

ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR FISCAL YEAR 2009

WEDNESDAY, APRIL 2, 2008

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 9:32 a.m., in room SD-124, Dirksen Senate Office Building, Hon. Byron L. Dorgan (chairman) presiding.

Present: Senators Dorgan, Murray, Domenici, Cochran, Craig, and Allard.

DEPARTMENT OF ENERGY

STATEMENT OF HON. RAYMOND L. ORBACH, UNDER SECRETARY FOR SCIENCE

OPENING STATEMENT OF SENATOR BYRON L. DORGAN

Senator DORGAN. The hearing will come to order. I thank all of you for being here today. We are here today to take testimony from three program offices within the Department of Energy that oversee major aspects of the U.S. Government's Science and Energy Research, Development, Demonstration and Deployment programs. This is a hearing of the Senate Appropriations Subcommittee on Energy and Water Development.

The programs that we will be discussing today from the Department of Energy run the gamut from basic research to applied research and development, and, finally, deployment of innovative energy technology projects. In essence, they represent the A to Z for energy technology research development and commercial deployment in the Department of Energy.

Important research performed by the Office of Science is the underpinning of our colossal achievements in energy. The research development and demonstration conducted by the Office of Energy Efficiency and Renewable Energy builds upon that basic research by working to make new technologies deployable.

And the Loan Guarantee Office provides the financial backing to industry for the development of new and innovative forms of conservation and energy. Without scientific and technical breakthroughs in these programs, the United States cannot expect to achieve the lofty goals that we have set for ourselves. Both the administration and the Congress have set very substantial goals in various energy initiatives and in recently enacted energy laws.

In the 2009 recommended budget for this Department, I think there are some concerns. I will express them during the questions. Science, of course—Mr. Orbach is with us—is the beneficiary in the budget request. The \$749 million increase is the largest in the Department's budget; energy efficiency is evidently the donor. The \$467 million reduction is also the largest reduction in the budget.

It seems to me that if we are serious about balancing our energy issues—for example, greater independence from foreign oil and all the other related matters—we've got to be serious about a wide range of things. That includes science.

It also includes energy efficiency, and it includes renewable energy, and so we'll talk about all of that today. The proposal from the President is simply his recommendation or set of recommendations. The Congress, both Republicans and Democrats, take a look at that and then evaluate what our recommendations are. In some cases we agree with the President and in other cases we do not.

I understand that those who are here today are duty-bound to tell us that they think the President's budget is just really wonderful, that they wouldn't change a thing, and that they think it's great. But I think, as we look at the priorities here, it's important for us in the Congress to evaluate how these recommendations relate to the decisions that we have previously made about where we want this country to go in energy policy.

With that, I will call on the ranking member, Senator Domenici.

OPENING STATEMENT OF SENATOR PETE V. DOMENICI

Senator DOMENICI. Thank you very much, Mr. Chairman. I look out at the three witnesses, and the only one that I am not personally familiar with—and that's my fault—is David Frantz. I have read about what you are doing, and I think we have hired the right person, but I wonder if you don't wonder, sometimes, whether you have been hired to do the right job, since it seems like more and more people want to make your job difficult when we thought it was going to be a very simple proposition.

Having said that, we hope that you are truly ready to go into the market and issue some loan guarantees as soon as possible, and we'll all be asking you that with a great deal of anticipation.

Mr. Chairman, I have prepared remarks. In some respects they sound somewhat like yours because you have put your finger on what this is that's before us here today. I want to take just a few moments, nonetheless, to talk about some of the things that are here.

Today we have these three witnesses who represent the entire pipeline of energy technology. Dr. Orbach has responsibility for discovery science and developing new technology solutions. The budget requests include \$100 million for Energy Frontier Research Centers, and I think we ought to have that explained so we know what that means.

Last year was a difficult year for Science funding, but I am pleased to see that the administration has not changed its direction and remains committed to its 10-year strategy of doubling the Office of Science: Not just you but all science was to be doubled in the next 10 years on the hard side, the science, engineering, physics, mathematics, et cetera.

Assistant Secretary Karsner and his office is the next step in the technology development, as you have indicated, and then I won't repeat the ins and outs of his budget but we'll talk about it here today.

It is important to put into perspective \$42 billion is nearly 10 times the annual budget of the Office of Science. The reason I bring that up is because Congress has provided \$42.5 billion in guarantee authority for all three for both nuclear and the two others that go with it that received excellence funding for their guarantees.

And this is a very large amount of money, but when we look at what America will probably have to spend to achieve some degree of energy independence, the number approaches \$350 to \$500 billion, and, certainly, some people say it's much higher. My own guesstimate would be that we'll spend much more than that to get out of the mess that we are in. And the loan guarantees are a substantial part, and that's why it makes it so important, Mr. Frantz, that we get this part moving.

I want to comment on, while we have Dr. Orbach here, I'm deeply concerned about the lack of investment in upgrading the science facilities of NNSA laboratories, specifically the LANSCE facility which is needed to be refurbished in order to support the ongoing science mission.

Third, I am frustrated that the Congressional Budget Office has charged our bill, Mr. Chairman, with 1 percent of the cost of Loan Guarantees program despite the fact that this program is self-financed, and the Department is required to cover the cost of the program. CBO believes the Department will miss the mark by 1 percent. I don't know why they assume it will be 1 percent all in one direction. It seems if you're going to miss, you'll miss some high, some low, and probably come out neutral. But they assume it will all be a miss, and we get charged \$352 million.

That's wrong. And if we had to bear that, that's just like coming into our budget, slicing out \$352 million for which we get nothing. Nothing. And, to me, the Congressional Budget Office just didn't read the law. I read the law this morning, and it's clear that we cannot lose money. And you have to deliver the full cost of the loan to the Secretary before he makes the loan and the full cost of the loan to the Government, That's the way it's done, and that's what you're going to do.

I don't understand it, and I hope we all get a hold of this one and make sure we do it right. Thank you, Mr. Chairman.

Senator DORGAN. Senator Craig?

STATEMENT OF SENATOR LARRY CRAIG

Senator CRAIG. Mr. Chairman, thank you. Both you and Senator Domenici have done the broad overview. I'll be more specific and probably a little more parochial. And, let me say to all of you gentlemen, this will be the last time you will be making full budget presentations before this committee. It will also be my last time as a Senator to be specific about some of the issues that I've been involved in for a good long while.

Secretary Orbach, as you know, I've been generally pleased with your office, overall. My only advice since we first met was to look for ways to utilize our Nation's lead nuclear laboratory, the INL,

as it relates to the help necessary and important with nuclear science. The fiscal year 2009 Science budget spends about \$3.6 million. That's less than 1 percent of your total annual budget at INL. That remains a question to me as to why that. But there are ways to fix it, and let me propose some ideas to you.

Your budget more than any other reflects the work of the Energy Committee, and the work we did in passing the COMPETES bill last year. Many educational provisions were funded. If you'll remember, a provision I put in with the cosponsorship of Senator Domenici and Senator Bingaman was the Nuclear Science Talent provision. That is section 5006.

It's my hope that this provision will be funded above the \$12 million that had been authorized so that DOE science and the INL Center for Advanced Energy studies, the CAES, can administer this provision and increase our competitiveness in nuclear science. We've simply got to get there, and it is not as robust as it has been authorized or as we should allow it.

Secretary Karsner, I've been continually impressed with the results of your office to do so much with so little—only \$1.2 billion. So I guess I am unabashedly pro-renewable, and I serve as a member of the Board of the Alliance to Save Energy. And efficiency is truly the most affordable clean energy solution we have.

A list of accomplishments from your office is too long, but there are some that attract my attention. The biomass, R&D, utilizing farm and forest waste is, I think, the nominal opportunity for us. Wind power in America, we're now frustrated about how we integrate the potential of so much wind power as an intermittent source into a baseload situation. Certainly, in the Pacific Northwest that may well be an opportunity and a difficulty.

Vehicle technology, advanced factories. I want my grand kids driving electric cars, so get with it because they're young, but they will soon be at that level, and I see that as a phenomenal opportunity even in a distant state like Idaho. Get us up to 400 miles, and we're in business. And I think that potential is there.

Industrial technology, I think across the board the R&D that we do there advances the efficiencies in all that are possible. So let me suggest that your lab and my lab have great synergy and cooperative relationships that can produce a lot of what you're attempting.

And, as Pete Domenici said, Director Frantz, we're glad to see you. We've been waiting for you for 2½ years and very disappointed that you weren't before us 2½ years ago. So get with it and deliver to us those kinds of loan guarantees that push science and push the technology out there.

As you know, I have focused a good deal on the frustration we now have growing out of this bulge in ethanol production, corn-base needing the move to cellulosic. In fact, I'm headed into Canada next week to look at a stand-up up there that we think has some potential, so it is very exciting that we get there. Caution is valuable, but daringness is more important as we push the edges of technology to get us to an area of energy independence. Caution will not get us there.

Thank you, Mr. Chairman.

Senator DORGAN. Senator Murray.

Senator MURRAY. Thank you, Mr. Chairman. I join you in welcoming our witnesses today. I will save my time for questions.

Senator DORGAN. Senator Allard?

STATEMENT OF SENATOR WAYNE ALLARD

Senator ALLARD. Mr. Chairman, for holding this hearing today. I don't think anybody can argue we're dangerously relying on foreign sources of energy, and we must decrease our reliance on foreign sources of energy by diversifying our energy sources, and increasing conservation. I have long felt that a balanced energy portfolio that takes no technology off of the table is what is best for this country.

I'd like to extend a special welcome to Mr. Karsner, who oversees the Office of Energy Efficiency and Renewable Energy, which, in turn, oversees the National Renewable Energy Laboratory in Colorado. NREL makes a major contribution to the development of renewable energy technology, and the technologies that are developed at NREL will remain vital to our Nation's energy progress, and they have established a great relationship with the research universities there, joining in the partnership with the University of Colorado, School of Mines, and Colorado State University in this renewable energy effort. And I commend them for joining that coalition. I think it helps make this a hub of renewable energy ideas.

Mr. Chairman, you and I co-chaired the Renewable Energy and Energy Efficiency caucus, and so I know I don't have to tell you about the importance of renewable energy. Renewable energy is a very important way that we can begin to reduce the demand for oil and thereby help make our country more secure.

There are great opportunities for solar, wind, geothermal, biomass, fuel cells, and hydro to make significant contributions. Research and the unit of both government and industry partners are very important to allowing these opportunities to live up to their potential.

I look forward to working with the community and share the research and development and all fields of energy technology are funded in a manner that is responsible, but sufficient to ensure that the development and implementation of new technology continue.

Thank you again, Mr. Chairman.

Senator DORGAN. Senator Allard, thank you very much.

We will now turn to the witnesses, and I want to thank all of them for coming today. We will begin with Dr. Orbach. Dr. Orbach, please.

STATEMENT OF HON. RAYMOND L. ORBACH

Dr. ORBACH. Thank you, Mr. Chairman. Thank you, Chairman Dorgan, Ranking Member Domenici, members of the committee. I'm very pleased to be able to appear before your committee for what I expect to be my final budget presentation for the Department of Energy's Office of Science. I would like to thank the Committee for your strong support for the Office of Science during my tenure.

I would particularly like to thank Senator Domenici for his invaluable service to the Nation and for his strong support for the Nation's scientific enterprise.

The President's budget request for fiscal year 2009 continues his strong and clear support for science in this country, expressed through his American Competitiveness Initiative and Advanced Energy Initiative, both announced in 2006. Congress has shown strong bipartisan support for an aggressive innovation and energy security agenda through the Energy Policy Act in 2005 and the America COMPETES Act and the Energy Independence and Security Act in 2007.

The President's fiscal year 2009 request to Congress for the Office of Science sustains this bipartisan platform for the long-term economic health, energy security, and intellectual strength of our country. Just a few examples:

We are introducing the concept of Energy Frontier Research Centers to accelerate scientific breakthroughs and innovations essential to the development of advanced energy technologies in the 21st century. We are providing \$100 million in fiscal year 2009 to award grants of \$2 million to \$500 million per year for an initial 5-year period on a competitive basis to groups of researchers in universities, laboratories, industry, and other institutions.

We seek to engage the Nation's finest intellectual and creative talent to tackle the scientific grand challenges associated with how nature works to direct and control matter at the quantum, atomic, and molecular levels, and to harness this new knowledge and capability for some of our most critical energy challenges.

Another example is ITER. While the 2008 appropriation for ITER was reduced to R&D, the President's request calls for the full \$214 million needed to fully engage in this crucial experiment. It is high risk, but the potential for energy security is immense. ITER will directly benefit U.S. domestic industries creating an American workforce knowledgeable in R&D and in the production of high tech components for the fusion industry.

My last example is high energy physics. The President's request firmly places this critical field back on track for world leadership. Former Princeton University President Harold Shapiro led the major National Academy of Sciences study on Elementary Particle Physics in the 21st century. He stated:

"The United States has been at the forefront of elementary particle physics for more than half a century. Particle physics inspires U.S. students, attracts talent from around the world, and drives critical intellectual and technological advances in many other fields. The United States has an unprecedented opportunity as a leader of nations to undertake this profound scientific challenge."

President Shapiro's last sentence applies equally across the frontiers of basic research in science. The Office of Science has prioritized its investments to maintain U.S. global scientific leadership. The President's fiscal year 2009 request to Congress gives us the chance to be a leader of nations. I urge this committee to give our country and its citizens that opportunity.

PREPARED STATEMENT

Thank you again for your strong support for the Office of Science and for basic research. I look forward to answering your questions.

Senator DORGAN. Dr. Orbach, thank you very much.
[The statement follows:]

PREPARED STATEMENT OF HON. RAYMOND L. ORBACH

Thank you Mr. Chairman and members of the committee. I am pleased to appear before your committee for what I expect to be my final budget presentation for the Department of Energy's Office of Science. I would like to thank the Committee for your strong support for the Office of Science during my tenure. This support has enabled the Office of Science to make investments in basic research and advanced research capabilities that have and will continue to improve U.S. global competitiveness, energy security, the environment, and our fundamental understanding of the universe around us.

Our Nation continues to face significant challenges in energy security and in our ability to maintain the scientific leadership and innovation that assures our continued economic security. These challenges are addressed by the President in his American Competitiveness Initiative and Advanced Energy Initiative announced in 2006. In this year's State of the Union address, the President again called our attention to the importance of harnessing the creative genius of American researchers and entrepreneurs in developing the next generation of clean energy technologies and in keeping our Nation at the forefront of basic research in the physical sciences. The budget request for fiscal year 2009 demonstrates his forceful, continued commitment to these important initiatives. The Congress has also spoken and expressed strong, bipartisan support for an aggressive innovation and energy security agenda in passing the Energy Policy Act (EPAAct) of 2005 and in following up with both the America COMPETES Act and the Energy Independence and Security Act (EISA) in 2007.

EPAAct and the COMPETES Act both recognize the pivotal role of the Office of Science in securing the advantages that basic research as well as science, math, and engineering education can bring to the Nation. EISA's provisions are intended to reduce America's dependence on oil, improve efficiency, and cut emissions. Technology development proceeds fastest where there is a strong grounding in scientific understanding, but we will not meet the targets with solely incremental improvements in current technologies. We need the breakthroughs that will result only from transformational basic research.

Here are a few examples. EISA mandates the use of at least 36 billion gallons of biofuels by 2022. Without transformational breakthroughs in deriving fuels from plant cellulose materials, we reduce our chances of reaching these aggressive goals. Even though conventional approaches, such as sugar-based and corn-based ethanol, can be modestly energy positive—although this is still debated—they consume large quantities of food and feed grain. Increasing use of these feedstocks raises environmental concerns associated with land use changes and impacts on atmospheric concentrations of carbon dioxide. Biofuels derived from cellulose, and in particular feedstock crops such as switchgrass that can be grown on marginal land with minimal water and nutrient requirements, can provide the basis for a sustainable biofuels economy in the United States while benefiting the American farmer. Breakthroughs in science are essential for the development of more efficient and cost-effective processes for deriving fuels from cellulose and for developing dedicated feedstock crops. The approaches to cellulosic ethanol deployed in many pilot and demonstration bioethanol plants across the United States rely on niche feedstocks and conversion technologies that are not yet cost competitive. New scientific discoveries supported by the Office of Science will speed revolutionary gains in production efficiencies and cost reduction—and in some cases may be the only way to meet our goals.

The transformational basic research undertaken by the Office of Science's Bioenergy Research Centers is one way the Department is addressing the difficulties of cost-effective bioethanol production with minimal environmental footprint, by using plant and microbial genomics and other novel approaches.

EISA also mandates a national fuel economy standard of at least 35 miles per gallon by 2020—an increase in fuel economy of some 40 percent that will save billions of gallons of fuel. Automobile manufacturers will need to employ numerous conventional and advanced engine and vehicle technologies to reach this goal. Office of Science basic research will be critical in the development of cost effective advanced engine and vehicle technologies through research in areas such as high-strength, low-weight materials; electrical energy storage; hydrogen production, use, and storage; fuel cell materials; catalysts, combustion processes, and materials under extreme environments.

In fiscal year 2009 the Office of Science will initiate Energy Frontier Research Centers. They will pursue innovative basic research to accelerate the scientific

breakthroughs needed to create advanced energy technologies for the 21st century. These Centers will pursue fundamental basic research areas mentioned above as well as solar energy utilization; geosciences related to long-term storage of nuclear waste and carbon dioxide; advanced nuclear energy systems; solid state lighting; and superconductivity.

The Office of Science seeks to engage the Nation's intellectual and creative talent to address scientific grand challenges. These are the necessary transformational discoveries which will fundamentally alter our approaches to energy production and use, and they will come from the next generation of scientists, mathematicians, and engineers. If our fiscal year 2009 request is approved, the Office of Science will be able to directly support the research of more than 4,300 graduate students—and many more who are supported by other agencies will use our world-leadership scientific research facilities in their dissertation research.

The Office of Science is accelerating the pace of discovery and innovation to address the Nation's energy needs through our multifaceted research portfolio. Your confidence in the Office of Science is based on a number of demonstrated successes in our mission areas, and your support for the Office of Science has enabled us to assess the basic research needs and engage the scientific community to respond aggressively. We routinely assess and update these research opportunities and priorities with an eye to our mission and with an ear to the research community, whether at a national laboratory, a university, or in industry. Since we build and operate large-scale, long-term, and, by necessity, cost-effective scientific research facilities, and because our mission is so important, we take these assessments seriously. We cannot afford to go in a wrong direction; we need the most complete and robust analysis of scientific opportunity, mission need, cost, and benefit.

A large part of this assessment effort in recent years has been accomplished through a series of Basic Research Needs workshops and other workshops led by our science programs in partnership with the Department's technology programs. These workshops have brought together subject experts with diverse views from the broader basic and applied research community to discuss and identify areas of focus for DOE's basic research efforts. These efforts have enabled the Office of Science to stay informed of research needs and new opportunity areas, as well as scientific and technological roadblocks, and have enabled us to create a prioritized and comprehensive research portfolio within our available funding.

While these workshops are critical to building and balancing our research portfolio, we also have a number of planning and advisory resources at our disposal to inform our long-term research portfolio planning. The National Academy of Sciences, our Federal Advisory Committees, informal and formal communication with the international scientific community, OSTP, OMB, the Congress, and our in-house Office of Science personnel all play important roles. Our programs are strong because our research portfolio and facilities are internally and externally assessed regularly and because our research and facilities are awarded through a competitive merit review process.

We have established effective processes for assessing basic research needs, and we have also developed the capacity to respond quickly with highly leveraged investments in scientific facilities and research at the national laboratories and universities. This informed, rapid response provides the world-class research results that will help solve some of our most intractable energy supply and environmental challenges, while keeping our Nation's scientific enterprise and industry at the forefront.

I think the best way to bring my statement into sharp focus is to discuss some examples of how your investments in the Office of Science have brought quick and remarkable results, and what we plan to do with the funding requested for fiscal year 2009 to enhance the U.S. scientific and innovation enterprise and ensure the best possible return to the taxpayer.

Perhaps the best example of this aggressive and nimble approach is the response by the Office of Science to the challenge of High Performance Computing (HPC). In 2002 the Japanese announced the Earth Simulator, a high performance computer for open science which combined unprecedented performance and efficiency. Congress responded by dramatically increasing HPC funding, and making the Office of Science the lead in an effort to surpass the Earth Simulator. I am pleased to report that your confidence in us has already resulted in the United States attaining world leadership in open scientific computing—by the end of this year we will achieve peak capacity of one petaflop at our Leadership Computing Facility in Oak Ridge. This exceptional capability is helping us model such phenomena as turbulent flows related to combustion and to model and simulate complex climate processes that will inform decisionmakers on climate change, mitigation, and adaptation.

The benefits of Office of Science HPC capabilities extend well beyond DOE. We provide access to these resources to other Federal agencies, universities, labora-

tories, and industry. We have been involved in modeling and simulation runs as diverse as determining hurricane effects to save lives, and modeling aircraft engines and airframes to improve energy efficiency and reduce time-to-market. We use the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program to openly compete access to these world-leading HPC resources. The Office of Science created INCITE for the purpose of bringing the capabilities of terascale computing to the community in order to transform the conduct of science and bring scientific simulation through computational modeling to parity with theory and experiment as a scientific tool. As a result, HPC modeling and simulation is now seen as a potent tool in the scientific toolbox; one that will potentially save lives, increase our energy and national security, and propels us to a competitive edge.

Another accomplishment of the past year is the successful competition and award of three Bioenergy Research Centers. These Centers will each take different approaches to discovering fundamentally new solutions and solving critical roadblocks on the path to energy security—how will we meet the new requirement to produce 36 million gallons of biofuels by 2022 from renewable plant sources that don't compete with the food supply? In authorizing and funding the Bioenergy Research Centers, Congress expressed its confidence in the ability of the Office of Science to tap the talent of our national laboratories and universities to tackle our fuels challenge, and these Centers are up and running well.

U.S. leadership in science and technology depends on the continued availability of the most advanced scientific tools and facilities for our researchers. The suite of research capabilities operated by the Office of Science and used annually by 20,000 researchers from industry, academia and government labs are still the envy of the world. And over the past several years, with your support, we have delivered new facilities and have achieved remarkable technical milestones with existing facilities, enabling the United States to work at the cutting-edge of many scientific disciplines. The Spallation Neutron Source, which came on line in 2006, is the world's forefront neutron scattering facility providing more neutrons, by a factor of 10, than any other neutron source in the world for research of materials and biological complexes. Let me give you just one example of why neutrons are so important. Neutrons are the only way to peer inside an operating fuel cell to view water forming and moving throughout the cell. In a fuel cell, water is formed as a by-product of the reaction between hydrogen and oxygen. If the water does not drain quickly and efficiently, then fuel cells will not work properly.

The Linac Coherent Light Source currently under construction will produce x-rays 10 billion times more intense than any existing x-ray source in the world when it comes on line in fiscal year 2010. It will have the capabilities for structural studies of nanoscale particles and single molecules and for probing chemical reactions in real time. All five Office of Science Nanoscale Science Research Centers are now in operation, providing unparalleled resources to the scientific community for synthesis, fabrication, and analysis of nanoparticles and nanomaterials. The Tevatron at Fermilab currently remains the world's most powerful particle collider for high energy physics. New records for performance in peak luminosity were achieved in 2006, enabling the observation of the rare single top quark and bringing researchers closer to understanding the basic constituents of matter and the laws of nature at high energies.

On October 24, 2007, the international ITER Agreement went into force. The ITER experiment will demonstrate for the first time that a reactor can create and sustain a burning plasma. The implications of this research are far-reaching. The world faces a series of tough choices in meeting our energy needs over the next century. While no silver bullet may exist, fusion appears to be the closest. Fusion energy provides the real possibility of abundant, economical, and environmentally benign energy, starting around mid-century. Our investments today will have huge pay-offs for our children and grandchildren. We are part of an international consortium that is sharing the cost and the risk of the project and will have full access to all experimental research data.

The Office of Science is aggressively pursuing a range of research areas that will provide answers critical to our future energy security, as the material that follows will show—and we also continue to plan for the future, seeking to identify opportunities within available resources and to update our priorities appropriately. An example of this is the “Facilities for the Future of Science: A 20-Year Outlook” report, which was released in November 2003 and updated last year. The Outlook contained a prioritized list of facilities to underpin our major research thrusts over the next 20 years and beyond. These facilities are designed to be world class and adaptable to evolving basic research needs to ensure that U.S. taxpayers get the most value for their money. These facilities also allow researchers access to the full array of physical and biological science large-scale resources, creating an all-important

balance and “unity” of science within the Office of Science. I ask the members during this appropriations cycle especially to consider the lasting value of the basic energy research done in the Office of Science to our Nation’s well-being and economic prowess.

The following programs are supported in the fiscal year 2009 budget request: Basic Energy Sciences, Advanced Scientific Computing Research, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, Workforce Development for Teachers and Scientists, Science Laboratories Infrastructure, Science Program Direction, and Safeguards and Security.

OFFICE OF SCIENCE FISCAL YEAR 2009 PRESIDENT’S REQUEST—SUMMARY BY PROGRAM

(Dollars in thousands)

	Fiscal Year 2007 Approp.	Fiscal Year 2008 Approp.	Fiscal Year 2009 Request	Fiscal Year 2009 vs. Fiscal Year 2008	
				Request	Percent
Basic Energy Sciences	\$1,221,380	\$1,269,902	\$1,568,160	+\$298,258	+ 23.5
Advanced Scientific Computing Research	275,734	351,173	368,820	+ 17,647	+ 5.0
Biological and Environmental Research	480,104	544,397	568,540	+ 24,143	+ 4.4
High Energy Physics	732,434	689,331	804,960	+ 115,629	+ 16.8
Nuclear Physics	412,330	432,726	510,080	+ 77,354	+ 17.9
Fusion Energy Sciences	311,664	286,548	493,050	+ 206,502	+ 72.1
Science Laboratories Infrastructure	41,986	66,861	110,260	+ 43,399	+ 64.9
Science Program Direction	166,469	177,779	203,913	+ 26,134	+ 14.7
Workforce Dev. for Teachers & Scientists	7,952	8,044	13,583	+ 5,539	+ 68.9
Safeguards and Security (gross)	75,830	75,946	80,603	+ 4,657	+ 6.1
SBIR/STTR (SC funding)	86,936	.....	.....	.....	.....
Subtotal, Office of Science	3,812,819	3,902,707	4,721,969	+ 819,262	+ 21.0
Adjustments ¹	23,794	70,435	.....	-70,435	-100.0
Total, Office of Science	3,836,613	3,973,142	4,721,969	+ 748,827	+ 18.8

¹Adjustments include SBIR/STTR funding transferred from other DOE offices (\$39,319,000 in fiscal year 2007), a charge to reimbursable customers for their share of safeguards and security costs (–\$5,605,000 in each of fiscal year 2007 and fiscal year 2008), Congressionally-directed projects (\$123,623,000 in fiscal year 2008), a rescission of a prior year Congressionally-directed project (–\$44,569,000 in fiscal year 2008), and offsets for the use of prior year balances to fund current year activities (–\$9,920,000 in fiscal year 2007 and –\$3,014,000 in fiscal year 2008).

BASIC AND APPLIED RESEARCH AND DEVELOPMENT COORDINATION

I would also like to highlight the fact that the Office of Science continues to coordinate basic research efforts in several areas with the Department’s applied technology offices through collaborative processes established over the last several years. These areas include biofuels derived from biomass, solar energy, hydrogen, solid-state lighting and other building technologies, the Advanced Fuel Cycle, Generation IV Nuclear Energy Systems, vehicle technologies, and improving efficiencies in industrial processes. The Department’s July 2006 report to Congress DOE Strategic Research Portfolio Analysis and Coordination Plan identified 21 additional areas of opportunity for coordination that have great potential to increase mission success. The Office of Science supports basic research that underpins nearly all 21 areas; and 6 areas are highlighted in the fiscal year 2009 Office of Science budget request for enhanced R&D coordination: Advanced Mathematics for Optimization of Complex Systems, Control Theory, and Risk Assessment; Electrical Energy Storage; Carbon Dioxide Capture and Storage; Characterization of Radioactive Waste; Predicting High Level Waste System Performance over Extreme Time Horizons; and High Energy Density Laboratory Plasmas. The Office of Science has sponsored scientific workshops corresponding to these focus areas in collaboration with related DOE applied technology program offices. The workshop reports identified high priority basic research areas necessary for improved understanding and revolutionary breakthroughs.

Advanced Mathematics for Optimization of Complex Systems, Control Theory, and Risk Assessment.—The Advanced Scientific Computing Research (ASCR) program supports basic research in advanced mathematics for optimization of complex systems, control theory, and risk assessment. A recommendation from the workshop focused on this subject indicated additional research emphasis in advanced mathematics could benefit the optimization of fossil fuel power generation; the nuclear fuel lifecycle; and power grid control. Such research could increase the likelihood for suc-

cess in DOE strategic initiatives including integrated gasification combined cycle coal-fired power plants and modernization of the electric power grid.

Electrical Energy Storage.—About 15 percent of the Basic Energy Sciences (BES) program funding requested to support basic research in electrical energy storage (EES) is targeted for a formally coordinated program with DOE applied technology program offices. The workshop report on this focus area noted that revolutionary breakthroughs in EES have been singled out as perhaps the most crucial need for this Nation's secure energy future. The report concluded that the breakthroughs required for tomorrow's energy storage needs can be realized with fundamental research to understand the underlying processes involved in EES. The knowledge gained will in turn enable the development of novel EES concepts that incorporate revolutionary new materials and chemical processes. Such research will accelerate advances in developing novel battery concepts for hybrid and electric cars and will also help facilitate successful utilization and integration of intermittent renewable power sources such as solar, wind, and wave energy into the utility sector, making these energy sources competitive for base-load supply.

Carbon Dioxide Capture and Storage.—BES, ASCR and the Biological and Environmental Research (BER) program support basic research in carbon dioxide capture and storage. The storage portion of this R&D coordination focus area was a subject of a BES workshop on Basic Research Needs for Geosciences in February 2007 that focused on the research challenges posed by carbon dioxide storage in deep porous saline geological formations. The workshop report noted that the chemical and geological processes involved in the storage of carbon dioxide are highly complex and would require an interdisciplinary approach strongly coupling experiments with theory, modeling, and computation bridging multiple length and time scales. The BES effort supports fundamental research to understand the underlying chemical, geochemical, and geophysical processes involved in subsurface sequestration sites. The BER research effort focuses on understanding, modeling, and predicting the processes that control the fate of carbon dioxide injected into geologic formations, subsurface carbon storage, and the role of microbes and plants in carbon sequestration in both marine and terrestrial environments. These aspects of this focus area were also the subject of additional SC workshops that identified basic research areas in carbon dioxide capture and storage that could benefit the optimization of fossil fuel power generation and the development of carbon neutral fuels. The ASCR research effort supports two Scientific Discovery through Accelerated Computing (SciDAC) partnerships with BER to advance modeling of subsurface reactive transport of contaminants; an area that has been identified as directly relevant to carbon sequestration research efforts.

Characterization of Radioactive Waste.—BES, BER, and the Nuclear Physics (NP) program support research in radioactive waste characterization. This R&D coordination focus area was the subject of six Office of Science workshops, including three BES workshops. The workshop reports noted that the materials and chemical processes involved in radioactive waste disposal are highly complex and their characterization requires an interdisciplinary approach that strongly couples experiments with theory, modeling, and computation bridging multiple length and time scales. The BES effort will focus on research relating to the underlying physical and chemical processes that occur under the conditions of radioactive waste storage, including extremes of temperature, pressure, radiation flux, and multiple complex phases. The BER research effort addresses processes that control the mobility of radiological waste in the environment. The NP research effort is focused on characterization of radioactive waste through the advanced fuel cycle activities. The NP program areas are structured as scientific disciplines with goals to understand the nuclear cross sections important for advanced fuel cycle reprocessing. A small portion of on-going research is relevant to the issues involved with radioactive waste and related advanced fuel cycles. The knowledge gained from this research will lead to enhanced understandings of radioactive waste characterization, which would make nuclear power a far more attractive component in primary energy usage.

Predicting High Level Waste System Performance over Extreme Time Horizons.—BES supports basic research in predicting high-level waste system performance over extreme time horizons. This R&D coordination focus area was a subject of a BES workshop on Basic Research Needs for Geosciences in February 2007, which focused on research challenges posed by geological repositories for high level waste. The workshop report identified major research priorities in the areas of computational thermodynamics of complex fluids and solids, nanoparticulate and colloid physics and chemistry, biogeochemistry in extreme and perturbed environments, highly reactive subsurface materials and environments, and simulation of complex multi-scale systems for ultra-long times.

High Energy Density Laboratory Plasmas.—The Fusion Energy Sciences (FES) program supports basic research in high energy density laboratory plasmas. In May 2007, Office of Science and the National Nuclear Security Administration (NNSA) jointly sponsored a workshop to update the high energy density laboratory plasmas (HEDLP) scientific research agenda. Three scientific themes emerged from the workshop: enabling the grand challenge of fusion energy by high energy density laboratory plasmas; creating, probing, and controlling new states of high energy densities; and catching reactions in the act by ultra-fast dynamics. In fiscal year 2009, the FES request expands existing HEDLP research in response to the research opportunities identified in the workshop.

BASIC AND APPLIED R&D COLLABORATION FUNDING SUMMARY

[Dollars in thousands]

	Fiscal Year 2007 Approp.	Fiscal Year 2008 Approp.	Fiscal Year 2009 Request	Fiscal Year 2009 vs. Fiscal Year 2008	
				Request	Percent
Advanced Mathematics for Optimization of Complex Systems, Control Theory, & Risk Assessment:					
Science: Advanced scientific computing research		\$1,900	\$2,000	+\$100	+ 5.3
Energy Efficiency and Renewable Energy ..			500	+ 500	.....
Nuclear Energy	\$10,000	19,410	55,000	+ 35,590	+ 183.4
Total, Advanced Mathematics	10,000	21,310	57,500	+ 36,190	+ 169.8
Electrical Energy Storage:					
Science: Basic energy sciences			33,938	+ 33,938	.....
Energy Efficiency and Renewable Energy ..			2,000	+ 2,000	.....
Electricity Delivery and Energy Reliability ..			13,403	+ 13,403	.....
Total, Electric Energy Storage			49,341	+ 49,341	.....
Carbon Dioxide Capture and Storage:					
Science: Basic energy sciences	5,915	5,915	10,915	+ 5,000	+ 84.5
Advanced scientific computing research ...		976	976	.....	.....
Biological and environmental research	16,841	16,874	17,374	+ 500	+ 3.0
Total, Science	22,756	23,765	29,265	+ 5,500	+ 23.1
Fossil Energy	97,228	118,908	149,132	+ 30,224	+ 25.4
Total, Carbon Dioxide Capture and Storage	119,984	142,673	178,397	+ 35,724	+ 25.0
Characterization of Radioactive Waste:					
Science: Basic energy sciences			8,492	+ 8,492	.....
Biological and environmental research			1,500	+ 1,500	.....
Nuclear physics	200	200	6,603	+ 6,403	+ 3,202
Total, Science	200	200	16,595	+ 16,395	+ 8,198
Nuclear Energy	37,190	53,722	59,000	+ 5,278	+ 9.8
Environmental Management	2,100	2,100	9,500	+ 7,400	+ 352.4
Total, Characterization of Radio- active Waste	39,490	56,022	85,095	+ 29,073	+ 51.9
Predicting High Level Waste System Performance Over Extreme Time Horizons:					
Science: Basic energy sciences			8,492	+ 8,492	.....
Environmental Management	500	500	1,500	+ 1,000	+ 200.0
Total, Predicting High Level Waste System Performance	500	500	9,992	+ 9,492	+ 1,898

BASIC AND APPLIED R&D COLLABORATION FUNDING SUMMARY—Continued

[Dollars in thousands]

	Fiscal Year 2007 Approp.	Fiscal Year 2008 Approp.	Fiscal Year 2009 Request	Fiscal Year 2009 vs. Fiscal Year 2008	
				Request	Percent
High Energy Density Laboratory Plasmas:					
Science: Fusion energy sciences	15,459	15,942	24,636	+ 8,694	+ 54.5
National Nuclear Security Administration ..	10,000	12,295	10,147	-2,148	-17.5
Total, High Energy Density Laboratory Plasmas	25,459	28,237	34,783	+ 6,546	+ 23.2
Total, Basic and Applied Research Col- laborations	195,433	248,742	415,108	166,366	+ 66.9

CONCLUSION

I want to thank you, Mr. Chairman, for providing this opportunity to discuss the Office of Science research programs and our contributions to the Nation's scientific enterprise and global competitiveness. On behalf of DOE, I am pleased to present this fiscal year 2009 budget request for the Office of Science.

This concludes my testimony. I would be pleased to answer any questions you might have.

Senator DORGAN. Next we will hear from Secretary Karsner. You may proceed.

Mr. KARSNER. Thank you, sir.

STATEMENT OF HON. ALEXANDER KARSNER, ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY

Mr. KARSNER. Chairman Dorgan, Ranking Member Domenici, members of the committee, thank you for this opportunity of testifying in the President's fiscal year 2009 budget request for the Office of Energy Efficiency and Renewable Energy.

EERE's fiscal year 2009 request of \$1.25 billion is approximately \$19 million higher than the fiscal year 2008 request and provides a balance in diverse portfolio of solutions to address the energy and environmental challenges facing us today. The request will enable the EERE to research and develop renewable energy technologies, to dramatically increase the amount of clean energy produced in the United States' advanced energy technologies and practices, to sustainably decouple energy demand from economic growth, and strengthen commercialization and deployment to support rapid adoption by private industry of clean energy technologies.

The need for clean energy solutions is abundantly clear. With the Nation's energy challenges plainly identified, our efforts today and onward need to be about the implementation of solutions: well-identified solutions, multipath solutions, parallel path solutions, trying what we must and at a pace that is commensurate with the magnitude and urgency of the challenges that we face.

On December 19, 2007, the President signed the Energy Independence and Security Act of 2007 into law. The new mandates included in EISA are unprecedented in size and in scope and in time frame. Together we've taken great strides to move beyond problem identification and towards problem-solving that will enhance our energy security, diversify our energy systems, and reduce our greenhouse gas emissions that contribute to the serious challenge of climate change.

EERE's overall budget request reflects the funding needed to meet our energy challenges head on. Advanced fuels in vehicles, renewable power, efficiency in buildings and industry, and technology deployment comprise EERE's portfolio and multipronged approach to energy solutions.

My written testimony which I'll submit for the record includes a description of the priorities and specific funding requests of the EERE's program areas. The achievement of EERE program goals could save consumers over \$600 billion by the year 2030, and as much as \$4 trillion by 2050, cumulatively.

Similarly, we expect that our portfolio will avoid at least six gigatons of carbon by 2030 and nearly 50 gigatons by 2050, cumulatively.

With action plans, performance milestones, clearly articulated deliverables, and continued performance, EERE's Budget Request will strengthen our dynamic partnership with private industry and academia that have grown our Nation's economic well-being.

PREPARED STATEMENT

Our laboratory products and partnerships resulting in industry commercialization at unprecedented levels will bring clean energy technologies and sources to large-scale commercial viability in the foreseeable future.

This concludes my prepared statement, and I'm happy to answer any questions the committee members may have. Thank you.

[The statement follows:]

PREPARED STATEMENT OF HON. ALEXANDER KARSNER

Mr. Chairman and members of the committee, thank you for this opportunity to testify on the President's fiscal year 2009 budget request for the Office of Energy Efficiency and Renewable Energy (EERE).

EERE's fiscal year 2009 request of \$1.255 billion, approximately \$19 million higher than the fiscal year 2008 request, provides a balanced and diverse portfolio of solutions to address the energy and environmental challenges facing us today. The request will enable EERE to research and develop renewable energy technologies that can help increase the amount of clean energy produced in the United States; advance energy efficiency technologies and practices; and promote adoption by private industry of clean energy technologies.

The need for clean energy solutions is clear. With the Nation's energy challenges plainly identified, our efforts today and onward need to be about the development of solutions—balanced, diverse, well-identified solutions, multipath solutions, as well as parallel path solutions.

On December 19, 2007, the President signed the Energy Independence and Security Act of 2007 (EISA) into law. Together, we have taken great strides to move beyond problem identification and toward problem solving that will enhance our energy security, diversify our energy systems, and reduce emissions that contribute to climate change.

EERE's overall budget request reflects the funding needed to meet our energy challenges head on. Advanced fuels and vehicles, renewable power, efficiency in buildings and industry, and technology deployment comprise EERE's portfolio and multipronged approach to energy solutions. I will now provide a description of the priorities and specific funding requests of EERE's program areas.

BIOMASS AND BIREFINERY SYSTEMS R&D

In fiscal year 2009, the Department is requesting \$225 million for the Biomass Program, an increase of \$26.8 million from the fiscal year 2008 appropriation. The Biomass Program's funding supports the Biofuels Initiative that was launched in 2006 as part of the Advanced Energy Initiative (AEI) and is designed to achieve cost competitive cellulosic ethanol by 2012. The funding also supports the President's

“Twenty-in-Ten” initiative, announced in the 2007 State of the Union, to reduce gasoline consumption by 20 percent by 2017.

EISA includes increased Corporate Average Fuel Economy (CAFE) standards and an increased Renewable Fuel Standard (RFS). The act increases CAFE standards to 35 miles per gallon for all passenger automobiles, including light trucks, by 2020; and mandates the replacement of 36 billion gallons of gasoline with renewable fuel by 2022, including 16 billion gallons of cellulosic ethanol. The Biomass Program’s funding request for technology development and demonstration is expected to support timely achievement of EISA requirements. The program is focused on: Feedstock Infrastructure to reduce the cost of feedstock logistics; Platforms R&D for efficiently converting feedstocks into cost competitive commodity liquid biofuels; and Utilization of Platform Outputs to demonstrate and validate integrated technologies that achieve commercially acceptable performance and cost targets through public-private partnerships. The program strategy is to accelerate development of the next generation of feedstocks and conversion technology options for validation and demonstration in integrated biorefineries at commercial and 10 percent of commercial scale. This strategy balances the program’s research, development, and deployment (RD&D) portfolio by encouraging technology transfer while maintaining core R&D funding for next generation technologies. The program will continue to emphasize cellulosic ethanol and expand the focus on other renewable biofuels, such as bio-butanol and green diesel.

VEHICLE TECHNOLOGIES PROGRAM

The fiscal year 2009 Vehicle Technologies Program’s request is \$221.1 million, an \$8 million increase over the fiscal year 2008 appropriation.

Vehicle Technologies Program activities focus on advanced, high-efficiency vehicle technologies, including combustion engines and enabling fuels, hybrid vehicle systems (including plug-in hybrids), high-power and high-energy batteries, advanced lightweight materials, and power electronics. These technologies are critical to near-term oil savings when used in advanced combustion hybrid and plug-in hybrid electric vehicles (PHEVs). In fiscal year 2009, emphasis will increase R&D for PHEVs, such as high energy storage batteries.

The program continues to place increasing emphasis on accelerating RD&D on lithium-ion batteries, plug-in hybrids (including plug-in hybrid vehicle demonstrations), and drive-train electrification to diversify and make our Nation’s vehicles more efficient to reduce petroleum dependency. The R&D centers on improving advanced combustion engine systems and fuels and on reducing vehicle parasitic losses. The Vehicle Technologies budget is modified in the fiscal year 2009 request by transferring three activities from the Hydrogen Technology Program: Education; Technology Validation; and Safety and Codes and Standards. These activity areas have congruent objectives with other efforts within the Vehicle Technologies Program, and combining them within one program enables management efficiencies.

The Program will continue fiscal year 2008 efforts to evaluate the impact of intermediate ethanol blended gasoline (i.e., greater than E10) in conventional (i.e., non-FFV) vehicles and to improve the efficiency of engines operating on ethanol blends. Late model and legacy vehicles will be tested for emissions, performance, and materials impacts. Intermediate blends could provide a way to increase ethanol use sooner. These efforts support existing requirements and the President’s 20 in 10 plan.

HYDROGEN TECHNOLOGY PROGRAM

The Hydrogen Technology Program’s fiscal year 2009 budget request is \$146.2 million, \$64.8 million less than the fiscal year 2008 appropriation, due in part to the movement of the three activities mentioned above to the Vehicle Technologies Program. In 2009, the program will focus on remaining critical path barriers to the technology readiness goals for 2015. Substantial increases are included for hydrogen storage and fuel cell R&D. To provide for those increases, all funding for hydrogen production from renewables was eliminated and systems analyses continues at a somewhat reduced funding level.

The Hydrogen Program continues to research and develop critical hydrogen technologies that enable near-term commercialization pathways. Hydrogen Storage is one of the most technically challenging barriers to the widespread advancement of hydrogen and fuel cell technologies in the transportation sector. Our portfolio continues to identify new materials for on-board storage having the potential for greater than 50 percent improvement in capacity than those available prior to 2004. Much needs to be done to enable these materials to operate at practical temperatures and pressures.

In 2009, the Hydrogen Program will significantly increase investment in applied R&D of novel materials and breakthrough concepts with potential to meet on-board storage system performance targets. R&D funding will be competitively awarded and conducted through both Centers of Excellence and independent projects. The overarching goal is lightweight, low-cost, low-pressure, and efficient on-board vehicular storage systems to achieve a driving range of greater than 300 miles, without impacting vehicular cargo or passenger space to be competitive with today's vehicles.

To address the critical barriers of fuel cell cost and durability, the fiscal year 2009 request significantly increases funding for Fuel Stack Components R&D. Our R&D efforts have made significant progress in this area and will continue efforts to achieve our stated goals, reducing the high-volume cost of automotive fuel cells from \$275 per kilowatt in 2002 to \$94 per kilowatt in 2007. In 2009, we hope to reduce the modeled cost of hydrogen fuel cell power systems to \$60 per kilowatt. One notable recent achievement was the cost-shared development of a membrane with 5,000 hours lifetime, a giant leap toward the 2010 goal of 5,000 hours durability in an automotive fuel cell system.

The Hydrogen Program's fuel cell R&D will continue to pursue a number of technological advancements. Proton-conducting membranes that are low-cost, durable, and operable at a low relative humidity will be developed. Non-precious metal and alloy catalysts will be identified and developed to further lower the cost of fuel cell systems. Gas flow through the flow fields will be modeled and measured while fuel cells are in operation to ensure optimal gas and water distribution over the catalyst and membrane surface. And fuel cells for distributed energy generation will continue to be developed with an emphasis on system integration, cost reduction and efficiency improvements. The Department will also continue its participation in the International Partnership for Hydrogen Economy (IPHE)—collaborating on R&D of materials for both fuel cells and storage, and working on such projects as the evaluation of fuel cell-related test protocols from different countries, as well as hydrogen pathway and infrastructure analyses.

SOLAR ENERGY PROGRAM

The fiscal year 2009 budget request for the Solar Energy Program is \$156.1 million, \$12.3 million less than the fiscal year 2008 appropriation. Through the President's Solar America Initiative (SAI), announced in the 2006 State of the Union, the Solar Program will accelerate market competitiveness of solar photovoltaic technologies through R&D aimed at less expensive, more efficient, and highly reliable solar systems. Targeting improved performance and reliability with reduced cost, the Solar Program focuses its RD&D activities in two technology areas: photovoltaics (PV) and concentrating solar power (CSP).

The Solar Program's goal in the area of photovoltaics is to develop and deploy highly reliable PV systems that are cost-competitive with electricity from conventional resources. The Program focuses on improving the performance of cells, modules, and systems; reducing the manufacturing cost of cells, modules, plant components, and systems; reducing the installation, interconnection, and certification costs for residential, commercial, and utility systems; and increasing system operating lifetime and reliability. To lower costs more rapidly and improve performance, the Solar Program is focusing on PV technology pathways that have the greatest potential to reach cost competitiveness by 2015. Industry-led partnerships, known as "Technology Pathway Partnerships," will be continued in fiscal year 2009 to help address the issues of cost, performance, and reliability associated with each pathway.

The Program's CSP focus is to develop concentrating solar technologies. A solicitation issued in fiscal year 2007 resulted in 12 industry contract awards focused on establishing a U.S. manufacturing capability of low cost trough components and the technical feasibility of low cost thermal storage. In fiscal year 2008, funds will be provided for Phase I of these contracts with the more promising contracts moving into Phase II in fiscal year 2009. One of the most important advantages of CSP is its ability to thermally store power for later use. The development of advanced thermal energy storage technologies in fiscal year 2009 will be expanded to include single heat transfer fluid systems that eliminate the need for multiple heat exchangers and thereby increase system efficiency and reduce cost. For distributed applications, research in fiscal year 2009 will continue on improving the reliability of dish systems through the operation and testing of multiple units as well as improving the manufacturability of dish systems.

WIND ENERGY PROGRAM

The Wind Energy Program's fiscal year 2009 request is \$52.5 million, an increase of \$3.0 million from the fiscal year 2008 appropriation. The Wind Energy Program supports the AEI objective to maximize wind energy resource utilization in the United States by leading the Nation's R&D efforts to improve wind energy generation technology and address barriers to the use of wind energy in coordination with stakeholders.

In 2007, the United States installed more wind generation capacity than any other country by bringing on-line 5 GW of new wind installations. Wind is now a major source of new electricity generation, and accounts for roughly 30 percent of new capacity from all energy sources. Since 2000, wind energy has increased more than 6-fold, from about 2.5 GW to nearly 16.8 GW today. While there are significant challenges, wind resources have the potential to provide up to 20 percent of our Nation's generation potential.

The Wind Program believes that wind energy is at a transitional point, particularly for large land-based wind systems. The program is concentrating on reducing technological barriers that limit the growth potential of wind energy in the United States by focusing on improving cost, performance, and reliability of large scale land-based technology. As a part of the effort, NREL will be testing its first utility-scale multi-megawatt turbine at the National Wind Technology Center in Colorado, through a competitive CRADA solicitation.

In addition, the Wind Program is facilitating wind energy's rapid market expansion by anticipating and addressing potential regulatory, transmission and manufacturing barriers; and investigating wind energy's application to other areas, including distributed and community owned wind projects.

The Program's focus also includes energy storage efforts in coordination with the Office of Electricity Delivery and Energy Reliability to maximize wind energy resource utilization, which supports diversifying the domestic energy supply while enhancing system reliability.

WATER POWER PROGRAM

The Water Power Program's budget request of \$3.0 million will support initial R&D activities, and follows an initial congressional appropriation of \$9.9 million in fiscal year 2008. The program needs to evaluate the results of its fiscal year 2008 R&D projects and technology assessments (which will continue into fiscal year 2009) before considering further applied research efforts. The mission of the Water Power Program is to research and develop innovative and effective technologies capable of harnessing hydrokinetic energy resources, including ocean wave and current energy.

The program will focus on conducting technology characterizations to identify manufacturers, performance limits and issues, known environmental impacts, and other relevant technical and market variables. In addition the program will engage in collaborative international activities.

GEOTHERMAL TECHNOLOGY PROGRAM

The fiscal year 2009 request for the Geothermal Technology Program is \$30 million, which is an increase of \$10.2 million from the fiscal year 2008 appropriation. The Geothermal Technology Program works in partnership with industry to establish Enhanced Geothermal Systems (EGS) as an economically competitive contributor to the U.S. energy supply. Geothermal energy generates "base-load" electricity and/or supplies heat for direct applications, including aquaculture, crop drying, and district heating, or for use in heat pumps to heat and cool buildings.

The Program focuses on the innovative technology of Enhanced Geothermal Systems (EGS), which are engineered reservoirs created to produce energy from geothermal resources that would otherwise not be economical. EGS is a new pathway for producing geothermal energy by drilling wells into hot rock, fracturing the rock between the wells, and circulating a fluid through the fractured rock to extract the heat. While EGS reservoirs have been designed, built, and tested in various countries, a number of technical hurdles remain to be overcome, the most important involving creation of EGS reservoirs with commercial production rates and lifetimes. The Department's approach will concentrate initially on issues related to reservoir creation, operation, and management. This may involve working with cost-sharing partners at existing geothermal fields to develop, test, and perfect the tools needed to fracture hot, impermeable rock and efficiently circulate fluids.

A feasibility study by the Massachusetts Institute of Technology (MIT) estimates that EGS could provide 100,000 MW of electric power by 2050—10 percent of currently installed electric capacity. This compares with today's 2,800 MW of installed

capacity at existing U.S. geothermal power plants using today's technology. Expected program outcomes will include creation of a commercial-scale geothermal reservoir and power plant (approximately 5 MW in generating capacity) capable of operating for 7 years by 2015. This initial plant, followed by others in differing geologic environments, should foster rapid growth in the use of geothermal energy as predicted by the MIT study.

BUILDING TECHNOLOGIES PROGRAM

The Building Technologies Program's fiscal year 2009 request is \$123.8 million, an increase of \$14.8 million from the fiscal year 2008 appropriation. The Building Technologies Program develops technologies, techniques, and tools for making residential and commercial buildings more energy efficient, productive, and cost-competitive. The Program's funding supports a portfolio of activities that includes solid state lighting (SSL), improved energy efficiency of other building components and equipment, and their effective integration using whole building system design techniques that will enable the design of net Zero Energy Buildings. The Program also includes the development of building codes and appliance standards and successful education and market introduction programs, including ENERGY STAR and EnergySmart Schools.

The Residential and Commercial Buildings integration components of the Building Technologies Program aim to transform the carbon footprint of the built environment through Zero Energy Buildings. The residential-focused Building America sub-program focuses on reducing total energy use in a new home by 60 to 70 percent. During fiscal year 2009, research for production-ready new residential buildings that are 40 percent more efficient will continue for three climate zones, with completion in two. The Program's activities in the commercial sector are focused on alliances of leading market companies with national portfolios of buildings. The Program will engage with the developers of these buildings, which will provide the opportunity to better understand what R&D is needed to help promote the construction of highly efficient commercial buildings. DOE's role as convener of partnerships with developers and other key actors help promote leveraging of resources and encourage the private sector to undertake market transformation activities.

The Emerging Technologies subprogram seeks to develop cost-effective technologies for residential and commercial buildings that enable reductions in building energy use. Solid State Lighting will develop technologies that can help reduce commercial building lighting electricity consumption. Space Conditioning and Refrigeration R&D will continue work on innovative HVAC design concepts. Other highlights include highly insulating windows and building integrated solar heating and cooling systems.

The Equipment Standards and Analysis subprogram develops minimum energy efficiency standards that are technologically feasible and economically justified as required by law. Federal energy conservation standards that have gone into effect since 1988 are projected to save a cumulative total of 75 quadrillion Btus (quads) of energy by the year 2045 (in 2007, total annual United States consumption of primary energy was about 103 quads). Between fiscal year 2005 and fiscal year 2007, the Department identified and carried out significant enhancements to rulemaking activities. The Department has made a commitment to clear the backlog of delayed actions that accumulated during prior years, while simultaneously implementing all new requirements of the Energy Policy Act (EPACT) of 2005. EISA significantly increases the number of efficiency standards and test procedures DOE must develop. The Department will continue to implement productivity enhancements that will allow multiple rulemaking activities to proceed simultaneously, while maintaining the rigorous technical and economic analysis required by statute. Energy conservation standards for 10 products were initiated in fiscal year 2006 and 2007 that will continue in fiscal year 2009. In fiscal year 2008, efficiency standards rulemakings were initiated on four additional products. In fiscal year 2008, DOE is proceeding simultaneously on rulemakings for 15 products and 10 test procedures. In fiscal year 2009, four more standards and test procedures for seven more products will be added.

The Technology Validation and Market Introduction subprogram funds activities that validate and promote clean, efficient, and domestic energy technologies. Expanding and modernizing the ENERGY STAR program to include solid state lighting, water heaters, photovoltaics, fuel cells, micro-wind turbines, combined heat and power, and other advanced technologies, as well as targeting the civic infrastructure (e.g., schools, hospitals, libraries, municipal facilities), are central activities that the program carries out to invest in Energy Smart solutions. DOE will continue to work with the Environmental Protection Agency on the development and implementation

of Energy Star and other efforts to minimize duplication and maximize efficiency. In addition to these efforts, the Program focuses on outreach efforts to help move specific technologies—such as solid-state lighting and high-performance windows—toward commercial applications. These efforts include design and rating tools, durability and product lifetime data, testing procedures, demonstrations, retailer education, and training on proper installation.

INDUSTRIAL TECHNOLOGIES PROGRAM

The Industrial Technologies Program seeks to reduce the energy intensity (energy demand per unit of industrial output) of the U.S. industrial sector through coordinated research and development, validation, and technical assistance activities to increase dissemination of energy efficiency technologies and operating practices. The fiscal year 2009 budget request for the Industrial Technologies Program (ITP) is \$62.1 million, which is \$2.3 million less than the fiscal year 2008 appropriation. Internal funding shifts reflect a continued strategy to emphasize more effective ways to increase energy efficiency among energy intensive industries. The shift toward more crosscutting and higher impact R&D activities will allow ITP to develop advanced, energy-efficient technologies to serve a broader set of industries.

The program will continue to support the Secretary of Energy's "Easy Ways to Save Energy" campaign through the Save Energy Now (SEN) industrial energy savings assessments at the Nation's most energy-intensive industrial facilities. This has been a very successful activity, having reached its 24-month goal of conducting 450 assessments from 2006 through 2007. With 89 percent of the plants reporting results from these assessments, the program has identified savings of over 88 trillion Btus of source energy, including more than 71 trillion Btus of natural gas, the amount used by almost a million U.S. homes. If implemented, the improvements recommended through SEN assessments have a potential energy savings of more than \$727 million per year and could also reduce carbon dioxide emissions by 6.3 million metric tons annually, which is equivalent to taking over one million automobiles off the road.

Building on this success, ITP will expand partnerships with leading corporations across major manufacturing supply chain and deliver DOE plant assessments, tools, and technologies to enable dramatic energy efficient improvements, contributing to the EPACT 2005 goal of reducing industrial energy intensity by 2.5 percent per year from 2006 to 2016.

FEDERAL ENERGY MANAGEMENT PROGRAM

The Federal Energy Management Program (FEMP) budget request for fiscal year 2009 is \$22 million, which is an increase of \$2.2 million from the fiscal year 2008 appropriation. FEMP enhances energy security, environmental stewardship, and cost reduction within the Federal Government through reductions in energy intensity in buildings, increased use of renewable energy, and greater conservation of water. These goals are accomplished by means of technical assistance, coordination of Federal reporting and evaluation, supporting alternative fuel use in the Federal vehicle fleet, and supporting the Secretary's Transformational Energy Action Management (TEAM) Initiative.

In a new effort this year, FEMP will support private sector development of alternative fuel stations at Federal sites, help the Federal Government identify opportunities for petroleum displacement to increase alternative fuel use, and conduct reporting and analysis of the Federal vehicle fleet. In addition, with DOE Specific Investments, FEMP will support the Secretary's TEAM Initiative, which will establish DOE as the Federal agency leader in strengthening energy and alternative fuels management. The TEAM Initiative works with DOE programs to help meet and exceed the goals of Executive Order 13423, such as a reduction of energy intensity of 30 percent by the end of fiscal year 2015.

As part of the TEAM initiative, the Secretary has instructed all DOE sites to host private sector energy service companies to assess efficiency opportunities across the complex, addressing all lifecycle, cost-competitive options. DOE will lead by example, deploying a wide variety of lighting and other advanced technologies to achieve maximum energy savings. The Secretary's TEAM Initiative is bold and, as Congress looks to "green" the Capitol Complex, I would be pleased to provide additional information and periodic updates to this Committee on our efforts and actions.

WEATHERIZATION AND INTERGOVERNMENTAL ACTIVITIES PROGRAM

The fiscal year 2009 request for Weatherization and Intergovernmental Activities is \$58.5 million. Stakeholders and partners include State and local governments, Native American Tribes, utilities, and international agencies and governments.

Significant changes in the fiscal year 2009 budget request include increases for the State Energy Program and the Asia Pacific Partnership, a refocusing for Tribal Energy Activities, and conclusion of funding for the Weatherization Assistance Program (WAP) and the Renewable Energy Production Incentive. The results of DOE's weatherization assistance activities are little changed in the last 2 decades: provision of positive limited benefits to selected recipients, but failing to catalyze broader solutions for the tens of millions of eligible homes that have never received retrofits. The Department requests no funding for WAP activities; however, States can continue to support weatherization assistance activities with resources provided by the Low-Income Home Energy Assistance Program at the Department of Health and Human Services. Concluding the program at DOE will allow the Department to focus on higher priority research and development as well as State, local, and utility energy projects in the State Grants program. Through fiscal year 2008, the Renewable Energy Production Incentive (REPI) provided financial incentive payments to publicly owned utilities, nonprofit electric cooperatives, and tribal governments and native corporations that own and operate qualifying facilities generating renewable electricity. The incentive value of REPI has diminished over time as renewable energy technologies have become competitive, rendering the program no longer necessary.

In fiscal year 2009, the State Energy Program will continue to include competitive grants for State policies and programs that increase adoption and compliance of advanced building energy codes, accelerate the use of performance contracting and alternative financing by State and local governments, and increase investments in utility delivered efficiency programs and other high priority EPACT 2005 and EISA programs.

The State Energy Program helps enable State governments to target their high priority energy needs and expand clean energy choices for their citizens and businesses. Benefits include reduced energy use and costs, environmentally conscious economic development, increased renewable energy generation capacity, and lessened reliance on imported oil. A combination of technical assistance, outreach, and financial assistance support effective program implementation of the National Action Plan for Energy Efficiency and provisions of EPACT 2005 and EISA.

FACILITIES AND INFRASTRUCTURE

The budget request for Facilities and Infrastructure supports operations and maintenance (O&M) for the National Renewable Energy Laboratory (NREL), a single-purpose laboratory dedicated to R&D for energy efficiency, renewable energy, and related technologies. The request for fiscal year 2009 is \$13.9 million: \$10.0 million for core O&M (a \$3.1 million increase) and \$4.0 million required to complete Phase I construction of the Energy Systems Integration Facility (ESIF).

This budget request represents a decrease of \$62.2 million compared to the fiscal year 2008 appropriation, primarily a reflection of Congress's fiscal year 2008 provision of \$54.5 million to initiate construction activities for the ESIF and to begin additional site infrastructure work. Funding beyond that which is requested for fiscal year 2009 is not needed, as much of the construction taking place was fully funded in prior years. The remainder of the decrease is a result of including requested solar research capital equipment replacements within the Solar Energy Program budget, where such equipment is typically funded.

CONCLUSION

The penetration of EERE technologies into the marketplace could save consumers over \$600 billion by the year 2030 and save as much as \$4 trillion by 2050, cumulatively. Similarly, the technologies in our portfolio could avoid 6 gigatons of carbon (GTC) by 2030 and nearly 50 GTC by 2050, cumulatively.¹ With action plans, performance milestones, clearly articulated deliverables, and continued performance, EERE's budget request supports priority R&D and the achievement of stated goals. Our laboratory products and partnerships will help bring cleaner energy technologies and sources to commercial viability in the foreseeable future.

Senator DORGAN. Mr. Karsner, thank you very much. Finally, we will hear from David Frantz. Mr. Frantz, you may proceed.

¹ Energy Efficiency and Renewable Energy Fiscal Year 2009 Congressional Budget, 20.

STATEMENT OF DAVID G. FRANTZ, DIRECTOR, LOAN GUARANTEE PROGRAM OFFICE, OFFICE OF THE CHIEF FINANCIAL OFFICER

Mr. FRANTZ. Mr. Chairman, members of the committee, I am pleased to be before you today to review our budget for fiscal year 2009 as well as give you a program update on our office.

I am happy to inform you that significant progress on this program has been made over the past year. In fact, just 1 year ago, the Department began its processing of the first 143 applications from the 2006 solicitation, and that period involved very rigorous technical and financial evaluations in accordance with criteria set forth by our Credit Review Board, the governing board of our program.

STAFFING OF LOAN GUARANTEE PROGRAM

Coincidental with this activity, I was hired and began as a top priority: the immediate staffing of the office with permanent Government, Federal employees. In the way of a background, I have over 35 years of international project financing experience, and that also includes over 10 years of experience with the Overseas Private Investment Corporation as a director of loan origination.

And I would add, parenthetically, that the initial cadre of our officers that we are hiring reflect my background. They are significant professional people who have long experience in the field and who also have experience with the Overseas Private Investment Corporation as well.

LOAN GUARANTEE PROGRAM APPLICANTS

On October 4th, we reached our first significant milestone. On that day we announced the promulgation, the announcement of the release of the final regulations for our program under title XVII, and we also announced the selection of 16 preapplicants to be invited to submit 4 applications for the Loan Guarantee Program.

Prescreening conferences have been held with all of these applicants, finishing in the month of January, and all 16 have indicated the desire to proceed with us to full loan guarantees through our process of due diligence.

In addition, a prodigious amount of work has been completed to formulate and write policies and procedures to execute this program and to institute systems that will facilitate us in a very responsive way to process these applications.

LOAN GUARANTEES BUDGET

I would bring your attention to emphasize two points with respect to our 2009 budget. The first is that we are asking for \$19.9 million of additional administrative expense to operate our office. And that is a function of the requirement to, essentially, double the size of our office within a year to accommodate our future solicitations.

And, finally, we also are seeking an extension on the fiscal year 2008 budget in accordance with the report language. As you're aware, the whole obligation terminates on September 30, 2009, and that's far too short a period of time for us to begin to prosecute our current workload as well as the new solicitations that you have en-

visioned in the report language. So we are seeking to extend that deadline to September 30, 2010, for all projects other than the nuclear plant facilities and for the nuclear plant facilities to extend that deadline to 2011.

In addition to the report, the language requires us to submit to you and the House Committee on Appropriations a Solicitation Implementation Plan for our future solicitations. We're in the process of working on that plan, and we hope to have it up to you within a month or so.

SOLICITATION IMPLEMENTATION PLAN

In conclusion, I would emphasize one or two items. We understand the objectives and roles of title XVII program. We are not a research and development program, nor are we an early stage venture capital finance group. We issue loan guarantees to help fund the advanced stages of projects that are designed to take pilot and documentation projects to full commercial viability.

We, in conjunction with the Department's Program Offices, will seek innovation and eligible projects as well as environmental benefits, and a reasonable assurance of repayment of our guaranteed loans in order to bring advances into the market, enabling others to replicate or to expand these technologies with full participation of the private sector.

Mitigating financial risk to the taxpayers is of utmost importance to us. In my personal conversations with the Secretary, he emphasized this point with me, and I can assure you our office is committed to do that.

A number of measures are being taken to ensure risks are properly mitigated for each project including a thorough investigation and analysis of each project's financial, technical, and legal strengths and weaknesses, as well as all identifiable risks. In addition to the underwriting expertise of our office, each project will be reviewed in consultation with independent engineering consultants outside of the Department of Energy.

PREPARED STATEMENT

Over the past 12 months a remarkable amount of work has been accomplished. Based on my experience at OPIC and my familiarity with other loan guarantee programs at other agencies in the Federal Government, I can tell you that the Department has moved very quickly in making the title XVII program operational. I know there has been some congressional frustration with the pace of activity, but we have sought to move quickly as possible while ensuring technical and fiscal soundness of the program.

I appreciate the opportunity to be before you today, and I will be happy to answer any questions you may have. Thank you.

[The statement follows:]

PREPARED STATEMENT OF DAVID G. FRANTZ

Mr. Chairman and members of the committee, I am pleased to be before you today to present the Department of Energy's Loan Guarantee Program Office (LGPO) fiscal year 2009 budget proposal and program update. The LGPO administers the Federal loan guarantee program that was authorized for title XVII of the Energy Policy Act of 2005 (EPA 2005). Under this program, DOE may issue loan guarantees for innovative energy technology projects that avoid, reduce, or sequester air pollutants

or anthropogenic emissions of greenhouse gases, and have a reasonable prospect of repaying the principal and interest on their debt obligations.

I am happy to inform you that significant progress on this program has been made over the past year. Let me quickly review with you some salient milestones. A year ago this week, two very experienced individuals were detailed from the U.S. Treasury Department to help lead the effort of evaluating a total of 143 pre-applicants seeking an invitation to submit full applications for loan guarantees. The 143 pre-applicants resulted from the initial solicitation of the program which officially closed on December 31, 2006. Supported by contractors, over the course of last summer the pre-applicants underwent a rigorous technical and financial review in accordance with criteria set forth by the Department of Energy's Credit Review Board (CRB), the governing board for the program. Coincidental with this activity, I was hired and began as a top priority the immediate staffing of the office with permanent Federal employees. In the way of background, I have over 35 years of project finance experience, predominantly in energy, independent power and heavy infrastructure industries. I have spent the past 10 years with the Federal Government's Overseas Private Investment Corporation (OPIC) as a Director of Loan Origination, which provided me with significant experience working under the Federal Credit Reform Act of 1990.

On October 4, 2007, DOE achieved two major milestones. DOE announced the release of its final regulations implementing the title XVII EPCA 2005. These regulations marked a significant step forward and were the result of a rigorous review and evaluation of Federal credit policy, public comments received on the notice of proposed rulemaking and analysis by DOE. The provisions of the final regulations have provided greater flexibility in the structuring of transactions as compared to the Guidelines originally published in August 2006, including the ability to provide guarantees up to 100 percent of one or more debt instruments employed in eligible projects. Simultaneously, the Department announced that 16 projects from the 143 pre-applications submitted in response to DOE's August 2006 initial solicitation would be invited to submit full applications for a loan guarantee.

Pursuant to those invitations, pre-screening conferences were conducted with the 16 pre-applicants during the months of December 2007 and January 2008 to provide the LGPO updates on the respective projects as well as to inform the project sponsors of the policies and procedures to be followed in preparing and submitting full applications. All 16 of the pre-applicants have indicated a desire to submit full applications and are currently in the process of preparing their applications in compliance with the requirements of title XVII program regulations. We expect that the first applications will be submitted to DOE this month through the Department's electronic data submission system, and the balance of the applications are expected to be received in an evenly distributed progression over the next several months. To date, the CRB has not established a firm deadline by which the 16 applications must be filed but the CRB may do so in the future. A prodigious amount of work has been completed to formulate and write policies and procedures for the application process; to establish the electronic data submission system for receipt of applications and supporting documents; to install requisite accounting systems and procedures for the office; and to develop a model for determining the credit subsidy cost of loan guarantees for projects that receive title XVII loan guarantees.

The LGPO has worked aggressively to assemble a staff of highly qualified project finance experts with significant experience in the private sector as well as in Government working under the Federal Credit Reform Act of 1990 closing other Federal loan guarantees. In accordance with the fiscal year 2008 budget, the plan is to fulfill organizational staffing for a total of 16 Federal full time equivalent (FTE) employees by September 2008 augmented by 6 to 10 contractors. This organization is sufficient to perform the credit underwriting and due diligence process associated with the 16 projects invited to submit full applications, as well as to issue new solicitations within the next year. The schedule for hiring additional staff will be undertaken in close coordination with the requirements for managing the new solicitations and the processing of subsequent applications.

FISCAL YEAR 2009 BUDGET REQUEST

The Department requests \$19.9 million in funding in fiscal year 2009 for administrative expenses to operate the LGPO and for support personnel and associated costs. This request essentially doubles the size of the office, over the fiscal year 2008 appropriation, to support continued processing and then monitoring of loan guarantees that may be issued in response to the August 2006 solicitation, as well as the execution of new solicitations to be released this year. This request will be offset

by fee collections from project sponsors in the same amount, as authorized both by EPCA 2005 and the Department's implementing regulations.

In the Committee Report accompanying the Consolidated Appropriations Act, 2008, Congress stated the Department should issue no more than \$38.5 billion in loan guarantees under the title XVII program before the end of fiscal year 2009. Pursuant to the act, the budgetary authority provided by the act to issue loan guarantees is available only until September 30, 2009. DOE's fiscal year 2009 budget request seeks to extend that budget authority through fiscal year 2010 for all projects other than advanced nuclear power facilities and through fiscal year 2011 for advanced nuclear power facilities. This extension is necessitated by long development lead times for completing all of the steps preceding the issuance of loan guarantees for major energy projects. Of the total loan guarantee amounts made available by Congress and identified in the fiscal year 2009 budget request, \$20.0 billion will be available through fiscal year 2010 to support projects such as Uranium Enrichment, Coal Based Power, Advanced Coal Gasification, Renewables, and Electricity Delivery. The remaining \$18.5 billion will be available through fiscal year 2011 to support nuclear power facilities. The \$38.5 billion total is in addition to the \$4.0 billion in authority provided in fiscal year 2007 under Public Law 110-5.

FISCAL YEAR 2008 AND FISCAL YEAR 2009 SOLICITATION IMPLEMENTATION PLAN

The Consolidated Appropriations Act, 2008 requires that at least 45 days prior to the execution of a new loan guarantee solicitation, DOE must submit a loan guarantee implementation plan to the Appropriations Committee of both houses of Congress. The implementation plan must define award levels and eligible technologies. DOE is in the process of preparing such an implementation plan. The Department plans to submit the plan to the Committees on Appropriations later this month.

CONCLUSION

In conclusion, I would like to emphasize the following points:

We understand the role and objectives of the title XVII loan guarantee program. We are not a research and development program nor are we early stage venture capital providers. We issue loan guarantees to help fund the advanced stages of projects that are designed to take pilot and demonstration projects to full commercial viability. We, in conjunction with the Department's Program Offices, will seek innovation in eligible projects as well as environmental benefits, and a reasonable assurance of repayment of our guaranteed loans, in order to bring advances into the market enabling others to replicate and to expand these technologies with full participation of the private markets.

Mitigating financial risk to taxpayers is of utmost importance to Secretary Bodman and to the LGPO in implementing the title XVII program. A number of measures are being taken to ensure risks are properly mitigated for each project prior to approval of a loan guarantee. First, the due diligence process includes a thorough investigation and analysis of each project's financial, technical, and legal strengths and weaknesses as well as all identifiable risks. In addition to the underwriting expertise of the LGPO staff, each project will be reviewed in consultation with independent engineering consultants. Finally, in addition to taking a significant equity stake in a project, each project sponsor will also be required to pay to the Federal Government the credit subsidy cost to offset the risks associated with the DOE's issuance of the loan guarantee.

The LGPO, when evaluating the eligibility of projects for loan guarantees, and throughout the process of negotiating terms and conditions with eligible applicants, will give due consideration to the technological and commercial maturity of each project in its development cycle. For that purpose, the LGPO will draw upon technical appraisals from experts both within and outside DOE.

Over the past 12 months, a remarkable amount of work has been accomplished. Based on my experience at OPIC and my familiarity with loan guarantee programs at other agencies, I can tell you that the Department has moved very quickly in making the title XVII program operational. I know there has been some Congressional frustration with the pace of activity, but we have sought to move as quickly as possible while ensuring the technical and fiscal soundness of the program. We are continuing to recruit additional qualified staff to finalize the credit subsidy model, as well as to institute comprehensive policies and procedures to initiate the application and due diligence process. Finally, we are developing state of the art accounting and processing systems that will allow the LGPO to monitor and manage the loans over the life of the projects.

I appreciate the opportunity to appear before you today. I will be happy to take any questions that the members of the committee may have.

Senator DORGAN. Mr. Frantz, thank you very much.
We thank all three of you for testifying. Senator Cochran has arrived. Senator Cochran, did you have an opening statement?

STATEMENT OF SENATOR THAD COCHRAN

Senator COCHRAN. Mr. Chairman, I simply want to congratulate the witnesses for the work they're doing to lead the way with the President's Competitiveness Initiative. It's hard work, and I think you're doing a commendable job, and I ask unanimous consent that the balance of my statement be printed in the record.

Senator DORGAN. Without objection.
[The statement follows:]

PREPARED STATEMENT OF SENATOR THAD COCHRAN

Mr. Chairman, I appreciate your holding this hearing to review budgets of the Department of Energy's Office of Energy Efficiency and Renewable Energy, Office of Loan Guarantees, and Office of Science. Development of efficient and clean energy technologies is one of the most pressing issues in the world today. I'm glad that we are here to consider the budgets for these accounts within the Department of Energy. I am pleased to welcome Dr. Raymond Orbach, who has been gracious in his efforts to keep me informed about current initiatives in the Office of Science. I'd also like to thank Dr. Karsner and Mr. Frantz for being here to provide testimony and answer questions.

It is important that the Department continue to look for alternative and renewable sources of energy to lessen our dependence on foreign sources of oil and gas, while promoting cleaner energy production. Mississippi is blessed with abundant resources capable of producing biomass-based energy, and funds need to be directed to the unique capacities of the Southeastern region of the United States. In order to reach a goal of domestic energy sustainability, we must research and develop a broad energy portfolio. I am hopeful that partnerships between Mississippi's research institutions and the Department of Energy will continued be strengthened.

I am glad that the Department of Energy has created cohesion between the Office of Science and the Office of Energy Efficiency and Renewable Energy. Without basic scientific research capability, the United States cannot reap the benefits of our natural resources to meet our growing energy demand. As the rest of the world rapidly increases energy demand, they are also advancing their scientific research. We need to stay competitive in the world market and make wise choices about fulfilling our energy needs.

Finally, I am pleased that the Loan Guarantee program has begun designating its appropriated funds to deserving technologies. I hope the program will continue to succeed in helping to fund forward-thinking projects.

Thank you all for your time today and for the good work you are doing.

RENEWABLE ENERGY FUNDING

Senator DORGAN. First of all, Mr. Karsner, I'm going to ask you a series of questions and as I've indicated before, I'm pleased that you have joined public service. I think you do an excellent job, and have an excitement and a passion for renewable energy. So let that be a precursor to my questions.

You indicate in your testimony, Mr. Karsner, EERE's fiscal year 2009 request of \$1.25 billion is approximately \$19 million higher than fiscal year 2008, and as I heard you I thought, well, that's good news. At least they are proposing an increase. And then I took a look at the grid sheet and saw that I'd already known: In fact, the budget proposal is nearly \$450 million less than the Congress appropriated last year.

So it's clever to say this is a \$19 million increase, but, in fact, your budget requests for a very important part of the Energy De-

partment is close to a half a billion dollars less than last year. To me, that's not justifiable, and so let me describe my concern.

Hydrogen technology. I'm a big fan of hydrogen fuel cells. Senator Domenici and I were the only two legislators invited to a big deal with President Bush about 3 years ago, because both of us have been big supporters of hydrogen, hydrogen fuel cell futures. So we went down to the Building Museum, and the President talked about his support. The fact is, this year's request for hydrogen is not only well under last year's request—it cuts it by well over a quarter—it's \$50 million short of what we were spending three years ago.

Weatherization Assistance is zero. And I'm going to show you when we talk about this, the McMillan Report demonstrates that building issues are by far the most likely areas to achieve substantial gains in energy efficiency. You know, my concern about solar energy is cut. The fact is, we're way behind in solar energy, and we ought to be doing much more with respect to solar.

So let me have you take a shot at that. I know you have a passion for these things. I know you can't possibly be up here feeling good about a budget request that's nearly a half a billion dollars under what we gave your office last year. How bad do you feel about this?

Mr. KARSNER. Well, thank you, Mr. Chairman, and thanks for your passionate support of our portfolio.

I feel good every day I serve the President and get to work with Congress and advance these goals. So to be clear, the budget request is above our 2008 request. Of course, the Congress was more generous with the request than last year—and that was an aberration over the historical line—so we enjoyed an enormous plus-up of our portfolio last year, an unanticipated surprise, and we are working to integrate and manage that money usefully.

But in terms of the multiyear planning, the programmatic technological R&D and deployment portfolio, it is a substantial aberration that we went up almost 50 percent last year, and so what I'm suggesting is that this year's request is back in line with what the administration's request had been consistent.

Senator DORGAN. Well, Mr. Karsner—let me apologize for interrupting you—the decision by myself and Senator Domenici and other members of this subcommittee, should not be called an aberration. We decided that this is where we wanted to invest the money because, in the context of the Energy bill that Congress passed, we decided we have to do much, much, much more in renewables.

And, if I might continue to interrupt for one second, this is the McKinsey & Company study which you're well aware of.

Mr. KARSNER. Yes.

Senator DORGAN. Go to the far left side. By far the biggest bang for the buck by far in terms of saving energy is building insulation. And yet you come with this proposal to zero out Weatherization Assistance. I mean, just because we added a half a billion dollars in this day and age when energy is so critical, don't call it an aberration. It was a decision by a subcommittee that was a very informed decision.

I'm sorry to interrupt.

Mr. KARSNER. No, it's a quite fair statement.
 Would you like me to address each of those, categorically?
 Senator DORGAN. Please do.

HYDROGEN TECHNOLOGY FUNDING

Mr. KARSNER. Okay. First let's talk about hydrogen. Hydrogen, obviously, was announced in the 2003 State of the Union and the President introduced it, a 5-year plan for \$1.2 billion. The Department had completed that 5-year plan in 2008 for the \$1.2 billion. Hydrogen remains amongst the most robustly funded of any of the programs in the EERE portfolio, precisely because of the progress that was made during the years of the hydrogen fuel initiative that enabled us to focus on the acute problems and the metrics that would define the barriers that needed to be overcome in order to achieve a 2014 commercialization decision.

We have upped the amount of budgetary focus on those key areas, principally: on-board storage in the vehicles that would enable a 300-mile driving range and further reduction of the fuel cell stacks, the Pennfuel cell stacks, that would get them to the programmatic target of \$30 per kilowatt on a manufactured basis. We are making continual progress on that, but we seek to accelerate the progress by moving more money, disproportionately, into those areas.

It's a little bit deceptive when we talk about the amount of money it was cut, because, actually, more than half of the hydrogen funding that appears to be lowered was moved over into the Vehicles Technology program—things like education cogent standard, technology validation, and demonstration—because of the need to diversify all of those things across biofuels, across plug-ins and hydrogen. In other words, Vehicles Technologies was a better-placed program to have a more agnostic technology-neutral view of all the technologies that we are cultivating for gasoline displacement. In order to do that, it has sort of become the air traffic control of transportation platforms for education cogent standard.

The other portion of hydrogen that was diminished are specifically those elements that we think are ready for prime time and commercialization, and eligible for the Loan Guarantee Program today, and that would be renewable production of hydrogen, principally through electrolysis. Electrolysis is not overly high tech; there is not a lot of value added. When compared to the amount of investment, we need to dedicate the fuel cell stacks and storage, and so we think we can still, in places like the Dakotas, wind power to hydrogen with electrolysis using loan guarantees on a commercial basis today. That would be a better use of the \$10 billion allocation that we have in that area. There are some things that need to graduate out based on the progress that we've made. That really sort of addresses hydrogen. Would you like me to go on, on this?

WEATHERIZATION GRANTS

Senator DORGAN. Well, because I want my colleagues to have ample time. Weatherization you zero out, and I was thinking of the—I forget who it was describe something as the “homeopathic soup made from boiling the shadow of a pigeon.”

How do you zero out weatherization and come here and say this is a good approach to dealing with energy efficiency?

Mr. KARSNER. Well, we're driven precisely by the chart that you held up with regard to the need to address building technologies in the built environment. The question isn't what is the mission of weatherization with respect to doing that, but what is the efficacy and efficiency of this mechanism, this program in doing that?

Weatherization grants are income-related assistance grants that are good and worthwhile things for the Federal Government to do, but, chronically, every year we have a discussion about not whether we should do them but where in the Federal budget they belong. Because competing against the Building Technology programs that are the ones that can satisfy the McKinsey metrics for 50 percent efficiency savings and that get 20-to-1 return, these chronically fall short, being rated at about 1.5 return on the dollars.

All of the metrics for weatherization suggest that it should be competed where it belongs in income-related assistance programming, which is a good and worthwhile thing, but it is, unfortunately, lodged to compete against these building technologies that deal with climate change, national security, that require much greater leveraging.

Senator DORGAN. But the President does not recommend it be over in the other area competing in his budget as I see the budget. So, I understand your point, but that's not what the President is recommending.

Mr. Frantz, I'm going to allow my colleagues, Senator Domenici and Senator Craig to have a pretty good opportunity to talk to you, and I know they've got a lot on their minds.

And, Dr. Orbach, I'm going to wait until a second round. I appreciate the work that goes on at our laboratories. Our laboratories are very important institutions for investment in the future of this country's science. And so I'll wait. But I appreciate your testimony, and you've raised a lot of interesting questions as well.

Senator Domenici.

LOAN GUARANTEES

Senator DOMENICI. Well, first, Mr. Chairman, thank you for holding this meeting, and let's hope that within the next 2 or 3 months we will be fully aware of the facts and the funding that we are going to put together for the country in this bill, which many fail to understand is so important to the country, this small appropriations bill.

First, let me talk about loan guarantees because nothing is more frustrating—it's not your fault, Mr. Frantz, but my good friend, Senator Craig, just handed me a piece of paper a little bit ago, and he put two dates on it, 2005 and 2011, because you indicated that you probably needed 2011 for the Nuclear—which is not your fault again. But we just looked at those two numbers and shook our heads.

Six years from the passage of the bill, the General Energy bill first in 12 or 15 years that had a provision in it about loan guarantees that, frankly, I can tell you everyone on this committee that helped with it—two of the members here helped on it—he helped a lot—we thought we passed a loan guarantee provision in that

bill, and we run it through every lawyer around, and we thought it was self-executed. And if you read it, it's clear that the full authorization for as much loan guarantee authority as the Secretary wanted, he could exercise. He didn't have to come back to Congress, and we were very happy. We thought even though we had then a reluctant Secretary of Energy—he was reluctant, he didn't think loan guarantees were the right thing—but let me make sure it's understood, he changed his mind, and he's been a strong supporter. But the changing of the mind took a little while.

Then we have the Secretary of the Treasury. You remember that, Senator Craig. I came to you and said, "Can you imagine? Now we have even a bigger bomber against us, the Secretary of the Treasury." He didn't know what he was talking about—excuse me, Mr. Secretary, but you didn't. He thought—he didn't read the section of the law, he thought we were pledging the Federal Government's full faith in credit to these loan guarantees when we aren't. And he didn't read they would pay for themselves, and they'd pay an up-front fee equivalent to what the estimate risk was. That was the theme, right? And it was right.

So contrary to that we had to go through this whole process of appropriating it, getting you hired, setting up a whole new operation, and it's been 6 years and we still do not—it'll be 6 years and we might get some of the loan guarantees for Nuclear. They're a little different, and it's how many do you have? How many do you clear?

Senator CRAIG. Sixteen, Senator.

Senator DOMENICI. Sixteen. They're different than that, and they're going to be big guarantees for a project, and we understand that's not going to be quite as difficult as sorting out, because you're not going to have 50 to compete. And we've got seven formal applications pending, though, which is rather exciting for our country.

Now, let me ask you, do you have everything you need to proceed with your job?

Mr. FRANTZ. I do, sir, thank you.

Senator DOMENICI. You're adequately funded and adequately—the Energy Department gives you adequate authority?

Mr. FRANTZ. Yes, sir, Senator. With the approval of this budget, I'll have sufficient resource to prosecute the—

Senator DOMENICI. All right. Now let me ask you, you were with which department of the Federal Government doing loan guarantees?

Mr. FRANTZ. With the Overseas Private Investment Corporation, sir.

Senator DOMENICI. Now, doesn't it strike you strange that the OPIC made money on its loan guarantees using the same provisions that we are? They don't lose money, they make money, and we've got the Office, the Congressional Budget Office, insisting that this one is going to lose 1 percent because we're going to make mistakes. You didn't even know who you are, what—how good you are, you're just going to lose 1 percent. So he charges us \$352 million for the whole portfolio even though we haven't spent a penny yet.

Does that strike you as a little bit wrong?

Mr. FRANTZ. It does, sir. As a matter of fact, I made a presentation, ironically enough, to the Congressional Budget Office on December 7, on this very subject and made the very point that you're making. And that is when a self-pay program which differentiates us from the Overseas Private Investment Corporation, as you're well aware, where our clients are actually paying this credit subsidy cost to cover our risk, that seems redundant, to say the very least, that this additional 1 percent would be levied on the projects.

The answer, the only answer we've received, is that it's because it's a new program and there is the technology aspect, the unproven technology risk associated with them.

Senator DOMENICI. Well, when you build a nuclear powerplant, it isn't as if somebody is toying around with new technology. When they invest \$4 billion, they're using a technology that is well known, and it has passed all kinds of gifted overseers to make sure that it's correct, and all kinds of things are built into the law to make sure that this happens. And so it's not like a gamble. They wouldn't gamble. American industry wouldn't gamble on nuclear power if they thought it was what he thinks over there at CBO.

Thank you very much. Let me move over to Dr. Orbach.

AMERICA COMPETES ACT

Dr. Orbach, last August Congress passed the President's—and the President signed—COMPETES, the COMPETES law. This proposal is consistent with the recommendations of the National Academy of Sciences rising above the gathering storm, and it directs the Department to focus greater attention on Science, Mathematics, Education.

Can you tell us, specifically, how your Department is supporting this legislation, and how much money is provided in the President's request, if you know, for COMPETES legislation?

Dr. ORBACH. Well, in the educational—

Senator DOMENICI. For COMPETES.

Dr. ORBACH. For the COMPETES—

Senator DOMENICI. Yes.

Dr. ORBACH [continuing]. Itself, I'll have to answer that, for the record, our budget is responsive to the America COMPETES Act and actually covers the issues that were addressed. So I would say that our increase in the budget request would deal with the America COMPETES Act.

Senator DOMENICI. All right.

Dr. ORBACH. In the specific area of education, we've increased the Workforce Development program within the Office of Science together with the Fellowship program that matched the education components of the America COMPETES Act. About half of them—there's a considerable opportunity there—will be found in our fiscal year 2009 budget request.

Senator DOMENICI. So is it fair to say that this time we are taking the COMPETES Act seriously, and we're attempting to fund it?

Dr. ORBACH. Yes, sir. I believe it's an opportunity for our country, and we are going to be fully behind it.

LOS ALAMOS NEUTRON SCATTERING CENTER (LANSCE)

Senator DOMENICI. All right. LANSCE Refurbishment and MaRIE, a proposal that is built around LANSCE; Dr. Orbach, you and I have spoken extensively about maintaining our science capability at our national laboratories, both the Office of Science facilities and NNSA labs. I believe you share my belief that we need to update LANSCE at the LANSCE facility to sustain cutting-edge science at that lab on materials research. That's what it has to do with. This will have relevant science applications for both NNSA Weapons programs and the Office of Science.

Now, why doesn't the 2009 budget request provide funding necessary to upgrade this excellent facility called LANSCE?

Dr. ORBACH. Well, our part of the funding that surrounds the operations of LANSCE works through the Lujan Neutron Center, and that's fully funded in the President's request.

In addition, the Nuclear Physics program has increased its funding at Los Alamos to about \$4 million. And, finally, we have invited Los Alamos to participate in the Energy Frontier Research Center competition, and there is a provision in there for materials under extreme conditions. And we think this is an opportunity for the whole country, but especially for Los Alamos in the competitive environment.

ENERGY FRONTIER RESEARCH CENTERS

Senator DOMENICI. What are the frontiers of science that you spoke of?

Dr. ORBACH. The Energy Frontier Research Centers cover the basic science that will enable energy prospects for our country for the future. Very frankly, we can't get to where we want to go using technology that was invented in the 19th century and developed in the 20th century.

The opportunities in the 21st century, as I outlined at the atomic molecular level, have yet to be plumbed. And those centers are focused on those issues, namely energy issues that use modern technology.

We're talking about opportunities for photosynthesis, artificial photosynthesis to take solar energy and produce fuels. We're talking about an electrical energy storage that will enable the grid issue, which was brought up before, to be dealt with which we can't do now, but with advanced technologies, with nanotechnology, and multielectron transfer, we believe are possible.

And other elements that I can go into—

Senator DOMENICI. That's fine.

Dr. ORBACH [continuing]. Of that basis.

Senator DOMENICI. So you're going to do this kind of advanced frontier work?

Dr. ORBACH. Absolutely.

Senator DOMENICI. Thank you, Mr. Chairman. I have some additional questions. I'll wait or I'll submit them.

ETHANOL TECHNOLOGY AND PRODUCTION

Senator DORGAN. Senator Craig?

Senator CRAIG. Thank you very much, Mr. Chairman.

Mr. Frantz, the chairman has already offered you up to Senator Domenici and I, so I will not miss that challenge or opportunity.

Let me walk you through a scenario that's going on in America as we speak that would suggest to me your sense of urgency in dealing with some of these loan guarantees in Advance Technology. Last year we produced 7.8 billion gallons worth of ethanol, corn-based. Everybody's frustrated now by its potential disruption of the food chain right down to, if you will, tortilla shells. And the reality that America's agriculture will suggest that we may be planting 8 percent less corn this year than we did last year.

We just have a new ethanol plant coming on in Idaho, and you're going to see unit trains of corn, literally, moving out of the Midwest to Idaho because we're not a corn-production State. We're largely cold weather grains and all of that, and yet those prices, the whole commodity market is considered by, at least historic values, upside down today.

Farmers are smiling and they should, and they're profiting and they should. The consumer is beginning to feel it at the shelf in some areas.

Having said that, last year we suggested, by law, that if ethanol production by 2022 can be at 36 billion gallons and yet we anticipate that corn-base can only take us to about 15, now having said that, we are already stressing out under the current environment at 8 to 10 billion gallons. So 15 may be a very real stretch unless Monsanto can bring on their GMO of 300 bushel of corn. But that's still out there in the scientist eye.

Now the environmentalists are concerned about the carbon footprint of corn-based ethanol and what that does in climate change, and it's very energy intensive, and it needs to be subsidized, but yet it's factoring into the price at the pump. Articles last week suggested that consumers were paying less for gas because of ethanol in the world market.

My point is quite simple: We believe, many of us who spend a lot of time looking at this, that to get to the 36 billion gallons or near that, we've got to get to cellulosic ethanol, and we must get there as soon as we can. And if you were the consumer out there—and you are, like all of us are—buying \$3.30 or \$3.40 a gallon for gas, there is a very real sense of urgency, the reason I penciled for Senator Domenici the spread of 6 years of time of bureaucratic movement in which we sense no urgency whatsoever.

Now, having said that, New York Auto Show, almost every automobile on the floor was a flex fuel or E85 or an electric car. And yet the world is not yet ready to produce that, or at least we had our discussion about hydrogen today, and the world is not yet ready to produce it in the volume that the car companies will need because they're about ready to bring to commercial value a hydrogen fuel cell car.

Time is of the essence, and I know you talk very optimistically about how you've geared up to handle this. Now, I hope that you have running shoes on and you are bringing that sense of urgency into that staff.

Now, diligence, surely. Responsibility, of course. But run 12 hours a day, turn the lights on, don't oh-hum this and move it through. America is ready to become independent, and we are

struggling to get there, and this whole committee senses that, and that's why we jumped in front of it in 2005, and we hit it again last year. And we're phenomenally frustrated when it's handed off downtown to a sluggish, uncertain, frustrating, and sometimes less-than-willing participant.

I don't know if we can get to cellulosic. I think there are some commercial operations stood up, but we ought to try. And we ought to try and if we fail in one, there are some technologies out there that might lead to the front.

Now, if you had the loan guarantees ready 2 years ago, we would probably have a commercial-grade stand-up operation going right now.

Senator DORGAN. For which?

Senator CRAIG. But we don't have that.

Senator DORGAN. For what?

Senator CRAIG. Cellulosic ethanol.

Senator DORGAN. Cellulosic ethanol.

Senator CRAIG. At least that's what we're told by the industries involved. I don't necessarily believe you need to respond to my small rant, but I hope you appreciate what we're sensing on the ground with the consumer, both in food and in energy as to their frustration today about their pocketbooks being stretched beyond their capability.

Mr. Orbach, I would like to suggest that in my conversation with the Center for Advanced Energy Studies in Idaho this last week, they will be contacting you, and sensing the opportunities that you hold in your office and that we hold at the lab; and I assured them that they should anticipate and expect full cooperation from you, as I know that will be the case, and I thank you for it.

I'm out of time, I'll come back. Thank you.

Senator DORGAN. Senator Craig, thank you very much.

Senator Murray?

PHYSICAL SCIENCES FACILITY

Senator MURRAY. Thank you very much.

Dr. Orbach, as you know well, we've had a number of conversations about the level of funding and various pieces of the budget that relate to the tri-party memorandum of understanding for the Physical Sciences Building being built at PNNL, and the 300 Area. I know you know the topic well.

Last year's fiscal year 2008 appropriations resulted in about \$65 million to the Department of Energy and the Department of Homeland Security. That wasn't an easy task because the Department of Homeland Security request was zero, and we had to work with our colleagues here to include an increase of \$15 million for that project.

I appreciate that the Department of Energy this year has requested the appropriate level of funding in the 2009 budget. However, the Department of Homeland Security's 2009 budget request is not what was assumed in that memorandum of understanding. Now, I have no idea what conversations have been between your office and Under Secretary Cohen's office, but I have been ensured by them that whatever additional funds I will be able to add to the

Department of Homeland Security budget for 2009 will be received, enthusiastically.

I wanted to ask you while you're in front of our committee today what your understanding is of the reasons why DHS didn't see the required funding in 2009 consistent with that MOU.

Dr. ORBACH. Senator Murray, first of all I want to thank you for your help in moving this critical project forward. We deeply appreciate it.

To be honest with you, I don't know why DHS submitted the numbers that it did. It is, as you point out, \$13 million less than the MOU requirement that we had agreed to. I have been in contact through my staff with Under Secretary Cohen, and your description is the same as mine, namely, that he is eager to implement the MOU. We will do everything that we can to see to it that that building is built on time and on schedule.

Senator MURRAY. Okay. I don't know the timing for the fiscal year 2009 appropriations bill, but ensuring that we have sufficient funds for that MOU is going to be a top priority of mine.

I want to ask you if I have your commitment that you will do what you can to assure this project as it is currently envisioned is going to continue on schedule regardless of when the funding is made available in 2009?

Dr. ORBACH. We'll do our very best to do precisely that.

Senator MURRAY. Okay, I appreciate that, and we'll work with you to do that.

ENVIRONMENTAL MOLECULAR SCIENCES LABORATORY

Dr. Orbach, I'm also really pleased to see a small increase in funding for the Environmental Molecular Sciences Laboratory, and I know the lab is planning to upgrade some of their equipment that's now several years old. I wanted to ask you today what your vision is for EMSL and what kind of challenges you foresee in the future?

Dr. ORBACH. Well, I have two comments to make both of which are laudatory about EMSL. When we visited 4 years ago, we set them a target. We said this is over the edge. "This is beyond normal, and if you can meet it, we will continue and expand our support of the laboratory." We didn't tell them what areas to invest in, but those two areas that they chose are now world-leading, and Interfacial Chemistry and Subsurface Biogeochemistry, if you say that phrase, people think EMSL. And it's really wonderful.

The opening of the new facility, jointly with Washington State University, is again a statement of how successful EMSL has been and how it now will have an educational component as well.

SCIENCES LABORATORIES INFRASTRUCTURE

With regard to the future, and in particular the infrastructure issue that you raised, this is, unfortunately, true not just of PNNL but of all of our laboratories. And you will see an increase in what we call our SLI component, our infrastructure component in the President's request. And I can tell you that over the next 5 to 10 years you will see that component increasing substantially as we attempt to address these needs.

I met yesterday with all 10 of the laboratory directors of the Office of Science, and to a person they spoke of the need for infrastructure support. And you will see substantial numbers increases as a consequence in our budget proposals.

Senator MURRAY. Very good, I appreciate that.

Mr. Karsner, I also wanted to ask you about the budget request for a small investment in Water Power to study the potential of marine, ocean, and wave energy. As you know, the 2007 Energy bill explicitly authorizes R&D for marine and hydrokinetic technologies—can you tell me a little bit about what your goal is for that research, including ocean and wave energies?

Mr. KARSNER. Yes, Senator. I'm actually quite excited about the introduction of that budgetary item as part of our request, along with the geothermal—reinvention of the Geothermal Program. It demonstrates what I'd like to think of as portfolio agility as new technologies evolve.

Obviously, in the early years, it is standing up the correct programmatic organizational piece that would be disproportionate than what we would predict for subsequent years. But we have specific statutory requirements as well that need to be addressed in terms of soliciting for Marine Energy Center partnerships around the countries. So finding out where the best skills lie in universities and laboratories, in businesses and product manufacturers around the country, we are not long for putting out a solicitation for that purpose in the very near future.

As well, we intend to facilitate some of the existing technologies that we know have evolved during the period of time that the Department has been engaged in this activity. So thanks for run-of-the-river hydro, buoys off the west coast of Washington and Oregon, in Hawaii, other places, and we also see an international component to this. There are other nations that have been engaged in this activity, principally in the United Kingdom and Scotland, in Spain, in China, where we want to sort of galvanize what the best of has been out and around the world.

We have our work cut out for us to catalyze something new. There's a hardware component to it—an organizational component to it.

Senator MURRAY. Okay. Well, you may know that the DOE's only Marine Science Lab is located on the Olympic peninsula in my home State.

Mr. KARSNER. I hope to visit there soon.

Senator MURRAY. And we'd love to have you come out and see it.

Mr. KARSNER. Yes, and I'm going to.

Senator MURRAY. I think you'd be really excited about it and some of the opportunities there.

Mr. KARSNER. Sure.

Senator MURRAY. And while you're out—my time is short—I'd love to have you stop by the Bioproduct Science and Engineering Lab at WSU and see that great public partnership there that's working on some biofuel and bioproduct.

Mr. KARSNER. My intention is to visit PNNL on May 8. Hopefully, I can work with your office in collaborating on it.

Senator MURRAY. We'd love to work with you on that. Fantastic. Thank you very much.

Senator DORGAN. Senator Allard?

ENERGY TRANSMISSION

Senator ALLARD. Thank you, Mr. Chairman, and Mr. Karsner. It's good to see you with us this morning. I'm real proud of the work that's being done on Colorado Renewable Energy.

I'm going to focus on another tangential area which I think is important when we look at the total energy picture. One is transmission. You know, particularly, in rural areas transmission is an issue where you're having electricity travel over a certain period of time. There's not only access to getting transmission lines, but I think there's some efficiency issues that come out.

What are we doing to develop some technology where, when you move your electrical current over a long period of time, you don't lose a lot of the electrons in the transmission process? And what are you doing in that particular area?

Mr. KARSNER. Thank you, Senator, and thank you for your leadership, both in terms of the Colorado Caucus and hosting NREL and the Renewable Caucus here up on the Hill. Let me say that the principal responsibility for the questions that you've asked reside in my colleague Kevin Kolevar's office, the Office of Electricity which at one point was part of our office, but has, because of the growing role—

Senator ALLARD. Yes.

Mr. KARSNER [continuing]. Of the issues that you just addressed has stood up admirably, an excellent program for both emergency response and grid integration issues.

On the latter, grid integration and integrating the new technologies to meet the intrinsic characteristics of renewable technologies, Kevin and I have worked very closely. In fact, we jointly program a great deal, and much of that is reflected in the budget. He talks about long distance DC lines and available technology that need citing, permitting, the transmission corridor authority that he's exercising, and also superconductivity. I don't want to go—

SUPERCONDUCTIVITY

Senator ALLARD. I do want to get into the superconductivity at this time. I understand those other problems, and what are you doing in that area?

Mr. KARSNER. And as I was just about to say, that superconductivity is an area where I can't go too far in, because that really is Kevin's portfolio.

Senator ALLARD. I see.

Mr. KARSNER. But I just would like to add, because of NREL's role, because of the new Energy Systems Integration facility that we're building, that the Office of Electricity will have a role in, that the transmission technologies that are evolving through Kevin's portfolio, and the deployment of those technologies that David's portfolio are taking care of, are indispensable to the growth of renewable technologies on the trajectories that our office plans.

Senator ALLARD. Okay. Yes, Mr. Orbach?

Dr. ORBACH. Senator Allard, I would like to comment on the Superconductivity, directly—

Senator ALLARD. Okay.

Dr. ORBACH. Because the Office of Science works very closely with Assistant Secretary Kolevar's program on electrical transmission. This is an example of where the applied program through Kevin Kolevar's program and the basic research work very closely together. And you will find in the budget a coordinated program for this effort.

We are using nanotechnology and other methods to increase the current carrying capacity at temperatures for high-temperature superconductors that would allow us to use liquid nitrogen cooling rather than having to go down to helium. This is a tremendous advance and a power line in the State of New York in Albany has already been put into place to demonstrate that you can, over reasonably short distances, conduct electricity without loss—

Senator ALLARD. That's interesting.

Dr. ORBACH [continuing]. Using high TC.

Senator ALLARD. I knew with high—with very cold temperatures you could do that. This is high temperatures using nitrogen.

Dr. ORBACH. Precisely, and that's what we've been working on very closely, and that's a perfect example of the interaction between basic science and the applied programs where we would call it use-inspired research.

Senator ALLARD. Yes.

Dr. ORBACH. And because of the new, as I referred to in my opening comments, the new capabilities that we have in the 21st century, we have made substantial progress.

ELECTRIC ENERGY STORAGE

Senator ALLARD. Thank you for your comments. The other area that's sort of tangential to all the energy development is storage. And, of course, though, when you talked about solar or wind, it's intermittent to some degree. In Colorado we happen to have plenty of both, so maybe it's not as much of a problem as it is in some States. But again, storage, I think, is an important issue.

What are you doing on storage technology? I'd like to hear some of your comments on that. Yes?

Dr. ORBACH. Could I respond to that? The problem that we have currently with storage is that our batteries are no different than they were in the 19th century.

Senator ALLARD. Yes, you have to think beyond just a traditional battery.

Dr. ORBACH. Precisely.

Senator ALLARD. Yes.

Dr. ORBACH. And there are two developments that are taking place right now that we have great expectations for, but they're difficult.

Senator ALLARD. Uh-huh.

Dr. ORBACH. The first is to take the battery, which currently takes one electron and transfers it, and do two-electron transfer—actually up to four-electron transfer. That would increase the capacity of storage by factors of two to four.

Senator ALLARD. Uh-huh.

Dr. ORBACH. That's what nature does.

Senator ALLARD. Are you changing the materials or—

Dr. ORBACH. Oh, yes. We'll be going to vanadium compounds, for example.

Senator ALLARD. Uh-huh.

Dr. ORBACH. People have even talked about six-electron storage.

Senator ALLARD. Uh-huh.

Dr. ORBACH. We're looking at these new materials to see which would be most efficient, but there's another area that's also developing, and if you ever built a radio, you remember the electrolytic capacitors back when I was growing up. They had microfarads of capacity.

We now, in the same volume, can store farads—a million times more electrical charge—and this is because, again, the new technologies that are being developed for nanoparticles, the very, very tiny spaces between the electrodes. So it's very possible that supercapacitors, which is what we call them, may well be an efficient energy storage device.

Senator ALLARD. I'd—go ahead.

Mr. KARSNER. I was just going to comment from the applied perspective.

Senator ALLARD. Sure.

Mr. KARSNER. Ray, Kevin, and myself, in fact, work very closely on storage because we all see it as a priority to enabling the growth of the technology solutions. So in our context it's both transportation and generation. We are moving on a much more wholesale basis on the generation side from multiple storage solutions that we had not previously invested in, like compressed air, molten salt for concentrated solar power, grid-based battery storage, electrolysis to hydrogen, viewing our hydrogen not just as a source but as a carrier and, of course, trying to optimize the best storage that's already available out there, which is natural gas turbines that we begin to alleviate the gas dependency in already existing hardware.

Senator ALLARD. Yes, I like the idea of the hydrogen.

CELLULOSIC ETHANOL

Mr. Chairman, I have one comment I want to make. I know my time has run out.

I visited a company in Colorado—they're a research company—call Range Fuels, and this is for Senator Craig.

They actually have developed a very ready-to-go on the product, cellulosic source of ethanol. And the by-product they bring back into the equipment and itself—they don't have to rely on energy itself, it can stand alone—and they're using wood chips and converting it to product, a combination of alcohols: ethyl, methyl, propo, butanol.

Then, obviously, there's a way of, you know, separating out those different alcohols. So they're ready to go, they tell me, but they need more wood than what Colorado can provide, and so they're going ahead to Georgia or Southern States where they have more wood and shorter growths time as far as the forests and what not are concerned.

So that's good news, and they did it with, I believe, a grant from your Energy Department in doing that, and they tell me they're ready to go to market.

Mr. KARSNER. In fact yesterday, it was announced in The Wall Street Journal that that group was the first to close of the six contracts related to the section 932 cellulosic facilities. They closed \$150 million in private funding against the \$76 million grant that we provided through the sector capital. So it is a success story, particularly in the current investment environment that cellulosic ethanol companies that are just breaking ground of this initial six are still able to track enormous private sector capital.

Senator ALLARD. Thank you, that's good to hear.

ITER PROJECT

Senator DORGAN. Dr. Orbach, a quick question about the Fusion Energy Sciences Program. Tell me, how close are we to some unbelievably exciting breakthroughs in that area?

Dr. ORBACH. Mr. Chairman—

Senator ALLARD. Unbelievable.

Dr. ORBACH.—I hope we're very close. We are, together with six other parties representing half of the world's population, prepared to put our money on the table to build an experimental reactor called ITER. And the reason we can do that now and could not do that before is our computational facilities have now shown that there's a good chance that we can keep that plasma continued and operating for significant periods of time.

This is the most important thing that I think the world addresses because we're starting construction within 8 years. The construction will be finished, we hope, within 5 to 10 years. It will meet its target of producing 10 times as much energy as it goes into the machine itself.

I think we're closer, so close that it's so exciting the opportunities that fusion brings if either is successful, will then generate a demonstration powerplant. And my guess is that's somewhere between 20 and 30 years away. So we're not talking 50, we're not talking in abstract terms; we're talking about leapfrogging the technology from ITER to a demonstration power plant.

ITER itself is half a gigawatt. It's not a small machine, and we have every expectation that it will work and work well, and we're working very hard on the basic science to make sure that it does work.

Senator DORGAN. The President's recommending close to a half a billion dollar—half a billion dollars in this coming fiscal year, \$493 million.

You talk about the other countries involves. What kinds of contribution exists from other countries?

Dr. ORBACH. We have fallen behind an order of magnitude. Europe is at the same level we are or higher, and Japan is also at the same level or higher. But you have to also now count China and India, which are making major investments in fusion.

In fact, the world's first superconducting tokamak is called East in Hefei, China. It's, believe it or not, our design, which we never developed. But it is now operating. They are putting major efforts into fusion research.

Senator DORGAN. Do my other colleagues have questions? One last one, go ahead, Senator Domenici?

Senator DOMENICI. Let Senator Craig, go ahead.

IDAHO NATIONAL LABORATORY

Senator DORGAN. Senator Craig, go ahead.

Senator CRAIG. Mr. Karsner, I did not have an opportunity to visit with you. In combination with the work that you're doing and the work that we have done and are currently involved in at Idaho and I'm talking about—we've already talked about hydrogen, hydrogen fuel cells, advanced vehicles in that sense, both the hybrids and the electrics. We've done a good deal of that work out at the lab, and the testing team continues to provide this function for present and future vehicle testing.

I would hope that, you know, where we partner that there's a relationship there that makes sense between what you do and what they do, and, you know, I know there is this desire that, oh, that's that technology. We will reach out and grab it and pull it in, and sometimes that effort isn't as productive as it relates to how you effectively utilize resources as it is to team and to partner.

We've, you know, when all of us sit here and look at our phenomenal lab facilities nationwide and sort out the resources as it relates to these labs, we recognize levels of expertise and talent, and know that that's where it ought to be versus going somewhere else.

Can you respond to that? What is your vision for the vehicle testing program, and what future do you see in the relationship that you would have with the INL and its role?

Mr. KARSNER. Well, yes Senator, and I would say I don't want to limit my comments to just vehicle testing, because you may or may not know that Idaho National Lab was the instrumental lab working together with NREL last year in resolving the FAA, Department of Defense radar challenges that we face.

Senator CRAIG. Yes

Mr. KARSNER. It almost closed down the wind industry, and the difference between the work that was done, the collaborative work between INL and NREL had it not occurred, had we not had that collaboration from that expertise located at the Idaho National Lab, we would not have been the world leader in wind energy last year. Arguably we would have had a fraction of the projects come on line.

What that tells us is exactly what you're suggesting, is that there are repositories of good work all around the laboratory system, and it has been my philosophy that even though I have responsibility exclusively for an applied lab, working together with Ray and the Office of Science, we want to maximize the available talent spread across all of these laboratories. That inspires our visits to Lawrence Livermore where they have 50 years of experience on radioactive diffusion of particles, so the best wind assessment data available globally that can inform the way that we grow that industry: Idaho on vehicles and battery technology, and wind, as I suggested has been indispensable. Sandia has a very old relationship with us and is a leader on the solar technologies and high performance computing. We are doing generalized lab calls that are new to us to say, what do you have out there? Who are we underperforming the

opportunity to engage? That's the way we approach these labs as national assets.

Senator DORGAN. Senator Domenici?

Senator DOMENICI. Thank you, Mr. Chair—Senator Craig are you finished?

Senator CRAIG. Thank you, I—

Senator DORGAN [continuing]. You at the end of the answer there, I think.

WIND ENERGY

Senator CRAIG. No, no. No. No, it's what I wanted to hear because I think that we sense that, and we hope that those relationships continue, then, and the wind issue, yes, I'm familiar with what went on out there. I think it was Gary Siefer?

Mr. KARSNER. That's right.

Senator CRAIG. That did the work. The Air Force might have stopped wind development otherwise. I mean there was that problem that got worked out, and he deserves a lot of credit for it.

Mr. KARSNER. Absolute credit for Gary. And bear in mind because that was a high security lab, we had all those people that can contribute had top-level to Q clearances that could engage the long-range missile radar that folks in my laboratory couldn't.

Senator CRAIG. Yes.

Mr. KARSNER. And so it was just a very important collaboration we intend to—

Senator DOMENICI. Thank you. Thank you very much.

First, Mr. Karsner, I wanted to say that I suspected when we had you before us not too long ago for your hearings on whether we should send you to the Senate after the President had sent you up here, I was convinced that there was no way to contain your enthusiasm, and that if we gave you enough to do, you would be enthusiastic every day of the week, and if you could invent an extra day you'd use that, too. And I have come to believe that that analysis that I made when I said we should hurry up and get you there was right.

Mr. KARSNER. Thank you, sir.

Senator DOMENICI. And I commend you for the exceptional work, and you also work—if you remember, you were very willing to say it—you were going to get something done even if we only had 2½ years.

Mr. KARSNER. Yes, sir.

Senator DOMENICI. Because no one expects you to stay on if a Democrat was elected president. We'll just have to see how that all works out. If it works out otherwise, you can rest assured we'll be recommending that you stay longer, if that's what you'd like.

Mr. KARSNER. Thank you, sir.

Senator DOMENICI. In any event—

Mr. KARSNER. My family has other plans for me.

Senator DOMENICI. I—specific questions. Did you want to comment? Am I wrong about you—

Mr. KARSNER. Thank you for that kind compliment, and I would say to you and Senator Dorgan, we've enjoyed so much support from your committee, the authorizers and the appropriators, that

it has made our job easier to work on a bipartisan basis and get things done.

Senator DOMENICI. I think the real problem we have is that so much is going on the poor American people don't believe us and don't know what's going on because to get from where we are to where we're going to be, it's not going to be a one-way path.

Mr. KARSNER. That's right.

Senator DOMENICI. And it's paths all over the place things are going on. Our money, private money is being invested all over with all kinds of people excited, and the public can't discern that. A breakthrough is going to be made in one or two of these areas and it makes things a lot easier to get where we have to go.

Who knows which ones it's going to be? It might be the one you and Dr. Orbach spoke about on capacitors, on storage. That may be one of the big ones, if we break it. But it seems to have difficulties. I hope you're right, both of you, that you're going to make some movement.

FEDERAL PROCUREMENT REGULATIONS

But I'm going to ask you about a New Mexico problem. Part of your responsibility problem includes increasing the Federal Government's usage of renewable energy, and I've been made aware of a Federal Procurement Rule that prevents an air base in Albuquerque from signing a long-term power purchase agreement beyond 10 years.

We have a site in New Mexico located between a major piece of property called Mesa del Sole and Kirtland Air Force Base. It has been identified as an ideal site for 100 megawatt concentrating power plant with a molten salt storage reservoir. However, procurement rules prevent the base from entering into the contract beyond 10 years. That's short of the useful life of the plant, which has a big impact on the economics of this transaction agreement—potential agreement.

Do you believe these procurement limitations are having an impact on the deployment of Clean Energy Technology, and if Congress were to change the requirement to allow Federal agencies to enter into a longer term power contracts, do you believe this would have a positive impact on commercial development of renewables?

Mr. KARSNER. Yes, sir. The answer is, unequivocally, yes it would have an impact, and I would go further and say nothing would have a greater impact to the Federal Government's role as an early adopter moving markets than to change the rules that enable life-cycle, cost-effective long-term procurement. It is a foolish limitation that is put upon ourselves to not be able to buy things cheaper.

An air base down in Texas buys renewable energy credits because it has to when it is surrounded by the cheapest source of wind energy available that those wind developers would like to sell to the Air Force direct. But they can't sell it directed 2½ cents because of the limitation in long-term contracting, so they have to sell it to them as renewable energy credits for 15 cents. So we lose twice. We fail to stimulate the market, and we charge the taxpayer more for it. Nothing could be greater than long-term contracts; and without it none of the dams across the West would have ever been

built. Life-cycle benefits of clean energy can't be realized if we can't give 20 and 30-year contracts.

Senator DOMENICI. Well, maybe we have to look into that and seek your assistance with where we'll put it.

Mr. KARSNER. We'd be pleased.

Senator DORGAN. Senator Domenici, might I interrupt for just a moment, as I want to understand this. I fully agree with you and with the intent of Senator Domenici's question.

But what would prevent, in the absence of a long-term contract, a wind developer from Texas providing power at 2½ cents to the air base in Texas. I don't understand what would prevent them doing that.

Mr. KARSNER. They do it, indirectly.

Senator DORGAN. But at 15 cents, what would prevent them from doing it, directly, at 2½?

Mr. KARSNER. Because what the power developer is seeking is that long-term contract—

Senator DORGAN. I understand what they're seeking.

Mr. KARSNER [continuing]. So if the base can't provide it, they sell it to the utility. So the utility gets the 2½ cent power, and the obligation then for the military to buy it is achieved through the sale of the attributes of the power, which is an independent market, the RECs, the Renewable Energy Credit.

Instead of buying the power, they're buying the attributes, the green attributes of the power. But it's driven by the fact that, ultimately, the developer needs a long-term contract from somebody. So the question is; is the Government allowed to be that somebody, in its own interest. They will get it from somebody. They will get it from a utility, or they won't show up.

Senator DORGAN. But I was trying to understand the point. Texas has the largest reservoir of wind power in the country.

Mr. KARSNER. Right.

Senator DORGAN. That wind power already exists. And I'm not talking about what's potentially—

Mr. KARSNER. But the base has to buy it, not wholesale, not direct from the supplier, but retail, indirect, from the utility.

Senator DORGAN. There's nothing that prevents them from buying it direct except—

Mr. KARSNER. The inability to get the long-term contract.

Senator DORGAN. But what prevents them from buying another short-term contract, year to year buying it direct?

Mr. KARSNER. A private developer won't have—that would put them in a merchant power situation where they're selling on the spot market their electrons. They need one big long-term, stable offtake agreement to pay for that new facility and to fund the project without it—

Senator DORGAN. You're talking about new facilities. I'm talking about the largest reservoir of wind power in America that's already built. So we'll talk about that later. I'm just trying to understand.

Mr. KARSNER. We'd be pleased to engage on this issue.

Senator DORGAN. I don't disagree on the central point that you're making—

Mr. KARSNER. Yes.

Senator DORGAN [continuing]. But I don't understand another piece of that.

Mr. KARSNER. Okay.

Senator DOMENICI. Okay. Well, we'll have to work on it because we've got to get agreement if we're going to get this change.

Mr. KARSNER. I'm enthusiastic about that one as a renewable energy developer.

Senator DOMENICI. All right.

Mr. KARSNER. So we'd definitely be pleased to provide any technical bipartisan direct—

CLIMATE CHANGE MODELS

Senator DOMENICI. Dr. Orbach, 2 weeks ago I traveled to New Mexico with Senator Bennett for a tour of the NNSA laboratories. During the tour we received briefings on the status of various climate models and challenges facing the scientist to develop an accurate predictive capability.

While your budget seeks modest increases in funding for climate modeling, it is unclear what your specific goals and priorities are for this program. Does the Department or the Federal Government have a roadmap for identifying and solving data gaps and modeling limitations, and what is the Department of Energy's role in solving these complex problems?

Dr. ORBACH. This is a very serious issue that we take particular interest in. There is an increase, as you noted, in our budget for Climate Modeling. Last week we held a measure workshop on precisely this question. It was joint with the NOAA from Commerce, the two agencies that are most active in the Climate Change Science Program. And it's through that program that the Office of Science contributes.

We believe that the new computational capabilities, some of which you visited, will give us opportunities for long-term climate change prediction that we've never had before. And so the purpose of this workshop was to lay out advice to us on where to invest our funding: how much we should invest in Measurements and how much we should invest in Modeling.

The results of that workshop are just becoming clear, and we're very excited about the prospect for U.S. leadership in this area.

Senator DOMENICI. Thank you very much.

SOLAR ENERGY TECHNOLOGY

Mr. Karsner, on Solar Power, recently Sandia Laboratory announced a world record for solar to energy conversion. On January 31, 2008, a sterling concentrating solar array located at Sandia Thermal Test Facility achieved a world record of 31.25 net efficiency rate.

Despite the promising performance, your budget maintains a wide disparity between funding for Photovoltaic research, \$137 million, and Concentrating Solar research (CSP), \$19 million. Based on the economics and technology performance with concentrating solar, a wide, large disparity, or is there—am I missing something?

Mr. KARSNER. No, sir, you're not. It's actually the CSP that has come back from almost nothing. Concentrated Solar Power a few

years ago before I was confirmed was actually knocked by the National Academy of Science and others that wasn't viable at all.

I think that their views on that have evolved, largely with the engagement of our office and much credit to Sam Baldwin, my chief technology officer, so we robustly funded it again, organizationally, to start it out and get the ball in motion. Because of some of the down selects last year and a greater focus on precisely the technology you were talking about, molten sodium, molten salt storage, it's a little lower this year than it was last year.

To be clear, I view the potential for concentrated solar power to be at par with wind power in this country if we can begin to iron out intermittency with improved storage capacities. And these new records that we are setting in that are proof of that.

Senator DOMENICI. What happened is exactly what you said. They had this capacity 20 years ago when we had the first solar energy push followed by the dramatic drop in oil prices down to \$8 again, and everybody went out of business. And up there at Sandia was this gigantic array thought to be worthless. But you're saying it's not worthless.

Mr. KARSNER. Not only that, I'm saying to your previous question, if we had 20- and 30-year Federal contracting authority through my Federal Energy Management Program, to bring the bases into compliance, to bring Federal assets into compliance with the EISA law, if we had that tool, you would see an explosion of concentrated solar projects in the country.

NANOSCALE SCIENCE RESEARCH

Senator DOMENICI. And my last one to you has to do with nanotechnology, Dr. Orbach. And the Department now has all the National Nanotechnology Centers in operation. And each center has more applications than they financially support. This leaves many important research projects without funding and you hear that, we hear that, it's a reality.

Your budget request provides \$20 million in operational funding for each center, roughly the same level for the last 2 years.

Now, I, myself, understand your limitations. You can't get around the fact that when the Federal Government's balancing the whole budget and talking about that to the people, and they're taking it all out of domestic discretionary spending, we don't have enough money to spend even for exciting things. And that's got to stop one of these days when we'll be down to zero, and then maybe we'll stop cutting it.

But, in any event, these Nano Center centers have great, great potential, and five of them you have in the country. They have to have money, and I'm just wondering, is \$20 million the right number for 2 years in a row for such an evolving, explosive kind of R&D? And they need to work with the private sector. Each one of them has to go out there and find people that work in the same area that put up money for the development. That has to happen, right? At each center and universities.

But can they do it with \$20 million?

Dr. ORBACH. So far we believe they can. Last year's budget was severe, and we were unable to fully fund those operations. This

year we restored the operations to what we believe is the optimum level.

But you are quite right. These centers are achieving performance targets that we did not expect them to achieve in 3 to 4 years, and so as their needs increase we will support them. It's a truly remarkable opportunity for the country. And, to be honest with you, we had no—we had some idea, but we were delighted at the developments that have taken place, especially at CINT.

Senator DOMENICI. Let me close by just telling you and Mr. Karsner, both, when you have an opportunity to go visit a Nano Center, or have an opportunity to go visit a Micro-Engine Management Center like they have at Sandia at Mason, and you see the development of little things, that's the real push: the development of little things.

And this doesn't mean "little" like this, so little that you have to work under a microscope, you can't see the machines you were operating. They're so small, and you put them on a pad just like you do now for computers and you see what they're going to do in the future; you just wish that you were 21 instead of my terrible vintage of 75, because it's so exciting.

And the nano is just coming to meet up with the micro. They're matching up, and I just think you don't want to drop the ball on the five centers that are fortunate to have this nanotechnology at their disposal. And if they need \$25 or \$30 or \$40 million, to me it's the best money we could spend.

I thank you, and thank you for listening to me so much today.

Mr. KARSNER. Thank you, sir.

Senator DOMENICI. I appreciate it.

FEDERAL PROCUREMENT REGULATIONS

Senator DORGAN. Senator Domenici, thank you very much.

Let me come back to the point I was trying to make, because I think we were talking past each other, Secretary Karsner, on the issue of wind energy. You're talking about the incentives to develop new wind energy.

Mr. KARSNER. Correct.

Senator DORGAN. I'm talking about an air base that's paying 15 cents a kilowatt hour for energy that exists. We have two air bases in North Dakota that are buying wind power. I set that up. There are no long-term contracts. The two wind turbines that provide that power for the Grand Forks and the Minot base, two wind turbines each, are owned by Rural Electric Co-ops. They then resell to the base, and that puts some money in the budget for the base to buy green power.

But, look, I'd agree with the central point that Senator Domenici was making and you're making about long-term contracts. I want to ask you about something else.

ALGAE RESEARCH

Two weeks ago I was in Phoenix, Arizona, and I toured an area where they are taking carbon off of a coal plant and using it to invest in algae. Now, algae is single-cell pond scum. It grows in waste water, and it grows by CO₂ and sunlight.

And we stopped funding algae research about 15 years ago. Last year for the first time I think we put some algae research money in, but this particular application is really interesting because when you get rid of the CO₂ by feeding pond scum, you create this algae. The algae increases its bulk in hours, and then you harvest it for diesel fuel.

And the diesel fuel from algae, for an equivalent amount of corn-based ethanol, for example, and equivalent amount of acreage, algae will produce roughly 10 times the diesel fuel that corn-based ethanol will produce for an equivalent amount. And so you have the capability of consuming CO₂—which is a terrific thing because we need to be able to use our coal plants—by feeding it to algae, growing the algae, and harvesting the algae for diesel fuel.

Now, there are a couple of projects around the country that I'm very interested in. The one in Arizona is a very big project, and they're not doing it in algae ponds, they're doing it in long greenhouse.

And so my question is, are you looking at that under renewable fuels? Because this is a renewable fuel when you can harvest the algae, and it's up to 10 times more capable of production than, for example, corn-based ethanol. Are you looking at that?

Mr. KARSNER. Yes, sir, we are looking at that. We just started looking at that, you're right. All of this has been in hibernation for quite some time while oil prices were low, and we're working, inaugurating work, with folks out of Sandia and Los Alamos. NREL has engaged Chevron on that subject. I'm aware of the project you're talking about. It's really two separate topics that require work. And Ray is aware of this, the push for carbon utilization as much as sequestration, as a pathway for dealing with climate change solutions, but also, obviously, the benefit of using algae and other microorganisms for advanced fuels that go beyond ethanol alone. So both of those areas are of keen interest to us.

Senator DORGAN. The Texas company that told me about the process they have developed—and this is not renewable energy, this goes more to carbon capture—and I know this is fossil energy—but they are apparently treating the flue gas chemically and producing chloride, hydrogen, and the equivalent of baking soda. And the baking soda contains and captures the CO₂, and then they just landfill the baking soda.

Dr. Orbach, you're waving your head yes?

Dr. ORBACH. Yes, that's correct.

Senator DORGAN. Do you agree with that?

Dr. ORBACH. There are two different ways of handling it. One is the way you just described it, which is chemically. Another is with the IGCC, the integrated plan where you actually separate out the CO₂ before combustion. Both of those now are becoming, you know, within factors of 20 percent, 30 percent, the same cost as normal coal-fired powerplant.

So those technologies are moving rapidly, and I can assure you that fossil energy, the Office of Science and EERE work very closely together in developing those parameters.

Senator DORGAN. I hope. And I hope that's the case because, 50 percent of this electricity comes from coal. We're going to have to

continue to use coal. The question is not whether, it's how, and we've got to find a way to capture and use, or sequester, or contain.

In June, we're going to have a climate change debate on the floor of the Senate. It's going to be a big debate. The question is: are the targets of that bill going to meet the capability, technologically, for us to deal with CO₂ and to be able to continue to use coal? And much of that is going to come, I think, from the basis of scientific inquiry and from the work in the case of algae. It would be a terrific thing if we could convert CO₂ that we don't want entering the atmosphere into a superfuel. It represents the best of all choices, it seems to me.

WEATHERIZATION PROGRAM

Now, one other point I want to make. I think that we have not done a very good job on solar. The fact is, there have been some technology changes in the last 20 years. I understand that the solar plates are still solar plates, but there have been some advances in solar capability, and I think both from a tax incentive standpoint and in other areas, our country has not done well with solar. We need to do much, much better, and I hope we can continue to talk about that.

And, finally, Mr. Karsner, you seemed not to be very disappointed about a proposal to cut your funding by about half a billion dollars. We're hoping to make you happier than you might want to let on.

Mr. KARSNER. Can I speak to that, sir?

Senator DORGAN. Yes, of course.

Mr. KARSNER. Because—and it's considered bad form to not—to speak to something and I wasn't directly asked, but this is my last hearing in front of this committee, and most of that cut is about the Weatherization Program.

Senator DORGAN. About half of it.

Mr. KARSNER. And so I wanted—but the largest chunk is weatherization.

Senator DORGAN. That's true.

Mr. KARSNER. Most of my mission today is making my successor more successful than I was. This issue is chronic, and we will work with anybody in this town, any administration or in Congress, to rationalize where income-related weatherization assistance can best be placed. It's something that is worthwhile and good, and I believe that the people that deserve that money ought to get it.

But 30 years into this, we have delivered 5½ million homes with an annual need of 27 million people. So we are underperforming that mission. Then, at the same time, we're underperforming the mission of the McKinsey Study that you held up by not enabling greater investment in the building technologies that can seriously transform the built-environment. We have got to separate the assistance programs from the technology programs and be able to serve them both. That is our mission this year.

Senator DORGAN. But the key is to serve them both, and the zeroing out here and not adding it elsewhere means that we're missing a part. And so that was my point.

I don't put on your shoulders the zeroing out of weatherization assistance. I don't assume that you recommended that, but—and it

is about half of the reduction—I do think, however, that the reduction in the Hydrogen Technology, and for all the reasons you have described, I still think it is not justifiable.

I think, if we're going to really make progress looking out 15 and 25 and 40 years from now about what we want to have our grandchildren drive—in my judgment hydrogen fuel cell vehicles—I think we really need to put our shoulder to the wheel and fund these projects. The same with solar and other things.

So I agree with Senator Domenici, I like your spirit and your passion, and, you know, I wish you had the resources in your President's budget to match your passion. But we'll probably see if we can help a little bit on that this year.

LONG-TERM INVESTMENT FUNDING

I do want to make one final point, because Senator Domenici was chairman of the Budget Committee for so long, and he made the point that we've got to make sense of all this. We understand that there has to be some belt-tightening, but it's also important the things that really invest in this country's future, really invest in a big way and pay dividends such as trying to fix this energy situation. Failure to invest also can cost you a lot of money.

Now, we have a big fiscal policy problem. People say the deficit this year is \$400 billion in the President's proposal. It's not. We're going to end up borrowing \$800 billion this year on the fiscal policy side, and \$800 billion red ink, and then Trade side \$800 billion. That's \$1.6 trillion on a \$14 trillion economy. There isn't anybody that looks at that from around the world and says that that's an economy on track.

So I understand the challenge. We've got to find a way to deal with all of this. My hope remains, however, that the allocation this subcommittee gets is an allocation that understands the difference between spending and investing. And there's a very big difference: Investments bring dividends, dividends that will accomplish a better future for this country. And I think if we understand that as we allocate funding in the appropriations process, the investments in energy, the investments of basic science, investments in clean energy facilities for the future, this country will be well served by those investments.

I want to thank all three of you for being here today, and wish you well as you work through this year. And I thank my colleague Senator Domenici for his work on this subcommittee.

FEDERAL LOAN GUARANTEE APPLICATIONS

Senator DOMENICI. Mr. Chairman, could I ask David Frantz, you mentioned how many applications you have and how many you've cleared. Are the subject matter of those cleared applications private? Or are they available for committee to look at?

Mr. FRANTZ. They're private, Senator, while we're processing them. They're business-confidential and proprietary information relative to each of the projects that are—

Senator DOMENICI. How long will that last? How long will that—a couple years, or—

Mr. FRANTZ. Yes, at least. Really, a lot of the information can only be released by the applicants that are applying, not on our side. Most of that information is business-confidential proprietary.

Senator DOMENICI. And aren't we going to know, for the people of our country, that we have funded a program doing such and such, or is that not going to happen on along that—

Mr. FRANTZ. We'll publicly, with their permission, we will publicly make announcements as we have reached a successful conclusion on each one of their applications.

Senator DOMENICI. I would hope so. I mean, it's very, very important.

Mr. FRANTZ. Yes, sir.

Senator DOMENICI. Not next week but that it be on your agenda.

Mr. FRANTZ. Yes, sir.

SOLAR ENERGY RESEARCH

Senator DOMENICI. And on solar and what I say, Mr. Chairman, I agree with you. And I think the mistake was made because we stopped the program when the price of oil came down because we made it—too big of demands on solar were made at that point because of the disparity.

But now we ought to relook at where we are, and maybe you and I could figure out a way to meet for an hour or so and talk about solar in our budget and see where we might make some better investments. And your use of the word "investment" used to not impress me when I was doing the budget because I was always being asked for more money; but as I look at how we spend our Government's money, the committees and all, without trying to take precedence, our committee over another, it is not too difficult to determine where we have an energy crisis, where we have energy-related investments.

I mean, this is the nucleus of whether we're going to get out of this mess 10 years early or 30 years later. Science breakthroughs, that's the difference. And we're there whether people like to spend money on us or not.

Thank you all very much.

Senator DORGAN. Senator Domenici, thank you.

ADDITIONAL COMMITTEE QUESTIONS

At this time, if the members of the subcommittee have any additional questions, please submit them for the record.

[The following questions were not asked at the hearing, but were submitted to the Department for response subsequent to the hearing:]

QUESTIONS SUBMITTED TO HON. RAYMOND L. ORBACH

QUESTIONS SUBMITTED BY SENATOR BYRON L. DORGAN

COMPETES

Question. Last August the Congress passed and the President signed the COMPETES legislation into law. This proposal, consistent with the National Academy of Sciences study "Rising Above the Gathering Storm," directs the Department to focus greater attention on science and mathematics education and research. Can you tell me specifically how the Department is supporting this legislation and how much

money is provided in the President's request to implement the COMPETES legislation?

Answer. The Department is committed to meeting its responsibility to help increase America's talent pool in science, technology, engineering, and mathematics and ensure that we will have the scientific workforce we will need in the 21st century to address future challenges and maintain U.S. global competitiveness. No additional funds were appropriated in fiscal year 2008 to expand existing programs or to establish new programs authorized under the COMPETES Act. The fiscal year 2009 request, however, contains increases for STEM education efforts aligned with the American Competitiveness Initiative and consistent with the goals of the COMPETES Act.

The fiscal year 2009 budget request includes \$13,583,000 for the Office of Science Office of Workforce Development for Teachers and Scientists (WDTS), a \$5,539,000 increase from the fiscal year 2008 appropriated levels. Of this increase, \$4,214,000 is for the DOE Academies Creating Teacher Scientists (DOE ACTS) program. The \$6.4 million requested for the DOE ACTS program is consistent with the summer institutes authorized in section 5003(d) of the COMPETES Act. This section calls for the establishment or expansion of programs of summer institutes at each of the DOE national laboratories to provide additional training to strengthen the science, technology, engineering, and mathematics (STEM) teaching skills of teachers employed in public schools for K-12 students. Fiscal year 2008 is the fourth year the DOE ACTS program will bring K-12 teachers into the laboratories for research intensive experiential-based opportunities to build their content knowledge in STEM fields that they then bring back to their classrooms. The teachers selected for the program participate in research at the DOE national laboratories for three consecutive summers and bring their new knowledge and skills back to their school districts. The fiscal year 2009 request will support an additional 227 teachers to participate in the program, for a total of 341 teachers.

The Outstanding Junior Investigator award programs carried out by the Office of High Energy Physics, the Office of Fusion Energy Sciences, the Office of Nuclear Physics, and the Office of Advanced Scientific Computing Research, and the Office of Science Early Career Programs are consistent with the early career award programs authorized in section 5006 of the COMPETES Act. These programs are focused on outstanding scientists that are yet to be tenured university faculty early in their careers and support the development of their individual research programs. Approximately \$10,298,000 is requested in fiscal year 2009 across the programs to support early career scientists.

In addition to the programs above, the Office of Science supports several activities that are consistent with the intent of several sections of the COMPETES Act, but differ in their specific implementation. The fiscal year 2009 budget request outlines several programs targeted towards support of graduate student activities and graduate student fellowships that are consistent with the PACE fellowships authorized in section 5009 of the COMPETES Act. The fiscal year 2009 request provides approximately \$19,121,000 in graduate programs that range from traditional graduate fellowships that include stipend and tuition support to summer programs for graduate students for experiential learning experience in a number of scientific disciplines supported by the Office of Science. This is an increase of \$983,000 over the fiscal year 2008 appropriated levels.

Section 2008 of the COMPETES Act authorizes discovery science and engineering innovation institutes at the DOE national laboratories. These institutes must focus on the missions of the Department and should support science and engineering research and education activities related to areas such as sustainable energy technologies, multiscale materials and processes, micro- and nano-engineering, computation, and genomics and proteomics. Several research centers supported by the Office of Science for a total of \$183 million are consistent with this authorization. This includes two of the three DOE Bioenergy Research Centers located at Lawrence Berkeley National Laboratory and Oak Ridge National Laboratory (\$50,000,000 total in fiscal year 2009) and seven of the Scientific Discovery through Advanced Computing (SciDAC) Centers for Enabling Technologies that are multiple institution partnerships but centered at the national laboratories. In fiscal year 2009 approximately \$18,800,000 is provided to support these seven centers. Additionally, approximately \$100,000,000 is requested for the Energy Frontier Research Centers in fiscal year 2009. The competition for centers is open to laboratories, universities, and private sector organizations, or partnerships among these groups. Awards for each center will be \$2-5 million per year for an initial 5-year period and centers will focus on innovative basic research to advance scientific breakthroughs relevant to 21st century energy technologies.

The fiscal year 2009 request of \$4,721,969,000 for the Office of Science will support approximately 23,700 Ph.D's, graduate students, undergraduates, and technical staff at universities and the national laboratories, a significant number of the Nation's scientific and technical skilled workforce. Additionally, the request will support the use of the Office of Science scientific user facilities by over 21,000 researchers in fiscal year 2009. These sophisticated research instruments and facilities are a significant pillar of the U.S. scientific enterprise, enabling U.S. researchers to remain at the cutting-edge of science and innovation, and provide tremendous training opportunities for researchers and students across the country.

LANSCCE REFURBISHMENT

Question. Dr. Orbach, you and I have spoken extensively about maintaining our science capabilities at our national labs—both the Office of Science facilities and the NNSA labs. I believe you share my belief that we need to upgrade the LANSCCE Facility to sustain cutting edge science at the lab in advanced materials research. This will have relevant scientific applications for both the NNSA weapons program and the Office of Science. Why doesn't the fiscal year 2009 budget request provide the funding necessary to support an upgrade of this facility?

Answer. The Office of Science-supported Manuel Lujan Jr. Neutron Scattering Center (Lujan Center) is part of the Los Alamos Neutron Science Center (LANSCCE). The combined facility is comprised of a high-power 800-MeV proton linear accelerator, a proton storage ring, and instrumented beam lines for the Lujan Center for civilian research and the National Nuclear Security Administration (NNSA) Weapons Neutron Research facility for national security research. NNSA is responsible for the accelerator upgrade project, which would increase the LANSCCE neutron source intensity by delivering more proton beam power to the neutron production target.

The Office of Science has invested a total of \$26 million in the development of six new instruments and the refurbishment of two existing instruments at the Lujan Center in the last decade, and significant strides have been made at the Lujan Center during the past several years. New sample environment capabilities complement existing strengths in high pressure and engineering stress, and the improved quality of user experiments are resulting in more scientific publications. Continued support of the Lujan Center by Science is contingent upon the Science triennial peer review, and further instrument upgrades by Science are contingent on the LANSCCE accelerator upgrade by NNSA. The LANSCCE accelerator upgrade was not possible in fiscal year 2009 due to competing priorities in NNSA.

Although the Spallation Neutron Source (SNS) will become the Nation's signature neutron scattering facility, an October 2006 workshop, "The Lujan Center in the SNS Era," concluded that a strong national neutron research program requires the SNS plus other high intensity user facilities. The Lujan Center can remain world class with a future emphasis on cold neutron instruments optimized for 20Hz repetition rate and a shift to more inelastic neutron scattering capabilities at the facility.

SANDIA—ADVANCED COMPUTING

Question. The fiscal year 2008 Energy and Water Conference report directed the Department to establish an Institute for Advanced Architectures and Algorithms at Sandia National Labs and Oak Ridge as a joint endeavor between the NNSA and the Office of Science to continue research of high performance computing architectures. I included this language because I am very concerned about maintaining the U.S. and DOE leadership in high performance computing. As you are well aware the Science-based Stockpile Stewardship program and the NNSA labs pioneered the advanced computing platforms being deployed today and we should not forfeit our leadership in this field. What is your office doing to carry out the congressional direction to establish this joint Advanced Computing R&D capability and what is your plan to sustain this research capability?

Answer. The Office of Science appreciates this committee's support for High Performance Computing in the Department. On January 28, 2008, Sandia and Oak Ridge briefed NNSA and the Office of Science and opened a dialogue about the Institute for Advanced Architectures and Algorithms. This was followed by a series of conference calls and a formal proposal from Sandia. The proposal was funded by the Office of Science in May and it is being jointly managed by the Office of Science and the NNSA.

As we look to the future, research on advanced architectures and algorithms will continue to be a critical element of the computing programs of both the Office of Science and the NNSA. This area is one in which sustained, multi-year efforts are required to achieve progress and where active collaboration between the Office of

Science and the NNSA will leverage scarce resources and enable the broadest impact.

CLIMATE CHANGE

Question. Dr. Orbach 2 weeks ago, I traveled to New Mexico to host Senator Bennett on a tour of the NNSA laboratories. During this tour we received briefings on the status of various climate models and the challenges facing the scientists to develop an accurate predictive capability. While your budget seeks a modest increase in funding for climate modeling, it is unclear what your specific goals and priorities are for this program. Does the Department, or the Federal Government, have a roadmap for identifying and solving data gaps and modeling limitations? What is the Department of Energy's specific role in solving these complex problems?

Answer. The Department coordinates its climate change research, including its climate modeling activities, with other agencies through the interagency Climate Change Science Program (CCSP). While the CCSP has a Strategic Plan that was released in 2003, it does not have an implementation plan or roadmap for achieving the scientific goals of the CCSP. The Department of Energy's Climate Change Research Program is focused on addressing data and information gaps and uncertainties that are limiting climate modeling. DOE has a draft strategic plan that provides a roadmap to address the key gaps and uncertainties and improve climate models and modeling. We will utilize findings and recommendations from several recent reports and workshops to revise our draft strategic plan before it is released. The reports we will use to guide the revision include a pending report from a recent DOE-sponsored workshop on grand challenges in climate change research, the 2007 Intergovernmental Panel on Climate Change (IPCC) Working Group I Report on the Physical Science Basis of Climate Change, a 2007 report from a jointly organized workshop by the Department of Energy's Program for Climate Model Diagnosis and Intercomparison and the World Climate Research Program on Systematic Errors in Climate and Numerical Weather Prediction Models, and National Research Council reports on climate change research science.

DOE's specific role in solving data gaps and limitations in climate modeling include developing and applying diagnostic tools and methods for evaluating climate model performance and identifying the limitations in model performance; supporting research and infrastructure to collect data and information; developing new and improved process models and parameterization schemes that more accurately represent the effects of clouds and aerosols, the two largest sources of uncertainty in climate modeling; developing and applying new and improved ocean, sea ice and land ice models for simulating their role in climate and sea level changes and potential feedbacks between sea and land ice changes and climate change; providing the climate modeling community with access to high performance computing capabilities at DOE laboratories needed to implement advanced, high resolution climate and Earth system models that are essential to modeling the physics of climate processes (e.g., transport of heat, atmospheric motion, formation and evolution of clouds, etc.) and the resulting response of climate to natural and human-induced forcing at regional to global resolution over decade to century time scales; and developing new and improved models of global carbon cycling in the ocean and terrestrial biosphere that can be incorporated in an Earth system model to simulate the interactions and feedbacks between climate, carbon cycling and CO₂ forcing of climate.

Question. The Advisory Committee for the Office of Biological and Environmental Research raised concerns in its report from May 2007 regarding the availability of computing time at the laboratories to run climate simulations. They also raised concerns regarding general difficulties in "engaging" DOE. What has been done to improve this interaction and access?

Answer. Two DOE Federal Advisory Committees, the Biological and Environmental Research Advisory Committee (BERAC) and the Advanced Scientific Computing Advisory Committee (ASCAC) were charged by me to address the computing needs for climate modeling, including changes that may be needed to provide and improve access to DOE high performance computing capabilities for climate modeling. The findings and recommendations in the report of a joint ASCAC-BERAC committee are under review, and a plan will be forthcoming that addresses the climate modeling access issues raised in the May 2007 BERAC report.

NANOTECHNOLOGY

Question. Dr. Orbach, the Department now has all the National Nanotechnology Centers in operation and each center has more applications than they financially support. This leaves many important research projects without funding. Your budget request provides \$20 million in operations funding for each center, roughly the

same level for the last 2 years. In light of the tremendous interest in this field of research, why hasn't your office sought an increase? If additional funding was provided to these centers, do you believe it would be well spent?

Answer. The fiscal year 2009 request provides for support that will allow for full operation of the five Office of Science Nanoscale Science Research Centers (NSRCs). The recently completed NSRCs are user facilities that scientists from all sectors—academia, Federal laboratories, and industry—can access to pursue their ideas and are still in the early phases of maturing their operations. As the unique capabilities of the NSRCs become more widely known, the NSRCs are becoming oversubscribed with applications for time from potential users. The synchrotron and neutron scattering user facilities operated by the Basic Energy Sciences program have a history of such oversubscription. It is important to understand that such oversubscription is natural and healthy, because all applications for use of the NSRCs undergo rigorous peer review, which ensures that the best user proposals are supported. Furthermore, the number of users to whom time can be allocated is not simply dependent on the level of operating funds. Each NSRC was designed to operate at its full capacity to serve users with an annual operating budget of approximately \$20 million. It is imperative, however, that the operating budgets for the NSRCs—and all SC user facilities—receive appropriate cost-of-living increases in subsequent fiscal years so that they may maintain full operations. This was not possible in fiscal year 2007 and 2008, and the fiscal year 2009 budget request for the NSRCs seeks to redress the situation. As with other user facilities, additional funding will be required and requested in subsequent years to re-capitalize the equipment in the NSRCs.

RADIATION R&D

Question. Dr. Orbach, in your testimony, you highlight the role your office is playing in "Predicting high level waste system performance over extreme time horizons." I would think this research would be very valuable to the EPA and the NRC which has responsibility for setting regulatory and safety standards for nuclear waste. How will the data your office develops be integrated into the rulemaking process to ensure that the standards are scientifically sound? How far into the future do you intend for your models to predict? Do you intend to make predictions as far out as 1 million years?

Answer. Predicting high level waste (HLW) system performance over extreme time horizons is one of the research coordination efforts proposed for the Office of Science in the fiscal year 2009 budget request. This area was identified as one of the scientific grand challenges in the Basic Energy Sciences (BES) workshop on Basic Research Needs for Geosciences in February 2007. The regulatory framework for HLW systems asks that the performance of a geological repository be predictable for time periods of up to 1 million years. Current models require significant improvements to become capable of more accurate predictions on such time scales. This is why the scientific community identified this area as a grand challenge in the BES Geosciences report and why we are targeting this area as one of our R&D coordination efforts in fiscal year 2009. The BES workshop report noted that the chemical and geological processes involved in the performance of HLW systems over extreme time scales are highly complex and require an interdisciplinary approach that strongly couples validation experiments with theory, modeling, and computation bridging multiple time and length scales. The report further concluded that fundamental research is required to provide the scientific basis for predictive models of HLW in geological repositories over extreme time horizons, including research on: computational thermodynamics of complex fluids and solids, the physics and chemistry of particles and colloids on the nanoscale, biogeochemistry in extreme and perturbed environments, highly reactive subsurface materials and environments, and simulation tools that can handle an enormous range of spatial and temporal scales.

The Office of Science is not directly involved in rulemaking regarding HLW systems. The data, scientific knowledge, and computational models generated from the fundamental studies we perform will, of course, be widely and openly disseminated in the scientific literature. In addition, the R&D coordination effort proposed for fiscal year 2009 will directly benefit and involve the Office of Civilian Radioactive Waste Management (OCRWM) and the Office of Environmental Management (EM). An important component of integration between BES and these offices are the strong BES programs in the DOE laboratories in actinide and radiation chemistry, materials sciences, and geosciences. Capabilities and knowledge developed in these lab programs are readily and directly conveyed to complementary programs in the labs that are supported by OCRWM and EM.

JOINT DARK ENERGY MISSION

Question. I have a few questions that underscore this committee's continued interest and support for DOE's role in JDEM and the science it is meant to address. Given that this now appears to be a NASA-led mission, are you comfortable that JDEM will yield the best science to address the science priorities of the Office of Science's High Energy Physics Office?

Answer. DOE and NASA will coordinate in selecting the winning concept for JDEM. An important part of the selection process will be to ensure that the science obtained by the concept will address the needs of both the NASA science mission and of the High Energy Physics science mission. If the submitted concepts fall short of either agency's mission need, then the agencies will reevaluate the mission.

Question. Last year the National Research Council considered a number of missions and experiments to advance the state of physics "Beyond Einstein." The resulting report stated that JDEM should be the top priority. Unfortunately, we've heard from BEPAC panel members that the mission being planned will not meet their very explicit expectations due to budget restrictions within NASA. Are you confident that the Joint Dark Energy Mission that results from NASA's competition will be within the range of the specific scientific objectives laid out by the NRC panel?

Answer. NASA and DOE are jointly planning the mission. Although NASA will issue the Announcement of Opportunity (AO), we will be working with them to write the terms of the AO and will coordinate the selection process. We will work together to ensure that the selected mission will significantly advance the study of dark energy in the most cost-effective manner. Until we see the actual proposals we cannot evaluate how well they meet the scientific objectives of the NRC panel. The agencies will need to decide whether the science provided by the selected JDEM concept is sufficient.

Question. Recent reports from NASA indicate that DOE's contribution to JDEM will be "up to" \$200 million. This is a big reduction from the \$400 million that DOE had pledged earlier. First, is this accurate? Second, if so, why was this change made and where is the remaining \$200 million going? DOE has requested and this committee has provided tens of millions of dollars in research and development for JDEM. We would hate to see our significant investments go underutilized.

Answer. DOE's expertise is in the areas of scientific collaborations and instrumentation. NASA, in addition to expertise in these areas, is the agency with the expertise and stewardship responsibilities for space launches and operations. The mission concept studies that are nearly complete indicate that the science could be done in a medium-class strategic mission targeted at a cost of approximately \$600 million, not including the launch services. The scientific package is estimated to cost about \$400 million and both DOE and NASA want to participate in the fabrication and operation of the scientific package. An equal partnership in the scientific package is the basis of the present \$200 million cost estimate for DOE.

With the reductions from the requested levels in the fiscal year 2007 and fiscal year 2008 congressional appropriations, there is no "remaining \$200 million," and indeed the present \$200 million commitment will stress the High Energy Physics program. In our planning, the projects and programs that can be supported depend upon the funding available and their priority for mounting a world-class, productive U.S. High Energy Physics program. The funding level is determined by congressional appropriations. We use guidance from the scientific community as input to establishing priorities within the funding available. Guidance is presently being sought from the High Energy Physics Advisory Panel about the options and priorities for an optimal U.S. program at different funding levels.

Question. Are you confident that DOE's investment in this project to date—that is, the country's investment in this project—will be adequately utilized?

Answer. Yes, DOE's investment has been and will be well utilized. DOE's investment to date is mostly in the Supernova/Acceleration Probe (SNAP) concept for JDEM for R&D on the advanced optical and infrared sensors that would be used in the camera, as well as in designing a mission concept. This sensor development R&D can also be used for other missions and by the general scientific community. The SNAP concept development funded by DOE has helped the technical advancement of the whole JDEM mission, which was noted by the National Research Council study as a particular strength of JDEM compared to some other Beyond Einstein mission proposals.

Question. Will DOE and NASA jointly select the winner of the JDEM competition?

Answer. Yes, DOE and NASA will coordinate in selecting the winning concept for JDEM.

Question. Dr. Orbach, can you give us the background on the development and overall strategy for the Energy Frontier Research Centers? As you know, this is an

initiative contained in the fiscal year 2009 budget that some might construe as an alternative to ARPA-E or as another way of funding additional programs in the Science budget, as opposed to the Energy R&D budgets.

Answer. The overall goal of the Energy Frontier Research Centers (EFRCs) is to foster, encourage, and accelerate high-risk, high-reward research that may provide the basis for transformative energy technologies of the future. The EFRCs will bring together the skills and talents of a critical mass of investigators, especially from universities, to enable energy relevant, basic research of a scope and complexity that would not be possible with the standard single-investigator or small-group award. EFRCs will enable research programs that are balanced and comprehensive and, as needed, support experimental, theoretical, and computational efforts. Finally, the EFRC program provides a tremendous opportunity for universities to engage in fundamental basic research critical to future energy technologies, and to inspire, train, and support leading scientists of the future who have a deep and sincere appreciation for the global energy challenges of the 21st century.

The scientific background for the EFRC initiative has been developed over the last 6 years through an extensive series of workshops sponsored by the Basic Energy Sciences (BES) program and its advisory committee, the Basic Energy Sciences Advisory Committee (BESAC). In 2002, BESAC sponsored a workshop on Basic Research Needs to Assure a Secure Energy Future. That workshop led to a series of 10 more BES workshops on basic research needs for the hydrogen economy, solar energy utilization, superconductivity, solid state lighting, advanced nuclear energy systems, combustion of 21st century transportation fuels, geosciences, electrical energy storage, materials under extreme conditions, and catalysis for energy. Finally, BESAC recently completed a report entitled *Directing Matter and Energy: Five Challenges for Science and the Imagination*. This set of 12 workshop reports, developed by some 1,500 scientists from universities, DOE laboratories, and industry, define the scientific and technological basis for the EFRC initiative.

The high-risk, high-reward fundamental research within the EFRCs represents 15 percent of the total BES funding for research; the success of the EFRCs depends in part on their integration with the core research programs in BES. All of the core research programs in BES are actively engaged in coordination efforts with the DOE technology offices to promote the flow of knowledge and ideas from basic to applied research. This integration obviates the need for the creation of a new ARPA-E bureaucracy, rendering it unnecessary and counterproductive.

Question. Dr. Orbach, can you give us the background on the level of funding for General Plant Projects (GPP)? I understand that the GPP level has increased over time to reflect inflation, etc. and the current level is \$5 million per project. Anything above \$5 million requires a reprogramming or to be a part of a Science Laboratory Infrastructure project. Do you believe the current level of \$5 million provides you the flexibility to do the projects that are necessary under those constraints? If not, what level would you recommend?

Answer. General Plant Projects are miscellaneous minor new construction projects of a general nature, the total estimated costs of which may not exceed \$5 million per project. This \$5 million threshold has been set since fiscal year 1999. A construction project that otherwise met the GPP criteria, but with a total cost above \$5 million, would have to be requested and appropriated as a line-item construction project, which could stretch the necessary time frame between identification of the need and completion of the project, and thus increase overall costs. Based upon the Engineering News Report Annual Construction Inflation Index, \$5 million in fiscal year 2009 would construct a project that would have required only \$3.6 million in fiscal year 1999. So over time, inflation has reduced the Department's flexibility to pursue minor construction projects using GPP. An increase in the GPP threshold to \$7 million would make the GPP threshold approximately equivalent after inflation to what it was when it was last increased in fiscal year 1999. GPP is supported both through direct funding and through Institutional General Plant Projects, or IGPP, which are funded through laboratory overhead for projects that cannot be allocated to a specific program. Examples of acceptable IGPP projects include site-wide maintenance facilities and utilities, such as roads and grounds outside the plant fences or a telephone switch that serves the entire facility. In the fiscal year 2009 Office of Science request, \$31 million is planned for direct-funded GPP and an additional \$35 million is anticipated in IGPP funding at Office of Science laboratories, for an overall level of \$66 million for such minor construction projects.

Question. Dr. Orbach, the Basic Energy Sciences budget has grown substantially over the past few years with the construction of several projects, namely SNS, the Nano Centers, and CLS at Stanford, etc. What do you envision the Basic Energy Sciences budget's steady state being in 5 years?

Answer. The fiscal year 2009 budget request of \$1,568 million for the Basic Energy Sciences (BES) program in the Office of Science reflects part of a Government-wide strategy to enhance U.S. world leadership in the physical sciences and maintain our Nation's competitive lead in technology. This strategy is the result of important actions by two branches of Government—first by the administration's American Competitiveness Initiative (ACI), and second by the congressional passage of two authorization acts, the America COMPETES Act (Public Law 110-69) and the Energy Independence and Security Act of 2007 (Public Law 110-140). Together these actions would approximately double the budget for the SC over a period of 7 to 10 years. The Science portfolio supports a broad research program and facilities operations that seek to understand the fundamentals of how nature works and then to use this understanding to promote transformational changes in the way we approach energy production, conversion, transmission, storage, and waste mitigation.

Under the ACI and congressional authorizations, we envision that the BES program will continue to be strong in 5 years with many exciting new capabilities. In developing future BES budget requests, Science will consider giving priority to six components of the BES budget: providing increases at least at the rate of inflation for core research programs and core facility operations; providing significant research increases in energy sciences, including the growth of Energy Frontier Research Centers; providing optimal construction funding, including for the NSLS-II project; providing instrumentation upgrades and fabrication for the scientific user facilities and the core research programs; upgrading and expanding the Spallation Neutron Source; and planning and conducting R&D toward the next-generation of light sources. The fiscal year 2009 request begins to put the BES budget on track with respect to the doubling path defined by the ACI and congressional authorizations. Projecting along that path in subsequent fiscal years would see the BES budget grow to approximately \$2 billion by fiscal year 2013. I encourage your strong support of the President's fiscal year 2009 request to help bring this vision to fruition.

Question. Dr. Orbach, the Office of Science budget this year includes funding that was formerly in the Office of Nuclear Energy budget dealing with medical isotopes. What is the rationale for the decision to transfer the funding from Nuclear Energy to Nuclear Physics?

Answer. The Office of Science, with sustained commitment in promoting physical science research and experience in facility operation and infrastructure management, is well equipped to meet the needs for a successful and viable national isotope program. In fiscal year 2009, the Nuclear Energy isotopes program will be transferred to the Nuclear Physics (NP) program within Science, and will be renamed and reformed as the Isotope Production and Applications program. This new program will expand the scope of the present program of radioisotope production to include research production of commercially-unavailable radioisotopes in response to the needs expressed by the entire research community. Based on the successful NP model of fostering fundamental research, and within the scope of fiscal year 2009 budget, the new program will include the support of \$3.2 million for development and production of research isotopes, based on competitive peer review. The recent report of the National Academy of Sciences (NAS), entitled "Advancing Nuclear Medicine Through Innovation" (September 20, 2007) raises concerns about Federal support for sustained U.S. competitiveness including deteriorating infrastructure, lack of a domestic source for research isotopes, shortage of trained workforce and lost opportunities. The NP has established a working group with the National Institutes of Health to address the recommendations in the report and is also planning a workshop in the summer that will bring, for the first time, all of the major stakeholders in isotope production together discuss the Nation's needs in isotope development and production and initiate the development of a community-driven strategic plan.

QUESTIONS SUBMITTED BY SENATOR DIANNE FEINSTEIN

Question. The Department of Energy (DOE) does not always allocate funding to transform basic research results into applied applications. What is the Department doing to expedite development and deployment of fuel cell technology and other technologies to bridge the gap between basic and applied research?

Answer. The Office of Science's fiscal year 2009 budget request contains proposals for four new areas of coordination between programs in Basic Energy Sciences (BES) and the applied technology offices within DOE. In each area, the basic research needs required to advance energy technologies and close the gap between basic and applied research have been identified through one or more of the Basic Research Needs workshops conducted by BES. The four areas are Electric Energy

Storage (EES), Carbon Dioxide Capture and Storage, Characterization of Radioactive Waste, and Predicting High-Level Waste System Performance Over Extreme Time Horizons.

In EES, the BES workshop on Basic Research Needs for EES (April 2007) identified key areas of interfacial chemistry, electrochemistry, and materials science required to advance EES for novel battery concepts in hybrid and electric cars and for the effective utilization in the utility sector of renewable, but intermittent energy sources, including solar, wind, and wave energy. DOE technology offices that might benefit include Electricity Delivery and Energy Reliability for utility-scale energy storage and Energy Efficiency and Renewable Energy for the FreedomCAR and Vehicle Technologies program and the Solar Energy Technologies program.

Carbon Dioxide Capture and Storage was a primary topic of the BES workshop on Basic Research Needs for Geosciences (February 2007), which identified the research challenges associated with the complex chemical and geological processes that occur when carbon dioxide is stored in deep porous underground formations. The Office of Fossil Energy is the primary beneficiary of this coordination effort.

Characterization of Radioactive Waste is a broad coordination area that was covered in three BES Basic Research Needs workshops: Advanced Nuclear Energy Systems (July 2006), Geosciences (February 2007), and Materials Under Extreme Environments (June 2007). These workshops noted the extraordinary combination of complex chemical and physics processes that occur under the extreme environments associated with radioactive waste (temperature, pressure, radiation flux, and multiple complex phases) and defined the materials, chemical, and geological sciences needed to address them. Technology offices that could benefit from this coordination area include the Offices of Nuclear Energy (NE), Environmental Management (EM), and Civilian Radioactive Waste Management (RW).

Predicting High-Level Waste System Performance over Extreme Time Horizons was also covered in the BES workshop on Basic Research Needs for Geosciences (February 2007), which addressed the remarkable challenge of developing the scientific understanding of the chemical and geological behavior of high-level waste in geological repositories necessary to develop models with predictive capability over extreme time durations, perhaps up to 1 million years. The DOE technology offices benefiting from this area include EM, NE, and RW.

These four new coordination areas complement and expand already ongoing areas of coordination between Science and the technology offices in the hydrogen fuel initiative (HFI) and solar energy utilization. Our HFI coordination is noteworthy because it has been in operation for over three fiscal years and has demonstrated impressive results, particularly in the area of fuel cells. The BES and EERE have coordinated their HFI activities through extensive interactions between program managers, including information sharing on proposal solicitations and awards, and by promoting scientific interactions between BES investigators and those supported by EERE through joint contractor research meetings, which began in fiscal year 2006 and have continued on an annual basis since then.

An example of the benefits of the HFI coordination in the area of fuel cells comes from work funded both by BES and EERE and conducted at Brookhaven National Laboratory. This work is aimed at developing electro-catalytic materials for hydrogen fuel cells that address one of the key barriers to widespread use of this technology—the prohibitive cost of fuel-cell catalysts that are based on precious metals, typically platinum. Basic research supported by BES led to the rational design, enabled in part by advanced computational chemistry, and development of nano-structured, electrocatalytic materials that have ultra-low platinum content. Detailed characterization of these new materials demonstrated improved catalytic activity toward the oxygen reduction reaction, which causes most of the efficiency loss in low-temperature fuel cells. In work supported by EERE, this fundamental discovery is being examined for its potential in making efficient catalysts that may be used to convert hydrogen to electricity in fuel cells for electric vehicles. While platinum is the most efficient electrocatalyst for accelerating chemical reactions in fuel cells in electric cars, platinum dissolves in reactions during stop-and-go driving—a major impediment. Recently, however, Brookhaven researchers added gold clusters to a platinum electrocatalyst, which kept it intact during an accelerated stability test under laboratory conditions, a potential breakthrough for fuel-cell technology.

Question. I am pleased to see the administration has again asked for an increase in spending at the Office of Science. DOE's Office of Science plays an essential role in developing cleaner sources of energy, stimulating breakthroughs in the biological sciences, pushing the frontiers of knowledge in physics, and improving energy efficiency. If Congress provides you with the increase to \$4.7 billion for the Office of Science, as requested, what will the agency be able to do that it cannot do under its current budget?

Answer. The fiscal year 2009 budget request will help enable the Office of Science to meet mission needs of the Department in energy, the environment, and national security as well as the goals of the American Competitiveness Initiative and the America COMPETES Act of 2007 for U.S. leadership in science and innovation.

Specifically the increase in the budget request will fully fund the U.S. fiscal year 2009 commitment for ITER (+\$203,874,000). In fiscal year 2008 funding for ITER was limited to \$10,626,000 and fell far short of the U.S. commitment of \$160,000,000. The ITER project, which will demonstrate the scientific and technical feasibility of fusion power, is the top priority new facility for the Office of Science and a high-visibility international commitment. While the Office of Science and the U.S. ITER Project Office have implemented a strategy to mitigate the adverse impacts in fiscal year 2008, the United States would likely be forced to default on its ITER commitments and terminate the U.S. ITER project if sufficient funds are not provided and would likely damage our credibility as a partner in future large scale international projects.

The requested increase will also allow the Office of Science Basic Energy Sciences program to initiate support for new areas in what we refer to as use-inspired research related to future energy technologies and fundamental research grand challenges that could result in greater understanding of how nature works. Approximately +\$100,000,000 will be for the Energy Frontier Research Centers. The centers will bring together the Nation's intellectual and creative talent from universities, national laboratories, and private sector organizations to conduct innovative basic research to advance scientific breakthroughs relevant to 21st century energy technologies. Research topics would include solar energy utilization; hydrogen production, storage, and use; electrical energy storage; advanced nuclear energy systems; superconductivity; solid-state lighting; materials under extreme environments; catalysis; combustion of 21st century transportation fuels; and geosciences related to long-term storage of CO₂ and nuclear waste. Awards for each center will be \$2–5 million per year for an initial 5-year period and we would expect to make 20–30 awards.

Approximately +\$71,270,000 of the requested increase would provide for more optimal operations of our major scientific user facilities. These facilities, from synchrotron light sources, neutron scattering sources, and whole genome sequencing facilities to particle colliders, high-performance computing resources, and nanoscale science research centers, are used by over 21,000 individuals each year. The suite of research capabilities and instruments supported by the Office of Science make up a significant pillar of the U.S. scientific research enterprise. Users come from universities, national laboratories, and industry. The increase in funding requested for the facilities will provide for maintenance, improved operations and extended operation times which enable greater researcher utilization.

Approximately +\$136,280,000 is requested for construction of the next generation scientific user facilities and instruments. This includes continued construction of the Linac Coherent Light Source at Stanford Linear Accelerator Center, an x-ray light source with unprecedented intensity and ultrashort pulses for probing materials and biological molecules and observing chemical reactions in real time; the initiation of construction of the National Synchrotron Light Source II at Brookhaven National Laboratory, which will have the capability to resolve molecular and materials structures down to the 1 nanometer level resolution; and the 12 GeV upgrade to the Continuous Electron Beam Accelerator Facility at Jefferson Laboratory, which will enable advanced studies of nuclear structure. The funding increase will also support scientific instrument fabrication for several projects including the Neutrinos at the Main Injector (NuMI) Off-Axis Neutrino Appearance (NOvA) detector at Fermilab.

Additional increases for research (+\$265,387,000) is requested for high performance computing, systems biology for bioenergy and environmental applications, chemistry, materials sciences, climate change research, plasma sciences, high energy physics, and nuclear physics and radioisotopes. Part of this increased funding is requested for international linear collider (ILC) research and superconducting radiofrequency (SRF) research to support the development of next generation accelerator-based facilities such as light sources, neutron sources, and particle colliders. Such research is not only critical to push the technology frontiers of future facilities, but it also enables advancements in technologies for medical instruments and cancer treatments. Fiscal year 2009 funding increases for neutrinos research capabilities such those enabled by NOvA, the ILC, and SRF research provide support for U.S. researchers to participate in the Large Hadron Collider at CERN. Such investments will position U.S. researchers to participate in the leading-edge high energy physics research here and abroad and maintain the critical scientific and technical capabilities to successfully lead the development of the next-generation particle collider facility in the coming decades.

Research increases in scientific computing and applied mathematics will enable U.S. researchers to take advantage of petascale computing capabilities for the advancement of some of our most challenging scientific questions that are not tractable through theory or experimentation. Increases will also support transfer of the DOE Isotope Program to the Office of Nuclear Physics from the Office of Nuclear Energy and the creation of a research and isotope production program that will focus on addressing the radioisotope needs of the medical, research, and industry communities in the United States.

The fiscal year 2009 request of \$4,721,969,000 for the Office of Science will support approximately 23,700 Ph.D's, graduate students, undergraduates, and technical staff and universities and the national laboratories, a significant number of the Nation's scientific and technical skilled workforce. In fiscal year 2006, the Office of Science provided approximately \$161,472,000 to California universities and research and industry organizations, not including the research and facilities supported at the four DOE laboratories in your State. The contributions that California scientists and engineers make to the Department's mission and to U.S. innovation and competitiveness are tremendous and I assure you they are well positioned to participate in the research activities we have proposed as part of the fiscal year 2009 budget request.

Question. I am interested by your proposed plan to establish Energy Frontier Research Centers (EFRC) Initiative. I think we can anticipate that many California universities will be eager to apply for the centers. How is the Department soliciting input from the scientific community on the initial areas of investment?

Answer. The areas of emphasis for the EFRC initiative were developed over the last 6 years in an extensive series of workshops sponsored by the Basic Energy Sciences program and its advisory committee, the Basic Energy Sciences Advisory Committee (BESAC). These began with a BESAC workshop on Basic Research Needs to Assure a Secure Energy Future in 2002. This was followed by a series of 10 Basic Research Needs workshops run by BES that covered the hydrogen economy, solar energy utilization, superconductivity, solid state lighting, advanced nuclear energy systems, combustion of 21st century transportation fuels, geosciences, electrical energy storage, materials under extreme conditions, and catalysis for energy. Finally, BESAC recently completed a report on scientific grand challenges, "Directing Matter and Energy: Five Challenges for Science and the Imagination." In total, some 1,500 scientists, the bulk of whom were from universities, participated in these workshops. The EFRC initiative requests proposals that satisfy two criteria with regard to topical areas—that they address one of the grand challenge themes from the BESAC report and that they address one of the energy grand challenges put forth in the series of 10 Basic Research Needs workshop reports.

Question. What is your vision for the centers?

Answer. We envision the EFRCs as centers that will bring together the skills and talents of a critical mass of investigators to enable energy relevant, basic research of a scope and complexity that would not be possible with the standard single-investigator or small-group award. The EFRCs should present research programs that are balanced and comprehensive and, as needed, support experimental, theoretical, and computational efforts. We expect that EFRCs will be lead and managed in such a way as to present world-leading programs that encourage high-risk, high-reward research. Finally, the EFRC program provides a tremendous opportunity to inspire, train, and support leading scientists of the future who have a deep and sincere appreciation for the global energy challenges of the 21st century.

Question. When do you anticipate the competition to be announced?

Answer. The Funding Opportunity Announcement (FOA) for the EFRC competition (DE-PS02-08ER15944) was initially published on April 4, 2008, and was amended on April 23, 2008. Applications in response to the FOA will be accepted through October 1, 2008.

Question. How will universities be judged?

Answer. Pursuant to section 989 of EPOA 2005 regarding DOE merit review of proposals, the EFRC FOA provides a single opportunity announcement for universities, for-profit companies, nonprofit entities, and DOE laboratories. The FOA is open equally and fairly to all of these entities and, importantly, is very flexible with regard to teaming between such entities. All applications, regardless of the nature of the lead organization, will be judged through rigorous merit review, in accordance with 10 CFR 605.10(b), on the basis of four major criteria: scientific and/or technical merit of the project, appropriateness of the proposed method or approach, competency of the applicant's personnel and adequacy of the proposed resources, and reasonableness and appropriateness of the proposed budget. Additional information on the EFRCs, including a link to the FOA, can be found on the EFRC webpage on the BES website at <http://www.sc.doe.gov/bes/EFRC.html>.

Question. As you know, Berkeley Lab is leading the Joint BioEnergy Institute (JBEI), along with Sandia, Livermore, UC Davis, UC Berkeley and the Carnegie Center for Plant Biology at Stanford. With funding from the Office of Science, JBEI is developing the science and technology that will drive sustainable biofuel solutions to the market in time to make a difference. Could you please give the committee a report on the progress of JBEI and the other bioenergy research centers? Is \$25 million per year, per center, enough to meet the biofuel production targets in the Energy Independence and Security Act?

Answer. All three DOE GTL Bioenergy Research Centers (BRCs) are up and running today and engaged in cutting-edge basic research needed to develop cost-effective methods of producing cellulosic biofuels. Secretary Bodman announced the award of the three BRCs on June 26, 2007, following an open competition and an intensive scientific merit review process. From July through September, DOE negotiated with the lead institutions of the selected BRCs on the terms and conditions of the awards. These negotiations were concluded before the end of fiscal year 2007, and each of the BRCs received \$9.97 million in fiscal year 2007 funds to accelerate their start-up. The Department plans to provide each BRC with \$25 million per year through fiscal year 2012, for a total 5-year program investment of \$405 million.

The three BRCs are the Joint BioEnergy Institute (JBEI), led by the Lawrence Berkeley National Laboratory (LBNL) and located near Berkeley, CA.; the Bio-Energy Sciences Institute (BESC), led by Oak Ridge National Laboratory (ORNL) and based on the ORNL campus in Oak Ridge, TN; and the Great Lakes Bioenergy Research Center (GLBRC), led by the University of Wisconsin-Madison (UMW) in partnership with Michigan State University and based on the UMW campus in Madison, WI. All three BRCs represent multi-institutional partnerships. Partner institutions include universities, DOE National Laboratories, private firms, and one nonprofit.

DOE will evaluate the performance of the BRCs on a yearly basis. The Department conducted an early Technical and Management Review of the BRCs in November 2007. As a result of the review, all three BRCs have put in place strong management plans and systems and have established clear sets of scientific milestones and deliverables to focus and guide their research programs.

The BRCs are geographically dispersed, with scientific approaches that are complementary and synergistic. All three BRCs are using the advanced genomics-based techniques of modern systems biology to re-engineer both plants and microbes for more efficient biologically-based conversion of plant fiber into fuels.

JBEI is focusing on the widely studied “model plants” of Arabidopsis and rice (as well as some work on switchgrass), for which there is abundant genotypic and phenotypic information. JBEI believes that critical changes can be accomplished more readily in model plants and then transferred to bioenergy crops. JBEI is pursuing a novel strategy vis-a-vis lignin—a substance that occludes cellulose and forms a major barrier to deconstruction of plant fiber. Through detailed analysis of cell wall biosynthesis, JBEI is seeking to change the monomer composition of lignin, replacing existing monomers with new monomers whose mutual bonds can be cleaved by specialized enzymes. In addition, JBEI is studying the use of ionic liquids for pretreatment using advanced imaging technology, in an effort to overcome the limitations of current pretreatment methods, which produce chemical byproducts that inhibit enzymes used in subsequent hydrolysis and that are often toxic to the microbes used for fuel synthesis. JBEI is pursuing a series of unique strategies on microbes, including re-engineering microbes to better degrade plant fiber and to produce a range of fuels beyond ethanol that are more like gasoline. JBEI is also seeking to adapt microbes to achieve Consolidated Bioprocessing, using single microbes or microbial communities.

BESC is focusing on the central problem of “recalcitrance,” i.e., overcoming the resistance of plant fiber, or lignocellulose, degradation into sugars that can be converted into fuels (usually by fermentation). Research by BESC investigators has shown that recalcitrance of plant fiber forms the major cost barrier to achieving commercially viable production of cellulosic ethanol and other fuels from lignocellulose. BESC is focusing directly on the bioenergy crops of switchgrass and poplar as well studying the microbes that can degrade them, attempting to re-engineer both the plants and microbes to facilitate degradation. On the plant side, BESC is building a high-throughput screening system with standardized pretreatment and enzymatic hydrolysis steps to screen thousands of genetic variants of switchgrass and poplar for amenability to deconstruction. The genomes of the most readily deconstructed variants will then be re-sequenced to identify the genes responsible for cell wall digestibility, providing a basis for genetically engineering optimized feedstocks. On the microbial side, BESC has engaged in bioprospecting in hot pools in Yellowstone National Park, inhabited by thermophiles that degrade cellulose.

Samples are being subjected to metagenomic DNA sequencing and analysis in an effort to discover more efficient cellulases (cellulose-degrading enzymes) that operate at high temperatures. BESC's long-term objective is to achieve "Consolidated Bio-processing," or combined degradation and fuel synthesis in one step, using a re-engineered microbe or community of microbes.

GLBRC, in addition to focusing on recalcitrance of plant fiber, is pursuing the alternative approach of engineering plants to produce more starches and oils. These substances can be more readily converted to fuels. GLBRC points out that a 20-percent increase in plant oil content could nearly double the fuel yield from plant biomass. GLBRC, reflecting its affiliation with universities with strong agricultural programs, is focusing on re-engineering a wide variety of plants as well as microbes that can degrade plants and produce fuels, and they are investigating the sustainability of biofuel production. GLBRC plant researchers (mostly located at the Plant Research Laboratory at Michigan State University) are pursuing in-depth, genomics-based analysis of the complex process of cell wall biosynthesis to find methods of inducing more starch and lipid production in these structures. GLBRC is also engaged in bioprospecting and metagenomic analysis of microbial communities using somewhat different techniques and focusing on samples from Costa Rican rain forests. GLBRC is utilizing the technique of directed evolution (accelerated by a new generation of genomic sequencing technologies now available at the DOE Joint Genome Institute) to optimize microbes for ethanol production. GLBRC is also studying the production of hydrogen through microbial biorefineries.

The current level of proposed funding for the three Bioenergy Research Centers will yield transformational discoveries that will enable dramatic improvements in our ability to produce biofuels from biomass at greatly reduced cost.

Question. Recently you described to me how the Joint Genome Institute in Walnut Creek, California is sequencing the genomes of the organisms within the guts of termites in search of ways to more efficiently and cost-effectively break down biomass for conversion into fuel. Could you please elaborate on why this research is important and why the Office of Science is the appropriate funder and steward of this type of scientific inquiry? Additionally could you explain the broader role the JGI is playing in the Office of Science's energy research objectives? Finally, please describe how technologies developed through the bioenergy research centers will make their way to the marketplace.

Answer. The diverse community of microbes inhabiting the guts of termites is one of nature's most efficient systems for breaking down cellulosic plant material and converting it into simpler products, including hydrogen and short chain carbon compounds, that feed the termite host. Although we have a general understanding of the chemical reactions that take place in the termite gut, we know relatively little about the specific microorganisms and enzymes that carry out these processes. However, new research techniques are now allowing us to directly probe novel metabolic capabilities encoded in the genomes of termite gut microbes. The DOE Joint Genome Institute recently completed sequencing of the microbial community genomes (i.e. "metagenomes") of two Costa Rican termites capable of very high rates of cellulose degradation. More than 800 new genes believed to be involved in cellulose breakdown were identified, as well as over 150 genes involved in hydrogen production and hundreds of additional genes encoding functions crucial to the operation of the system. Far more than just a catalogue of new genes and enzymes, this study provides researchers with an important new tool to understand the complex systems biology that allows the host and microbial community to act as an integrated whole. Continued studies of the termite gut symbiosis will allow us to not only consider novel approaches that are being applied to the conversion of plant biomass to biofuels, but also provides critical new information on a key component of the global carbon cycle. As the Federal Government's lead agency for biofuels research, DOE's Office of Science is the appropriate funder and steward for this fundamental, transformation research.

In addition to its critical sequencing of the termite gut metagenome, the JGI is playing a key role in the DNA sequencing and analysis of prospective biomass crops, including the poplar (the first tree genome), soybean (for biodiesel), and switchgrass and of other microbes with enzymes or biochemical pathways important for cellulose degradation and carbon cycling.

All three DOE Bioenergy Research Centers have already begun laying the groundwork for eventual transfer of new technologies that emerge from their research. Both the BioEnergy Sciences Institute (BESI), led by Oak Ridge National Laboratory (ORNL), and the Great Lakes Bioenergy Research Center (GLBRC), led by the University of Wisconsin-Madison (UMW) in partnership with Michigan State University, have industry partners as integral members of their respective teams. All three BRCs have advisory boards with industry representatives. The Joint Bio-

Energy Institute (JBEI), led by the Lawrence Berkeley National Laboratory (LBNL) and located near Berkeley, CA is developing close relations with the biotech industry and investment community centered in the San Francisco Bay Area. The BRCs will have multiple paths for commercialization of new technologies that flow from their discoveries. In addition, BER is coordinating the research in its Genomics:GTL program, including research at its Bioenergy Research Centers, with biorefinery demonstration projects funded by DOE's Office of Biomass Programs.

Question. The Department of Energy's Office of Science pioneered the field of modern supernova cosmology. DOE's strength in this area has led to many awards, prizes and international recognition of the strength of this program. It was your personal support of this important work that set the stage for this international scientific leadership. Through the Joint Dark Energy Mission, which is a collaboration between your office and NASA, are you confident that DOE will maintain its vitality and leadership in the field? Please give the Committee an update on the Joint Dark Energy Mission.

Answer. The DOE sponsored scientific community has broad expertise in scientific collaborations, data analysis, and advanced instrumentation. By contributing to these areas of expertise the community will maintain vitality and a leadership role in the field.

DOE, NASA, and OSTP have been meeting regularly to lay out the plan for the Joint Dark Energy Mission (JDEM). As a result of the agency collaboration, DOE and NASA have agreed to participate in a JDEM; JDEM will be a medium-class strategic mission with a competitively selected, principal investigator-led dark energy science investigation; DOE and NASA will partner in the fabrication and operation of instrumentation necessary to execute the science investigation; and DOE's cost for the fabrication and operations phase is estimated to be up to \$200 million in fiscal year 2008 dollars, or roughly 25 percent of the cost of the expected total lifecycle mission. The agencies are currently working on a Memorandum of Understanding describing the collaboration. The planning schedule includes the release of the Announcement of Opportunity (AO) near the end of 2008, with a draft in summer; selection of a particular concept and start of conceptual design in fiscal year 2009, and launch in 2014 or 2015.

QUESTIONS SUBMITTED TO HON. ALEXANDER KARSNER

QUESTIONS SUBMITTED BY SENATOR BYRON L. DORGAN

BIOMASS/ETHANOL MANDATE

Question. The Energy Independence and Security Act of 2007 requires that suppliers must blend 36 billion gallons of renewable fuel into gasoline by 2022. Of the 36 billion gallons of renewable fuel, 21 billion gallons must be "advanced biofuels" (fuels produced from non-corn feedstocks). On March 4, Guy Caruso, Administrator of the Energy Information Administration, testified before the Senate Energy Committee, and said that it was unlikely that we would reach these mandates by 2022. Do you believe that we can reach the 36 billion gallon mandate by 2022?

Answer. The Department believes that the Renewable Fuels Standard (RFS) established in EISA is achievable. Achievement of the RFS will require consistent policy and regulatory certainty so as to sustain the necessary private investment.

The RFS is not limited to ethanol. Other biofuels, including biodiesel and biomass-to-liquids, may contribute to the mandates specified in the RFS. However, ethanol is expected to play a central role in the fulfillment of this standard. In terms of ethanol produced from corn, the current U.S. ethanol production capacity exceeds 9.9 billion gallons with an additional 3.7 billion gallons under construction.¹ Based on current trends and our analysis of industry plans, we believe that the industry will likely reach the 15 billion gallons of conventional biofuel requirement before the scheduled 2015 date.

Integrating large amounts of renewable fuels required by the RFS into the current transportation fuel distribution system presents unique challenges, most likely requiring the use of either E85 or possibly intermediate ethanol blends. Combining the supply and demand elements of the RFS will require close coordination among renewable fuel and feedstock producers, transportation fuel producers and blenders, and Federal and State agencies. The Biomass R&D Board will play an important role in achieving the national goals established in EISA by bringing coherence to

¹ See Renewable Fuels Association, <http://www.ethanolrfa.org/industry/locations/> as of August 20, 2008.

Federal strategic planning. The Board is co-chaired by the Departments of Energy and Agriculture, and also consists of senior decisionmakers from across the Federal Government.

Question. What advanced biofuel do you foresee making up the 21 billion gallon requirement?

Answer. In terms of advanced biofuels, DOE's goal is to make cellulosic ethanol cost-competitive by 2012. We anticipate that cellulosic ethanol will comprise the majority of the 21 billion gallon "advanced biofuel" requirement.

WEATHERIZATION

Question. Mr. Karsner, I understand that since 1976, we have spent \$8 billion on the Weatherization Program, but only improved 5 million homes. Your budget states that, "EERE's Energy Efficiency portfolio has historically provided approximately a 20 to 1 benefit to cost ratio; in comparison, Weatherization has a benefit to cost ratio of 1.5 to 1." Clearly, we have a considerable amount of work to do to make our buildings and homes more energy efficient. But, as policy makers we need to understand the quickest and most cost effective way to do so. If you were to develop a more effective program what would you propose?

Answer. After almost three decades, DOE has weatherized about 5.5 million homes out of the 34 million annually eligible. As you have noted, based on a study by the National Research Council, investments in some energy efficiency applied R&D between 1978 and 2000 resulted in returns 20 times greater than the cost of the investment.² In contrast, the energy savings from Weatherization Assistance Program grants result in a significantly lower benefit/cost ratio of 1.53 to 1. This ratio was calculated by Oak Ridge National Laboratory based on past evaluation efforts and Energy Information Administration projected energy prices.³ Weatherization Assistance is an important goal, but is an anomaly because it addresses social welfare goals in addition to energy efficiency improvement.

Prudent portfolio management requires DOE to focus available resources on its core areas of expertise and mission consistent with the DOE Strategic Plan. DOE is currently prioritizing development of new technologies, model building codes, and innovative programs for existing homes. Through the Building Technologies Program, the Department is committed to developing reliable, affordable, and environmentally sound renewable energy and energy efficiency technologies that significantly reduce the energy consumption and peak electrical demands of residential and commercial buildings. During the design and construction of a new home, far more can be achieved to bring it to net zero energy use in a cost-effective way than can be done with an existing building. Furthermore, many of these gains can be achieved in new construction at no initial first cost. It is important that buildings added to the housing stock be more energy efficient when built, so as to prevent the more costly and less effective task of fixing the problem by retrofitting them in the future.

However, building energy codes only establish a minimum level of construction below which builds cannot be built. While it is important to continue to raise the building energy codes bar, it is also important to invest in research, development and demonstration of homes that can achieve greater energy efficiency than code and eventually net-zero energy homes, as well as to apply these technologies to existing homes as much as possible. It is important to raise the bar on appliance standards, so that replacement appliances and equipment are made continually more efficient than the models they replace. It is also important to put in place incentive programs, such as Home Performance with ENERGY STAR, to encourage private sector investment in greater efficiency, as well as upgrade our existing building stock.

²"Energy Research at DOE: Was It Worth It?" National Research Council (<http://www.nap.edu/openbook.php?isbn=0309074487>). This study, published in 2001, analyzed investments in 17 energy efficiency R&D activities between 1978 and 2000 costing a total of \$1.566 billion (p.23) and representing about one fifth of energy efficiency program spending in that time frame. The NRC found overall net economic returns of about \$30 billion (p.29). This is a public return 20 times greater than the cost of the investment within the time period considered. In addition, the NRC calculated net environmental benefits worth \$3–20 billion for these activities. As is the case with many diverse R&D investment portfolios, most of the benefits were generated by few—in this case, 3 of 17—activities assessed (p. 29).

³The ORNL analysis can be found on the web (<http://weatherization.ornl.gov/pdf/CON-493FINAL10-10-05.pdf>). The benefit/cost ratio in the study is 1.34—the 1.53 ratio cited above uses the same calculations with energy cost data updated for 2006.

MESA DEL SOL SOLAR PROJECT

Question. Mesa del sol.—Mr. Karsner, part of your responsibilities include increasing the Federal Government usage of renewable energy. I have been made aware of Federal procurement rules that prevent Kirtland Air Force Base from signing a long term power purchase agreement beyond 10 years. We have a site in New Mexico, located between Mesa del sol and Kirtland AFB that has been identified as an ideal site for a 100 MW concentrating power plant with a molten salt storage reservoir. However, procurement rules prevent the base from entering into a contract beyond 10 years, well short of the useful life of the plant, which has a big impact on the economics of the deal. First, do you believe these procurement limitations are having an impact on the deployment of clean energy technology?

Answer. It is true that the Government-wide authority for utility purchases is limited, in most instances, to 10 years. That authority was created for traditional utility purchases and is not well-suited to the type of renewable energy projects that would require a substantial initial capital investment.

Question. If Congress were to change the requirement to allow Federal agencies to enter into longer term power contracts, do you believe this would have a positive impact on the commercial deployment of renewable energy technology? Would you support this change?

Answer. The Federal Government should lead by example in its use of renewable energy. To do so, we should assess whether there are legal impediments to its use. If so, the administration stands ready to work with Congress to develop workable solutions.

CONCENTRATING SOLAR POWER

Question. Recently Sandia National Lab announced a world record for solar to energy conversion. On January 31, 2008, a sterling concentrating solar array located at Sandia Thermal Test Facility achieved a world record of 31.25 percent net efficiency rate. Despite the promising performance, your budget maintains a wide disparity between funding for photovoltaic research (\$137 million) and concentrating solar research. (\$19 million). Based on economic and technology performance with concentrating solar technology, why the large disparity in funding? How will the Department facilitate the commercial deployment with such low levels of funding?

Answer. The Department believes that it has struck an appropriate balance between photovoltaic (PV) and concentrating solar power (CSP) technology funding. CSP's advantages include a lower cost than solar PV technology, as well as the capability to store thermal energy for later use. PV, however, remains the focus of most of DOE's solar program funding for several reasons.

Primarily, PV can provide energy solutions for the entire Nation, not just the Southwest. Also, PV technology faces more challenges to be cost competitive with conventional electricity sources. It has a significantly larger and more diverse industry base with Federal R&D support needs in multiple technology areas (e.g., crystalline silicon, thin films, multi-junction cells) at various links in the supply chain (e.g., semi-conductor devices, PV modules, inverters). Significant R&D advances will be needed to achieve the aggressive Solar America Initiative PV electricity goal, to be cost-competitive nationwide with grid electricity by 2015.

PLUG IN HYBRID TECHNOLOGY

Question. There is no doubt that we must improve our battery technologies across a broad range energy sources that rely on storage as a key component. In my opinion, energy storage is one of the most important pieces currently missing in our energy puzzle. What is EERE currently doing to advance battery technologies?

Answer. In fiscal year 2008, DOE's Office of Energy Efficiency and Renewable Energy (EERE) is providing approximately \$48.2 million to support long-term research, applied research, and technology development of advanced batteries for electric, hybrid-electric and plug-in hybrid vehicle (EV, HEV and PHEV) applications. EERE's applied research is focused on developing advanced materials for the next generation of energy storage technologies that offer the potential for significant improvements over existing batteries. In fiscal year 2009, DOE plans to award battery contracts focusing on improving battery performance through the development of manufacturing technology. This approach is expected to improve performance attributes such as cycle life, while simultaneously fostering domestic manufacture of advanced battery technology and reducing production cost.

In addition to battery research, EERE is providing \$22 million in support of modeling, simulation and testing of PHEVs in fiscal year 2008. Activities include laboratory and closed track testing, and real-world monitored fleet evaluations.

Question. When do you believe we can have large scale deployment of plug-in hybrid cars and what public policies changes are needed to achieve this objective?

Answer. The Department is working to achieve faster market penetration of plug-in hybrids (PHEVs) by developing technological and cost improvements to battery and electric drive components. The Department's goal is to reduce the high-volume production cost of lithium ion batteries to \$300/kWh by 2014, which, along with other improvements, could help PHEVs become cost competitive.

Lower costs help enable industry make the decision to commercialize, but ultimately greater market penetration is dependent on automakers as they make production decisions over the next several years, and by investments in battery manufacturing. GM plans to introduce its Chevy Volt PHEV in 2010, but we expect that there will be significant incremental cost that may prevent large-scale deployment. Other manufacturers have been non-committal on dates for commercially offering PHEVs.

Consistent and durable policies have been critical to the rapid uptake of hybrids, and will be critical to PHEVs as well. Automakers, suppliers, and battery manufacturers may also be eligible to apply for the Department's Loan Guarantee Program under title XVII of the Energy Policy Act of 2005, which lowers the financial risk of private enterprise in moving the successful results of research investments from the laboratory to the commercial marketplace. The Department is currently soliciting up to \$10 billion in loan guarantees for innovative energy efficiency, renewable energy, and advanced transmission and distribution technologies in fiscal year 2008.

BUILDING TECHNOLOGIES

Question. I know that it is the goal of the Building Technologies program to spur commercial production of Net-Zero Energy Homes by 2020. I believe that building technologies can play a very significant role in reducing our Nation's energy consumption. How do you expect this program to have nationwide effectiveness when numerous States do not even have a building code?

Answer. The Department's Building Technologies Program goal of achieving commercially viable Net-Zero Energy Homes by 2020 is a research and development effort involving building industry leaders, many of whom recognize the inherent value in building homes that perform significantly beyond State and/or national model codes. While State and national building codes set the minimum levels of performance, our zero energy building-related efforts do not rely on the existence of codes in a jurisdiction, in moving "beyond code." Codes require a minimum level of construction and energy efficiency below which houses should not be built. While there is substantial value in State adoption, implementation, and enforcement of building energy codes for the Nation, it is important for all housing can benefit from advances in building energy codes. We can encourage the construction of a significant number of Net-Zero Energy Homes by 2020.

To reduce energy consumption and to help U.S. home builders and buyers make informed decisions about efficiency and distributed energy, the Department has developed activities to encourage a robust market demand for more efficient homes through national and regional consumer education efforts. Combined with market forces (i.e. energy prices) and acceptance (i.e. consumer demand), builder training and codes can work in concert to drive standard practice toward net-zero energy homes over the long term for broader deployment of energy efficient technologies.

QUESTIONS SUBMITTED BY SENATOR DIANNE FEINSTEIN

Question. Mayor Villaraigosa and the city of Los Angeles are interested in the green technologies funded by EERE. What is the best way for the Appropriations Committee to assure that EERE's funding is spent in a way that rewards the best ideas of local government?

Answer. The proven way to ensure funds are allocated to the best ideas is the competitive solicitation process. The Department offers a number of resources for local governments, including programs in the Solar Technologies Program (Solar America Cities), Vehicle Technologies Program (Clean Cities), Building Technologies Program (Building America), and the Wind and Hydropower Technologies Program (Wind Powering America). In addition, cross-cutting resources are available such as the State Energy Program formula and competitive grants, and the Technical Assistance Project supported by the Department's national laboratories and funded by the State Energy Program. Funds for Solar America Cities and State Energy Program-competitive grants are awarded competitively to applicants through a rigorous merit review process. Funds provided to local governments through the State Energy Program-formula grants are allocated according to a method determined by the

individual State. The Technical Assistance Project (TAP) requires an application process and proposal review to determine eligibility for assistance. TAP helps States with individualized, short-term assistance in areas that are not covered by other DOE programs. Projects are limited to \$5,000 or between 30–60 hours of staff time. Funding is used to cover staff time and travel for laboratory experts and is not distributed directly to the applicant.

Question. According to a recent study by McKinsey and Company, one of the most cost effective opportunities to reduce greenhouse gas emissions is in household electronics. Specifically, the growing use of electricity in televisions and computers is a matter of great concern. What can EERE or Congress do to reduce this energy use?

Answer. DOE is actively engaged in establishing energy efficiency standards for consumer electronics. The Energy Independence and Security Act recently prescribed efficiency standards for the most common class of external power supplies which become effective July 1, 2008. In addition, the Department is currently in the beginning phases of initiating a rulemaking on battery chargers and external power supplies, which is scheduled for completion by July 2011. This rulemaking will address the energy use associated with a wide variety of products including laptop computers, cell phones, power tools, and printers, among others.

In addition, the Energy Independence and Security Act of 2007 (EISA 2007), Public Law 110–140, authorizes DOE to incorporate standby mode and off mode energy consumption into all new or revised standards adopted after July 1, 2010 (for residential products). The Department is now working to revise certain test procedures to account for standby mode and off mode energy consumption in accordance with the deadlines in EISA 2007. When in place, these energy efficiency standards have the potential to greatly reduce energy consumption and greenhouse gas emissions.

DOE and the Environmental Protection Agency jointly administer the ENERGY STAR program to promote more efficient products, including consumer electronics. The Federal Government generally is required to purchase energy efficient products, including ENERGY STAR-labeled products, and has led in the procurement of low standby power devices.

Question. I was pleased to see EERE ask for money to fund geothermal research this year. Please describe exactly how these funds will be spent, and for what purpose.

Answer. The mission of the Department's Geothermal Technology Program is to conduct research and development (R&D) on Enhanced Geothermal Systems to advance the technology as an economically competitive contributor to the United States energy supply. Enhanced Geothermal Systems (EGS) are engineered reservoirs created to produce energy from geothermal resources deficient in hot water and/or permeability. If EGS development is successful, the technology may be deployable nationwide as opposed to conventional geothermal technology that is limited to the western United States.

The Department issued a competitive solicitation on June 18, 2008, for awarding industry cost-shared EGS projects. Two topic areas are listed in the solicitation: component R&D technologies that address key aspects of reservoir creation, management, and utilization, and demonstration projects that will test and validate stimulation techniques for improving well productivity. The EGS-related R&D in the areas of reservoir stimulation, fracture mapping, and fluid circulation will also have applicability for expanding conventional (i.e., hydrothermal) fields.

IMPACT OF TAX CREDITS FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY

Question. I have worked with my Senate colleague Olympia Snowe to extend existing tax credits for renewable energy and energy efficiency. Please describe what impact these tax credits are having in the market place. Please identify the amount of new investment in renewable energy and energy efficiency that has resulted as a result of these tax provisions. Please estimate the job impacts if Congress allowed these credits to expire at the end of 2008.

Answer. While the Department is unable to quantify the exact amount of investment in energy efficiency and renewable energy directly resulting from these tax provisions, the past 10 years demonstrate a strong correlation between the intermittent availability of the 1-year production tax credit (PTC) extension and the volume of investment in renewable energy sources such as wind power. The tax policy has likely spurred investment; however, American Wind Energy Association data show that expirations of the Federal PTC in 1999, 2001, and 2003 were followed by drops in new wind installations in 2000, 2002, and 2004.

With the tax credit in effect in 2007, the United States led the world in new wind installations with over 5,300 MW installed.⁴ This growth translates into approximately \$9 billion (real 2007 dollars) invested in wind project installations.⁵ While there are no studies on the exact number of jobs directly associated with the tax credit, increased demand has led to increased manufacturing jobs in the wind industry, which may compete with other energy sectors.

QUESTIONS SUBMITTED TO DAVID G. FRANTZ

QUESTIONS SUBMITTED BY SENATOR BYRON L. DORGAN

TIMETABLE

Question. Mr. Frantz, it has been over 90 days since the President signed the Consolidated Appropriations Act providing the Department with \$38.5 billion in loan guarantee authority. This bill directed the Department to develop a plan to execute the program and to send this report to Congress for review within 45 days. When can we expect the Department to send this proposed plan to Congress? When do you expect to put a solicitation out on the street for bids and how soon do you expect to make awards?

Answer. On April 11, 2008, the Department of Energy submitted an "fiscal year 2008 Implementation Plan." The Consolidated Appropriations Act, 2008, requires that DOE wait for a period of 45 days from submission of the Implementation Plan to Congress prior to issuing a new loan guarantee solicitations. The Implementation Plan outlines the Department's plans to issue loan guarantee solicitations in two stages this summer for up to \$38.5 billion for projects that employ advanced technologies that avoid, reduce, or sequester emissions of air pollutants and greenhouse gases. These planned solicitations will mark the second and third rounds of solicitations for the Department's Loan Guarantee Program, which encourages the development of new energy technologies and is an important step in paving the way for clean energy projects.

LOAN GUARANTEE POTENTIAL

Question. Mr. Frantz, I have noticed from your bio you have over 35 years of experience in project finance in the energy sector and served 10 years as the Director of Project Finance for OPIC. That is quite an extensive amount of experience. Can you please explain what the financial advantage the loan guarantee program provides to the investors of these alternative energy projects? What is the cost savings of receiving Federal assistance?

Answer. One of the goals of the Department of Energy's title XVII Loan Guarantee Program is to encourage the commercial use in the United States of new or significantly improved energy-related technologies. There are a number of financial advantages that the loan guarantee program provides to investors of these types of alternative energy projects. Primarily, without a loan guarantee, investors in an innovative energy project may not have the financing necessary to establish the project, thereby potentially denying the commercial scale up of their respective technologies due to the unavailability of alternative debt financing.

While the Department's loan guarantee program offers clear benefits to alternative energy project investors, there is no measurement of the aggregate cost savings of participating in the program. In fact, energy investors might not even be permitted to proceed to full commercialization due to the unavailability of alternative financing. Each project supported by a loan guarantee will be evaluated on its particular strengths and weaknesses to determine the risk factor associated with the project. Depending on this risk assessment, each project will be levied a credit subsidy cost and other fees that will determine the ultimate cost to the project sponsors.

CREDIT SUBSIDY MODEL

Question. Mr. Frantz, I understand that the Department has been working to perfect its credit subsidy model, which is the risk calculation of each loan. Getting this model correct is important as it sets the level of payment each borrower is required to pay under the EPACT title 17 loan program and will have an impact on the scor-

⁴See Annual Report on U.S. Wind Installation, Cost, and Performance Trends: 2007, U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (May 2008) <http://www.nrel.gov/docs/fy08osti/43025.pdf>.

⁵Id.

ing of our bill by the Congressional Budget Office. What is the status of the credit subsidy model and how confident are you that this will provide an accurate risk analysis of each loan to ensure taxpayers are not on the hook for bad technology loans? What other agencies have reviewed this model for accuracy?

Answer. The Department has been working for several months to develop the credit subsidy cost model and is confident that once completed it will allow the Department to accurately calculate the subsidy costs of title XVII loan guarantees. It will not be made publicly available. The Office of Management and Budget must review and approve credit subsidy cost estimates. We expect it to be completed in the near future.

STAFFING OF LOAN GUARANTEE OFFICE

Question. Mr. Frantz, in your testimony you state that you have 16 people on your staff to execute the \$40 billion loan guarantee program. This sounds like an immense challenge. Can you explain how this compares to similar loan guarantee programs at other Federal agencies?

Answer. There are presently 16 members of the staff which is an adequate number to prosecute the 16 successful applicants under the 2006 solicitation representing an allocation in excess of \$4 billion. This staff is also adequate to initiate the proposed solicitations for fiscal year 2008 which is presently planned for \$38.5 billion. This staff is presently inadequate to prosecute the results of the fiscal year 2008 solicitation. The Loan Guarantee Program Office (LGPO) has requested in its fiscal year 2009 administrative budget \$19.9 million with a planned staff of 35 full-time employees (FTEs), augmented by independent contractors as necessary to handle the workload associated with the fiscal year 2008 solicitations. The organizational plan of the LGPO is based upon years of experience by the existing LGPO staff at the Overseas Private Investment Corporation.

CURRENT INVESTMENT CLIMATE

Question. Mr. Frantz and Mr. Karsner, the clean energy technologies being developed by the Department can only be effective if they are commercially deployed. Can you please describe the financial environment for renewable energy technologies and the financial barriers facing these technologies? How has the credit crisis impacted investment in these sectors?

Answer. The two principal goals of the title XVII Loan Guarantee Program are to encourage commercial use in the United States of new or significantly improved energy related technologies and to achieve substantial environmental benefits, with a reasonable certainty of repayment. In general, debt capital, a key component of an optimally financed project and the kind of financing the loan guarantee program encourages, flows to what is perceived to be the least risky investment. While many renewable energy projects can represent both a sound investment to investors and a benefit to the public through environmental benefits, debt financing will often instead flow to projects in industries that have a long and established history of low risk. The credit crisis only magnifies the barriers to financing of advanced renewable energy projects, both making capital less available for all project finance deals, but also encouraging the flight of capital to established industries and technologies and away from the type of projects supported by the Department's Loan Guarantee Program.

SUBCOMMITTEE RECESS

Senator DORGAN. This hearing is recessed.

[Whereupon, at 11:21 a.m., Wednesday, April 2, the subcommittee was recessed, to reconvene subject to the call of the Chair.]