation's energy needs in the years to come. The report's release is planned for later this year and I look forward to briefing Congress when the review is complete.

Conclusion

As the largest federal sponsor of basic research in the physical sciences, the Department of Energy plays a key role in advancing our understanding of nature and advancing the energy, economic, and national security of the United States. The FY 2016 budget request continues funding the core programs within the Office of Science as well as expanding key initiatives to continue to advance the United States' competiveness in key scientific areas.

Mr. SIMPSON. Dr. Dehmer.

Mr. DEHMER. Thank you. Thank you, Chairman Simpson, Ranking Member Kaptur and members of the committee. I am very pleased to be here today to talk about the Office of Science budget for 2016. I first want to thank you for your continued support and for your support in 2015.

Our 2016 budget request will support about 22,000 people at more than 300 U.S. academic institutions and all 17 of our DOE laboratories. Our 30 user facilities will support about 31,000 researchers from all around the country. We actually touch more people at our scientific user facilities than we do by direct support.

I think you well know our six programs that support research in high energy nuclear and plasma physics, materials and chemistry, biology and environmental sciences, and mathematics and computing. Our request invests in discovery science in all of those, and also supports a portfolio of basic research that addresses unresolved questions in energy production, conversion, efficiency, and use.

This morning I would like to have my opening remarks do something a little different than I have done in the past. I would like to tell you a personal story that has affected the way I view investments in the Office of Science today.

Only infrequently in a science career does one see advances that are transformational, that drive a change in the way we think about the world around us. I was fortunate to be working in atomic and molecular physics in the 1970s and the 1980s when that field was transformed, it was revolutionized really, by the discovery and widespread application of infrared and invisible light lasers. These lasers certainly allowed us to do ongoing research better, and in fact that is how we started using them. But soon, and more importantly, entire new worlds of science exploration were opened because of the power and coherence of the laser beam. We could study phenomena that were inconceivable and sometimes unknowable before the laser was developed. Multiple Nobel Prizes came from such studies, including one to our former Secretary of Energy, Steve Chu.

Today we are living through two transformations of this magnitude. Among our highest priorities is the robust support of investment in these research areas. The first area is high-performance computing. We are well along the path to developing a capable exascale computer by early the next decade. For a decade now, computational science using terascale and petascale computers was recognized as a partner, first a small partner and now an ever-growing partner to theory and experiment. More recently, big data has emerged, tempting us with the promise of insights from previously unimagined volumes of data produced by experiment and computation.

The potential impact of the next generation of computing, that is exascale computing, coupled with aggressive analyses of massive amounts of data cannot be overstated. From materials discovery without synthesis to engineering without prototyping, we will gain new awareness of the world around us and we will see transformational, not merely incremental improvements in our understanding and our predictive capabilities.

The second example that I want to talk to you about is the X-ray laser, the first of which worldwide was the Linac Coherent Light Source at SLAC National Accelerator Laboratory. In the late 1990s, by the time I was here already, and in the early 2000s initiating construction of the LCLS was viewed as bold and quite risky. But in less than a decade the LCLS was lasing and it was a stunning success. Immediately after the demonstration of X-ray lasing in April of 2009—and, by the way, even that morning there were some people who said it wouldn't work, but it did, on the first try——

Mr. ORR. Including one of my colleagues from my university.

Mr. DEHMER. Including one of your colleagues, yes.

Immediately after that demonstration the world raced to catch up.

Just as visible light lasers revolutionized atomic and molecular physics 30 to 40 years ago, the LCLS X-ray laser promises similar revolutions. The ability to watch, actually watch in real time molecular mechanisms of photosynthesis, biological transformations and catalysis will change how we think about chemistry, biology, and material sciences. Just as we didn't appreciate the impact of lasers in the 1970s and 1980s, I don't think we have yet begun to imagine the potential of this new tool.

If history is a guide, when we look back in 5 to 10 years at the impacts of high-performance computing and X-ray lasers, we will be embarrassed to admit how little we predicted. With apologies to "Star Trek" and grammarians everywhere, the history of the Office of Science is one in which we boldly go into new territories.

The two examples I discussed today are those with the greatest budget increases in 2016 and therefore I highlighted them, but there are other equally exciting stories in our six research programs.

In summary, I believe that this budget will propel science, will deliver remarkable new 21st century tools, and will make the U.S. the leader in key areas of science important to competitiveness. I thank you, and I look forward to your questions.

[The information follows:]

Statement of Patricia Dehmer, Acting Director of the Office of Science

U.S. Department of Energy

Before the

House Committee on Appropriations

Subcommittee on Energy & Water Development

March 17, 2015

Thank you Chairman Simpson, Ranking Member Kaptur, and distinguished members of the Committee. I am pleased to come before you today to discuss the President's FY 2016 Budget Request for the Office of Science in the Department of Energy (DOE). I also want to thank you for your support of the Office of Science (SC) in the recent FY 2015 Omnibus appropriations bill, which we are now implementing.

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

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

The FY 2016 Budget Request is an excellent budget for the Office of Science, with an increase of 5.3 percent over the FY 2015 Enacted level. We continue our distinguished history of making important investments in basic research, scientific user facilities, and facility construction across our six program areas. As you know, the Office of Science is the Nation's largest source of funding for basic research in the physical sciences.

I would like to highlight a few key features of the FY 2016 Request. First, exascale computing and disciplinary computational sciences continue to be a top priority for the Department and for the Office of Science. There is a substantial increase of $80 million in Advanced Scientific Computing Research (ASCR) to advance rapidly toward an exascale machine. We also continue with additional funding in Basic Energy Sciences (BES) for computational work on material sciences, which was initiated in FY 2015 and has transformational potential for a broad range of energy applications.

Second, our Budget Request is responsive to the 2014 High Energy Physics Advisory Panel (HEPAP) Particle Physics Project Prioritization Panel (P5) report. I was impressed with the very broad outreach to the large high energy physics community, and I am pleased that the community has united behind the recommendations of the report. Most notably, the Request contains $20.0 million for the Long Baseline Neutrino Facility at Fermi National Accelerator Laboratory (Fermilab). The Office of Science and Fermilab continue to work together to properly internationalize this project, following the recommendation of the P5 subpanel.

Finally, scientific user facility operations and construction remain an extremely important part of the Office of Science budget. The Linac Coherent Light Source upgrade project at SLAC and the Facility for Rare Isotope Beams project at Michigan State University reach the peak year of their construction funding profiles in FY 2016. Most of our user facilities are funded to operate at or near optimal levels. In Fusion Energy Sciences, we expect the newly upgraded National Spherical Torus Experiment at Princeton Plasma Physics Laboratory to resume operations for a 14-week run. The Office of Science is committed to operating and constructing world-leading user facilities.

Additional details on our six program areas are below:

Advanced Scientific Computing Research (ASCR) supports research to discover, develop, and deploy computational and networking capabilities to analyze, model, simulate, and predict complex phenomena important to DOE. The ASCR budget increases $80 million or 14.8 percent relative to the FY 2015 appropriation.

The FY 2016 Budget Request for ASCR makes significant new investments in research and partnerships to advance the Department's goals for capable exascale computing. Capable exascale computing will mean a thousand- fold increase in performance over today's systems when used for science applications important to the DOE mission and the High Performance Computing (HPC) scientific community. Exascale computing will address the next generation of scientific, engineering, and large-data problems, advancing the Department's science missions into the next decade.

There is a sizable increase in investment in Research and Evaluation Prototypes. In this activity, ASCR will competitively select R&D partnerships with U.S. vendors to initiate the design and development of node and system designs suitable for exascale systems. These efforts will influence the development of exascale prototypes.

Included in the ASCR Request is $10.0 million for the Computational Science Graduate Fellowship (CSGF). Training the next generation of computational scientists to understand the challenges and complexities of massively parallel exascale systems is a top priority for ASCR and the Nation. The CSGF program was singled out as an example by the Advanced Scientific Computing Advisory Committee as a key investment in workforce development supported by the Office of Science.

Basic Energy Sciences (BES) supports research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies. The BES budget increases $116 million or 6.7 percent from the FY 2015 appropriation.

The FY 2016 Request continues funding for computational modeling in materials science, which invests in the scientific foundation and tools for predictive design of functional materials. This activity supports the Administration's Materials Genome Initiative for Global Competitiveness that was initiated in June 2011, and it will continue to significantly improve U.S. modeling capabilities. The Computational Materials Sciences activity also supports the second year of research awards that will be issued in FY 2015; additional funds are requested for underrepresented research topics in predictive design of functional materials. A new investment in midscale instrumentation is also requested to develop cutting-edge electron scattering tools to advance the forefront of ultrafast science.

Additional funding is requested for the Energy Frontier Research Centers (EFRCs) to invest in strategic areas of basic energy sciences that are not represented or are underrepresented in the current EFRC portfolio. Beginning in FY 2016, the EFRC program will transition to a biennial solicitation. All EFRCs will undergo a mid-term review in FY 2016 to assess progress toward meeting scientific research goals

and DOE will issue a Funding Opportunity Announcement for approximately five new EFRC awards in FY 2016.

The FY 2016 Request for BES will support ongoing core research activities at or above the FY 2015 Enacted level. Funding for the Batteries and Energy Storage Energy Innovation Hub will continue as planned. The Fuels from Sunlight Energy Innovation Hub is undergoing a review for a possible renewal for a final term with a maximum duration of five years; a renewal decision will be made in the second quarter of FY 2015.

In FY 2016, BES will support near optimal operations of five x-ray light source facilities, two neutron source facilities, and five Nanoscale Science Research Centers. FY 2016 will be the first full year of operations for the newly constructed National Synchrotron Light Source-II (NSLS-II). It is the latest example of the Office of Science's tradition of building world-class user facilities on-budget and on-time. In the case of NSLS-II, the project was completed under-budget and ahead of schedule. The Linac Coherent Light Source-II project will ramp up construction activities, reaching its peak year of funding in FY 2016. The Advanced Photon Source Upgrade and the NSLS-II Experimental Tools (NEXT) major item of equipment projects will be supported as planned. FY 2016 is the last year of funding for the NEXT project.

Biological and Environmental Research (BER) supports fundamental research and scientific user facilities to achieve a predictive understanding of complex biological, climatic, and environmental systems for a secure and sustainable energy future. The BER budget increases by $20.4 million or 3.4 percent relative to the FY 2015 appropriation.

The Request of $193.0 million continues support for research in Genomic Science, including $75.0 million requested for core research at the DOE Bioenergy Research Centers to provide a scientific basis for sustainable and cost effective bioenergy production. These efforts are complemented by continued research on potential plant feedstocks for bioenergy purposes, new efforts to understand the sustainability of bioenergy production, and biosystems design efforts to modify plants and microbes for bioenergy purposes. The budget requests $69.5 million for the DOE Joint Genome Institute to provide scientific users with plant and microbial genome sequences of the highest quality and advanced capabilities to analyze, interpret, and manipulate genes in support of bioenergy, biosystems design and environmental research.

The BER Request for Climate and Environmental Science supports fundamental science and research capabilities that enable advances in ecosystem process science, climate science, and modeling research.

BER's integrated portfolio includes research on clouds, aerosols, and the terrestrial carbon cycle. Our understanding of the interdependence between climate and ecosystems is enabled by SC's unique facilities and long-term observing capabilities - most managed by DOE national laboratories - to collect and analyze data to understand climate processes. These facilities include: The Atmospheric Radiation Measurement Climate Research Facility (ARM) to understand cloud-aerosol-precipitation interactions with the Earth's radiant energy balance; Ameriflux to measure ecosystem carbon, water, and energy fluxes to support environmental research; and Next Generation Ecosystem Experiments (NGEE) to explore ecological, biogeochemical, and soil process interactions of sensitive and climatically interesting ecosystems. Data from ARM, NGEE, and Ameriflux are coordinated under SC's data informatics capability, enabling efficient use and integration by the scientific community. SC's Leadership Computing Facilities at Oak Ridge National Laboratory and at Argonne National Laboratory, enable research to understand earth and environmental system process interactions based on synthesis of complex data sets.

In FY 2016, the BER Request for Climate Model Development and Validation combines advanced code development and numerical methods with ARM data to design an Earth system model with sub-10 km resolution that can adequately represent extreme events and can be run on next-generation and exascale computers. The Request also funds foundational work in support of the Department's Energy-Water Nexus crosscut. Specifically, tandem investments in Climate and Earth System Modeling and Integrated Assessment activities support an advanced, integrated data, modeling, and analysis platform to improve understanding and inform decision-making of coupled energy-water systems for a broad range of users and at multiple scales. The request also supports subsurface biogeochemical research that advances fundamental understanding of coupled physical, chemical, and biological processes controlling both the terrestrial component of the carbon cycle and the environmental fate and transport of DOE-relevant contaminants, and supports the Environmental Molecular Sciences Laboratory (EMSL).

Fusion Energy Sciences (FES) supports research to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation of fusion energy. The FES budget decreases $47.5 million or 10.2 percent from the FY 2015 appropriation.

After the first year of experimental operations with the upgraded device in FY 2015, funding for operations of the National Spherical Torus Experiment Upgrade (NSTX-U) user facility will support 14 weeks of run time in FY 2016. FES will support a strong research program to develop the improved understanding of the spherical torus configuration required to establish the physics basis for next-step

facilities, broaden scientific understanding of plasma confinement, and maintain U.S. world leadership in spherical torus research.

Twelve weeks of research operations at the DIII-D facility are planned for FY 2016, with experiments focusing on high-priority, advanced tokamak issues. Areas of research will include studies of transport and radiative processes in detached divertor conditions, and disruption physics and mitigation systems. Additionally, the request supports targeted upgrades for DIII-D such as installation of new magnet power supplies for the 3D and shaping coils, and continued work on improving the neutral beam heating control system.

The Alcator C-Mod facility will continue operation in FY 2015 to complete student research and critical experimental work before the facility ceases operations by the end of FY 2016.

Funding is provided for the U.S. contributions to the ITER project to support the U.S. ITER Project Office operations, the U.S. cash contribution to the international ITER Organization, and continued progress on in-kind hardware contributions. These include industrial procurements of central solenoid magnet modules and structures, toroidal field magnet conductor fabrication and diagnostics, and tokamak cooling water system procurement. We are observing closely whether the newly nominated Director General will take steps to improve the management of this project.

The strategic planning process for the domestic Fusion Energy Sciences program is nearing completion. Input for the plan derives from the Fusion Energy Sciences Advisory Committee (FESAC) report *Strategic Planning: Priorities Assessment and Budget Scenarios* released in October 2014 as well as several other recent studies. A series of FES-supported technical workshops to be held in May and June 2015, prompted by the FESAC report, will subsequently refine details of the plan.

High Energy Physics (HEP) supports research to understand how the universe works at its most fundamental level by discovering the most elementary constituents of matter and energy, probing the interactions among them, and exploring the basic nature of space and time itself. The HEP budget increases by $22.0 million or 2.9 percent above the FY 2015 appropriation.

The FY 2016 Budget Request implements the recommendations contained in the P5 subpanel report, unanimously approved by the HEPAP in May of 2014.

Support is requested for full operation of existing major HEP facilities and experiments; the planned construction funding profile for the Muon to Electron Conversion Experiment (Mu2e), and fabrication for recent major items of equipment (MIEs) for the Super Cryogenic Dark Matter Search at the new Sudbury

Neutrino Observatory laboratory (SuperCDMS-SNOLab), the Large Underground Xenon (LUX) –ZonEd Proportional scintillation in Liquid Noble gases (ZEPLIN) experiment (LZ), and the Dark Energy Spectroscopic Instrument (DESI) projects.

Funding is requested to continue support of Major Items of Equipment for the camera for the Large Synoptic Survey Telescope (LSSTcam) project, the Muon g-2 Experiment, and the U.S. contributions to the Large Hadron Collider (LHC) A Toroidal LHC Apparatus (ATLAS) Detector Upgrade, and the LHC Compact Muon Solenoid (CMS) Detector Upgrade.

The internationalization and re-scoping of the Long Baseline Neutrino Experiment to optimize science impact is a major recommendation from the P5 subpanel. HEP will pursue the development of a more capable long baseline experiment by recruiting international partners. To recognize this change, we have adopted the P5 subpanel recommendation of the name change to the Long Baseline Neutrino Facility (LBNF.)

Nuclear Physics (NP) supports research to discover, explore, and understand all forms of nuclear matter, including experimental and theoretical research to create, detect, and describe the varied forms of nuclear matter that can exist, including those that are no longer found naturally. The NP budget increases $29.1 million or 4.9 percent over the FY 2015 appropriation.

The NP FY 2016 Request supports an increase for NP research across the program at universities and laboratories to address important challenges identified by the research community. Fundamental research to understand properties of different forms of nuclear matter are conducted through both experimental and theoretical efforts. Most experiments today in nuclear physics use particle accelerators to collide matter at nearly the speed of light, producing short-lived forms of matter for investigation. Theoretical approaches are based on a description of the interactions of quarks and gluons described by the theory of quantum chromodynamics (QCD).

In FY 2016, operations of the Relativistic Heavy Ion Collider (RHIC) facility are maintained at the FY 2015 level with increases provided for the critical staff, equipment, and materials that are required for effective and reliable support of operations; research is focused on characterizing the perfect quark-gluon liquid discovered in collisions of relativistic heavy nuclei through research on particle flow and jet energy loss. Operations of the A Toroidal Large Hadron Collider (LHC) Apparatus (ATLAS) facility are optimized, exploiting the new capabilities of the Californium Rare Ion Breeder Upgrade (CARIBU) and completing the campaign with the GRETINA gamma ray spectrometer. Beam development and commissioning activities continue to ramp up at the Continuous Electron Beam Accelerator Facility

(CEBAF) as the 12 GeV CEBAF Upgrade project approaches completion and scientific instrumentation is implemented in the experimental halls. The Facility for Rare Isotope Beams (FRIB) at Michigan State University reaches the peak of its construction funding profile in FY 2016. FRIB will provide intense beams of rare isotopes for research in nuclear structure and nuclear astrophysics.

Science Laboratories Infrastructure (SLI)

Ongoing projects that will provide new laboratory buildings, renovated facilities, and upgraded utilities are proceeding towards on-time completion within budget. The request provides continued funding for the Materials Design Laboratory project at Argonne National Laboratory, the Photon Science Laboratory Building project at SLAC National Accelerator Laboratory, and the Integrative Genomics Building project at Lawrence Berkeley National Laboratory. In addition, this request includes increased funding for the Infrastructure Support subprogram. This increase addresses a basic need for renewal of core general purpose infrastructure. The Request also initiates support for nuclear operations at the Oak Ridge National Laboratory that was previously funded by Congressional Direction under the Office of Nuclear Energy.

Mr. SIMPSON. I thank you for your testimony. And we are going to be, unfortunately, having votes before too long. In fact, I think they started, but would like to get on with a couple of questions here before we do that and have to have you sit around for a little bit while we go over and do those votes.

I am going to turn first to my colleague from New Jersey, the former chairman of this committee, Mr. Frelinghuysen.

Mr. FRELINGHUYSEN. Mr. Chairman, thank you for yielding me just a couple of minutes.

Mr. Secretary, in your prepared comments you say, "As Under Secretary, my job is to coordinate our scientific research efforts with the applied energy research and development that will lead the Nation to a low carbon future." I have served on this committee for 20 years, I have had a chance to read your statement, and I can't believe that we have such an inherently political statement put into the record. This is a very bipartisan committee, not a political committee, and I think it is unfortunate that I am reading this here, "with an end to mindless austerity and manufactured crises."

I mean, I think the federal debt does represent a crisis. I work—and you mentioned the Joint Chiefs of Staff—I work with the Joint Chiefs of Staff every day, and our best military minds and leaders never invoke the fact that Congress is mindless and manufacturing crises. So I would just attribute this to the fact that maybe somebody gave you this statement to read. I should hope, coming from your position at Stanford, that you wouldn't be associated with such a political statement.

Would you like to explain the origin of this statement?

Mr. ORR. I think that the statement deals with the budget issues that we have going forward, and the attempt is to argue that the science and energy investments that we are proposing are in the national interest and ones that——

Mr. FRELINGHUYSEN. Well, you should know this committee works in a nonpartisan, bipartisan way to make those investments. We always have. I would just say I think in my 20 years I have never read such a statement given to a committee. It is a matter of public record. I think it is unfortunate. And I don't think it reflects the purpose of the Department or the sector which you are responsible for. I just want to register my strong feelings.

Mr. Chairman, thank you very much.

Mr. SIMPSON. Thank you.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman.

And thank you, Mr. Secretary and Dr. Dehmer, for your testimony today.

I wonder if, in terms of the priorities that you have outlined for additional research and are seeking additional funding, could you give us a bigger frame about the global context in which we are pursuing these objectives? Who are our major competitors for the science in those fields? And what are you seeing internationally? And why is this so important to our country?

Mr. ORR. Well, let me start, and then Pat can add the tail.

For a long time the United States had more of a, monopoly is not the right word, but we had a strong concentration of scientific leadership. But as the rest of the world has developed and as they have

put their own efforts into it, there are lots more competitors out there. In many of the science arenas this is a perfectly good result. There are so many fundamental and important questions about understanding nature that we need all the players we can get on the field and should take advantage of them. And as was noted, there are international endeavors that really bring countries together to work on some of the most important fundamental questions.

Ms. KAPTUR. Who are the chief competitors, Doctor?

Mr. ORR. Well, Europe is a place of great strength. China is building hard and working to develop its capabilities. And then there are other smaller efforts around the world.

I don't know what you would say, Pat, in terms of the competitors?

Mr. DEHMER. So I think about two areas. I think about high-performance computing, and for years we were the undisputed leader. China now has the number one computer in terms of speed and has had for a couple of years. We have 4 in the Department of Energy in the top 10, in the top 500 list, but Japan and Europe and China are coming on strong. That is one area where I don't think we want to cede leadership.

Another area where I don't think we want to cede leadership is in characterization at the atomic level, and I think typically of the light sources. For years we were the undisputed leader in light sources, and now many, many countries have capabilities that equal or rival ours.

As Dr. Orr said, there are areas where we do want to cooperate. For example, in particle physics, in accelerators, where you will find only one mega-facility in the world. But there are also areas where we want to be the leader or among the leaders and we don't want to cede leadership, and I think sometimes in those areas I am worried.

Ms. KAPTUR. Do you have hacking of any of your sensitive information?

Mr. DEHMER. Not that I am aware of.

Mr. ORR. But constant attempts.

Mr. DEHMER. Constant attempts, constant, constant attempts.

Ms. KAPTUR. Would Russia be one of the countries that is doing that or not?

Mr. ORR. I don't have any direct knowledge to answer the question, but I would be surprised if there is not an element of that in there.

Ms. KAPTUR. I wanted to ask, following on that line of questioning, where does the United States rank worldwide in terms of investment in science, high science? What would your guess be?

Mr. DEHMER. In terms of dollars or GDP?

Mr. ORR. We are discussing how to frame the question.

So the truth is that I don't know either the dollars or GDP, fraction of GDP number, off the top of my head, but we would be happy to go figure that out and get back to you on that.

Ms. KAPTUR. I want to allow my colleagues to ask questions.

Mr. DEHMER. I know that in terms of GDP we are not number one and we are far from number one. In terms of dollar amount, because we are so big, we may be very high there.

Ms. KAPTUR. That would be most interesting to look at and provide to the record. Thank you.

[The information follows:]

Mr. DEHMER.K. IN TERMS OF OVERALL R&D SPENDING, WHICH INCLUDES BOTH INDUSTRY AND GOVERNMENT, THE UNITED STATES RANKED FIRST IN THE WORLD, AT $492 BILLION, IN 2011, THE MOST RECENT YEAR FOR WHICH INTERNATIONAL COMPARATIVE DATA IS AVAILABLE. HOWEVER, THE U.S. SHARE OF GLOBAL R&D HAS BEEN STEADILY DECLINING, FROM 37 PERCENT OF TOTAL GLOBAL R&D SPENDING IN 2001 TO 30 PERCENT IN 2011. CHINA IS THE SECOND-RANKED PERFORMER AND BY FAR THE SINGLE BIGGEST COMPETITOR, WITH $208 BILLION IN R&D EXPENDITURES IN 2011. CHINA'S ANNUAL GROWTH RATE IN R&D AVERAGED OVER 20 PERCENT DURING THE LAST DECADE, WHILE THE U.S. GROWTH RATE WAS JUST OVER 4 PERCENT. LARGELY AS A RESULT, THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD) HAS PROJECTED THAT CHINA WILL SURPASS THE U.S. IN R&D SPENDING BY THE END OF THE DECADE. IN TERMS OF R&D SPENDING AS A PERCENTAGE OF GDP, IN 2011 THE UNITED STATES RANKED TENTH WORLDWIDE, AT 2.8 PERCENT, BEHIND SUCH NATIONS AS ISRAEL, SOUTH KOREA, FINLAND, JAPAN, SWEDEN, DENMARK, GERMANY, AND SWITZERLAND, ALL OF WHICH DEVOTE A LARGER PORTION AT THEIR GDP TO R&D INVESTMENTS.

Ms. KAPTUR. And I will allow the others to ask questions, Mr. Chairman.

Mr. SIMPSON. Dr. Dehmer, the ITER project is an incredibly complex endeavor involving seven international partners contributing the equivalent of roughly $20 billion. A recent internal report of ITER's project management team found this group to be overly bureaucratic, inefficiently run, and unacceptably slow, and made a series of recommendations to fix these problems. This committee took steps to ensure that these management reforms were implemented before the U.S. made further cash contributions to the ITER organization.

Can you provide us with an update on how implementation of those management reforms is going? Is the organization making the necessary management reforms to your satisfaction? And is there anything this committee can do to be constructive in our approach to support ITER while ensuring that our tax dollars are wisely spent?

Mr. DEHMER. I think the top management recommendation in that report, the Management Assessment report of 2013, was to change the top management of the ITER organization quickly. And as you know, that has just been done. At the March 5 council meeting they installed a new director-general, Bernard Bigot. We are very pleased with that switch and we are looking forward to seeing what Director-General Bigot will do in the coming months and year.

Mr. SIMPSON. Because there are going to be efforts to defund it essentially in this appropriations cycle, I am pretty sure. Would that be a mistake?

Mr. DEHMER. Right now I am just going to speak to the 2016 budget. We are investing what we think is the appropriate amount.

Lynn, you want to talk?

Mr. ORR. As you know, the United States has made commitments to participate in the project. Most of those commitments are actually construction of magnets and other elements of facilities. So the spending that will take place as part of the ITER project is actually devoted to at least partially to supporting the fusion energy enterprise in the United States, even as we contribute to the broader project.

The pace of that has been set to provide balanced funding with the domestic programs and the international effort, and each of those complements the other. So we believe that it is in our interest to continue to participate, but we recognize the concerns that you mentioned in your initial question.

Dr. Bigot, as he has taken charge, he was just confirmed in the position as of March 5, so he has put together an aggressive 200-day plan to take a hard look at every aspect of how they are operating. And we think the right thing to do is to watch that carefully and pay close attention and make that judgment as we go forward and see how they perform.

Mr. SIMPSON. I guess one of my concerns is last year during the budget negotiation or the appropriation negotiations on this bill my argument was now is not the time to drop out of this and withdraw our funding from it and we need to see how these reforms come about. Is that going to have to be my same argument again this year?

Mr. ORR. Well, I think it is the right argument, that it is in process. The changes that we and others thought were required in order to get the project on track have started. They have a very capable and respected new leader with more authority, I think, to do what needs to be done. But there is a lot to do and it will require the cooperation of all the participants.

Mr. SIMPSON. If the United States somehow decided not to participate in the ITER project any further, how would that affect the fusion research that is done at our universities now?

Mr. ORR. Well, Pat can respond as well, but I would say that partially it would remove support for some of the design and equipment activities. So because all of the people that are involved in this participate in those, it would remove part of the support for those activities in our own research program. So I think to do it in the short term would have a negative impact on those programs.

Mr. SIMPSON. Same thing.

Mr. DEHMER. We are in the process right now of looking at a strategic plan for the domestic fusion program. It is actually going to turn out to be a very robust plan, with half a dozen elements or so. I think if something as you described would happen to the ITER project we would immediately revisit that to see how we could strengthen the domestic program.

Mr. FRELINGHUYSEN. Would the chairman yield?

Mr. SIMPSON. Sure.

Mr. FRELINGHUYSEN. So I get some degree of equivocation here? I mean, when the administration first took a look at ITER and domestic side you were highly supportive. Is there some equivocation here? I mean, this is sort of like stranded investments here. We have been making investments in this committee in the ITER project, sort of like the Joint Strike Fighter if we are talking about the military. We back off, what does that mean?

Mr. ORR. Well, then——

Mr. FRELINGHUYSEN. Are you agreeing with the contention that we shouldn't be supporting this international endeavor which we have been supporting for how many years now?

Mr. ORR. No, I am sorry if I gave that impression. I think that we should support it, and that is with the budget requests.

Mr. FRELINGHUYSEN. Ultimately it is the science that we would benefit from.

Mr. ORR. Indeed, yeah, absolutely.

Mr. FRELINGHUYSEN. Isn't that what your purpose in life, is to provide for that?

Mr. ORR. Yes, indeed. On the other hand, we also understand that it is a complicated project that has had some management challenges that need to be addressed.

Mr. FRELINGHUYSEN. Okay. Thank you, Mr. Chairman.

Mr. SIMPSON. There are only 2 minutes left during this vote, so I would suggest that we recess the hearing and go vote. And we will be back. We have got a series of 3 votes, shouldn't take more than 6 hours. Not really. It won't take that long. We will be right back.

Mr. ORR. We will be here.

[Recess].

Mr. SIMPSON. Hearing will be back in order.

Mr. Honda.

Mr. HONDA. Thank you, Mr. Chairman.

And I want to welcome both Dr. Orr and Dr. Dehmer. We were talking a little bit about light sources. And I have had pleasure on several occasions to tour the great light sources at Berkeley Lab and at SLAC, and I always leave impressed at the power of these amazing scientific user facilities. In fact, when I started to understand light sources it shed a different light, I guess, on everything that I understood in terms of how precise some of the photos that before it was very difficult to produce images.

Unfortunately, other countries are catching up or passing us up on light source capabilities and capacity. So I was wondering if this worries you and if we are doing enough across the full X-ray spectrum to stay competitive and ensure that the U.S. doesn't fall behind in light source technology. Could you describe what more we should be doing?

Mr. DEHMER. I think the roadmap for light sources was produced by the Basic Energy Sciences Advisory Committee in mid-2013, and the recommendations that came out of that report were very aggressive. Basically it said that the U.S. will not be number one if we don't take certain actions.

And those actions include the completion of the National Synchrotron Light Source II at Brookhaven, and that was just completed in December. Upgrade of the Linac Coherent Light Source at SLAC, which we are doing, and upgrade of the storage ring light sources, and that is the Advanced Photon Source at Argonne and the Advanced Light Source at Berkeley.

We are already going forward with the Advanced Photon Source Upgrade, and we are talking with Berkeley Lab now about possibilities for going forward with the upgrade of the Advanced Light Source.

Mr. HONDA. Okay, great. So I sense that since we are on task than the concern is minimal.

Mr. DEHMER. I think my concern would have been much greater if we hadn't impaneled the Basic Energy Sciences Advisory Committee to do this study, come up with some very aggressive recommendations, and we followed those recommendations.

Mr. HONDA. Thank you.

Mr. ORR. But if I could just add to that, that the hard work that Pat and her team have done to keep us in the forefront here is very important, but there is no reason to be complacent. We will need to continue to make investments in the science user facilities over time. And, fortunately, Pat and her colleagues have put together a very disciplined process for evaluating the needs and then figuring out how to do it in an efficient way.

Mr. HONDA. In terms of investments, in the area of nanotechnology, I remember in 2003 I was one of the lead coauthors of the National Technology Research and Development Act that paved the way for the Federal Government's increased investments in nanotech, and had the pleasure of attending the groundbreaking and the dedication of the Molecular Foundry at Berkeley Lab. That was a lot of fun. I just didn't understand how that building stayed stable, it had a slope.

But it looks like nano research centers have made pretty good progress in producing world-leading science. I was just wondering if you could describe the benefits of these national scientific user facilities and what the future looks like for these centers and for nanoscale science at the DOE generally.

Mr. DEHMER. Thank you for the question. I am happy to do that. You were the distinguished speaker at the groundbreaking for the Molecular Foundry. I was there too. And I remember that day well. They were worried that it was going to be inclement weather and so the groundbreaking was inside, in a giant kitty litter box with dirt in it.

All five of our nanoscale science research centers, including the Molecular Foundry, are now done and operating. And basically they have exceeded expectations. We expected maybe 250 to 300 users a year. There are more than 500 or 600 users a year. The science is magnificent. The permanent staff at those institutions have really embraced the idea of working with the users to get the most out of the facilities. We are very, very pleased with that program.

Mr. HONDA. With the $3.7 billion initial grant that was signed out by President Bush in 2003.

Mr. SIMPSON. That was hard coming out, wasn't it? President Bush.

Mr. HONDA. I couldn't remember whether it was Reagan or Bush. I had to start thinking about my age.

Mr. SIMPSON. I am just kidding.

Mr. HONDA. The need for another infusion, could you talk a little bit about the necessity of a continuous infusion of grants for research?

Mr. DEHMER. Yes, I am happy to do that. The National Nanotechnology Initiative and the bill that you referred to I think are the most dramatic basic research investments that I can remember. The National Nanotechnology Initiative (NNI) and all of the things that surrounded it made an enormous difference in research in this country. The NNI, as it is called, has continued, continues today, with new and vital directions.

But I definitely agree with your statement that we need to continue to invest in material sciences, nanoscale science, mesoscale,

which continues at slightly larger dimensions. And we need to use the knowledge that we have learned over the last decade of the NNI to begin to design material from first principles and synthesize materials to exactly the specifications that we want.

This was not a onetime thing. Material sciences is incredibly important to this country. In fact, the Department of Energy is the largest investor in material science in the government because of the needs in energy.

Mr. ORR. Well, I was going to add, but Pat stole my thunder on the very last line there, that this is an example where the fundamental science of nanostructured materials is now finding its way through a whole variety of energy applications, many of which we didn't exactly foresee when we started that out. So it just illustrates the idea that good fundamentals will find applications and that we can use research needs on the application side to pick out good science problems to do.

And an example of that would be in the fundamental area of catalysis. Catalysts are used everywhere across industry. But we would love to be able to say, gosh, we need a catalyst that can do this. Once you have a really fundamental understanding of the properties of the materials you can come back and answer, here is a material that might actually do the job that you want by so-called materials by design. So there is a crosstalk there that is absolutely essential to our energy future.

Mr. HONDA. If I may, Mr. Chairman, last question.

Regarding health and health concerns at the nanoscale level, any activities or thoughts or comments you want to make in that area?

Mr. DEHMER. Well, we have actually taken a hard look at that right from the beginning, and our philosophy has been, if the material is uncharacterized, if we don't know the health effects, we treat it as though it could be dangerous. And so we are very, very conservative with nanoparticles that are uncharacterized, and, in fact, over the years the Department has put out secretarial directives to that effect.

Mr. HONDA. Thank you, Mr. Chairman.

Mr. SIMPSON. Mr. Fleischmann.

Mr. FLEISCHMANN. Thank you, Mr. Chairman.

And to Dr. Orr and Dr. Dehmer, thank you for your patience. We had our votes and we are back now.

I would like to start my comments by thanking both Dr. Orr and Dr. Dehmer for their support of the nuclear facilities operating funds at Oak Ridge National Lab in the Fiscal Year 2016 budget. I appreciate the Office of Science and the Office of Nuclear Energy for understanding the investment needed to maintain these facilities that support the various Department of Energy missions.

I would like now, though, to switch over to high-performance computing. I know we have discussed some of these things. But this is another one of the hallmarks of the Oak Ridge National Laboratory.

For a long time now I have been a supporter of the Advanced Scientific Computing Research program. I was very pleased to see the Fiscal Year 2016 budget request for this program and specifically the new investments to advanced exascale computing.

Mr. Chairman, I am pleased to support DOE's request in this area, but I wanted to raise one issue within the ASCR budget that I hope we can address, and that is Leadership Computing Facilities funding is down from fiscal 2015.

Dr. Orr and Dr. Dehmer, I think you would agree that to have a successful exascale program we need to continue our investment in our Leadership Computing Facilities.

I have got a four-part question. I asked the Secretary, but I would like to ask you also to speak to the value of the LCF program and how it relates to the broader exascale program.

Mr. DEHMER. The Leadership Computing Facility Program was begun in about 2007 in response to international competition in computing. It has catapulted the U.S. into a leadership position in high-performance computing. The two leadership computing facilities at Oak Ridge and Argonne are stunning examples of what can be done when you combine leading-edge hardware with a large investment in software capabilities.

Mr. FLEISCHMANN. Dr. Dehmer, can you explain how exascale differs from how today's supercomputers function?

Mr. DEHMER. Well, first, it is faster, but I think there is more to it than that. I think in going from where we are now at tens of petaflops, to exaflop computing, or exascale computing, it is no longer a linear transition. We have to invest in hardware that is far more energy efficient, and that requires significant investments in component technology. We have to invest in software, everything from the operating systems for these computers to middle-ware to disciplinary software, and that requires an enormous investment in talent and people.

And there are things about computing at the exascale that are different than computing at the petascale. There can be more errors in the output, and we have to figure out how to know when there are errors and correct for them. Because you can have not thousands or tens of thousands, but hundreds of thousands and a billion computers operating simultaneously.

So in moving from where we are now, from where Oak Ridge is now, from the next generation at Oak Ridge to the exascale requires a step function change in how we do business.

Mr. FLEISCHMANN. I think you have addressed the major technical hurdles and I appreciate that.

Dr. Orr, what does the Nation gain from a large investment in exascale computing? And what will we be able to do that we can't do now as a Nation?

Mr. ORR. Well, I said earlier and I will say it again now because it is so important that the ability to do this very large-scale computing underlies almost everything we do in the energy space. I will give you one example. We are entering a world with the grid where we will have many, many more sensors to tell us what is going on in the grid. We will have microgrids connected, we will have the ability to control which way power goes, and we will have a much more capable grid system to allow us to go forward.

But that also means we will have much more data, we will need to be able to compute the state of that system in real time, we can't quite do that today, and then we will need to be able to make management and operating decisions on a time scale that will require

both intelligent operators, but intelligent tools around them. Those kinds of challenges are ones that will demand computing power that this approach will allow.

In other areas, we talked a few minutes ago about the idea of materials by design, but the ability to compute the properties of materials from the very most fundamental descriptions of how they work, those are very demanding calculations. And if you are going to do them in the kind of design space that you would like to use, that will require them as well. And as I said before, well, even interpreting the experiments that come from something like the detectors at CERN in Europe or the Long-Baseline Neutrino Facility, those are big computational tasks as well.

So the ability to do absolutely high-performance computing is enabling across the entire space in which we they work.

Mr. HONDA. Would my friend yield for just a real quick comment?

Mr. FLEISCHMANN. Absolutely.

Mr. HONDA. This subcommittee has worked on this issue of increasing the size of wafers from 300 to 450 millimeters. And that kind of technology, is that the kind of technology that you are also talking about when you said hardware, increasing research in chip design and making them smaller, faster, more efficient, more efficient in terms of not creating heat, but being able to produce the heat consumptions, is that the kind of technology that you are looking at, that would be piggybacking on my friend's question?

Mr. DEHMER. Chip design is absolutely part of it. I don't know if wafer size is. I just don't know the answer to the wafer size question.

Mr. HONDA. Wafer size would be more competition, I guess.

Mr. ORR. But it is true that the energy-efficiency aspect is very important, as Dr. Dehmer said. If you just went to linear increases in power consumption, then it is untenable. We really have to redesign how we think about these massively, massively, massively parallel machines that use energy more efficiently. And then of course what gets developed there will find its way into all kinds of other stuff, you can be absolutely guaranteed.

Mr. HONDA. Thank you.

Mr. FLEISCHMANN. Thank you.

I have one final question that I would like to address to both of you. Dr. Orr and Dr. Dehmer, how do the major science facilities, such as the light and neutron sources, support American manufacturing, and how can we increase support for industry when building such projects? As a follow-up to that, the construction of large science facilities has often driven cutting-edge manufacturing. What science projects will require major construction, such as ITER or SNS, and will they help develop American manufacturing, either now or in the future?

Mr. ORR. So let me start in a general way and then Pat can fill in some specific examples.

While I was waiting for the Senate to vote on my confirmation I went to visit, well, as it happened, all 17 of the national labs. I had lots of time. And in doing that, I went to all the user facilities, and I was surprised to learn how many of the experimental stations were actually funded by industry or actually used by energy

industries or other industries because it gave them the capability to do measurements that were applicable to their business.

So I realized in that process that there is actually quite a lot of industry interaction at the light sources and that we can expect that to continue. There are two models. If it is all published information, then they can compete for time for machines like anybody else, any other scientist, but if they want to do proprietary stuff then they pay the full freight.

So there is already a good mechanism for including them, and I think we have seen lots of benefits from those relationships already.

If you want to then correct any lies and distortions in what I just said, it would be good to do that.

Mr. DEHMER. No. I will add, though, that I was involved in a lot of construction when I was heading the Basic Energy Sciences program, and that construction definitely uses U.S. labor and U.S. industry, conventional construction very significantly, but also high tech, magnets, superconducting cavities, and so forth. So there is a sizable involvement of industry.

The Leadership Computing Facilities have deliberately reached out to industry and are working very closely with them in all areas, in turbines, airplanes, combustion, and so forth. So I think we recognize the responsibility to reach out to industry and we are doing it.

Can I just get back to your original statement about the funding for the Leadership Computing Facilities in 2015 and 2016?

Mr. FLEISCHMANN. Please.

Mr. DEHMER. The reason for the decrease is that we invested heavily in 2015 to prepare those facilities to receive the next generation of computers. And so that funding was finished in 2015 to upgrade the facilities so they could receive the next computers.

Mr. FLEISCHMANN. Thank you, thank you.

Mr. Chairman, I yield back.

Mr. SIMPSON. Ms. Roybal-Allard.

Ms. ROYBAL-ALLARD. I would like to go back to a topic that we were discussing just before we had votes, and that has to do with ITER. In your comments you mentioned that Dr. Bigot had an action plan and that that action plan was endorsed by the ITER council.

My question is if you could elaborate on how the director-general's action plan addresses the ITER Management Plan recommendations and what specific improvements will you be looking for in 2015 and 2016? Also, if you could also comment if you share the concern that has been expressed by some U.S. policymakers and fusion research of the impact of ITER's funding on the availability of DOE resources for the domestic fusion program.

Mr. ORR. I imagine that both of us can respond to various parts of this question.

The plan that is in place so far that was proposed by Dr. Bigot lays out a series of additional steps to alter the way they do the management of the project and to work on sort of reconstituting the time line of the construction and taking a hard look at all the budget questions. That takes place over time, so the remainder of this year, those pieces come into place as they really assemble a

team that takes a very hard look at kind of every aspect of managing this extremely complicated construction project. And so the kinds of things that we will pay attention to are exactly those that were raised in the external review of the management issues there and of course all these timing and budget issues going forward.

Now, with regard to the balance of the program, Pat and her troops have done a very careful job of figuring out how to allocate resources across the various research areas and projects. And the budget we are recommending this year we think is a balanced approach to meeting both the international objectives and the domestic program.

And I would note also that there is not a hard distinction between the international and the domestic, because 80 percent of the contribution toward ITER is actually design and construction of components of the reactor that are done here in the United States, using the United States fusion teams. So there is sort of synergy amongst those and contributions across, and we think the budget recommendation this year is a good balance of those.

Mr. DEHMER. I don't have anything more to add.

Ms. ROYBAL-ALLARD. The President's budget, Director Dehmer, requests a funding increase of 5.1 percent for Workforce Development for Teachers and Scientists. As you know, in recent budget cycles there have been several changes to the federal science, technology, engineering, and mathematics education effort. What role can we expect the Department of Energy to play in STEM education and workforce development in future years, and how will the Department of Energy uniquely contribute to the federal STEM education portfolio?

Mr. ORR. Well, so I have to admit that I am too new to have a really detailed knowledge of that, so I can either take that for the record or perhaps Pat can comment in a way that can help us along that path.

Ms. ROYBAL-ALLARD. And any additional information you can submit for the record.

Mr. DEHMER. Okay. I am happy to talk a little bit about this, because about 4 years ago, when the director of the Workforce Development for Teachers and Scientists program left to take a different job I actually took the program over, so I have been managing it for 4 years.

We have structured that program in a way that is actually quite unique in the Federal Government. We put about 1,000 people a year at the DOE laboratories for summers, for semesters, or for longer. We have undergraduates who go to the laboratories as interns. We have graduate students at universities who spend from 3 to 12 months at the laboratory doing part of their thesis research. We have visiting faculty come to the laboratories for summers or for longer periods of time, many of whom come from minority-serving institutions.

And we believe that the Department of Energy laboratories are a unique way to increase the workforce for Department of Energy missions by bringing these people to the laboratories and introducing them to DOE labs and DOE science.

Ms. ROYBAL-ALLARD. Mr. Chairman, I have no further questions.

Mr. SIMPSON. Thank you.

I am always kind of fascinated by the Office of Science because it is a lot of stuff I don't understand.

Mr. ORR. Me too.

Mr. SIMPSON. Yeah. It is kind of baffling, isn't it?

I am going to ask you just a general question because I get asked this question all the time, and I will guarantee there will be amendments that are offered on the floor and all this kind of stuff. And it is not just what we do in the Office of Science, it is also you could say NIH, the National Science Foundation, all this other kind of stuff. And that is, why do we do it? Why does the government need to do it? Why isn't private industry doing it? Isn't this corporate cronyism or whatever you want to call it and all that kind of stuff? I mean, I have my answer.

I would like to hear your answer why we invest in these things. And if you talk to some of these people they will say, well, of course, if the government is going to do it why would private industry invest in it? But if we don't do it, then they will have to do it, because that is how they advance. Edison didn't need the Federal Government to invent the light bulb.

Mr. ORR. Yeah. So let me take a crack, with your permission of course.

Mr. SIMPSON. Sure.

Mr. ORR. And then I will ask Pat to chime in.

So the science and energy enterprise for the Nation should be based on a portfolio. And that portfolio certainly involves industrial applications. We have very capable energy industries that will do that. But it also should have the full spectrum that goes from the fundamental science, which we know from long history that investments in fundamental science will pay off eventually down the road a ways. But as you are doing the individual things you don't know which bits of the portfolio yet will be the ones that turn out to be most important. And in fact they will get woven together in interesting ways that it is very hard to foresee.

What is appropriate for the Federal Government is the fundamental research, the early stage investments in ideas that then eventually will find their way, compete their way into the energy marketplaces. So we really need all the players. We need the support that the Federal Government provides, but we also are going to need all the commercial and industrial actors at the other end. They typically have a focus, a time focus that sort of might be in the next 5 to perhaps 10 years, sometimes longer. But we really tend to focus on the things that will get applied over a spectrum of time.

Mr. ORR. So I think that you really need all those parts.

Mr. SIMPSON. So we are not trying to pick winners and losers?

Mr. ORR. No, in fact, we are trying to—you can kind of think about this is a—I don't know——

Mr. SIMPSON. You are trying to pick winners and losers in terms of technology?

Mr. ORR. Well, you can think of it as a—it may be a funnel is the right——

Mr. SIMPSON. Yeah.

Mr. ORR. [continuing]. That at the wide end of the funnel, you want as many ideas as competing as possible. And even as you

transition into potential technologies, they will develop at different rates. So sometimes, you know, something might be ready now for a big explosion in application, but others need some more development that involves—maybe you need another piece of invention that hasn't quite gotten there yet to put it all together, and then those will march through.

So this is anything but a linear process. It involves lots of looping and iteration and designers and thinking, but eventually, through that complicated process, we will get things that make it into the marketplace and contribute in a very big way. So, taken together, that portfolio aspect of it is important to a diverse and successful, stable energy system going forward.

Mr. DEHMER. Part of the portfolio aspect that was just described, has to do with the time horizon.

When I started, many of the industries had very robust basic research programs. Those are largely gone, save for a short term, and that means 5-ish years, maybe a little bit more. We have seen the demise of Bell laboratories, we have seen pharmaceutical companies change over their research so that they are investing in things that may come to fruition relatively soon.

So, the portfolio also has a time component to it. And industry just simply doesn't invest in things with very long-time horizons. And there is another component to the Office of Science, high-energy physics, nuclear physics, fusion energy sciences. There would be no one that would invest in that if it weren't for the Federal Government.

Mr. SIMPSON. And thank you for that answer.

How do I explain to—I mean, you are talking to people in this room that agree with what we are doing and know that we need to do more and that research and development is very important and what the Federal Government does is very important and so forth. Well, let's say I am an auto mechanic out in Idaho, or better yet, I am a dentist out in Idaho, since I was one of those, and I go to work and every morning and I drill and fill and bill and I pay my Federal taxes and everything. Why does it matter to me whether we have exascale computing? How do I explain that to your everyday taxpayer that is paying for all of this?

What does it mean to me? What do I get from this?

Mr. ORR. I would love to have a simple, straightforward answer for your question, but I don't. But I think we can say that we live in a complicated modern society, with energy woven through every aspect of it. The fact that we take it sort of for granted is partially the success of the enterprise that has taken the fundamentals of electricity and magnetism and turned it into a grid and motors and transportation and all those kinds of things. All of those are built on scientific underpinnings that were done, in those examples, sort of in as early as 20th century.

Mr. SIMPSON. Before there was a Department of Energy.

Mr. ORR. Before there was a Department of Energy, but with a world that was much smaller scale and much less sophisticated. And what we are doing now is preparing for all the kinds of advances that will make life still better and more secure and economically productive in the future. And that needs to be built on

the science that we will do now and we will continue to do in the future.

Mr. SIMPSON. What do you say to those people who say that we ought to do away with the Department of Education, the Department of Energy, and the other one I can't think of? Whoever that is.

Mr. ORR. I would say that, I do not think that would be in the national interest, that we will be better off if we can apply the science that we do for the betterment of mankind.

Mr. SIMPSON. Okay. Dr. Dehmer, the nuclear physics program in your office will likely face some difficult tradeoffs between major facilities in the near future. There are currently two construction projects within this program, the upgrades for the accelerator facility at Thomas Jefferson Lab in Virginia, and the construction of the facility for rare isotope beams at Michigan State University.

While these two construction projects continue, operations continue at Brookhaven National Lab to run Relativistic Heavy Ion Collider (RHIC). A flat or shrinking budget within the nuclear physics program simply may not be able to support all of the activities at their desired levels. While this year's request increases the nuclear physics program by $29 million, we have to think about priorities under a flat scenario.

Previous long-range plans have identified the upgrades at Jefferson Lab and the construction of the facilities for rare isotope beams as the highest priorities within nuclear physics. Under a flat-budget scenario, the long-range plans recommended shutting down RHIC. In a flat-budget scenario, does this prioritization remain the same?

Mr. DEHMER. No, I don't think so. This is absolutely the wrong time to close the RHIC. It is producing world-leading results. And, you know, I talked in my opening remarks about surprises; RHIC is producing surprises that we had never anticipated before. The quark-gluon plasma is a perfect fluid. And we never anticipated that we would see that. So no, this is the wrong time to close RHIC.

I am fighting very hard to dispel the recommendations of the previous NSAC report. In fact, we have another NSAC, long-range plan coming out in the fall of this year, and that will speak again to priorities in different budget scenarios. But the answer is, is it the right time to close RHIC? It is absolutely not the right time to close RHIC.

Mr. SIMPSON. Well, if you have to live within existing or shrinking budgets for nuclear physics, what do you think strikes the right balance in order to fund the priorities within the program?

Mr. DEHMER. So at this point we put in a request for the 2016 budget that we believe is the right request.

Mr. SIMPSON. But it is not a flat priority.

Mr. DEHMER. No.

Mr. SIMPSON. So you are saying you have no alternative if it ends up being flat?

Mr. DEHMER. I am saying, I am going to support that budget for nuclear physics.

Mr. SIMPSON. You support the President's budget, right?

Mr. DEHMER. I do.

Mr. SIMPSON. Oh, okay. I have heard that before. Thank you.

Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman.

I am going to take a little different tack here just for a second. We all look at life through prisms; sometimes they are from heredity, sometimes from geography, sometimes from opportunity, education, and our employment experiences. So we don't come here without these prisms that we look through.

When I was on the NSF Committee, I was amazed coming from my part of the country looking at the top ten universities around the country, over my entire career that have always gotten the bulk of money from the Federal Government. And so the prism I come from is one that—and a perspective I come from is that over the years, the Federal Government has made certain decisions and they kind of keep going the way that they started, for whatever reason, the history.

Recently, a Harvard scholar named Robert Putnam has written another book called "Our Kids." And his last book, "Bowling Alone," he became very famous. But his perspective is that, America really is dividing much more than in prior years, by class. But he defines class in a little bit of a different way: Those who have been highly educated and are able to manage in this very difficult economy; and those who simply have no hope, they just simply won't get there. And that divide is growing.

And the reason I mention that is, that the prospects of those of the majority of children being born will never have the opportunity to do what we are doing here today. I worry about that. It is one of the reasons that motivates me to office because I think this is a country created for all not just for some.

So as I look at the geographic location of the labs, I think to myself, what divide does that create and how do I get some of those resources to be directed to the places that are part of the other America? And I believe, and I have experienced living in our part of the country, you know, no labs—not that if they had been present we wouldn't have gone through what we have, but the tremendous loss of manufacturing jobs in the industrial heartland, to a point that our productivity has been seriously harmed and the average income of citizens going down about $7,000 over the last 15 to 20 years. That is a huge hit. And some have had a more severe hit.

So, my prism is, if I view the world that way, then I want to use every single asset I have to help lift the places that have endured the most harm. And how do I get the special preserves that exist in our country, to find those places and begin to ask the question how can we apply some of what we know, to help lift those places?

So one of my questions is, someone mentioned earlier today, and it might have been the other panel, but when this car was made by 3D manufacturing, additive manufacturing, where was that done?

Mr. ORR. Well, one of the companies, I believe, was actually located in Ohio, in Youngstown, although I might be mixing it up with the other—there is another advance composites outfit that I might not have that straight. But I know that there was an Ohio connection in one of those, and I think it was the 3D printing car.

Ms. KAPTUR. There is a Youngstown 3D additive manufacturing center.

Mr. ORR. Yeah, a manufacturing one yeah.

Ms. KAPTUR. I know that. But I am very interested in how the labs look at the universities that are out there in this sea of places that stretch all the way from Gary, Indiana, up to Buffalo, through the industrial heartland corridor that have been through—I just talked to the member from Rochester—hell. And how do we as a country provide more balance to the ship?

And so I am asking you, how does your budget advance the cause of these places, particularly those that have endured two-thirds of job loss, two-thirds, in the manufacturing sector? And I guarantee you, most of the universities that exist in that corridor probably aren't in receipt of big dollars from the Department of Energy nor from the NSF. I think there is a real opportunity for a prism to look through here and to use the rigor, the intellectual rigor you have to figure out ways to begin to reconnect and identify platforms for innovation in those places because they are so needed.

And I will say this also, if you look at those places, they are not centers of government. If you look in most of our States now, the places that are growing are the capital cities. The capital cities to me, just like Washington, are false creations. They are just there because of the productivity of the rest of the country. And so they are lucky. And you can sort of take comfort by fleeing there and living there, but really the productive wealth of the country is in these other places and we have to pay more attention there.

And so I am just asking you, in your budget, think about what kinds of effort you could make to better connect and thread through those places. It is hard for you, because you are segmented in so many different research centers, but there are nodes of opportunity there, but they don't have the sunk investment of these incredible minds and assets.

And it is likely, if you look at your budget, you are still building what is already there. You are not necessarily ferrying out to a new region that so desperately needs to be lifted economically, where you could really—you could make a major difference.

Mr. ORR. Well, I have a couple of reactions. Though I grant you that these are complicated problems and that it is unlikely that we will fix them entirely. One is that when we talk about things like the user facilities, those serve, I don't know, well it depends on who you count, but typically 22,000 science researchers and then maybe 31,000 including all the other actors, so those folks come from everywhere.

The reason we have these big-user facilities is so that not every university will ever afford them—you know, some of these—not any university will afford them, but they provide access to these machines. That is all done through proposal competitions. And Pat, I am sure, can give you plenty of statistics that these folks come from every kind of university. So, access and the ability to compete for time on those machines is one thing that we can and do provide.

Second of all, if we do our jobs correctly, then in the longer term, energy will be less expensive and everybody's—they will have an opportunity to use what resources they have in ways that can pro-

vide at least more of the access to the benefits that so many of us enjoy. And so the work that we do, even if not everybody can participate in doing the science work, we can provide benefits that do apply to everybody in the society.

And then we should work hard to make the communities in which we work much more inclusive, that is the educational side is something that Pat just addressed. And, you know, we have an assortment of programs that we hope will increase participation of minorities in energy work. And so here again, we need a portfolio of things that can help work on these problems.

Ms. KAPTUR. Doctor, you know, I just want to tell a story, okay. This is my moment to vent, but we learn by doing this. We mentioned earlier that for solar, the leading solar firm in our country was birthed in, of all places, Toledo, Ohio, at the University of Toledo. Not a major NSF grant recipient, nor a major DOE grant recipient. That is an amazing story. It is two Chinese companies and then first solar.

So I am out at Berkeley and visiting the lab, and as I am leaving the campus somebody says, see that site there? I said, yeah. They said, well, we are going to build $100 million solar facility there. I said, oh, what leading company comes out of here that even comes close to the one that I represent? And nobody answered. And I sort of left the campus saying, hmm, well, they have a lot here. And I am not against what they have, but I live in a place where we have had great innovation without the recognition of that kind of investment in a place that really needs it, the Detroit, Gary, Toledo, Cleveland, Pittsburgh, all the way to Buffalo, Rochester corridor.

I look at that and I go, what is wrong with us? Why doesn't the Federal Government see us? Why—you know, why do we have to go to California when, in fact, the innovation happened here and the manufacturing happened here?

So, I am interested in a more specific answer to the question on 3D manufacturing, even though Youngstown was involved, because I defy any Member of Congress to represent as many automotive companies as I do. There might be one somewhere.

But I say to myself: This matters, the manufacturing sector. I don't live in a capital city. I don't live where, you know, I don't have Harvard or Berkeley in my district, but I have got the Cruze, I have got the Jeep Wrangler. I mean all this stuff is happening in our region. I have got the Ford EcoBoost engine in our district. I look at all this and I am going, what is wrong with us? Why don't we get this kind of attention? What do we have to do to the Federal Government to say, hey, pay more attention here?

Because as you see those jobs come online, if we just had a little bit more help, do you realize what would happen for this country, with the manufacturing capability and the private sector, I call it the free enterprise zones of America, with just a little more attention? In regions that are not water short. But we don't somehow have the patina of some of these other places. And I am not jealous of the other places, but I am saying pay attention.

So, that is my message today to the Department of Energy. And I support your budget. I fight for your budget. I do it for the country. But then I say, what is wrong with us? We have tried hard.

We matter. Our people matter in this corridor. But we don't get the attention.

I can put on the record we have the smallest NASA center in the country. This isn't your fault. Right? But we have John Glenn and Neil Armstrong. Shouldn't we have the largest? We have the smallest. But we gave the country—they gave the country their lives. And I say to myself, what is going on here?

So the playing field is tipped, and I am just trying to make a very vivid point for you. Take your needle and start threading it through these places. I will send you a map and you can take a look at it and just think about it in terms of where latent productivity could happen based on the assets that are there, but we don't have some of your academic fire power.

And there is a way to do that and make it more easily available, and you will get more—you will get more bang for the buck there, if you just figure out a way to engage it. So that is my—you know, and I support the labs. Don't take this message the wrong way. But let's look at some of the places that can help solve the class divide that Dr. Putnam so ably describes in his book. And this is one way to do so it. Thank you.

Mr. SIMPSON. Thank you.

Thank you both for being here today. Some interesting stuff you guys work on. It is very important to the country. And I didn't mean by my questions to say I don't support it or anything. I just like to be able to answer the questions that come to me all the time. And you will see some of them on the floor during debate and during amendment debate. But thank you for what you do.

Thank you, Pat, for coming out to Idaho earlier.

Mr. DEHMER. My pleasure.

Mr. SIMPSON. Enjoyed our tour out there. And look forward to seeing you back out there. Thank you. Hearing adjourned.

QUESTIONS – SUBCOMMITTEE SET

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE COMMITTEE ON APPROPRIATIONS

Hearing
Department of Energy
Office of Science
Tuesday, March 17, 2015

STRATEGY AND PROGRAM MANAGEMENT

NEW FACILITIES COMING ONLINE

Subcommittee. Dr. Orr and Dr. Dehmer, several major facilities or upgrades are under construction and slated to come online in the next several years. These include the Linac Coherent Light Source-II at Stanford, the upgrade to the accelerator facility at Thomas Jefferson Lab, and the Facility for Rare Isotope Beams at Michigan State. These facilities promise cutting-edge science capabilities, but also will require hundreds of millions of dollars to operate.

Can you give us an overview of the new facilities coming online in the next few years, how they position our programs globally, and what scientifically they'll let our researchers and industries do?

Dr. Orr. The FY 2016 Budget Request supports investments in several new user facilities and major upgrades to existing facilities:

In Advanced Scientific Computing Research (ASCR), there is a substantial increase of $80 million to advance rapidly toward an exascale machine. Capable exascale computing will mean a thousand-fold increase in performance over today's systems when used for science applications important to the DOE mission and the High Performance Computing (HPC) scientific community. Exascale computing will address the next generation of scientific, engineering, and large-data problems, advancing the Department's science missions into the next decade.

In Nuclear Physics, the Facility for Rare Isotope Beams (FRIB) project at Michigan State University reaches the peak year of its construction funding profile in FY 2016. FRIB will provide intense beams of rare isotopes for research in nuclear structure and nuclear astrophysics. The 12 GeV Upgrade project at the Continuous Electron Beam Accelerator Facility is nearing completion at Thomas Jefferson National Accelerator Facility. This upgrade will provide unprecedented capability to illuminate the physical nature and internal structure of nucleons.

In Basic Energy Sciences, the Linac Coherent Light Source-II upgrade project at Stanford Linear Accelerator Center National Accelerator Laboratory (SLAC) reaches the peak year of its construction funding profile

in FY 2016. The request supports R&D for the Advanced Photon Source upgrade project at Argonne National Laboratory and the NSLS-II Experimental Tools (NEXT) Major Item of Equipment project to construct new beamlines at Brookhaven National Laboratory's newly operational NSLS-II x-ray light source. Each of these investments is focused on maintaining U.S. pre-eminence in the extremely competitive international landscape of x-ray science. These tools enable a wide range of research to understand matter and energy on the atomic scale – knowledge that is critical to innovation in many fields.

In High Energy Physics, the Request contains $20.0 million for the Long Baseline Neutrino Facility at Fermi National Accelerator Laboratory (Fermilab). This facility will reveal fundamental knowledge of the ubiquitous, yet mysterious, neutrino particle and will provide a measure of the amount of matter-antimatter asymmetry present in neutrino interactions, and in turn, why our universe consists primarily of matter and not antimatter. The Office of Science and Fermilab continue to work together to properly internationalize this project, following the recommendation of the P5 subpanel.

Subcommittee. As these facilities come online, you will likely be under a flat budget. Where will you find savings to pay for these new operating budgets?

Dr. Orr. The decades-long history of the Office of Science shows that both research programs and facilities have been terminated in order to pursue the most promising new investments in research, tools, and major facilities. Such transitions are made in both flat and increasing budgets. Recent budget requests demonstrate the Office of Science's willingness to make the difficult decisions to close long-running user facilities in order to realize new investments. Last year the Office of Science closed the National Synchrotron Light Source at Brookhaven National Laboratory and the Manuel Lujan Center for Neutron Scattering at Los Alamos National Laboratory; in recent years the Office of Science closed the Tevatron at Fermilab, the Holifield Radiation Ion Beam Facility at Oak Ridge National Laboratory, and the Intense Pulsed Neutron Source at Argonne National Laboratory. However, we believe that budgets with modest growth would provide the resources for the Office of Science to successfully deliver our highest priority investments in new and upgraded user facilities while continuing to serve today's mission needs.

Subcommittee. As budgets have tightened, it's become increasingly difficult over the last several years to meet all of the construction and operating budget needs for facilities across the Office of Science. It is especially difficult for us to make wise decisions when we have little context with which to analyze your budget proposal—something that makes little sense, given the multi-year nature of construction projects and operating budgets. Can we expect to see a five-year plan from the Department with its future construction needs?

Dr. Orr. In formulating its budgets annually, the Office of Science considers the long-range—5-to-10 year—impacts of facility construction and operations in a variety of budget scenarios. Maintaining balance among research, facility construction, and facility operations in the outyears is an important consideration as the Office of Science budget is developed.

OFFICE OF SCIENCE – U.S. IN THE GLOBAL CONTEXT

Subcommittee. Dr. Dehmer, the recently published strategic plan for U.S. particle physics, or the P5 report, specifically addresses investments the U.S. can make to remain a leader in an increasingly globalized science arena. Although the report focuses on particle physics, there are many parallels within other Office of Science program areas.

Since so much of cutting-edge science seems to rely on such expensive machines that often require contributions from many countries, how should we think strategically about positioning this country to maintain global scientific leadership?

Dr. Dehmer. We need to make a careful distinction between areas of science where international cooperation clearly serves the interests of all concerned, on the one hand, and areas of science where national economic competitiveness is at stake, on the other. Clearly, when it comes to fundamental discovery science at the Large Hadron Collider at CERN, or at a proposed Long Baseline Neutrino Facility in the United States, the P5 report is right to emphasize that international cooperation serves everybody's interest and is in fact increasingly essential as these facilities grow in complexity and cost. But when it comes to facilities such as supercomputers and large x-ray light sources, as well as facilities for areas such as nanoscience, nations and regions of the world are very much in competition with one another for the best facilities. That is because these facilities will ultimately translate into comparative economic advantage for the nations that deploy them. They help industry both directly and indirectly by advancing the scientific and technological base of those nations. So a strategy for maintaining U.S. global leadership in science must begin with a clear recognition of areas where international cooperation is of benefit to our Nation and our scientists versus areas of science and technology where we find ourselves in an increasingly challenging competition with other nations around the world.

HIGHEST PRIORITIES OF THE OFFICE OF SCIENCE

Subcommittee. Dr. Orr, it's clear from the increases provided in the Office of Science that construction increases, exascale computing, and optimal facility operations are the highest priorities for this account. The previous two years of flat funding for the Office of Science should give the indication that increasing baselines are not the reality. Trade-offs between running facilities at full capacity and researching new technologies will have to be made in the coming years.

Can you discuss the strategic future of the Office of Science given a flat budget scenario?

Dr. Orr. As discussed above in the answer to Q1(b), we believe that budgets with modest growth would provide the resources for the Office of Science to successfully deliver our highest priority investments in new and upgraded user facilities while continuing to serve today's mission needs. A scenario of continuing flat budgets will inevitably lead to trade-offs between termination of existing facilities and new investments.

Subcommittee. What are the Office of Science's greatest strengths and how can we improve them in light of flat funding scenarios?

Dr. Orr. The Office of Science's greatest strength has been sustained, robust investment in research to advance scientific knowledge essential to the Department of Energy (DOE) mission and the large-scale scientific tools at the DOE national laboratories to enable that research. The basis for this strength is our commitment to long term strategic planning with the scientific community to identify research opportunities, as well as Congress's history of consistent support.

The President's FY 2016 Budget Request makes significant investments across the entire Office of Science portfolio to maintain U.S. scientific leadership in a broad spectrum of disciplines. A scenario of continuing flat budgets will inevitably lead to a contraction of U.S. leadership in selected areas.

FUSION ENERGY SCIENCES

TEN YEAR VISION FOR FUSION

Subcommittee. Dr. Dehmer, in October the Fusion Energy Sciences Advisory Committee ("FESAC") developed a ten year vision for the future of the fusion energy sciences in the U.S. In order to provide a realistic assessment, the FESAC operated under three assumptions: modest budget growth, small budget growth, and a flat budget scenario. The request for Fusion Energy Sciences this year provides a ten percent cut. Dr. Dehmer, this Committee has grave concerns about how this proposal can meet any of the FESAC ten year vision recommendations.

Can you briefly describe the ten year vision that FESAC developed?

Dr. Dehmer. FESAC recommended emphasizing four scientific themes, each grounded in previous community and FESAC studies: 1) prediction and control of deleterious transient events in fusion plasmas, 2) taming the plasma-material interface in fusion devices, 3) validated whole-fusion-device modeling using high performance computing, and 4) an enhanced fusion nuclear science subprogram aimed at construction of a major fusion materials science facility.

These emphases, with some qualifications, are being included in the ten-year strategic plan for Fusion Energy Sciences (FES) that is presently under review within the Administration. The main points of the FES plan will be the following:

First, massively parallel computing with the goal of validated whole-fusion-device modeling will enable a transformation in predictive power, which is required to minimize risk in future fusion energy development steps. The Department's global leadership in high performance computing and planned investments in exascale computing presents a major opportunity to advance fusion science.

Second, materials science as it relates to plasma and fusion sciences will provide the scientific foundations for greatly improved plasma confinement and heat exhaust. The Department's wide-ranging expertise in materials science offers a platform for U.S. leadership in the emerging area of materials science related to fusion plasmas.

Third, research in the prediction and control of transient events that can be deleterious to toroidal fusion plasma confinement will provide greater confidence in machine designs with stable plasmas.

Fourth, continued stewardship of discovery at the plasma science frontier that is not expressly driven by the energy goal will address frontier plasma science issues underpinning great mysteries of the visible universe and will help attract and retain a new generation of plasma/fusion science leaders.

Fifth, FES facilities will be kept world-leading through robust operations and regular upgrades.

Although FESAC also recommended a major new fusion nuclear science facility, the DOE plan for fusion energy sciences research over the next decade does not include this, due to funding constraints. Instead, research in nuclear effects on materials (e.g., neutron irradiation) will be part of the fusion materials emphasis.

Subcommittee. Considering the request cuts the fusion program by ten percent, how does the future change under this scenario?

Dr. Dehmer. The President's FY 2016 Budget Request provides the resources to pursue the areas of importance outlined above.

Subcommittee. There were criticisms of the process that lead to the ten year vision for fusion. Are you doing anything moving forward to address the concerns?

Dr. Dehmer. After FESAC approved its strategic plan report last fall, the Fusion Energy Sciences (FES) program took a number of steps to listen to and address concerns raised not only about the process that produced the report, but also the report itself. FES led a discussion at a town hall meeting hosted by the University Fusion Associates at last October's annual meeting of the American Physical Society Division of Plasma Physics. FES introduced a plan to initiate a series of technical community-led workshops during 2015 in order to seek further community engagement and input for future program planning activities. Planning for five such workshops continued with discussions with community leaders late last fall. Three of these workshops correspond to critical areas identified in the *FESAC 2014* report as areas where increased emphasis would be beneficial as the fusion

program moves further into the burning plasma science era: namely, Integrated Simulations, Transients, and Plasma-Materials Interactions. Two more workshops will be held, both in the area of Plasma Science Frontiers (or "discovery plasma science," as it has been known), which received less attention in the *FESAC 2014* report. The output of these workshops will serve to inform and update the thrusts of the FES strategic plan going forward. FES is committed to vigorous community engagement in service to these goals.

AN INADEQUATE REQUEST FOR DOMESTIC FUSION

Subcommittee. Dr. Dehmer, this year's request decreases the domestic fusion program by $37 million, or 14 percent. These cuts will decrease run times at the major facilities, increase the backlog of experiments, and will result in fewer research grants made to universities.

Do you feel that this year's request allows you to support this nation's leadership role in fusion sciences while many other countries invest heavily? How can this Committee best support our domestic fusion program and its facilities?

Dr. Dehmer. The FY 2016 Congressional Budget Request for the Fusion Energy Sciences (FES) program is $420 million, which represents a small increase over the FY 2015 Budget Request of $416 million. The Department remains committed to long-term investment in fusion energy. The Budget Request for FY 2016 will support a program that has high impact, including world-class large-scale magnetic fusion facilities, vigorous and well-targeted international partnerships that leverage U.S. expertise, leading research in fusion high-performance computing and materials science, and a wide range of innovative university programs in the fusion and plasma sciences that serve the research needs of over 250 students nationwide.

DOMESTIC FUSION FACILITIES AT PRINCETON, GENERAL ATOMICS, AND MIT

Subcommittee. Dr. Dehmer, this year marks the ramping down of the fusion facility at MIT and the completion of a major upgrade of the NSTX user facility at Princeton. At the same time, the Department continues to support another fusion facility at General Atomics in California.

Can you describe how the Department's different fusion facilities complement each other's research?

Dr. Dehmer. The DIII-D, NSTX-U, and Alcator C-Mod tokamaks operate with different capabilities and plasma parameters that allow for comparison and validation of theoretical models across a range of fusion plasma conditions. Important complementarity resides in many areas, but a leading example resides between DIII-D and NSTX-U, which differ substantially in a parameter called "aspect ratio," or degree of compactness. Aspect ratio is central to a tremendous range of physical processes governing fusion plasma science, as well as to determining the ultimate cost of a future fusion energy system. Thus, DIII-D and NSTX-U being able to study similar plasma processes while at different aspect ratios provides uniquely powerful scientific leverage for U.S. researchers. DIII-D has plasma-facing components made entirely of carbon and utilizes both energetic neutral beam and microwave heating. Alcator C-Mod, the smallest device, has all metal plasma-facing components and two different radiofrequency heating systems. NSTX-U has the smallest aspect ratio, utilizes both neutral beam and radiofrequency heating, and conducts extensive research on the effects of lithium coatings on its plasma-facing components. A wide range of plasma conditions and dynamics can be studied with these complementary systems, thus enabling more effective and efficient validation and development of models in the quest for predictive understanding of fusion plasmas.

Subcommittee. How do these facilities fit into the global effort with or without ITER?

Dr. Dehmer. Our user facility capabilities are world-leading in several areas and create a foundation for international outreach. In addition, collaboration with international fusion facilities enables the extension of results to plasma regimes not accessible in U.S. experiments. The U.S. is

engaged in active collaborations in which methods and operational scenarios developed on the shorter-pulse U.S. tokamaks are being adapted for and tested on longer-pulse superconducting devices such as KSTAR in South Korea and EAST in China. In fact, U.S. scientists have demonstrated remote control of EAST from U.S. soil through a partnership with General Atomics in San Diego. Such collaborations will likely continue on other international devices, such as JT60-SA under construction in Japan, so that these techniques and operating regimes can be used to maximize the performance and scientific productivity of ITER when it begins operation. The larger size of the JET tokamak in Europe allows for further exploration of theoretical size scalings, and its ITER-like plasma-facing components motivate research in the U.S. on impurity transport into the core plasma.

The U.S. domestic research effort would remain largely the same with or without ITER because the U.S. efforts are predicated on longstanding, well-identified research needs to advance fusion energy science. These needs include the goal of continuing to refine and optimize the design of a future magnetic fusion research facility that can obtain burning plasma conditions.

SUPPORT FOR ITER

Subcommittee. Dr. Orr, I'd like to take a few moments to discuss ITER, the international fusion project located in France. This year's budget request of $150 million would provide the same level as fiscal year 2015. According to the project data sheets, the U.S. is 25 percent complete with its share of the project and has completed over half of the design phases for the technical systems the U.S. is responsible for delivering. There have been many management and technical challenges that have increased costs and extended the timeline for ITER's completion. These challenges have also prevented your office from being able to accurately estimate the total cost of the project.

Dr. Orr, when can we expect to see a new project baseline for the ITER project?

Dr. Orr. The 2013 Management Assessment report recommended a number of reforms and improvements at the ITER Organization. Two major recommendations were the accelerated appointment of a new Director-General and the creation of a resource-loaded schedule and baseline. A new Director-General, Dr. Bernard Bigot, was appointed on March 5 and has begun work on reforming the ITER Organization. He has also taken control of the preparation of the resource-loaded schedule and baseline, which is now expected in November 2015. We believe that it is critical for the Director-General to take full responsibility for developing the schedule in order for it to be credible.

Subcommittee. I think it's safe to say ITER is in a holding pattern at the moment. What has to change for the project to move forward?

Dr. Orr. The appointment of Dr. Bernard Bigot as the new Director-General fulfills a key recommendation of the 2013 Management Assessment. The new Director-General has undertaken a series of structural and management reforms that are already showing promise with regard to more timely execution of the project. While we are optimistic that these changes, as well as others planned for the near future, will have the effect of transforming the ITER Organization into a more effective and efficient construction management organization, we also recognize that these changes will take time.

Subcommittee. What is the consensus about the ITER project from the partner countries?

Dr. Orr. The other Members are in accordance with the U.S. position that ITER must improve performance and have accepted all of the recommendations from the 2013 Management Assessment. The ITER Members unanimously nominated and appointed Dr. Bernard Bigot as the new Director-General and gave him latitude to carry out necessary reforms in line with the Management Assessment recommendations.

Subcommittee. After decades of fusion research, the ITER project will generate energy on the scale of a sizeable commercial power plant—and, if successful, it will generate ten times more power than it takes to run it. This is significant step from today's fusion facilities towards commercial-scale generation.

Dr. Dehmer, I understand that ITER is still an experimental facility, not a power plant. Can you explain to us the ways in which that facility will not be a market-ready power plant?

Dr. Dehmer. ITER is designed and optimized to perform scientific research on fusion plasmas and to explore the engineering of fusion technologies. It has many features specifically designed to create and measure test fusion plasmas and to adjust performance through modifications of operating conditions. The results from these experiments will be used to optimize the design for a potential future demonstration fusion power plant, which will be more closely aligned to a production fusion energy plant. A key difference between ITER and a demonstration power plant is that ITER will not possess the ability to take the heat produced internally by the fusion plasma and use it for the generation of steam to drive turbines. Such "balance of plant" apparatus will not be part of the ITER installation nor are they part of any ITER plans.

Subcommittee. If ITER works as intended, what are the steps between ITER and commercialized fusion power, and at what cost?

Dr. Dehmer. The current roadmaps to commercialized fusion power acknowledge the need to develop one or more demonstration fusion energy power plants, and major facilities to create materials and components that can survive the harsh conditions of fusion reactor environments (e.g., burning plasma). The cost of a demonstration plant is not currently known, since much of the input to the design is dependent upon results from ITER, as well as from component testing and materials facilities, but is likely to be several billion dollars.

BASIC ENERGY SCIENCES

FLAT BUDGET SCENARIO

Subcommittee. The Basic Energy Sciences [BES] program budget consists of funding for research, the operation of existing user facilities, and the construction of new facilities and equipment. The long-term success of the BES program hinges on striking a careful balance among these three areas. However, the increasing level of research commitments, higher operating costs, and new construction make it difficult to adequately fund all three components within existing budget constraints. Anything short of a considerable increase for BES will force us to decide which activities or facilities to shrink — or in a few cases, which to terminate.

Dr. Dehmer, what are the top priorities of the BES program?

Dr. Dehmer. The highest priority for the BES program is construction of the Linac Coherent Light Source-II (LCLS-II) at SLAC National Accelerator Laboratory. LCLS-II is a key component of the BES strategy to advance its mission through construction and operation of world-class light sources. It will provide unprecedented x-ray properties for temporal control and energy resolution that will enable groundbreaking research in a wide range of scientific disciplines. LCLS-II will not just benefit a single field; it will advance a host of science from advanced materials to energy to life sciences.

Subcommittee. In a flat budget scenario, what would you propose to cut within BES?

Dr. Dehmer. The BES program supports a balanced portfolio of (1) forefront research in the sub-disciplines supported by BES in condensed matter and materials sciences, chemical sciences, geosciences, and biosciences, and (2) the operation, upgrade, and construction of a diverse suite of world-leading scientific user facilities comprising x-ray photons, neutrons, and electron materials probes as well as tools for nanoscale science. Each facet of this portfolio is essential to maintaining our international competitiveness in new materials discovery and chemical process control, which are the foundation for many applications of potential societal benefit. The FY 2016 President's Request supports a balanced approach that sustains these critical investments. Under a flat funding

scenario in FY 2016, BES would experience a reduction of over $115M from the FY 2016 Budget Request. A decrease of that magnitude would likely necessitate staffing reductions in our research portfolios and our user facilities at Department of Energy laboratories as well as a substantial decrease in the number of new and renewal university grants. It is also likely that a significant cut of available instruments and run time at the scientific user facilities would be required.

"LIGHT SOURCE" FACILITIES

Subcommittee. The recently completed National Synchrotron Light Source II at Brookhaven is one of the most powerful x-ray light sources in the world. While it's encouraging to see the completion of this project, the Office of Science also supports the continued operation of three other light source facilities at Argonne National Lab, Stanford National Lab, and Lawrence Berkeley National Lab. In addition to the continued support of these facilities, the Office of Science is also requesting the peak year of funding to construct a new light source facility at Stanford.

What is the US position relative to other countries when it comes to light sources?

Dr. Dehmer. Presently, the U.S. is regarded as a world leader in x-ray light sources. However, maintaining U.S. leadership is a significant challenge especially in view of the fast-paced and substantial recent investments by governments in Europe and Asia.

The Basic Energy Sciences (BES) program currently operates five x-ray light source user facilities: the Stanford Synchrotron Radiation Laboratory (SSRL) and the Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory, the National Synchrotron Light Source-II (NSLS-II) at Brookhaven National Laboratory, the Advanced Light Source (ALS) at Lawrence Berkeley National Laboratory, and the Advanced Photon Source (APS) at Argonne National Laboratory. Four of the BES light sources are storage ring-based sources. The LCLS is an x-ray free electron laser (XFEL) based upon a linear accelerator. The measurement capabilities and properties of the x-ray light at each of these sources – the "colors" of the light, its temporal and spatial qualities, and brightness – is distinct; each facility therefore is particularly adept in certain areas of scientific research and less well-suited in others.

The 2013 BES Advisory Committee report on *Future X-ray Light Sources* established clear recommendations for the future strategic investments in U.S. light sources, based on identified scientific opportunities, recent advances in accelerator technology, and the landscape of international competition. Based on this report, BES is pursuing upgrades for the LCLS and the APS light sources; brief justifications and background are provided below.

Shortly after LCLS began operations in 2010 as the first XFEL, international competition intensified significantly. Japan's hard x-ray FEL successfully produced its first beam of x-ray laser light on June 7, 2011. The European X-Ray Laser Project XFEL started construction in early 2009 in the Hamburg area in Germany; commissioning will begin in 2017. Other competing XFEL efforts will come on line in South Korea in ~2016 and Switzerland in ~2017. To stay competitive with the foreign XFEL facilities currently under construction in Asia and Europe, the LCLS-II project will provide a new world-leading high repetition rate x-ray free electron laser source.

It has been nearly 20 years since APS started its operations. APS is one of the three high-energy "hard" x-ray synchrotron sources in the world; the other two comparable sources of similar vintage are in Germany and Japan, both of which have already started major upgrade projects. Since then, many new storage-ring-based light source facilities have been constructed with newly developed advanced technologies. Advanced storage ring synchrotrons have just been completed in China and Taiwan. There are more advanced storage ring based light sources being planned in Europe, India, and Brazil. The APS Upgrade (APS-U) project will deliver three orders of magnitude enhancement in brightness with unprecedented coherence. The project will enable the U.S. to sustain leadership in hard x-ray science in the coming decades.

In view of this fierce competition worldwide, the Administration believes that the current upgrade projects are a high priority, lest we risk falling behind in sustaining what has proven over decades to be a critical component of the Nation's infrastructure for scientific and technological innovations.

Subcommittee. Dr. Dehmer, can you describe how these light sources differ from each other and how they advance science and U.S. leadership?

Dr. Dehmer. The BES light sources are indispensable tools for the exploration of matter. These versatile light sources provide researchers with x-rays with a wide range of wavelengths capable of probing material structure as small as individual atoms and molecules (10^{-7} mm) and as large as biological cells (10^{-3} mm). They are important tools for research in materials science, physical and chemical sciences, metrology, geosciences, environmental sciences, biosciences, medical sciences, and pharmaceutical

sciences. Many unexpected scientific communities, such as forensic science and archaeology, are also exploring opportunities to use them in their research. There are many exciting scientific achievements, including four Nobel Prizes, based on experimental results from using BES light sources since 2003. In FY 2014, the BES light source facilities supported 12,000 users, including academic, industrial, and government researchers from every state in the U.S. as well as foreign users seeking access to these unique research tools.

There are significant differences in the measurement capabilities and x-ray light characteristics at each light source facility. One principle to keep in mind is that to understand the structure and function of any material or chemical process typically requires precise measurement of the elements that make up that material; to "see" an individual element requires a particular "color" of x-ray light that resonates with that element. As a high energy hard x-ray source, the Advanced Photon Source emphasizes x-ray scattering more than imaging and spectroscopy. The Advanced Light Source, a low energy light source, emphasizes imaging and spectroscopy in the soft x-ray region. Stanford Synchrotron Radiation Lightsource is a medium energy light source predominantly with beamlines dedicated to x-ray scattering and spectroscopy. The National Synchrotron Light Source-II will provide new capabilities with unprecedented spatial and energy resolution, especially for x-ray imaging. The Linac Coherent Light Source is the world's first hard x-ray laser; its x-rays, which arrive in incredibly short, incredibly intense coherent bursts, are qualitatively very different from the ring-based sources. LCLS has opened up an entirely new area of stroboscopic x-ray research in which scientists use its staccato laser pulses to reveal the rapid atomic-level changes at the heart of a variety of dynamic physical phenomena.

Subcommittee. In particular, can you describe how this research is utilized by the private sector?

Dr. Dehmer. The BES light sources are an important tool for industrial research and development in a variety of sectors. For example, General Electric employed the in-situ diffraction technique to study their new "Durathon™" sodium metal halide battery; Visteon used ultrafast synchrotron x-ray full-field phase contrast imaging technique to reveal instantaneous velocity and internal structure of optically dense fuel sprays. Nitinol Devices & Components, Inc, a medical device maker, used

synchrotron x-ray imaging techniques to understand the effects of microstructure on the stability and lifetime of super-elastic stent scaffolds.

The BES light sources also contribute to advances in cancer drug research and development. Eli Lilly used unique scientific capabilities at the light sources in its development of potentially lifesaving drugs by examining protein structural information, for example, in methylation enzymes that play important roles in cell signaling. AstraZeneca studied the enzyme structure that affects the pathway of producing bacterial DNA to guide the development of novel compounds for the treatment of drug-resistant infections. Plexxikon developed a new skin cancer drug (vemurafenib) based on structural information determined at BES light source facilities of a mutated protein. Most recently, Genentech studied protein structures to understand the mechanism of action of a newly developed anticancer drug (onartuzumab) to evaluate its effectiveness in clinical trials.

BES user facilities provide advanced capabilities and in-house expertise to play an important and unique role in advancing the Nation's science in basic and applied research. Our industrial users employ a variety of x-ray techniques such as macromolecular crystallography, powder diffraction, absorption spectroscopy, and small angle scattering are regularly used by industry to advance their research and products. Other sophisticated experimental techniques such as in-situ diffraction, stress and strain measurements, and imaging are also being used to make significant contributions to U.S. industrial research and development needs.

ENERGY FRONTIER RESEARCH CENTERS

Subcommittee. *The Energy Frontiers Research Centers are multi-disciplinary centers designed to bring together teams of investigators to focus on complex energy research that goes beyond the standard research awards. An open recompetition of the program took place in 2014 and changed the funding terms from five years to four years and added mid-term reviews.*

In 2014 the initial five year period of the Energy Frontiers Research Centers (EFRC) program the Office of Science decided to hold an open competition for a second round of the EFRCs. Of the original 46 EFRCs, 22 were renewed for a second round and ten new EFRCs were created.

How does the EFRC model advance basic energy research in a way not covered by other research awards in Basic Energy Sciences?

Dr. Orr. The EFRCs support multi-disciplinary teams of investigators to perform energy-relevant, basic research with a scope and complexity beyond what is possible in typical BES single-investigator or small-group awards.

The EFRCs involve partnerships among universities, national laboratories, nonprofit organizations, and for-profit firms to conduct fundamental research focusing on one or more "grand challenges" and use-inspired "basic research needs" identified in major strategic planning efforts by the scientific community. By design, EFRC's lend themselves to benefit directly from the collaborative team approach and the scientific problems tackled by EFRCs require interdisciplinary expertise and capabilities. Through well-defined missions and goals and strong central leadership, EFRC's integrate the talents and expertise of leading scientists spanning several disciplines in a setting designed to accelerate transformative research toward meeting our critical energy challenges.

Subcommittee. One of the features of the second round of the EFRCs is the awards cover four years instead of five and they are subject to a mid-term review. How do you intend to measure the success of each EFRC when you conduct the review?

Dr. Orr. BES intends to conduct an external peer review during the second year of the four-year awards to assess the scientific progress of each EFRC. As part of the review, each EFRC will submit written review documents that will be evaluated by BES program managers and external peer reviewers. The review will consist of a combination of mail reviews and in-person panel reviews. The review criteria will largely parallel the review criteria in the 2014 EFRC Funding Opportunity Announcement, with additional consideration on assessing the progress of each EFRC toward their stated scientific goals.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

EXASCALE COMPUTING

Subcommittee. The "Exascale initiative" is a major thrust of the Office of Science in this year's request. It's hard to imagine but exascale computers would be about one thousand times faster than today's fastest systems.

Dr. Dehmer, can you briefly explain how exascale computing differs from how today's supercomputers function?

Dr. Dehmer. The most important way in which exascale computing will differ from today's high performance computing is in its capability to support modeling and predictive simulation with a fidelity and accuracy not yet seen.

Another difference has to do with how exascale computers will operate and the new technologies needed to deliver greater computing capabilities. Over the past several years, the Department of Energy (DOE) has become aware that future-generation systems will require significant changes in how high performance computers are designed and developed.

Historically, improvements in supercomputer performance followed along the curve of "Moore's Law" and Dennard scaling, which said that microprocessors doubled their performance roughly every 18 months.

It was known that this rate of performance improvement could not continue indefinitely; the increasing energy requirements were becoming prohibitive and the need for improved energy efficiency is a key factor driving the need for change in the way DOE acquires supercomputers.

The exascale designs being proposed by DOE, in conjunction with industry, will increase the levels of massive parallelism to levels the high-performance computing (HPC) user community has never experienced.

Subcommittee. What are the major technical challenges?

Dr. Dehmer. The most critical challenges include:

Reducing power requirements - Sustainability of operations costs requires a radical shift in overall energy consumption and new technologies for efficiency;

Coping with run-time errors - Ensuring that systems will continue to execute correctly through common component failures and other kinds errors;

Exploiting unprecedented levels of parallelism - New tools for data management and programming languages are essential to ensure the usability of the new machines and ensure that users can take advantage of the staggering new capabilities; and

Maintaining balanced systems - This includes ensuring a balance among computation, data storage, and data flow. Memory technology, for example, is not advancing as fast as processors but memory is vitally important to scientific and engineering applications therefore, we need to develop exascale (and beyond) architectures that preclude memory from becoming the bottleneck.

In 2014, the Advanced Scientific Computing Advisory Committee, reviewed these challenges and identified ten technical approaches to addressing them. Thus, the Department's approach to overcoming these challenges is to address not simply a single, albeit, exceptional computing performance goal, but rather, to set the U.S. on a new design trajectory of a broad spectrum of computer technology capabilities over the succeeding years. It is critical that we do this to build a sustained future of achievement and competitiveness that will extend well beyond the current targeted exascale platforms and beyond the Department's applications.

Subcommittee. Dr. Orr, what does the nation gain from a large investment in exascale computing – what will we able to do that we cannot today?

Dr. Orr. The Secretary's Advisory board, in their Report of the Task Force on Next Generation High Performance Computing, identified several needs for exascale or the next generation of high performance computing systems. For instance, coupling increased capability for traditional modeling and simulation with the capability for big data analytics in an exascale system will provide new capabilities and understanding by allowing us to study several "what if" scenarios. The exascale systems that result from this

investment will make possible real-time regional weather forecasting, innovations in advanced manufacturing, highly efficient disaster recovery planning, and major new advances in science and engineering.

Our exascale investments will ensure that we maintain our lead in high-performance computing and large-scale data analysis, and thus our competitive advantage in a wide array of sectors in basic science, national defense, and economic prosperity, including energy, health care, space, transportation, education, and information technology. Furthermore, maintaining our technological lead will safeguard us from vulnerability to cyber-security and computer supply chain risks that could be posed by other nations.

HIGH ENERGY PHYSICS

FUTURE OF HIGH ENERGY PHYSICS

Subcommittee. Dr. Dehmer, with the discovery of the Higgs boson in 2012, we have heard talk of moving beyond the standard model of physics and into a new frontier of high energy physics. I'd like to take a moment to understand how this new frontier of science will be supported here in the U.S. and with our participation in international projects. The large hadron collider at CERN will be the locus for many of these new experiments but limits exist in its ability to detect dark matter.

Can you describe, in broad terms, what has changed with the discovery of the Higgs boson?

Dr. Dehmer. The recently discovered Higgs boson is a form of matter never before observed, and it is mysterious. U.S. particle physicists play leadership roles in the global effort to understand the Higgs boson and use it as a new tool for discovery. They are driven by deep questions about our universe, including: What principles determine the Higgs boson's effects on other particles? How does it interact with neutrinos or with dark matter? Is there one Higgs particle or many? Is the new particle really fundamental, or is it composed of others? The Higgs boson offers a unique portal into the laws of nature.

In the Standard Model of particle physics, the Higgs boson is uniquely responsible for generating the mass of fundamental particles and it affects many Standard Model predictions. Some models of new physics predict more than one type of Higgs boson or additional particles that would interact with the Higgs boson. By precisely measuring the Higgs boson's properties, researchers will be able to establish its exact character and discover if there are indications of new physics beyond the Standard Model.

Subcommittee. The large hadron collider will begin its second run this year after a period of upgrades. How will these upgrades be used to push forward this new frontier of high energy physics?

Dr. Dehmer. The U.S. has made key contributions to the Large Hadron Collider (LHC) at CERN and the experiments it serves, and our scientists play leading roles in the associated scientific collaborations. The

LHC was recognized in the recent high energy physics long-term strategy report as a core part of the U.S. particle physics program, since it presents unique physics opportunities including being the only facility currently capable of producing the Higgs boson.

Since the discovery of the Higgs boson, experiments at the LHC have continued to actively measure the particle's properties and results thus far have strongly indicated consistency of the Higgs boson with the Standard Model picture. The second run of the LHC will provide data that will allow researchers to measure the Higgs boson's properties with greater precision. Through such studies, scientists will be able to establish the particle's exact character and discover if there are additional effects that are the result of new physics beyond the Standard Model.

Subcommittee. What kind of experiments will be necessary to increase our knowledge of this new frontier? What are the plans to utilize U.S. facilities in pursuit of this knowledge?

Dr. Dehmer. The recent long-term strategy report identified five compelling lines of inquiry that show great promise for discovery in particle physics:

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles

The long-term strategy report did not prioritize these drivers because they are intertwined, perhaps more deeply than is currently understood. The report also recognized that to address the most pressing scientific questions and maintain its status as a global leader, the U.S. must both host a unique, world-class facility and be a partner on the highest priority facilities hosted elsewhere.

The long-term strategy report presented a comprehensive strategy aimed at addressing these science drivers and enabling discovery. Strong U.S. participation in the LHC program, including its planned upgrades, is a key element in that strategy. The strategy also calls for the U.S. to host a world-

leading neutrino program that leads to an international long-baseline neutrino facility. The strategy further envisions investments in a mix of large, medium and small projects that will produce scientific results continually over a twenty-year time frame, including investments in dark matter direct detection experiments, experiments that study dark energy, and precision experiments involving muons.

INTERNATIONAL SHIFT OF LONG BASELINE NEUTRINO EXPERIMENT

Subcommittee. Dr. Dehmer, this past May the High Energy Physics Advisory Panel released its ten year strategic plan for high energy physics in the United States with a special focus on global context. One of the major recommendations of that panel is to rescope the Long Baseline Neutrino Experiment into a facility with international project support.

Can you explain the current plan and walk us through the new proposal changes?

Dr. Dehmer. The U.S. high energy community has responded swiftly to the long-term strategy report's call for an internationalized long-baseline neutrino facility, using the highly successful model of the LHC as a foundation for their efforts. Fermi National Accelerator Laboratory (Fermilab) has developed a plan to work with international partners to establish a world-class Long Baseline Neutrino Facility (LBNF) that will be capable of providing the megawatt-class beam power necessary to produce the intense neutrino beam called for in the strategy report. Fermilab has taken the lead in organizing a series of meetings between the U.S. neutrino community and interested international partners. That effort has culminated very recently into a proposed reformulation for organizing the internationalized project, which will include LBNF for construction of experimental facilities at Fermilab and South Dakota, and the Deep Underground Neutrino Experiment (DUNE) project which will deliver the detectors that will be installed at Fermilab and South Dakota.

Subcommittee. If your office determines to rescope this project, how will your office reach out to international partners and determine the different project support roles?

Dr. Dehmer. Fermilab will play a leading role in coordinating with international partners to successfully achieve the world-leading neutrino program envisioned by the long-term strategy report. Management and coordination will be modeled on the practices in use by CERN to manage the partnerships that make the LHC and its experiments a success. Participating international partners will have the flexibility to oversee management of their in-kind contributions, and DOE contributions will be

managed through our standard and successful project management practices and critical decision milestones.

Subcommittee. How would this new focus change the cost profile of the experiment?

Dr. Dehmer. The swift establishment of the international DUNE project is a strong indication of the high level of interest from the neutrino community in achieving this global vision. Progress has been much faster than envisioned when the long-term strategy report recommended this significant change in direction in late May 2014. Serious discussions with international partners began immediately, and Fermilab organized and coordinated a series of meetings that brought together interested scientists from around the world and potential international partner agencies. Over the remainder of 2014, international governance documents were drafted and presented to Fermilab. In January 2015, the new international collaboration held its first meeting and by March 2015, they had elected new spokespersons and established a new identity as DUNE.

We are planning a "refresh" review of DUNE to assess the rapid progress that has been made in bringing together the international neutrino community. The outcome of this review and the status of our international agreements with interested partners will inform any updates to the cost estimate and spending profile for this project.

COSMIC FRONTIER AND OTHER HIGH ENERGY PHYSICS EXPERIMENTS

Subcommittee. The Cosmic Frontier of the High Energy Physics program has produced significant contributions to experimental physics made possible by the unique capabilities offered by our national labs. One recent achievement is Dr. Saul Perlmutter's work on the accelerating expansion of the universe, which won him the Nobel Prize. By using supernovae as yardsticks to measure the geometry of the universe, Dr. Perlmutter discovered that galaxies are moving away from one another faster now than once were. These results went against the long-held notions that the universe was either contracting or, at the very least, slowing its expansion, and initiated new lines of research into a new force called 'dark energy.'

Most programs in the Office of Science have a number of large experimental facilities or systems. Setting aside the Long Baseline Neutrino Experiment, what other operating or upcoming major experiments are keeping our High Energy Physics community relevant on the world stage?

Dr. Orr. The recent long-term strategy report for U.S. particle physics presents opportunities at the small, medium, and large investment scales that, together, produce a continuous flow of major scientific results throughout a twenty-year timeframe. Time-ordered highlights include:

Continued participation in the highly successful LHC program, including the planned upgrades that will significantly extend its discovery potential;

The Muon g-2 and Muon-to-electron Conversion (Mu2e) experiments at Fermi National Accelerator Laboratory (Fermilab), which provide complementary ways of exploring the unknown for signs of new particles and interactions;

A coordinated set of short-baseline neutrino experiments that will address the observed anomalies in current neutrino experiments while advancing the R&D necessary for LBNF and DUNE;

The next-generation dark matter direct detection experiments, jointly selected by the Department of Energy and National Science Foundation to include the Axion Dark-Matter eXperiment Generation 2 (ADMX-Gen2),

LUX-Zeplin (LZ), and Super Cryogenic Dark Matter Search at SNOLab (SuperCDMS-SNOLab);

The continuation of the dark energy program, moving from the current generation of experiments to the Large Synoptic Survey Telescope (LSST) and the Dark Energy Spectroscopic Instrument (DESI);

An advanced cosmic microwave background experiment sensitive to the early expansion phase of the universe;

Along the way, investments in a portfolio of small projects would allow U.S. particle physicists to address timely physics topics in a manner that yields opportunities for a broad exposure to new experimental techniques, provides leadership roles for young scientists, and allows for partnerships among universities and national laboratories.

NUCLEAR PHYSICS

SETTING PRIORITIES IN NUCLEAR PHYSICS

Subcommittee. Dr. Dehmer, the Nuclear Physics program in your office will likely face some difficult tradeoffs between major facilities in the near future. There are currently two construction projects within this program: the upgrades to the accelerator facility at Thomas Jefferson Lab in Virginia and the construction of the facility for rare isotope beams at Michigan State University. While these two construction projects continue, operations continue at Brookhaven National Lab to run RHIC [pronounced "RICK"]. A flat or shrinking budget within the Nuclear Physics program simply may not be able to support all these activities at their desired levels. While this year's request increases the Nuclear Physics program by $29 million, we have to think about priorities under a flat scenario.

Previous long range plans have identified the upgrades at Jefferson Lab and the construction of the facility for rare isotope beams as the highest priorities within Nuclear Physics. Under a flat budget scenario, the long range plans recommend shutting down RHIC. In a flat budget scenario, does this prioritization remain the same?

Dr. Dehmer. The Office of Science planning, and FY 2016 Budget Request, is based on continued operations at the Relativistic Heavy Ion Collider (RHIC) because the RHIC facility science program has a profound impact on the international field of heavy-ion physics and its science mission remains vital while the properties of the new state of matter discovered at RHIC – the "perfect" quark-gluon liquid – are being determined. RHIC is a unique discovery tool – no other facility worldwide, existing or planned, can rival its range and versatility.

The Nuclear Science Advisory Committee's recommendation for triage of the 2007 Long Range Plan for Nuclear Science under severe budget constraints was based on flat funding from the FY 2013 appropriation, which was 8.7% below the FY 2014 appropriation, 12.7% below the FY 2015 appropriation, and 16.8% below the FY 2016 President's Request. The Committee also noted that excising any one part of Nuclear Physic's facilities would, "be a significant loss to the U.S. in terms of scientific accomplishments, scientific leadership, development of important new applications, and education of a technically skilled workforce to support

homeland security and economic development," and that, "It would be a disaster for U.S. nuclear science –a clear short term problem that would likely be the start of a longer term decline of the field as a whole."

Subcommittee. If you have to live within existing or shrinking budgets for Nuclear Physics, what do you think strikes the right balance in order to fund your top priorities within this program?

Dr. Dehmer. Our priorities for Nuclear Physics (NP) are to complete the 12 GeV Upgrade, construct the Facility for Rare Isotope Beams, optimize the operations of scientific user facilities, and optimize the support of research at universities and laboratories. The FY 2016 Budget Request for NP strikes an appropriate balance to support these priorities.

ISOTOPES PROGRAM TRANSITION TO OFFICE OF SCIENCE

Subcommittee. Several years ago, the Department of Energy transitioned all isotope production programs to the Office of Science—a transition that was ordered by the Congress a number of years prior.

Is the Office of Science working to ensure that commercial isotope producers have a direct working relationship with user facilities on day-to-day operational matters as it continues its effort to coordinate isotope production activities across the DOE complex?

Dr. Orr. The Department of Energy (DOE) Isotope Program maintains close communication and coordination with isotope customers through frequent discussions with the National Isotope Development Center (NIDC) and by semi-annual meetings between customers and Office of Science and NIDC staff. Management of day-to-day operations necessary for the production of isotopes is the responsibility of the National Laboratories; activities at National Laboratories are not managed by outside organizations. To ensure fair business practices and the equal treatment of all customers, communications with customers regarding isotope production are handled by the NIDC and its Isotope Business Office (IBO), located at the Oak Ridge National Laboratory; customers have expressed satisfaction with the responsiveness and effectiveness of the NIDC/IBO in coordinating isotope production activities at the various National Laboratories. It is essential that communications go through the NIDC/IBO since isotopes are produced at multiple National Laboratories for multiple customers.

Subcommittee. The office is authorized to charge its customers fees to recover its costs. I am told that it also imposes an additional surcharge to all or most customers, which the office says is to pay for infrastructure across all isotope facilities. Do you believe the pricing, including the surcharges, is well-justified and fair to both the taxpayers and isotope customers?

Dr. Orr. There is no surcharge for infrastructure. The "surcharges" in the price of an isotope are small fees to provide contingency to cover isotope production cost variability and operation of the NIDC, which manages isotope sales. The added fees are calculated as a percentage of isotope production costs and are currently 4% for contingency and 6% for the NIDC. These fees, essential to the viability of the isotope program business model, are required in order to ensure that the program can maintain full cost

recovery for commercial isotope production. Research isotopes are sold at a reduced price to ensure high priority research requiring them does not become cost prohibitive, and does not include the 10% fee. Given that the DOE Isotope Program is typically producing unique and/or "boutique" isotopes, with innovative technical approaches at complex Government facilities, we believe a 4% fee for production cost variability is well justified, as is the modest fee to support the customer and contractual activities of the NIDC.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

BIOFUELS RESEARCH AND THE BIOENERGY RESEARCH CENTERS

Subcommittee. Dr. Dehmer, the Department is currently supporting three Bioenergy Research Centers in their second five-year term. These centers focus on the basic science needed to develop cost-effective biofuels. By all accounts, these centers are producing good research and driving the science that can help to reduce our dependence on imports and address high gas prices.

Can you bring us up to date on the research progress at these centers and other related research at the Office of Science? How close is the science to delivering cost-effective biofuels from non-food crops?

Dr. Dehmer. The Bioenergy Research Centers (BRCs) continue to make progress on the basic science needed to underpin a burgeoning biofuels industry such as the development of dedicated bioenergy crops, sustainable practices for bioenergy crop production, efficient methods to deconstruct a broad variety of biomass to its chemical components, such as cellulosic sugars and aromatic compounds from lignin, and new biotechnology methods to engineer microorganisms to cost effectively convert biomass components to a broad range of biofuels and bioproducts. The research is progressing very well but the challenge is complex and immense. While the BRCs have demonstrated how basic science can lead to development of a few bioenergy crops, more are needed. Future broad development of bioenergy production from biomass will require several types of crops adapted to different geographical regions. Deconstruction methods will need to be improved or refined to be feedstock agnostic, cost effective and able to produce several product streams from biomass for later downstream conversion to a range a biofuels and bioproducts. Likewise a broader range of platform microorganisms will be needed to not only demonstrate new and efficient pathways to biofuel production but to develop a metabolic engineering basis to produce a range of bioproducts from biomass. As the ability to produce more types of products from biomass, in addition to biofuels, increases so does the overall cost effectiveness of the entire process. The BRCs are laying a basis to more cost effectively use renewable and sustainable resources to produce a range of fuels and products that are currently produced from petroleum. The science is progressing very

well. We can produce a range of fuels and products from biomass in the lab, and this has been shown in small scale pilot projects but broader scale-up of these techniques to production scale, particularly in the private sector, is influenced by a host of additional economic and/or market-based factors. However, with several cellulosic plants now in operation in the U.S., the ability to test new methods for full scale production of cellulosic biofuels is now possible and will pay dividends for future bioenergy development in this country.

Subcommittee. How do these centers interact with other government funded work, for example the Department of Agriculture? Is this duplicative?

Dr. Dehmer. The Biological and Environmental Research program (BER) does coordinate with other entities engaged in bioenergy research both internal to the Department of Energy (DOE) such as the Office of Energy Efficiency and Renewable Energy (EERE), Advanced Research Projects Agency – Energy (ARPA-E) and the Basic Energy Sciences (BES) program and external to DOE such as the U.S. Department of Agriculture (USDA). Research results from the BRCs are regularly shared with these other agencies to prevent overlap of efforts. In fact, BER has a long standing jointly-funded effort (10 years) with USDA is the area of bioenergy crop development. Within DOE, BRC research is discussed quarterly in meetings with colleagues from EERE and ARPA-E to look for opportunities to translate basic research findings to DOE programs with more of an applied science focus.

CLIMATE RESEARCH FUNDED BY THE DEPARTMENT OF ENERGY

Subcommittee. Dr. Dehmer, this year's budget request proposes to increase modeling capabilities and improve earth system models utilizing the high performance computing capabilities of the Office of Science. This is a collaborative effort with the National Science Foundation but the explanation for the increase provides little detail how this partnership will continue.

Has the National Science Foundation provided a similar increase to implement these shared activities?

Dr. Dehmer. The National Science Foundation (NSF) and Department of Energy (DOE) coordinate investments in community earth system modeling. DOE's budget request proposes an increase to improve climate predictions of extreme weather that well benefit capabilities of all models within the family of community earth system models; this will also involve the utilization of sub-grid field data with spatial resolutions of order 10's of meters to be used for both model development and validation. While DOE has a priority to model the interdependencies of Energy-Water nexus to understand their roles as embedded components of climate change predictability, NSF's budget request proposes an increase of $75M to advance the understanding of interdependencies at the nexus of food-energy-water (FEW). The NSF FEW request will be informed by community models, some developed by NSF and others by DOE.

Subcommittee. How does your office work with other agencies in this field and how do you ensure that duplication is avoided?

Dr. Dehmer. DOE is one of 13 members of the US Global Change Research Program (USGCRP), where a robust coordination and planning process is conducted at its monthly meetings. As part of USGCRP, a set of Interagency Working Groups (IWGs) is tasked to provide detailed roadmaps and planning processes, including efforts to eliminate unnecessary redundancy. The IWG on modeling is currently chaired by DOE, and there is active participation of program managers from NSF, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the U.S. Environmental Protection Agency, the

U.S. Department of Agriculture, the Department of Defense, and other agencies.

ADDITIONAL QFRS

THE HONORABLE MICHAEL HONDA

HIGH PERFORMANCE COMPUTING

Mr. Honda. During the hearing, there was a discussion about hardware innovations in high performance computing and the need to address power consumption and heating challenges for exascale computing to work.

Are you investing in technologies like photonic interconnections that could drastically reduce power consumption and heat loss?

Dr. Orr. The Department is keenly interested in developments in photonics for both our advanced networking and high performance computing efforts. Both the Energy Sciences Network (ESnet) and our Next Generation Networking for Science research activity have invested in this area for many years and have coordinated developments with both our computing Facilities and Computer Science research activity. Our exascale efforts have always included regular evaluation of the technology developments in this area through workshops, some research efforts and industry partnerships. For example, the Department of Energy (DOE) funded exascale design teams are currently evaluating photonics technologies for exactly the reasons you propose.

In addition, the DOE Small Business Innovation Research (SBIR) program has focused on the development of new photonic technologies for many years. These projects complement the DOE exascale effort because they accelerate industry roadmaps for specific technologies through engagement with the innovative and agile small business community. DOE has fostered interaction between the SBIR Phase1 and Phase2 teams and the DOE exascale design efforts. Also, DOE is working closely with the Optical Society of America (OSA) to determine what features are needed for photonics to be better aligned with our computing needs, and concrete technology demonstrations of those features.

Mr. Honda. NERSC, at Berkeley Lab, is the Office of Science's major scientific computing resource, with close to 6,000 users from throughout the nation – about five times more users than Science's other HPC facilities at

Argonne and Oak Ridge national laboratories. In order to meet use needs and to move toward exascale, what are your plans for upgrading NERSC to ensure adequate power capacity and infrastructure?

Dr. Orr. We agree that NERSC is a strategic resource for the Office of Science and, since 2009, Advanced Scientific Computing Research has been working with NERSC to provide additional power and infrastructure in Lawrence Berkeley National Laboratory's new Computational Research and Theory Facility (CRT) to support current systems and the proposed Cori system. NERSC will complete its move to the CRT in FY 2016. Initial discussions for a planned upgrade in 2020 have begun with the conclusion of NERSC's identification of the Office of Science's computing requirements in that timeframe. Similar to past upgrades, planning for the upgrade will focus on the needs of the Office of Science programs and power and infrastructure will be an integral part of the project.

DESI AND LZ EXPERIMENTS

Mr. Honda. The budget requests for the Dark Energy Spectroscopic Instrument (DESI) and LUX-Zeplin (LZ) experiment do not reflect the P5 recommendations.

Why is this?

Dr. Orr. The FY 2016 Budget Request supports both the DESI and LZ projects, which are both in early stages. Both projects are expected to be baselined in FY 2016. Some flexibility from the P5 recommendations was needed at this stage to accommodate high priority activities. The Department is committed to following the vision and priorities presented in the P5 report.

Mr. Honda. How do you plan to maintain the critical timelines for these projects?

Dr. Orr. Both projects are expected to be baselined in FY 2016. The Department is committed to ensuring these projects are executed on time and on budget.

OUTREACH AND EDUCATION

Mr. Honda. I have heard troubling stories about high level Office of Science staff telling national laboratory employees that "we don't do outreach." These researchers say that they don't dare mention outreach when they are reviewed, because superiors don't want to see any of their research funds diverted to outreach or education; and that if they ask for a small amount of funding for outreach, they are told that it is not appropriate. By comparison, NASA spends 2 percent of its budget on outreach and education. As we talk about the need to help more Americans understand the importance of the work of DOE and the Office of Science and to attract more young people into the STEM fields, I am left to wonder whether the Office is holding back one of the best resources it has to reach out and spread its message - its own researchers.

What is the Office of Science's policy on national laboratory employees participating in outreach and education activities?

Dr. Orr. The Office of Science (SC) encourages National Laboratories to support excellence in science and mathematics education and workforce development; for the ten Office of Science laboratories, it is a direct expectation described in the Management and Operating (M&O) contracts for the labs. SC sponsors several programs at the Department of Energy (DOE) laboratories to bring in undergraduates, graduate students, and faculty for authentic research experiences under the guidance of a DOE laboratory scientist. Every year DOE laboratory scientists volunteer their time to mentor thousands of undergraduate and graduate students through these DOE sponsored programs as well as programs sponsored through other sources, and we are especially grateful for their contributions.

The Office of Science does not have a policy regarding national laboratory employee participation in outreach activities. DOE laboratories are authorized and encouraged to engage in outreach activities. National Laboratory staff are employees of the M&O contractor of the laboratory and must follow the contractor's policies for how they spend their time on outreach activities.

Mr. Honda. How much of the Office of Science's budget is spent on outreach and education activities? Of that, how much of that work involves DOE scientists doing grassroots activities?

Dr. Orr. The Office of Science (SC) makes a distinction between education activities, which are largely workforce training activities aligned with the SC research areas, and outreach activities. SC's largest impact in education and workforce training is in its support of students as part of individual research awards to researchers at universities and the national laboratories. For example, SC supports nearly 4,000 graduate students across all of research awards. The following table provides a summary of the SC budget for distinct education/workforce development activities outside of the general support of students on research awards.

(dollars in thousands)

	FY 2014 Enacted Approp.	FY 2015 Enacted Approp.	FY 2016 President's Request
Advanced Scientific Computing Research	8,700	3,000	10,000
Basic Energy Sciences	0	451	451
Fusion Energy Sciences	0	300	0
High Energy Physics	614	614	614
Workforce Development for Teachers and Scientists	24,500	17,600	18,600
Total, Office of Science	33,814	21,695	29,665

The SC Office of Workforce Development for Teachers and Scientists (WDTS) has an Outreach subactivity that is supported at $500,000 in FY 2015 for outreach activities related to the recruitment of students and faculty to SC's programs. Outside of the WDTS subactivity, SC does not have a dedicated outreach budget. SC considers support for proposals based on merit and peer review, including proposals that may include some appropriate level of outreach.

THE HONORABLE CHUCK FLEISCHMANN

FUSION ENERGY DEVICES

Mr. Fleischmann. Does the DOE fund alternative, non-tokamak fusion energy devices?

If so, what are funding levels for this FY and next?

Dr. Orr. Funding amounts in FY 2015 and in the President's FY 2016 Budget Request to Congress, respectively, are provided for the following categories:

Stellarators: $6,494,000 / $5,069,000

Self-organized exploratory magnetized plasma systems $10,409,000 / $10,409,000

Mr. Fleischmann. Does DOE have a grading system in place that will permit higher funding for alternative fusion systems as warranted by progress and developments in the field as a whole and with individual projects?

Dr. Orr. The mission of the Fusion Energy Sciences (FES) program is to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. To that end, any potential investment in a non-tokamak fusion energy device is evaluated through the question of the device's potential to contribute to enhancement of scientific knowledge. All proposals to FES and the other Office of Science programs are evaluated through merit-based peer review using the established criteria in 10 CFR 605: 1) Scientific and/or technical merit or the educational benefits of the project; 2) Appropriateness of the proposed method or approach; 3) Competency of applicant's personnel and adequacy of proposed resources; 4) Reasonableness and appropriateness of the proposed budget; and 5) Other appropriate factors, established and set forth by the Office of Science in a notice of availability or in a specific solicitation..

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