THE DEPARTMENT OF ENERGY FISCAL YEAR 2009 RESEARCH AND DEVELOPMENT BUDGET PROPOSAL

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

MARCH 5, 2008

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THE DEPARTMENT OF ENERGY FISCAL YEAR 2009 RESEARCH AND DEVELOPMENT BUDGET PROPOSAL

WEDNESDAY, MARCH 5, 2008

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:10 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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Subcommittee on Energy and Environment

Hearing on

The Department of Energy Fiscal Year 2009
Research and Development Budget Proposal

Wednesday March 5, 2008
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Witness List

Mr. C. H. "Bud" Albright
Under Secretary of Energy, Department of Energy

Dr. Raymond L. Orbach
Under Secretary for Science, Department of Energy

Mr. Mark E. Gaffigan
Acting Director, Natural Resources and Environment Team
U.S. Government Accountability Office

Dr. Arthur Bienenstock
President, American Physical Society

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

The Department of Energy Fiscal Year 2009 Research and Development Budget Proposal

WEDNESDAY, MARCH 5, 2008
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Wednesday, March 5, 2008 the Energy and Environment Subcommittee of the House Science and Technology Committee will hold a hearing on the Department of Energy's (DOE) fiscal year 2009 (FY 2009) Budget Request for research and development programs.

Witnesses

- **Dr. Raymond Orbach** is the Under Secretary for Science at DOE, where he directs the Office of Science, serves as the Secretary's science policy advisor for all departmental programs, and oversees DOE's 17 national laboratories and education activities. Prior to joining the Department, Dr. Orbach served as Chancellor of the University of California at Riverside.
- **Mr. C. H. "Bud" Albright Jr.** is the Under Secretary of Energy at DOE, where he oversees the Energy and Environment programs which include research and development efforts in the offices of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy, Electricity Delivery and Energy Reliability, among others. Prior to joining the Department in 2007 Mr. Albright served as the Republican Staff Director of the U.S. House Committee on Energy and Commerce.
- **Mr. Mark Gaffigan** is an Acting Director in the Government Accountability Office, Natural Resources and Environment Team, which is responsible for recently produced reports on DOE funding for advanced energy technologies, the hydrogen fuel initiative, oil production shortages, and the oil and natural gas research program.
- **Dr. Arthur Bienenstock** is the President of the American Physical Society, which tracks funding for basic research at DOE, among other agencies, and has also produced several reports on applied energy research in recent years. Dr. Bienenstock is also a Professor of Physics as well as the Special Assistant to the President for Federal Research Policy at Stanford University.

Fiscal Year 2008 and 2009 for DOE non-defense R&D (in millions)

Programs	President's FY2008 Request	FY2008 Omnibus Approps	President's FY2009 Request	Delta President FY09/ Omnibus	%
Office of Science	**4397.9**	**4017.7**	**4722**	**704.3**	**18%**
Basic Energy Sciences	*1498.5*	*1269.9*	*1568.2*	*298.3*	*23%*
Advanced Scientific Computing Research	*340.2*	*351.1*	*368.8*	*17.7*	*5%*
Biological and Environmental Research	*531.9*	*544.3*	*568.5*	*24.2*	*4%*
High Energy Physics	*782.2*	*688.3*	*805.0*	*116.7*	*17%*
Nuclear Physics	*471.3*	*432.7*	*510.1*	*77.4*	*18%*
Fusion Energy Sciences	*427.9*	*286.5*	*493.1*	*206.6*	*72%*
Energy Efficiency and Renewable Energy	**1236.2**	**1722.4**	**1256.1**	(466.3)	-27%
Hydrogen	*213.0*	*211.1*	*146.2*	*(64.9)*	*-31%*
Biomass and Biorefinery Systems	*179.2*	*198.2*	*225.0*	*26.8*	*14%*
Solar Energy	*148.3*	*168.5*	*156.1*	*(12.4)*	*-7%*
Wind Energy	*40.1*	*49.5*	*52.5*	*3.0*	*6%*
Geothermal Energy	*0.0*	*19.8*	*30.0*	*10.2*	*52%*
Hydropower/Marine and Hydrokinetic	*0.0*	*9.9*	*3.0*	*(6.9)*	*-70%*
Vehicle Technologies	*176.1*	*213.0*	*221.1*	*8.1*	*4%*
Building Technologies	*86.5*	*109.0*	*123.8*	*14.8*	*14%*
Industrial Technologies	*46.0*	*64.4*	*62.1*	*(2.3)*	*-4%*
Weatherization and Intergov. Actitivies	*204.9*	*222.8*	*58.5*	*(164.3)*	*-74%*
Electricity Delivery and Energy Reliability	**114.9**	**138.6**	**134.0**	(4.6)	-3%
Fossil Energy Research and Development	**558.2**	**742.8**	**754**	**11.2**	**2%**
Coal	*426.6*	*493.4*	*623.7*	*130.3*	*26%*
Natural Gas Technologies	*0.0*	*19.8*	*0.0*	*(19.8)*	*-100%*
Oil Technology	*0.0*	*5.0*	*0.0*	*(5.0)*	*-100%*
Plant and Capital Equipment	*0.0*	*12.9*	*5.0*	*(7.9)*	*-61%*
Fossil Energy Environmental Restoration	*9.6*	*9.5*	*9.7*	*0.2*	*2%*
Advanced Metallurgical Research	*0.0*	*0.0*	*0.0*	*0.0*	*0%*
Cooperative R&D	*0.0*	*5.0*	*0.0*	*(5.0)*	*-100%*
Office of Nuclear Energy	**801.7**	**961.6**	**853.6**	(108.0)	-11%
Research and Development	*567.7*	*603.8*	*629.7*	*25.9*	*4%*
Infrastructure	*157.7*	*239.3*	*143.4*	*(95.9)*	*-40%*
Innovative Technology Loan Guarantee Program (Administrative Expenses)	**8.4**	**5.5**	**19.9**	**14.4**	**262%**
Total	**7117.3**	**7588.6**	**7739.6**	**151.0**	**2%**

The $7.7 billion request for DOE civilian energy R&D funding in FY 2009 is divided among five offices. The Office of Science (SC), represented in the hearing by Dr. Orbach, funds basic research at universities and 17 national laboratories, and is the single largest federal supporter of physical sciences research. The other four offices, represented by Mr. Albright, focus on applied research and technology development in the fields of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy, and Electricity Delivery and Energy Reliability.

OFFICE OF SCIENCE

The FY 2009 budget request for the DOE Office of Science is $4.7 billion. This represents an increase of $704 million, or 18 percent over the FY 2008 enacted level of funding, and $478 million or nine percent below funding authorized in COMPETES. (Note: COMPETES includes only a top-line authorization level for the DOE Office of Science; it is silent on funding for specific research program areas.)

The request for **Basic Energy Sciences (BES)** is $1.6 billion, an increase of $298 million or 23 percent over enacted FY 2008 funding. As the largest program

within the Office of Science, BES conducts research primarily in the cross-cutting areas of materials and chemical sciences, and based on a series of recent workshops, plans to focus more on specific research areas for energy applications.

The budget would provide $369 million for **Advanced Scientific Computing Research (ASCR),** an increase of $18 million or five percent over enacted FY 2008 funding. This includes funds to continue upgrading the Leadership Class Facilities at Oak Ridge National Laboratory and Argonne National Laboratory.

Biological and Environmental Research (BER) would receive $569 million under the President's budget, which is $24 million over current year funding. In addition to the role of BER in areas such as genomics, climate change research, medical applications, and environmental remediation, the FY 2009 request supports continued funding for three bioenergy centers established in FY 2008.

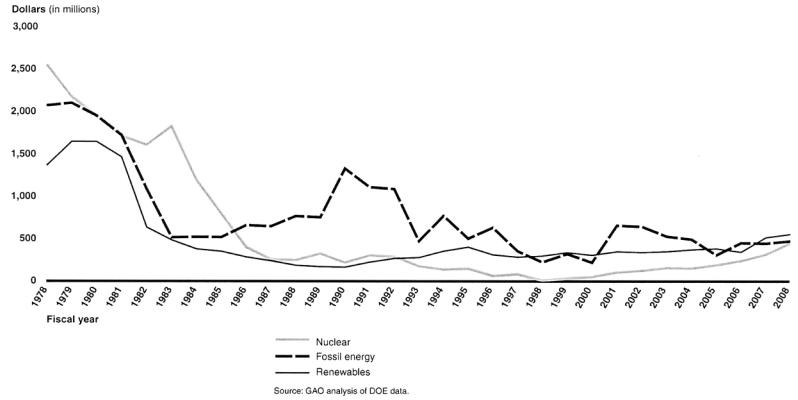
The FY 2009 funding request for **High Energy Physics (HEP)** is $805 million, which is $117 million or 17 percent more than the enacted FY 2008 level. This program conducts fundamental research in elementary particle physics and accelerator science and technology. Funding for the NOνA neutrino physics experiment and research in preparation for the International Linear Collider at the Fermi National Accelerator Laboratory and Stanford Linear Accelerator Laboratory are restored in this request.

Fusion Energy Sciences (FES) receives $493 million, an increase of $207 million or 72 percent over enacted FY 2008 funding. Of this amount, $214 million is dedicated to restoring funding for the U.S. role in the International Thermonuclear Experimental Reactor (ITER). Finally, **Nuclear Physics (NP)** would receive $510 million, an increase of $77 million (18 percent) over FY 2008 funding.

APPLIED ENERGY TECHNOLOGY PROGRAMS

While the total budget for energy R&D has risen in recent years it is still a fraction of the robust levels seen when the Nation responded to the energy crisis of the late 1970's. According to the U.S. Government Accountability Office the Department of Energy's budget authority for energy R&D fell 85 percent from 1978 to 2005 (inflation adjusted). Within the applied programs funding has varied greatly over the years according to shifting Administration and Congressional priorities, as the chart below indicates.

DOE'S Budget Authority for Renewables, Fossil, and Nuclear Energy R&D for Fiscal Years 1978-2008



Note: Budget authority is in real terms, adjusted to fiscal year 2008 dollars to account for inflation. The budget data focuses on development of advanced energy technologies and excludes such R&D areas as Vehicle Technologies because its focus is improving the energy efficiency of vehicles.

The Energy Information Administration (EIA) projects that U.S. electricity generation will grow from 3,900 billion kilowatt-hours in 2005 to 5,500 billion kilowatt hours in 2030. With continued high natural gas prices and sizable barriers to deployment of renewable and nuclear power technologies, coal will likely make up the largest percentage of this growth and continue to provide the largest part of U.S. electricity generation for the foreseeable future (roughly 50 percent). Despite heavy investments in wind, solar and geothermal energy R&D, the bulk of the Nation's

renewable energy portfolio comes from hydropower and still comprises only seven percent of total electricity generation. There are currently 104 operating nuclear power reactors in the U.S., with several new reactors in various stages of planning. However, it is expected that, short of very aggressive investment in nuclear capacity, new nuclear plants will only serve to replace aging existing plants in terms of overall electricity market share in the near-to-medium term. For the foreseeable future oil will fuel the Nation's transportation sector, though recent Administration and Congressional biofuels initiatives aim to drastically decrease its 97 percent market share.

Energy Efficiency and Renewable Energy (EERE)

The President's proposal of $1.26 billion for the Energy Efficiency and Renewable Energy program at DOE represents a 27 percent cut from FY 2008 congressional appropriations, with the elimination of the **Weatherization Assistance** program, a key component of the Nation's energy efficiency strategy, bearing a large brunt of the decrease.

Biomass and Biorefinery Systems would receive $225 million, a 14 percent increase over FY 2008 funding. This program seeks to make ethanol from cellulosic sources cost-competitive through advancing the technologies and practices to make the entire ethanol supply chain more efficient. The largest share of the increase ($36.4 million) goes to work with industry for demonstration of biorefineries at both the commercial-scale and at smaller scale for higher risk technologies.

The FY 2009 request of $221 million for **Vehicle Technologies** is an increase of $8 million over the FY 2008 appropriations, while funding for the Hydrogen Technology program decreased by $64 million, or over 30 percent. The large decrease in funding for the **Hydrogen Technology** marks the end of the Administration's five-year commitment to hydrogen R&D, and a shift of program priorities to wider applications of advanced vehicle technologies, especially for plug-in electric vehicle platforms. The FY 2009 budget proposes a transfer of $31 million from the Hydrogen Technologies program to the Vehicle Technologies Program largely for increases in the hybrid electric systems and technology integration initiatives. The hybrid electric systems program funds R&D to reduce the cost of battery systems. The technology integration program aims to accelerate the adoption and use of alternative fuel and advanced technology vehicles through demonstrations and education initiatives.

The proposed funding for the **Solar Energy** program would be decreased by $12.4 million, a seven percent reduction, to a total of $156.1 million in FY 2009, which is also $93.9 million below the level authorized in EPACT 2005. **Wind energy** is slated for $53 million, essentially even with FY08 levels.

The **Geothermal Technology Program** would receive an increase of $10 million to a total of $30 million in FY 2009. This is a reversal from last year's budget which proposed eliminating this program, but is still far short of the $95 million authorized in the *Energy Independence and Security Act of 2007.*

The budget request provides $3 million for both conventional **hydropower and marine and hydrokinetic energy research,** a 70 percent reduction, despite explicit authorization in the *Energy Independence and Security Act of 2007* for R&D in marine and hydrokinetic technologies at the level of $50 million in FY 2009. It is expected that a significantly higher level of federal effort is required to take advantage of this underdeveloped renewable resource in an environmentally friendly manner.

The Administration's request for **Industrial Technologies Program (ITP)** of $62 million is a three percent decrease from FY 2008 appropriated levels, and $128 million less than the amount authorized in the *Energy Independence and Security Act of 2007.* Heavy industry accounts for approximately one-third of energy use in the U.S., and the ITP has maintained a long and successful history of developing technologies and deploying them in industry, despite being funded at one-third of the levels from as recently as FY 2000 ($175 million).

Office of Nuclear Energy

The Administration request for Nuclear Energy (NE) is $629.7 for research and development, with nearly half of that request dedicated to the **Advanced Fuel Cycle Initiative** which is focused on implementing the Global Nuclear Energy Partnership (GNEP). For NE's Research and Development programs, this represents approximately $191.7 million above the FY 2008 enacted funding level ($438 million).

The United States has been conducting research on the reprocessing of spent nuclear fuel since 2002 under the Advanced Fuel Cycle Initiative (AFCI). In 2006, the Administration announced a change in this program when it unveiled GNEP as its

plan forward to develop advanced, proliferation-resistant nuclear fuel cycle technologies that would maximize the energy extracted from nuclear fuels and minimize nuclear waste. GNEP has drawn criticism based on the substantial costs estimated for implementing the program and the technical challenges associated with developing, demonstrating and deploying advanced technologies for recycling spent nuclear fuel that do not separate plutonium. Last fall, the National Academies issued a report expressing similar concerns. The FY 2009 request is $301.5 million, substantially higher than the FY 2008 enacted funding for GNEP of $181 million. GNEP aside, general research activities on a closed nuclear fuel cycle are more widely considered to be worthwhile.

The FY 2009 budget request eliminates funding for the University Reactor Infrastructure and Education Assistance program. However, it also includes directions to Nuclear Energy, through its Energy Research Initiative process, to designate at least 20 percent of the R&D appropriated funds for purposes of supporting R&D activities at university research institutions through competitive awards focused on advancing nuclear energy technology.

Office of Electricity Delivery and Energy Reliability

The Office of Electricity is requesting $134 million for FY 2009, a $4.5 million reduction from FY 2008 appropriations. Of the total for this office the Administration proposes $100.2 million for R&D, a $9.3 million decrease from FY 2008 appropriations. However, the request does include $13.4 million for Energy Storage and Power Electronics which doubles the FY 2008 appropriation for that program. Advancing energy storage systems is critical for modernizing the electric grid and expanding the use of renewable energy sources for power generation.

Innovative Technology Loan Guarantee Program (LGP)

The FY 2009 budget proposes $19.9 million to administer the Innovative Technology Loan Guarantee Program established under Title XVII of the *Energy Policy Act of 2005* (P.L. 109–58). The FY 2008 omnibus appropriations bill included $38.5 billion for loan obligation authority for FY 2008 and FY 2009. Within that authority, $18.5 billion was designated for nuclear power facilities, $6 billion for coal-based power generation and industrial gasification facilities, $2 billion for advanced coal gasification projects, $10 billion for renewable and efficiency projects and $2 billion for front end advanced nuclear facilities. The Administration's FY 2009 request does not seek additional loan obligation authority, but requests an extension for the loan authority until 2011 for nuclear facilities and a 2010 extension for all other projects.

Fossil Energy R&D

Fossil Energy R&D would receive $754 million in FY 2009, an increase of $11.2 million compared to FY 2008 appropriations. The funding increase would go to coal R&D, including the **Clean Coal Power Initiative (CCPI)** which will focus on validating carbon capture and storage in power generation applications in Round III of the program this year. CCPI funding is available to support projects on both existing power plants and new power plants. The **FutureGen program** would see a substantial increase to $156 million which more than doubles the FY 2008 appropriations of $74.3 million. The Administration has proposed a major revision of the FutureGen program which will now place an emphasis on early validation of clean coal technologies through multiple demonstrations of CCS technologies at commercially operated electric generating plants. This proposal is intended to capitalize on industry's investment in clean coal power plants by providing the funds for the CCS component of the advanced power plants and is a significant restructuring of the original program, which was promoted as a near-zero-emissions power plant that would combine electricity and hydrogen production. The **Fuels and Power Systems program,** which includes R&D on advanced coal technologies to reduce emissions of carbon dioxide (CO_2) at pulverized coal plants and continues R&D on promising technologies for capture, separation and compression of CO_2, would receive an increase of $33 million to $382.7 million in FY 2009. With the momentum to develop a national greenhouse gas reduction program growing, it is critical to have an appropriate investment in RD&D to cost effectively reduce CO_2 emissions from the use of coal, and sequester CO_2 on a commercial scale.

The FY 2009 budget once again proposes to eliminate all oil and gas R&D, including $50 million in direct spending (mandated in the *Energy Policy Act of 2005*) for unconventional onshore and ultra-deepwater offshore natural gas exploration technologies that would go largely to smaller independent oil and gas producers.

Chairman LAMPSON. This hearing will come to order. Good morning and welcome to today's hearing on the fiscal year 2009 Department of Energy budget request and future directions for energy research and development.

As indicated in the Committee's schedule notice, we invited Mr. Albright, the Under Secretary for Energy, and Dr. Orbach, the Under Secretary for Science, to present the Administration's Fiscal Year 2009 budget request on January 8. Unfortunately, they felt that they could not appear before the Subcommittee this morning. I am disappointed in the treatment that this subcommittee is receiving by the Department. Although the witnesses were invited in January, they didn't provide their testimony to the Subcommittee until 9:00 p.m. last night. Apparently, DOE does not approve of one panel hearings, which is commonplace on this committee and has been essentially the standard practice since the time Representative Sensenbrenner chaired this committee. I am very surprised and disappointed by this situation, but I am prepared to proceed with the scheduled hearing.

Mr. Isakowitz, although you were not invited to appear before us this morning, I want to give the Administrative an opportunity to present their budget request to the Members of this subcommittee, so I invite you to stay seated where you are, take your seat at the witness table to participate in the hearing this morning, and I thank you for coming.

The obstacles we face in energy and sustainability are of unprecedented scale and complexity. The Senate and House are working on legislation to institute a cap-and-trade program for greenhouse gases. We are still heavily dependent upon non-renewable energy supplies that are located outside our borders. We will only meet these challenges through aggressive and sustained support of research and development.

That said, I understand the difficult task of balancing priorities for energy research and development in an unfavorable budget climate. In general, I believe the Administration's budget request for DOE is a reasonable one. The Administration has proposed increases for a number of important energy R&D programs; however, I believe we need more invested in other areas that hold the great promise for diversifying our energy supplies, energy efficiency and renewable energy technologies.

The budget request for the Office of Science is consistent with our efforts in the *America COMPETES Act* and the Democratic Innovation Agenda to increase investments in basic energy research and development. It was unfortunate that Congress was forced to make significant cuts to the Fiscal Year 2008 basic research budget to avoid the President's veto, and I hope that a bipartisan commitment to ensuring our country's future prosperity will help to avoid a repeat of this situation in the year ahead.

I am pleased that this budget supports a restoration of funding for the U.S. contribution to the ITER International Fusion Project, as well as research towards a proposed International Linear Collider. It is important for us to honor our international commitments. The credibility of the United States as a reliable partner in future international research projects will be significantly undermined if these corrective actions aren't taken.

The picture for applied energy programs is not quite as good as the one for basic research. The budget request for Energy Efficiency and Renewable Programs is 27 percent below the appropriation for this year. While there are some notable proposed increases, there are some reductions that take us in the wrong direction.

The cheapest, cleanest energy we will ever find is the energy we don't use. Therefore, I cannot understand why the Administration has once again elected to eliminate the Weatherization Assistance Program. We should be looking for more ways to encourage deployment of products and technologies that increase energy efficiency. We should also provide increased support for solar and wind energy. If we are to expand the energy supplied by these renewable sources, we will need sustained increases in funding for these programs.

In the U.S., industry is responsible for one-third of all energy consumed, with the majority of that attributable to the heavy manufacturing sector that is struggling to stay competitive in an increasingly global marketplace. The Administration's proposal to decrease funding for the Industrial Technologies Program is baffling, especially in light of its record of success.

On the positive side, I am pleased to see the proposed increase for research and development in biomass and biorefinery systems. The increased investment in research and development for cellulosic ethanol production is essential if we are going to meet the targets we have set for bio-based fuels.

I am also pleased to see the Administration's proposal to increase funding for the Geothermal Technology Program after the Administration proposed closing out this program just a year ago. The proposed funding level of $30 million is still far short of the $95 million authorized in the '07 Energy Act, but at least we are now moving in the right direction.

There is much in this budget proposal that we can agree on, but not everything. What most troubles me is the Administration's repeatedly ignoring the law by withholding funds and trying to repeal programs that Congress authorized and funded, and I am going to repeat that slowly. What troubles me most is this Administration repeatedly ignoring the law by withholding funds and trying to repeal programs that Congress has authorized and funded.

Specifically I am talking about the oil and gas research project funded in Section 999 of the *Energy Policy Act of 2005*. The Administration should take the time to understand this program and see the potential in research collaborations between universities and small, independent producers and to let them do their work. We cannot flip the switch overnight, and it is essential to develop and utilize new technologies that will enable us to reduce our dependence on foreign sources of energy.

And finally, I must note the absence of ARPA-E in the budget request. What the Department proposes in its place, a smattering of small, inter-disciplinary projects and a half-hearted reworking of the technology transfer policy, simply will not suffice as a substitute for implementation of this program.

I have noted just a few items in this diverse budget proposal. Energy is essential to our way of life. We must do all that we can to ensure the Department of Energy has the resources to accomplish

the monumental task of guiding us to a future with a more diverse energy supply that has fewer environmental impacts. Research and development investments are the key to that future. I hope the Administration will work with us to secure a budget for DOE that will accomplish these goals.

We have a distinguished panel of witnesses with us this morning, and I look forward to hearing your testimony.

Right now I am pleased to yield to the distinguished Ranking Member of the Subcommittee, Mr. Bob Inglis.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

This hearing of the Energy and Environment Subcommittee will come to order.

Good morning and welcome to today's hearing on the FY09 Department of Energy budget request and future directions for energy R&D.

The obstacles we face in energy and sustainability are of unprecedented scale and complexity. The Senate and House are working on legislation to institute a cap-and-trade program for greenhouse gases. We are still heavily dependent upon non-renewable energy supplies that are located outside our borders. We will only meet these challenges through aggressive and sustained support of research and development.

That said I understand the difficult task of balancing priorities for energy R&D in an unfavorable budget climate. In general, I believe the Administration's budget request for DOE is a reasonable one. The Administration has proposed increases for a number of important energy R&D programs. However, I believe we need more invested in other areas that hold the great promise for diversifying our energy supplies—energy efficiency and renewable energy technologies.

The budget request for the Office of Science is consistent with our efforts in the *America COMPETES Act* and the Democratic Innovation Agenda to increase investments in basic energy R&D. It was unfortunate that Congress was forced to make significant cuts to the FY08 basic research budget to avoid the President's veto, and I hope that a bipartisan commitment to ensuring our country's future prosperity will help to avoid a repeat of this situation in the year ahead.

I am pleased that this budget supports a restoration of funding for the U.S. contribution to the ITER international fusion project, as well as research towards a proposed International Linear Collider. It is important for us to honor our international commitments. The credibility of the United States as a reliable partner in future international research projects will be significantly undermined if these corrective actions aren't taken.

The picture for applied energy programs is not quite as good as the one for basic research. The budget request for Energy Efficiency and Renewable programs is 27 percent below the appropriation for this year. While there are some notable proposed increases, there are some reductions that take us in the wrong direction.

The cheapest, cleanest energy we will ever find is the energy we don't use. Therefore, I cannot understand why the Administration has once again elected to eliminate the Weatherization Assistance program. We should be looking for more ways to encourage deployment of products and technologies that increase energy efficiency.

We should also provide increased support for solar and wind energy. If we are to expand the energy supplied by these renewable sources we will need sustained increases in funding for these programs.

In the U.S. industry is responsible for one-third of all energy consumed, with the majority of that attributable to the heavy manufacturing sector that is struggling to stay competitive in an increasingly global marketplace. The Administration's proposal to decrease funding for the Industrial Technologies Program is baffling especially in light of its record of success.

On the positive side, I am pleased to see the proposed increase for R&D in biomass and biorefinery systems. The increased investment in R&D for cellulosic ethanol production is essential if we are going to meet the targets we have set for bio-based fuels.

I am also pleased to see the Administration's proposal to increase funding for the Geothermal Technology Program after the Administration proposed closing out this program just a year ago. The proposed funding level of $30 million is still far short of the $95 million authorized in the 2007 Energy Act, but at least we are now moving in the right direction.

There is much in this budget proposal we can agree on, but not on everything. What most troubles me is the Administration repeatedly ignoring the law by withholding funds and trying to repeal programs that Congress has authorized and funded.

Specifically I am talking about the oil and gas research project funded in Section 999 of EPAct 2005. The Administration should take the time to understand this program and see the potential in research collaborations between universities and small, independent producers, and let them do their work. We cannot flip the switch overnight, and it is essential to develop and utilize new technologies that will enable us to reduce our dependence on foreign sources of energy.

Finally, I must note the absence of ARPA–E in the budget request. What the Department proposes in its place—a smattering of small interdisciplinary projects and a half-hearted reworking of the technology transfer policy—simply will not suffice as a substitute for implementation of this program.

I have noted just a few items in this diverse budget proposal. Energy is essential to our way of life. We must do all we can to ensure the Department of Energy has the resources to accomplish the monumental task of guiding us to a future with a more diverse energy supply that has fewer environmental impacts. R&D investments are the key to that future. I hope the Administration will work with us to secure a budget for DOE that will accomplish these goals.

We have a distinguished panel of witnesses with us this morning. I look forward to hearing your testimony.

I am pleased now to yield to the distinguished Ranking Member of the Subcommittee, Mr. Bob Inglis.

Mr. INGLIS. Thank you, Mr. Chairman, and I suppose I should respond to your opening statement, and that is that generally the Department of Energy has the courtesy of testifying—of having its Under Secretaries testify on a single panel. And just last week Admiral Lautenbacher, for example, in a similar situation testified on a separate panel. I don't know why the Committee decided this week to change all that and decide that it would not accord this protocol to the Department of Energy, but as a result we are not hearing from Mr. Albright and Mr. Orbach. But we are happy to have the rest—the other panel here.

And I would ask Mr. Chairman that, just to make sure that this is the case, that Mr. Albright's and Mr. Orbach's testimony—written testimony will be included within the record.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Thank you Mr. Chairman, and I want to thank our witnesses from the Department of Energy (DOE), the Government Accountability Office (GAO), and the American Physical Society for appearing here today to discuss funding for vital research and development projects.

After looking over the Administration's FY 2009 DOE Budget proposal, I find myself in agreement with the two points Dr. Beinenstock made in his submitted testimony: (1) the FY08 Omnibus significantly damaged DOE funding and DOE is now scrambling to recover (2) It's not a good idea to cut funding for the Office of Energy Efficiency and Renewable Energy.

Mr. Gaffigan from GAO will tell us that our investments in alternatives to oil are nowhere near what they were following the energy crisis in the 1970s. I wonder if that's because we don't believe we're coming up on an energy crisis of our own in this century, or if it's just that we're ignoring it? I'm disappointed to see that this budget proposal cuts away at hydrogen, solar and nuclear energy alternatives that can create new industry, new jobs, and a better climate.

Last year, about this time, I asked Andy Karsner for assurance that the final year of the President's Hydrogen Fuel Initiative did not mark the end of our commitment to hydrogen research and development. Mr. Karsner assured me that while the Hydrogen Fuel Initiative was coming to a close, it didn't mark "the end of the Hydrogen Program and its robust future that [DOE] expects to continue growing to meet its technological readiness milestones which are necessary over the next decade." Today, DOE will suggest that we cut $64.9 million from the Hydrogen Program.

Such a reduction would suspend applied research on renewable hydrogen and delay the advent of a hydrogen future. If enacted, this funding decrease would mean closure of laboratories dedicated to renewable hydrogen projects and a subsequent loss in the valuable momentum and research.

The Department of Energy can help lead this country to energy security. American ingenuity, venture capitalists, and industry are ready to join in this effort. I hope that we can find agreement that breaking free of oil requires great goals and great commitments. This budget should embody those goals and empower those commitments.

Thank you, Mr. Chairman, and I yield back.

Mr. COSTELLO. Mr. Chairman.

Chairman LAMPSON. Mr. Costello.

Mr. COSTELLO. I object.

Chairman LAMPSON. The objection is heard, and it will not be inserted in the record.

Mr. INGLIS. That seems nasty.

Mr. COSTELLO. Mr. Chairman, if I can be heard on my objection.

Chairman LAMPSON. Mr. Costello.

Mr. COSTELLO. I thank you. Mr. Chairman, I find it highly offensive that the Administration did not send Mr. Albright, the Under Secretary, over here today to present their budget and to allow Members to ask questions concerning the Administration's budget.

I am not aware of the protocol in terms of who serves on what panel or is invited to testify before this subcommittee on particular panels, but I certainly do not believe that it should be up to this Administration or any other Administration as to how this committee conducts its business or who serves on what particular panel to present their testimony.

Further, I believe that if we allow the Administration just to submit their written testimony to this committee without coming over to allow Members the opportunity to discuss the budget and ask questions, then what is to say that future Administrations will say, well, the Bush Administration got away with it. Why don't we just send our written testimony over and protect our Department from questions that the Members of this subcommittee and Committee may ask.

So that is my objection, and that is why I am reserving our——

Chairman LAMPSON. Thank you, Mr. Costello.

Mr. INGLIS. May I be heard on the point? It is—I wonder, Mr. Costello, last week what do you think we did with NOAA?

Mr. COSTELLO. I don't know what the decision was, but my point is that it should be up to this committee and not the Administration, this Administration or future Administrations, to determine who is going to be invited on which panel to testify. That should be left to the discretion of this committee.

You know, are we in the future going to say, well, we invite you to come over and testify before this subcommittee and then have the Administration tell us when they want to testify, what they are going to testify to, and if they don't get their way, they are not going to come? They will just submit written testimony?

I find it highly offensive and I think every Member of this subcommittee should be offended by the fact that Mr. Albright did not appear here today, and I personally believe that there are other motives why they are not here today. I think it was to avoid questions concerning some of the decisions that have been made in this budget.

Mr. INGLIS. If I can be heard on that?

Chairman LAMPSON. Before you comment let me just make, that there are two hearings scheduled next week under similar circumstances; NASA—excuse me. Single panel. Single panel——

Mr. INGLIS. It appears to me that we would have had actually more time for questions, would we not, if there were separate panels? You would have another round of questions for everybody on the panel up here, so it doesn't make any sense what you just said, that there would be less questions.

In other words, so let us do the math. If we have two people out here, and we have five people up here, five people get to ask two people questions. If we then go to a second panel, you actually multiply the number of questions, don't you? You double the number of questions for each panel.

Mr. COSTELLO. I don't think we are—if the gentleman would yield, I don't think we are talking about the number of questions. I think we are talking about one, letting the Administration determine business that should be conducted by and rules that should be adopted by this committee, decisions that should be adopted by the Committee, and secondly, it is not a matter of the number of questions. I think—my personal opinion is that Mr. Albright is not here today because he doesn't want to answer questions concerning certain issues in this budget, in particular about FutureGen. Now, that is my personal opinion.

But go back to the point that either this Administration or future Administrations should not determine decisions that should be made by this subcommittee. And I am highly offended that they would not be here today, and I think that every Member of this subcommittee should be highly offended on both sides of the aisle.

You know, who knows what is going to happen in the next election and which Administration is going to be serving in the White House next. I don't think they ought to dictate the rules. I think we should.

Mr. INGLIS. Yes. Something tells me that that will change if we get the post-partisanship, and if a future Administration says that, would you give us the courtesy of letting our Under Secretaries get back to their jobs.

Mr. COSTELLO. Well, you are conceding that your side will not win, take the Majority over in the November election.

Mr. INGLIS. No. I am hoping that Mr. McCain will also move us to post-partisanship. I am not sure you got a nominee, but I assume you will have one before the big dance in November, but we have got a nominee, and I think that he will be talking about post-partisanship.

And it seems to me quite a normal courtesy to simply say to the DOE witnesses, come, testify, answer plenty of questions, and then get back to work. Don't wait around while you have—having people you want to put on the panel so the Under Secretaries are detained here. They are happy to come and testify. They are willing to come and testify, but now what we have got is a little waste of time here as we discuss whether we did—we are upset and offended that they didn't come and testify. Well, they are happy to come and testify, and they were going to answer questions. It is just—it is a courtesy to allow the Administration to come in, testify, and then leave. We

did that last week. I don't know why we are not doing it this week. It really—it is one of those things where it is just sort of somebody got their back up, I guess, and decided that pride was more important than just moving along. And it is unfortunate, I think.

So here we are in Science Committee with what is typically done in other committees, where you just have a little bit of pride entering into the situation and not allowing good work to be done.

Mr. COSTELLO. Mr. Chairman, I don't know about the pride factor, but I do know this. I do know that this Administration should not make decisions concerning policy that should be reserved for decisions made by this subcommittee. For that reason I continue to object.

Mr. MCNERNEY. Mr. Chairman, I would like to be heard on the issue.

Chairman LAMPSON. You are recognized for five minutes.

Mr. MCNERNEY. I am going to follow up by saying I am surprised and disappointed that the DOE is not represented here this morning. I am looking forward to some of the testimony. I read what I was given this morning, and they seem to be setting a precedent here of not complying with our requests for testimony.

So I hate to see a pattern develop in which this committee and other committees call for testimony and are not given the obligation.

So I am going to join Mr. Costello and add my objection and disappointment to this behavior by the Department of Energy and the Administration.

Chairman LAMPSON. Your objection is noted. I might add that Mr. Isakowitz has been asked to represent the Department and allowed to take the place, and I want to make a comment that I thought post-partisanship was already here, and it began with me when I came back to the House of Representatives and my effort to try to make sure that we didn't have nonsense like this.

We do have a responsibility in this Congress, and our responsibility is that of oversight. We have, I thought, the right to set the rules when somebody invites, when I invited someone to our house. If a guest comes into my home, I typically don't allow them to tell me what I have to do in being a good host. It seems to me that that is the courteous way to handle something like this.

I did not want this, Bud Albright is a friend of mine and has been for a very long time. I have not spoken with him. I don't know all of the reasons why this is occurring. It seems to me that the bottom line in my mind is that it is our responsibility to hear testimonies. When we invite someone to come here to help us understand what that proposal is, we ought to at least be able to set the terms of those visits.

It has been that way. I believe that it was done that way under Mr. Sensenbrenner when I served under him and he was the Chairman of the Science Committee. I know that there have been Cabinet Members who have sat in this room at that table with outside witnesses. It was not intended to be offensive to the people that we invited to be our guests in any way whatsoever.

I think that in order to be consistent and to make sure that we do things to set the precedent that needs to occur for future panels that we sit on, that I would uphold the objection.

Ms. BIGGERT. Mr. Chairman.

Chairman LAMPSON. Does anyone else wish——

Ms. BIGGERT. Mr. Chairman.

Chairman LAMPSON. Yes. Ms. Biggert, you are recognized.

Ms. BIGGERT. Thank you. I am disappointed that the gentlemen are not here, but maybe this side of the aisle is the hostess with the host, and there is a difference of opinion about this situation.

And I don't think that the DOE is being unreasonable since the Committee has not and will not be asking other Administration witnesses from NOAA and NSF and NASA to the DHS tomorrow to testify on a panel with outside experts. So I guess we are in—maybe we are in the silly season, but I think that is too bad.

I am most concerned with the gentleman from Illinois' comment that they are not here because they didn't want to answer questions. They have submitted their testimony, and we have it. I don't see any reasons for not including that, and we have somebody that represents them to answer the questions. I don't know what evidence there is that they have something that they want to—not want to tell us. I think that they have always been very open and answered our questions extremely well and have been here. And I think this is just too bad that we have this situation.

And I would ask that their testimony be included.

I yield back.

Chairman LAMPSON. Thank you. I just want to point out that on Tuesday and Thursday of next week there are panels of Administration officials who are going to be serving or testifying with outside panelists. So it is being done, and like I said a minute ago, there was one Cabinet Member who came with outside panelists under——

Ms. BIGGERT. If the gentleman will yield. I think that——

Chairman LAMPSON. Be happy to.

Ms. BIGGERT.—they are not—the rule is not being applied uniformly, and so that this is why we—the question is raised.

Chairman LAMPSON. How has it not been applied uniformly or not being applied?

Ms. BIGGERT. Well, NSF and NOAA——

Chairman LAMPSON. NASA and NIST have a hearing scheduled next week.

Ms. BIGGERT. Yeah, but some of them have outside and some have not.

Chairman LAMPSON. Of these two, these two have, and I think that it should be the decision of this committee, not the decision of the Administration telling us how we need to run our business. And again, it should cut across partisan lines. There should be no difference 10 years from now or two years ago. It should be that we set the rules, in my opinion.

Ms. BIGGERT. Could the gentleman from Illinois answer what is the evidence that they don't want to answer questions?

Mr. COSTELLO. If the gentlelady will yield, I didn't say that I had evidence. I said it was my personal opinion that Mr. Albright does not want to answer questions concerning the decision to scrap the Future Generation Project. As the gentlelady may know, the Chairman of the Full Committee, along with the Chairman of the Subcommittee, myself, and other Members have asked the GAO to re-

view the decision and how the decision was made by the Administration to scrap this program after five and one-half years of investments and so on.

But it is my personal opinion. That is not the point. The point here this morning is should the Administration set policy for this committee, or should this subcommittee set our own policy and determine exactly what the rules will be for conducting business before this subcommittee. I don't think, you know, the Administration as the Ranking Member said, that Mr. Albright was willing to come here this morning, but apparently he was willing to come under his rules and under his terms and conditions as to how he would testify or what panel he would be on. And I don't think that should be in this Administration or any Administration's discretion to set policy for this committee.

And that is the entire point that I am making.

Mr. INGLIS. If Mr. Chairman——

Chairman LAMPSON. Ms. Biggert, are you finished with your time? Ms. Biggert, are you finished with your time?

Ms. BIGGERT. Yes, sir.

Chairman LAMPSON. Okay.

Ms. BIGGERT. I yield back.

Chairman LAMPSON. Then I recognize Mr. Inglis.

Mr. INGLIS. I would just like to respond to the gentleman from Illinois that as of seven o'clock, eight o'clock last night Mr. Albright was coming and was perfectly willing to come. DOE tells us that they have never testified at a budget hearing in a situation like this. In other words, that it has been the practice of this committee and the procedure to allow Administration witnesses to present the budget and then get back to work. This is their work as well, but they also can—they have other things that they need to attend to.

So I think it is not accurate to say that Mr. Albright didn't want to come here and answer questions. He was happy to be here and to answer questions. And if you do the math, he would have answered more questions this way. In fact, if you want more questions about FutureGen, do the math, and you got more question opportunities with two panels than you got with one. So if you want to make a point about FutureGen, the math works in your favor to have two panels.

So—but what we are asking for here is simply this. Now we are—the DOE has not been afforded the courtesy, and now the Minority is about to not be afforded a courtesy and that is to ask unanimous consent, and I would specifically ask unanimous consent to allow the testimony of Mr. Orbach and Mr. Albright to be admitted as part of the record.

Mr. COSTELLO. Mr. Chairman, I object, and if we, in fact, follow this course and accept the testimony, we are sending a message to the Administration and to the Department of Energy and for that matter, other departments that this subcommittee has jurisdiction over that they can set the rules, and if they do not like the policy set by this committee, they just simply do not have to come over and testify. They can submit their written testimony and set policy for this committee.

We, you know, we can continue this all morning if you would like, but the fact is I think we are setting a terrible precedent here.

I think as I said earlier, all Members of this subcommittee on both sides of the aisle should be highly offended that the Administration has decided that they will come before this subcommittee only when they set the policy and under the conditions that they like.

So with that, Mr. Chairman, I object.

Chairman LAMPSON. And the objection is noted.

Mr. INGLIS. I request a vote to the objection notwithstanding to proceed with putting it in the record.

Mr. MCNERNEY. Mr. Chairman, before the vote I would like to ask a question of the Ranking Member.

Chairman LAMPSON. Hold on one second.

Mr. INGLIS. Mr. Chairman, I am not sure it is debatable at this point. I think we ought to proceed to a vote.

Chairman LAMPSON. Mr. McNerney.

Mr. MCNERNEY. Thank you, Mr. Chairman. The Ranking Member said the DOE has never presented in a panel with other experts.

Chairman LAMPSON. Hold on one second, please. I have to do something slightly differently than that. I have to say that it is my prerogative, I believe, to allow this testimony to go into the record or not, and I am choosing to not allow that testimony.

And at this point in time you may appeal that decision.

Mr. INGLIS. And so I appeal the ruling of the Chair, Mr. Chairman.

Chairman LAMPSON. Further proceedings on this will be postponed to the call of the Chair.

Recess for 15 minutes as of now.

[Recess.]

Chairman LAMPSON. Okay, our meeting is back in session. I would recognize Mr. Costello for five minutes.

Mr. COSTELLO. Mr. Chairman, thank you. Mr. Chairman, as you know, we have been talking to the Minority on this issue. I would be willing to withdraw my objection if the Minority will agree that we will not accept the testimony of the Administration in the future in lieu of an Administration witness appearing before the Committee to offer testimony, unless there is unanimous consent to do so.

I yield to the Ranking Member for his comment.

Mr. INGLIS. I thank the gentleman from Illinois' suggestion. I think it is a good suggestion. I agree with him that it should not be a precedent that we allow Administration officials to duck hearings and submit written testimony. So I appreciate his offer and am happy to accept it.

Mr. COSTELLO. I thank the gentleman, and at this time I withdraw my objection.

Chairman LAMPSON. The objection is withdrawn, and I ask Mr. Inglis to continue with his opening statement.

Mr. INGLIS. So, thank you, Mr. Chairman, and we have achieved post-partisanship here. See, we have worked together cooperatively, and the nice thing about this committee is even though we have differences of opinion that arise from where you sit determines where you stand and all that, still there is no personal acrimony, and I very much appreciate that in the Chairman and the gentleman from Illinois, my friends whom I am happy to work

with. And so thank you for the cooperative spirit we just saw in working through that.

Mr. Chairman, thank you for holding this hearing, and I want to thank our witnesses from the Department of Energy and the Government Accountability Office and the American Physical Society for appearing here today to discuss vital research and development projects and the funding for those.

After looking over the Administration's fiscal year 2009 DOE budget proposal, I find myself in agreement with the two points that Dr. Beinenstock made in his submitted testimony. One, that the fiscal year 2008 Omnibus significantly damaged DOE funding, and DOE is now scrambling to recover, and two, it is not a good idea to cut off funding for the Office of Energy Efficiency and Renewable Energy.

Mr. Gaffigan from GAO will tell us that our investments in alternatives to oil are nowhere near what they were following the energy crisis in the 1970s. I wonder if that is because we don't believe we are coming up on an energy crisis of our own in this century, or if it is just that we are ignoring it? I am disappointed that this budget proposal cuts away at hydrogen, solar, and nuclear energy alternatives that can create new industry, new jobs, and a better climate.

Last year about this time I asked Andy Karsner for assurance that the final year of the President's Hydrogen Fuel Initiative did not mark the end of our commitment to hydrogen research and development. Mr. Karsner assured me that while the Hydrogen Fuel Initiative was coming to a close, it did not mark "the end of the Hydrogen Program and its robust future that DOE expects to continue growing to meet its technological readiness milestones which are necessary over the next decade." Today DOE would suggest that we cut $64.9 million from the Hydrogen Program.

Such a reduction would suspend applied research on renewable hydrogen and delay the advent of a hydrogen future. If enacted, this funding decrease would mean closure of laboratories dedicated to renewable hydrogen projects and a subsequent loss in the valuable momentum and research.

The Department of Energy can help lead this country to energy security. American ingenuity, venture capitalists, and industry are ready to join in this effort. I hope we can find agreement that breaking free of oil requires great goals and great commitments. This budget should embody those goals and empower those commitments.

Thank you, Mr. Chairman. I yield back.

Chairman LAMPSON. Thank you, Mr. Inglis. I ask unanimous consent that all additional opening statements submitted by the Subcommittee Members be included in the record.

Without objection, so ordered.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Mr. Chairman, thank you for overseeing this budget hearing today. I appreciate the opportunity to take a closer look at the Department of Energy's (DOE) budget request for fiscal year 2009 and also to discuss the FutureGen project, a prototypical clean coal research project five years in the making which was recently scrapped by DOE.

I've been very clear that I think the decision by DOE to back out of the agreement to build the FutureGen project in Mattoon, Illinois was about politics. It is hard for me to believe that the Administration would have pulled the plug on the project had the Alliance decided to build the plant in Texas. Until just weeks before announcing their decision, Secretary Bodman stated that they were "diligently working to complete the process and issue the Record of Decision." Although I have heard DOE's reasoning behind the changes to the project, I don't believe any of the problems were insurmountable, nor do I believe the newly proposed project is any better than FutureGen as originally envisioned.

What I do know, Mr. Chairman, is that none of the reasons previously stated by officials at DOE for scrapping FutureGen in Mattoon warranted the inevitable lengthy delays that this decision will cause to carbon capture sequestration technology research and development. After the President announced this clean coal initiative at the State of the Union in 2003, after five years of work, coalition building and negotiation, and after more than ten million dollars of taxpayer money spent, it's absolutely baffling that a decision as short-sighted as this was made.

Finally, I'm afraid that in addition to "re-scoping" the FutureGen project and delaying the development of this critical technology, this decision has sent a terrible signal to our private sector partners to not invest in coal technology and not to trust the Federal Government. I firmly believe that a significant investment by the Federal Government to fully develop clean coal technologies. DOE's decision to cancel this project and start again at square one is a huge disappointment and represents irresponsible government. At a time when we are spending close to a trillion dollars in Iraq, certainly we can afford to invest in our energy future. Waiting three years will not make this project any cheaper and does not get us any closer to fully developing coal as an energy resource. This decision says to all those who have invested in this project-to the people of Mattoon, to the FutureGen Alliance of energy companies and to countless others that the government can walk away from a project whenever it wants.

Thank you, again, Mr. Chairman, for the opportunity to discuss the DOE budget. I am committed to advancing clean coal technology, I believe that developing our domestic coal reserves to use coal cleanly and efficiently should be an essential part of this nation's energy policy. I look forward to hearing from our panelists on this matter.

[The prepared statement of Mr. Bartlett follows:]

PREPARED STATEMENT OF REPRESENTATIVE ROSCOE G. BARTLETT

In order for the United States to expand the use of commercial nuclear power, an expansion which I strongly support, it will be necessary to increase the number of trained and certified nuclear engineers and technicians. That is why I was extremely disappointed when the Department of Energy chose two years ago to propose termination of the existing University program within the Office of Nuclear Energy. While the Department continued providing applied R&D funding to universities through its GNEP program, the lack of basic stewardship support and organizational accountability has had a tangibly negative impact on nuclear engineering programs and research reactors around the United States, including at the University of Maryland, College Park.

In its FY 2009 budget submission, the Department has apparently rethought the need to be a steward of the U.S. University-based nuclear education enterprise. The FY 2009 budget again recommends elimination of funding for the University Reactor Infrastructure and Education Assistance program. However, it also includes directions to the Office of Nuclear Energy, through its Energy Research Initiative process, to designate at least 20 percent of the R&D appropriated funds for purposes of supporting R&D activities at university research institutions through competitive awards focused on advancing nuclear energy technology.

The budget justifications also highlight the Department's intention to support investigator-initiated basic research, fellowships and young faculty awards, and infrastructure and equipment upgrades for University-based research reactors and laboratories.

Who within the Office of Nuclear Energy will be responsible for management of DOE-funded R&D activities at university research institutions?

How does the Department intend to allocate these funds?

Will there be University-specific solicitations?

Will these solicitations be peer-reviewed?

How much of the 20 percent will be dedicated to mission-specific applied R&D?

I look forward to receiving answers to these questions from the Department of Energy.

Chairman LAMPSON. It is my pleasure to introduce our witnesses this morning. Our first witness is Mr. Steve Isakowitz, the Chief Financial Officer of the Department of Energy, Mr. Mark E. Gaffigan is the Acting Director of the Natural Resources and Environment Team for the U.S. Government and Accountability Office, and Dr. Arthur Bienenstock is the President of the American Physical Society and Professor at Stanford Synchrotron Radiation Laboratory and in the Departments of Applied Physics and Materials Science and Engineering at Stanford University.

You will each have five minutes for your spoken testimony.

Mr. Gaffigan and Dr. Bienenstock, your written testimony will be included in the record for the hearing, and when you are all complete with your testimony, we will begin with questions. Each Member will have five minutes to question the panel.

Mr. Isakowitz, please begin.

STATEMENT OF MR. STEVE ISAKOWITZ, CHIEF FINANCIAL OFFICER, DEPARTMENT OF ENERGY

Mr. ISAKOWITZ. Mr. Chairman, Congressman Inglis, Members of the Committee—Subcommittee, thank you for giving me the opportunity to appear before you to discuss the Department of Energy's budget request for 2009.

I think it is safe to say that the goals of the Fiscal Year 2009 budget are largely unchanged from our budget goals in previous years. This budget request provides us the resources needed to continue to move forward on our five central missions.

First, promoting and enhancing energy security. Second, nuclear security. Third, the scientific discovery and innovation, fourth, environmental responsibility, and fifth, management excellence.

Since 2001, this Administration and Congress have invested more than $180 billion in the Department of Energy and its programs. These investments have been used to address the growing demand for affordable, clean, and reliable energy, have helped safeguard our national security, and have enabled scientific research, leading to significant improvements in the quality of life and health of the American people and our environment.

The Department's fiscal year 2009 request in the amount of 25 billion was developed with the need to continue these activities in mind and to address the energy challenges that confront us daily.

An investment of this size allows us to fulfill our central missions as well as advance the goals of the President's American Competitive—Competitiveness Initiative to ensure the U.S. technological competitiveness and economic security.

It also allows us to continue our progress towards the goals of the President's Advanced Energy Initiative, accelerating the research, development, and deployment of clean, alternative energy technologies.

The Department of Energy is responsible for promoting America's energy security. We encourage the development of reliable, clean, and affordable energy supplies, as well as strengthening U.S. competitiveness by leading in innovation and scientific discovery. At the same time we continue to ensure the security of the nuclear

stockpile, and we reclaim and restore the sites that are the Nation's environmental legacy. All this is done under the rubric of sound management, consistent with the President's management agenda to improve performance and accountability.

But this budget request also reflects our concerns about America's energy future. The projected growth in global energy demand is a major challenge for us all. It is a challenge that must be met with responsible action. Global demand will continue to grow. We cannot depend solely on hydrocarbons to meet it. This is a problem for all nations, energy producers, and consumers alike.

I believe, therefore, that it is vital that the United States pursue policies that enhance global energy security, not just our own. We need new energy options, cleaner, more efficient technologies, and alternative fuels, and we must support fully the research and innovation necessary for their development. We must diversify our energy supplies, diversify our energy suppliers, and establish and secure additional energy supply routes.

This budget document should also be viewed as a roadmap showing the future course of America's energy security. This course will not, in my judgment, be an easy one, but it is necessary. These efforts will require a sustained commitment on the part of Government, strong private sector investment, and strategic collaborations between the Government, the private sector, and the research community, including academia. Our goal is to foster continued economic growth and promote a sustainable energy future.

Mr. Chairman, this concludes my statement, and I am pleased to answer any questions you or the other Members of the Subcommittee may have about the Department's budget request.

Chairman LAMPSON. Thank you, Mr. Isakowitz.

Mr. Gaffigan, you are recognized.

STATEMENT OF MR. MARK E. GAFFIGAN, ACTING DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT TEAM, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. GAFFIGAN. Thank you, Mr. Chairman. Mr. Chairman and Members of the Subcommittee, I am pleased to be here to discuss long-term trends in DOE's energy R&D funding and key barriers to the development and deployment of advanced energy technologies. These issues are of critical importance as the Nation strives to meet its energy needs.

Today, the United States is heavily reliant upon conventional fossil fuels with oil, natural gas, and coal providing most of our energy. Fossil fuels have provided the benefits of relatively cheap and plentiful energy and great economies of scale from a fossil fuel-based infrastructure.

However, this is a dual-edged sword, as the lack of diversification in our energy portfolio does not easily provide alternatives when concerns about the cost and supply of fossil fuels rear their ugly head.

Well, after a relative lull in these concerns since the price spikes and shortages of the 1970s and early '80s, these concerns are back, bigger than ever. Fossil fuel prices have risen, and a continued reliance on these finite resources, in particular foreign oil, has raised concerns about supply.

However, adding to the mix of these renewed price and supply concerns is a relatively new and sustained concern about the environmental costs of fossil fuels. In particular, the combustion of fossil fuels that account for significant amounts of greenhouse gas emissions.

Advanced energy technologies offer the promise of alternatives to our current energy portfolio. DOE has funded research and development in advanced renewable, fossil, and nuclear energy technology since the 1970s.

Today I would like to address two issues. One, the trend in DOE energy R&D funding, and two, the key challenges to develop and deploy advanced energy technologies.

First, as the chart to my right shows, the trend in DOE energy R&D funding over the past 30 years has been a story of steep decline, followed by slight recovery. In today's dollars DOE energy R&D funding for advanced technologies in renewable, fossil, and nuclear energy peaked 30 years ago at $6 billion, falling 92 percent in 20 years to about a half billion dollars before a rebound over the last 10 years to about $1.4 billion in 2008.

However, funding today still has not reached a quarter of its peak of 30 years ago. DOE's fiscal year 2009 budget for this R&D is about $1.8 billion. In addition, DOE's Office of Science has requested $4.7 billion, primarily for fundamental research in such areas as basic energy sciences, high energy physics, and fusion energy. Some aspects of this basic research for things like material sciences may have useful applications for advanced energy technologies.

Regarding advanced energy technologies, the development and deployment of these technologies present key technical costs and environmental challenges. For renewable energy, a key challenge is to make these technologies cost competitive. For fossil energy, a key challenge is to address the environmental impacts of emissions, in particular the carbon dioxide and mercury emissions of coal plants. Nuclear energy faces key challenges in addressing its high capital costs and environmental concerns about minimizing and managing nuclear wastes.

However, while DOE has spent about $57 billion over the past 30 years for R&D and these technologies, the Nation's energy portfolio has not dramatically changed. As the second pie chart shows here to my right, conventional fossil energy in 1973 provided 93 percent of our needs, yet 30 plus years later it still provides 85 percent of our energy.

It is clear that DOE energy R&D funding alone will not be enough to deploy advanced energy technologies. Thus, coordinating DOE energy R&D with other federal energy R&D programs and policies, incentives, standards, and mandates will be important. In addition, other governments at the local, State, and foreign levels, and the worldwide private sector will play key roles.

To put all this in some perspective, one energy consulting firm recently estimated that worldwide clean energy investment could surpass $7 trillion by 2030. That is 122 times the $57 billion DOE has spent in the last 30 years. As the Nation goes forward, it will be important for DOE energy R&D to find its niche amidst all these players and activities. Given the limited research dollars

available to DOE, in the fiscal environment of a nation with a $9 trillion debt, it is important to make these dollars count. These dollars can count the most by targeting them towards specific and measurable goals with a clear federal role and benefits that make advanced energy technologies cost competitive and environmentally sound so that their deployment will be sustainable in the marketplace.

Mr. Chairman, this concludes my opening remarks. I have submitted a written statement for the record, and I welcome any questions you might have. Thank you.

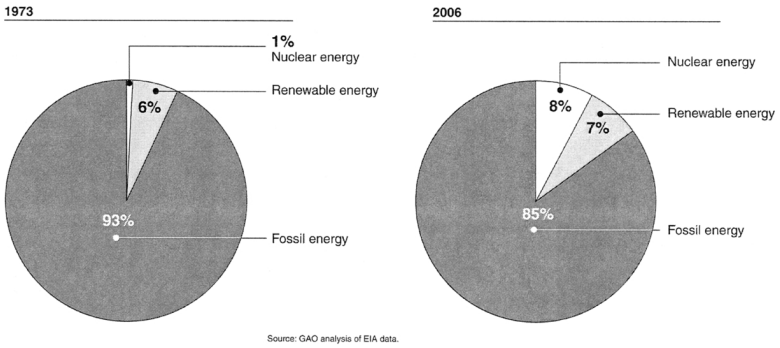
[The prepared statement of Mr. Gaffigan follows:]

PREPARED STATEMENT OF MARK E. GAFFIGAN

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the challenges that our nation faces in meeting its future energy needs. The United States has primarily relied on market forces to determine its energy portfolio. The market has generally succeeded in providing us with plentiful, reliable, and inexpensive conventional fossil fuels—oil, natural gas, and coal—to power our vehicles and run our homes and businesses. However, as shown in Figure 1, the Nation's energy portfolio today has not dramatically changed since 1973. In 2006, fossil fuels accounted for 85 percent of the Nation's energy supply as compared with 93 percent in 1973—the primary difference in the portfolio was the growth of nuclear power in the 1970s and 1980s. Oil continues to account for 97 percent of the energy consumed for transportation and fossil fuels continue to generate 71 percent of the Nation's electricity; renewable energy grew slightly during this period to seven percent of U.S. energy consumption.

Figure 1: Comparison of the U.S. Energy Portfolio in 1973 and 2006



While conventional fossil fuels have provided us with relatively inexpensive and plentiful energy, they present economic and national security risks and have adverse health and environmental impacts. For example, about two-thirds of the oil we consume is imported, and supply constrictions have contributed to major energy price shocks several times since 1973. More recently, decreased domestic production and increased world consumption of oil have pushed prices upward, nearly doubling the amount American consumers have paid for oil in just the past three years. In addition, DOE projects that U.S. transportation demand will increase by 31 percent and U.S. electricity demand will increase by 35 percent by 2030. Furthermore, emissions from the conventional burning of fossil fuels have contributed to health problems—about 50 percent of Americans live in areas where levels of one or more air pollutants are high enough to affect public health. Also, the combustion of fossil fuels account for most of the greenhouse gas emissions—particularly carbon dioxide—that have been linked to global warming.

Since its inception in 1977, the Department of Energy (DOE) has had leadership responsibility for energy research, development, and demonstration (R&D) to deploy

advanced renewable, fossil, and nuclear technologies. DOE's energy R&D goal is to develop technologies for meeting future energy demands, addressing health and environmental issues, and diversifying the Nation's energy portfolio.[1] During the past 30 years, DOE has spent about $57.5 billion for R&D in renewable, fossil, and nuclear technologies. In addition, DOE's Office of Science has spent about $34.3 billion from fiscal year 2000 through fiscal year 2008 on related basic energy research in such areas as high energy and nuclear physics, basic energy sciences, and fusion energy.

DOE's fiscal year 2009 budget requests $1.8 billion for renewable, fossil, and nuclear energy R&D and $4.7 billion for the Office of Science. In addition, several other federal agencies perform R&D to develop advanced energy technologies. For example, the Department of Agriculture funds R&D on ethanol and biodiesel production and energy crops that maximize ethanol production. The Department of Defense is the Nation's largest consumer of transportation fuels, spending $13.6 billion on energy in fiscal year 2006. The Department of Defense is conducting R&D—some of it in collaboration with DOE—to develop alternative fuels to displace oil. One Air Force program has already certified a new fuel for the B–52 bomber, a 50/50 blend of the standard oil-based JP–8 jet fuel and a new synthetic fuel currently derived from natural gas that may be derived from biomass in the future.

In addition to R&D funding, the Federal Government can attempt to tap the vast resources of the private sector through tax incentives, such as tax credits to companies that make certain types of energy investments. These tax preferences—which are legally known as tax expenditures—result in forgone revenue for the Federal Government. The revenue losses can be viewed as spending channeled through the tax system. The Federal Government provides the energy industry and consumers with 20 tax expenditures affecting energy supply, totaling $6.3 billion in fiscal year 2007 and $4.9 billion in fiscal year 2008.[2] While the tax subsidies were historically directed toward the conventional energy sector, they have also been directed toward stimulating the deployment of advanced energy technologies.[3] For example, the *Energy Policy Act of 2005* provided a (1) two-year extension of the production tax credit for renewable technologies, (2) new investment tax credit of up to $1.3 billion for constructing new clean-coal power plants, and (3) new production tax credit of 1.8 cents per kilowatt-hour for up to 6,000 megawatts of new nuclear power capacity lasting eight years after each qualifying nuclear reactor begins service. The *Energy Policy Act of 2005* also authorized DOE to implement a new loan guarantee program for energy projects that decrease air pollutants or greenhouse gases, employ new or significantly improved technologies, and have a reasonable prospect of repayment. In February 2007, the Congress authorized DOE to guarantee loans of up to $4 billion.[4] In December 2007, the Congress directed DOE to make loan guarantees of up to $38.5 billion in fiscal years 2008 and 2009.[5]

Moreover, the Federal Government can enact standards and mandates that could impact the Nation's energy portfolio. For example, the Federal Government has recently revised the renewable fuels standards to require the use of 36 billion gallons of biofuels by 2022.[6] For electricity, the Congress has considered renewable portfolio standards that require a percentage of electricity be generated from renewable sources. Consideration has also been given to either a carbon tax or a carbon cap and trade program to reduce the environmental impact of carbon emissions and to better enable the market to compare total costs of conventional fossil energy sources with advanced energy technologies. Many states and foreign governments have enacted energy portfolio standards, mandates, and financial incentives to stimulate the deployment of renewable energy technologies that address their growing energy needs and environmental concerns. In particular, 29 states have established renewable portfolio standards requiring or encouraging that a fixed percentage of the state's electricity be generated from renewable sources. For example, in response to the Texas renewable portfolio standard's requirement that 5,880 megawatts of renewable capacity be installed by 2015, electric power companies had installed over 1,900 megawatts of new renewable capacity by September 2006—about three per-

[1] DOE is also responsible for energy efficiency programs, which are integral to addressing future energy challenges by reducing demand.

[2] Summing of tax expenditure estimates does not take into account interactions between individual provisions.

[3] The alternative fuels production credit, the largest energy-related tax credit, is a tax credit of $3 per oil equivalent barrel (in 1979 dollars) for gas produced from biomass or synthetic fuels produced from coal.

[4] See Pub. L. No. 110–5 (2007).

[5] This direction appears in an explanatory statement to Pub. L. No. 110–161 (2007), published by the House of Representatives.

[6] Pub. L. No. 110–140 (2007).

cent of Texas' total electricity consumption. Similarly, to develop a sustainable energy supply and protect the environment, Germany established a goal to increase the share of renewable energy consumption to at least 4.2 percent of its total energy requirements by 2010 and 10 percent by 2020.

Within this broader context, I will discuss today (1) funding trends for DOE's renewable, fossil, and nuclear energy R&D programs and its Office of Science and (2) key challenges in developing and deploying advanced energy technologies. My remarks are primarily based on our December 2006 report on key challenges to developing and deploying advanced technologies for using renewable, fossil, and nuclear energy.[7] I will also highlight findings from our recent reports on DOE's R&D for oil and natural gas and the Hydrogen Fuel Initiative.[8] We conducted our work for these reports from October 2005 through December 2007 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In summary, DOE's budget authority for renewable, fossil, and nuclear energy R&D dropped by 92 percent (in inflation-adjusted terms) between fiscal years 1978 and 1998 before bouncing back in part during the past 10 years. Specifically, DOE's budget authority for renewable, fossil, and nuclear energy R&D of about $6 billion was near its high point in fiscal year 1978, when the Nation faced severe energy crises. DOE's budget authority subsequently declined in the 1980s and 1990s as energy prices returned to historical levels reaching its lowest level in fiscal year 1998 at $505 million (in inflation-adjusted terms). Since then, DOE's budget authority for renewable, fossil, and nuclear energy R&D has increased to $1.4 billion in fiscal year 2008. The Office of Science's budget authority also grew by 16 percent from fiscal year 2000 through fiscal year 2008.

Further development and deployment of advanced renewable, fossil and nuclear energy technologies faces three key challenges. First, there are technology-specific challenges. For example, high-wind sites have generally been developed using current wind turbine technology. To further expand the use of wind energy, DOE is working with industry to develop new wind turbine designs and materials that exploit low-wind and offshore sites. Second, there are cost challenges. These advanced energy technologies often face high up-front capital costs and the need to improve operating efficiency so they can better compete with conventional energy technologies. The nuclear industry, for example, projects that new nuclear power plants will likely cost between $4 billion and $6 billion each, about twice the cost of comparable conventional coal power plants. Finally, these technologies face challenges in addressing emerging concerns related to public health and the environment. For example, DOE is working with electric power companies to demonstrate coal gasification and carbon sequestration technologies designed to enable coal plants to reduce carbon dioxide and mercury emissions.

DOE's Budget Authority for Renewable, Fossil, and Nuclear Energy R&D Has Substantially Declined in Real Terms Since 1978

DOE's budget authority for renewable, fossil, and nuclear energy R&D dropped by 92 percent (in inflation-adjusted terms) from $6 billion (in inflation-adjusted terms) in fiscal year 1978 to $505 million in fiscal year 1998 before bouncing back to $1.4 billion in fiscal year 2008. As shown in Figure 2, R&D budget authority in renewable, fossil, and nuclear energy peaked in the late 1970s and fell sharply in the 1980s. Since fiscal year 1998, R&D budget authority for renewable and nuclear energy R&D have grown, while fossil energy R&D funding has fluctuated in response to coal program initiatives.

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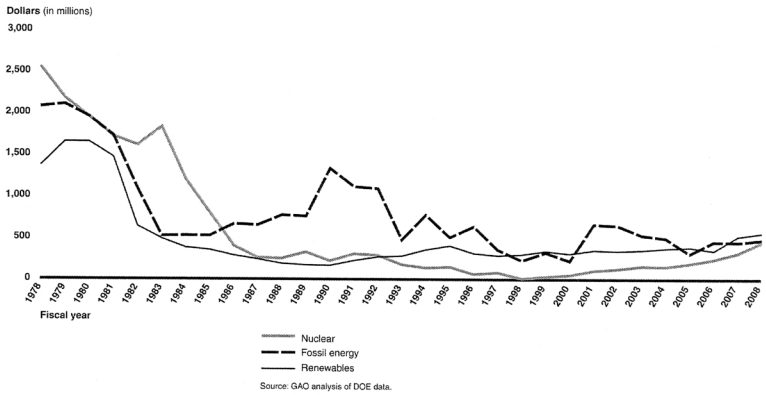
[7] GAO, *Department of Energy: Key Challenges Remain for Developing and Deploying Advanced Energy Technologies to Meet Future Needs,* GAO–07–106, (Washington, D.C.: Dec. 20, 2006).

[8] GAO, *Department of Energy: Oil and Natural Gas Research and Development Activities,* GAO–08–190R, (Washington, D.C.: Nov. 6, 2007) and GAO, *Hydrogen Fuel Initiative: DOE Has Made Important Progress and Involved Stakeholders but Needs to Update What It Expects to Achieve by Its 2015 Target,* GAO–08–305, (Washington, D.C.: Jan. 11, 2008).

Figure 2: DOE's Budget Authority for Renewable, Fossil, and Nuclear R&D, Fiscal Years 1978-2008



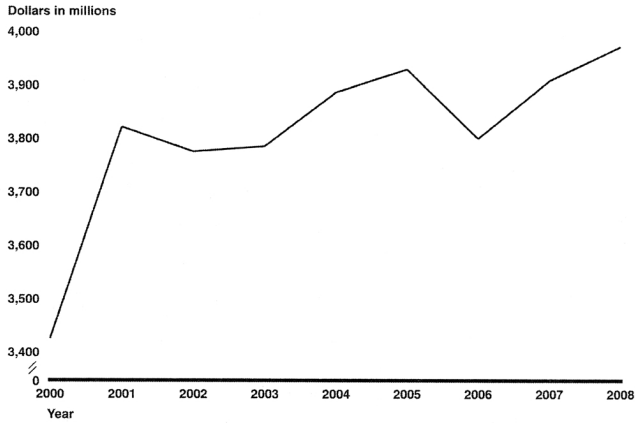
Source: DOE.

Note: Budget authority is in real terms, adjusted to fiscal year 2008 dollars to account for inflation. The budget data focuses on development of advanced energy technologies and excludes such R&D areas as Vehicle Technologies because its focus is improving the energy efficiency of vehicles.

Nuclear energy R&D, which received no funding in fiscal year 1998, experienced the largest increase, rising to $438 million in fiscal year 2008. During this period, budget authority for renewable energy increased by 89 percent and fossil energy increased by 116 percent. A comparison of DOE's fiscal year 2009 budget request with the fiscal year 2008 appropriation shows that renewable energy R&D would decline slightly, while fossil energy R&D and nuclear energy R&D would increase by 34 percent and 44 percent, respectively (see App. 1).

As shown in Figure 3, budget authority for the Office of Science increased by 16 percent from $3.4 billion in fiscal year 2000 to $4 billion in fiscal year 2008. The budget request for the Office of Science for fiscal year 2009 is $4.7 billion, a 19-percent increase over the fiscal year 2008 appropriation. Because the Office of Science funds basic research in materials sciences, for example, many of its R&D programs may have useful applications for energy R&D. In fiscal year 2009, the Office of Science has requested $69.1 million for research related to the solar energy R&D program, $42.9 million related to biomass R&D, and $60.4 million for the Hydrogen Fuel Initiative. The Office of Science also funds fundamental research in such areas as high energy physics, nuclear physics, and fusion energy.

Figure 3: DOE's Budget Authority for Office of Science, Fiscal Years 2000-2008



Source: GAO.

Note: Budget authority is in real terms, adjusted to fiscal year 2008 dollars to account for inflation.

DOE Faces Key Challenges in Developing Advanced Energy Technologies for Deployment

There are key technical, cost, and environmental challenges in developing advanced renewable, fossil, and nuclear energy technologies to address future energy challenges.

DOE's R&D Challenges for Advanced Renewable Energy Technologies

DOE's recent R&D focus in renewable energy has been in (1) biomass-derived ethanol, (2) hydrogen-powered fuel cells, (3) wind technologies, and (4) solar technologies. The primary focus of ethanol and hydrogen R&D is to displace oil in the transportation sector. The primary focus of wind and solar technologies is to generate electricity. DOE also conducts R&D on geothermal and hydropower to generate electricity, but they have reflected a small proportion of the R&D budget in prior years and are not discussed here.

Biomass-derived ethanol. DOE's short-term R&D goal is to help meet the administration's "20 in 10" goal of substituting 20 percent of gasoline consumption in 10 years with alternative fuels, primarily biomass-derived ethanol. DOE's longer-term R&D goal is to develop new technologies to allow the ethanol industry to expand enough to displace 30 percent of gasoline requirements—about 60 billion gallons—by 2030. In 2007, industry produced over seven billion gallons of ethanol, displacing about three percent of the Nation's oil consumption.[9] Ethanol, however, faces high production and infrastructure costs, creating challenges in competing with gasoline nationally.[10] Ethanol refiners in the United States rely mostly on corn as a feedstock, the use of which has contributed to price increases for some food products, and ethanol's corrosive properties create challenges in developing an infrastructure for delivering and dispensing it. DOE's R&D focuses on (1) developing a more sustainable and competitive feedstock than corn, primarily by exploring technologies to use cellulosic biomass from, for example, agricultural residues or fast-growing grasses and trees; (2) reducing the cost of producing cellulosic ethanol to $1.33 per gallon by 2012 and $1.20 per gallon by 2017; (3) converting biomass to biofuels through both biochemical and thermochemical processes to help the industry expand; (4) contributing to a strategy to develop a national biofuels infrastructure, in-

[9] Biodiesel, electricity from batteries, and other technologies also contribute to the displacement of oil. DOE's R&D efforts also include, among other things, liquid fuels from biomass and plug-in hybrid vehicles.

[1] See GAO, *Biofuels: DOE Lacks a Strategic Approach to Coordinate Increasing Production with Infrastructure Development and Vehicle Needs,* GAO–07–713, (Washington, D.C.: June 8, 2007).

cluding demonstration projects for integrated biorefineries to develop multiple biomass-related products; and (5) promoting market-oriented activities to accelerate the deployment of biomass technologies. Although DOE has made progress in reducing ethanol production costs, cellulosic ethanol in 2007-based on current corn prices-still cost about 50 percent more to produce than corn ethanol.

Hydrogen-powered fuel cells. The long-term R&D goal of DOE's Hydrogen Fuel Initiative is to provide hydrogen fuel cell technologies to industry by 2015 to enable industry to commercialize them by 2020. To be commercialized, hydrogen fuel cell technologies must be competitive with gasoline vehicles in terms of price, convenience, safety, and durability. Hydrogen is the preferred fuel for vehicle fuel cells because of the ease with which it can be converted to electricity and its ability to combine with oxygen to emit only water and heat as byproducts. Let me clarify, however, that hydrogen is not an energy source, but, like electricity, is an energy carrier. Furthermore, because hydrogen is lighter than air, it does not exist on Earth and must be extracted from common compounds. Producing hydrogen through the extraction process requires energy from renewable, fossil, or nuclear sources, adding to the challenge of developing hydrogen technologies. Our January 2008 report concluded that DOE has made important progress in developing hydrogen fuel cells, but the program has set very ambitious targets and some of the most difficult technical challenges—those that require significant scientific advances—lie ahead. Specifically, R&D for vehicles includes reducing the cost of commercial-scale manufacturing of fuel cells by nearly fourfold, storing enough hydrogen on board a fuel-cell vehicle to enable a 300-mile driving range, and increasing the durability of fuel cells by more than threefold to match the 150,000 mile life-span of gasoline vehicles. DOE also conducts R&D on stationary and portable fuel cells which could be used, for example, to replace batteries on fork lifts and diesel generators used for back-up power. We recommended that DOE update its overarching R&D plan to reflect the technologies it reasonably expects to provide to industry by 2015 to accurately reflect progress made by the Hydrogen Fuel Initiative, the challenges it faces, and its anticipated R&D funding needs. I would also note that developing the supporting infrastructure to deploy the technologies nationally will likely take decades, tens of billions of dollars in investments, and continued R&D well beyond the 2015 target date.

DOE's fiscal year 2009 budget request would reduce funding for the Hydrogen Fuel Initiative by 17 percent from $283.5 million in fiscal year 2008 to $236 million in fiscal year 2009. The budget also proposes to increase the proportion of longer-term R&D by increasing the funding for basic research. Although the Hydrogen Program Manager told us that funding is sufficient to meet target dates for critical technologies, other target dates for supporting technologies—such as hydrogen production from renewable sources—would be pushed back.

Wind technologies. DOE is assessing its long-term vision of generating 20 percent of the Nation's electricity using wind energy by 2030. Its current R&D efforts, however, are focused on more immediate expansion of the wind industry, particularly on utility-scale wind turbines. More specifically, DOE has focused its R&D efforts on improving the cost, performance, and reliability of large scale, land-based wind turbines, including both high- and low-wind technologies; developing small and mid-size turbines for distributed energy applications, such as for residential or remote agricultural uses; and gathering information on more efficient uses of the electricity grid and on barriers to deploying wind technology and providing that information to key national, State, and local decision-makers to assist with market expansion of wind technologies.[11] For example, one of DOE's targets is to increase the number of distributed wind turbines deployed in the United States from 2,400 in 2007 to 12,000 in 2015. Although wind energy has grown in recent years, from about 1,800 megawatts in 1996 to over 16,800 megawatts in 2007, the wind industry still faces investors' concerns about high up-front capital costs, including connecting the wind farms to the power transmission grid.

Solar technologies. DOE's R&D goal is for solar power to be unsubsidized and cost competitive with conventional technologies by 2015 by, for example, developing new thin-film photovoltaic technologies using less expensive semiconductor material than crystalline-silicon to reduce the manufacturing cost of solar cells. Specifically, DOE is working to reduce the costs of photovoltaic systems from about 18–23 cents per kilowatt hour in 2005 to about 5–10 cents per kilowatt hour in 2015. DOE is also conducting R&D to reduce the cost and improve the reliability of concentrating solar power technologies, which use various mirror configurations to convert the sun's energy to heat to generate electricity. In addition, DOE has expanded R&D to address low-cost thermal storage to allow solar thermal systems to be more valuable to util-

[11] DOE continues to perform R&D on offshore wind technologies as well.

ity grid power markets. Along these lines, both the photovoltaic and concentrated solar power activities have ramped up efforts in the areas of grid integration and reliability to facilitate the transition to larger scale, centralized solar electric power plants. Investors' concerns about high up-front capital costs are among the most significant challenges in deploying photovoltaic or concentrating solar energy technologies. This requires both technologies to have lower costs for installation and operations and maintenance, better efficiency of converting solar power to electricity, and longer-term (20 to 30 years) durability.

DOE's R&D Challenges for Advanced Fossil Energy Technologies

Since fiscal year 2006, DOE has proposed eliminating its R&D in oil and natural gas R&D and, in January 2008, announced a restructuring of its coal R&D program.

Increased oil production. Since fiscal year 2006, DOE has proposed to terminate its oil R&D. In November 2007, we reported that DOE's R&D focuses on increasing domestic production primarily by improving exploration technologies, extending the life of current oil reservoirs, developing drilling technology to tap into deep oil deposits, and addressing environmental protection. DOE officials stated that if the oil R&D program continues, it would focus on such areas as enhanced oil recovery technologies and expanding production from independent producers. Independent producers account for about 68 percent of domestic oil production.

Natural gas technologies. Since fiscal year 2006, DOE has proposed to terminate its natural gas R&D. Our November 2007 report noted that DOE's R&D focuses on improving exploration technologies, reducing the environmental impact of natural gas operations, developing drilling technology to tap into deep gas reservoirs, and developing the technology for tapping into natural gas in naturally occurring methane hydrate found in permafrost regions on land and beneath the ocean floor.

Clean coal technologies. DOE's R&D goal is to reduce harmful power plant emissions to "near-zero" levels by 2020. For new power plant applications, DOE is developing and demonstrating advanced integrated gasification combined cycle (IGCC) technologies. In 2003, DOE announced plans to construct a near-zero emissions commercial scale R&D facility called FutureGen with an alliance of coal mining and coal-based electric generating companies. DOE had originally pledged about three-quarters of the estimated $1 billion cost of the FutureGen project (in constant fiscal year 2004 dollars). With escalation costs and rising price of materials and labor, the estimated project costs rose to nearly $1.8 billion. As a result, DOE announced in January 2008 that it is restructuring FutureGen to focus on multiple, competitively selected projects that demonstrate carbon capture and sequestration at commercially viable power plant project sites. The impact of DOE's restructuring on FutureGen at this time is not known, but an industry official from the FutureGen Alliance noted that the project cannot go forward without Federal Government assistance. Separate from the FutureGen project, DOE also conducts R&D on near-zero emission power plants—including carbon capture and sequestration—through its fuels and power systems programs and its Clean Coal Power Initiative.

DOE's R&D Challenges for Advanced Nuclear Energy Technologies

DOE has focused nuclear energy R&D in the following three areas:

- The Nuclear Power 2010 program focuses on reducing regulatory and technical barriers to deploying advanced "Generation III" nuclear power reactors, which are designed to be more efficient than currently operating reactors. Because no electric power company has applied to the Nuclear Regulatory Commission for a license to construct a new nuclear reactor in the past 30 years, Nuclear Power 2010 shares the costs with industry of preparing early site permits and or construction and operating license applications for submission to the Nuclear Regulatory Commission. Nuclear Power 2010 also regulates the risk insurance authorized by the Energy Policy Act of 2005 that protects industry from certain regulatory delays during licensing and construction.
- The Global Nuclear Energy Partnership program—an extension of the Advanced Fuel Cycle Initiative—develops proliferation-resistant nuclear fuel that maximizes energy output and minimizes waste. Specifically, the program is designed to reduce the threat of global nuclear proliferation by developing advanced technologies for reprocessing spent nuclear fuel in the 2030 time frame. One of the critical elements of this effort is to develop a sodium-cooled fast reactor designed to burn a wide variety of nuclear fuels to reduce the total amount, temperature, and radiotoxicity of the fuel that might otherwise have to be stored for thousands of years in a repository.
- Beginning in fiscal year 2008, the Generation IV Program is focusing solely on the Next Generation Nuclear Plant (NGNP), designed as a versatile, effi-

cient, high-temperature reactor capable of generating electricity and producing hydrogen. DOE collaborates with 12 other international partners on R&D related to fuels, materials, and design methodologies as part of the Generation IV International Forum.

Concluding Observations

In the current wake of higher energy costs and the growing recognition that fossil energy consumption is contributing to global climate change, the Nation is once again assessing how best to stimulate the deployment of advanced energy technologies. While still considerably below its peak in the late 1970s, DOE's budget authority for renewable, fossil, and nuclear energy R&D has rebounded to $1.4 billion during the past 10 years after hitting a low point in fiscal year 1998. However, despite DOE's energy R&D funding of $57.5 billion over the last 30 years, the Nation's energy portfolio remains heavily reliant on fossil fuels. Many technical, cost and environmental challenges must be overcome in developing and demonstrating advanced technologies before they can be deployed in the U.S. market. Our December 2006 report suggested that the Congress consider further stimulating the development and deployment of a diversified energy portfolio by focusing R&D funding on advanced energy technologies. However, because it is unlikely that DOE's energy R&D funding alone will be sufficient to significantly diversify the Nation's energy portfolio, coordinating energy R&D with other federal programs, policies, incentives, standards, and mandates that can impact the Nation's energy portfolio will be important for targeting any desired goals to change the Nation's energy portfolio. In addition, State and local governments and other nations, along with a worldwide private sector, will play a role in developing and deploying advanced energy technologies both here and throughout the global energy market. A key factor to any sustainable deployment of advanced energy technologies will be to make them cost competitive, while addressing technical and environmental challenges, so that the market can support a more diversified portfolio. Otherwise, without sustained higher energy prices for our current portfolio, or concerted, high-profile Federal Government leadership, U.S. consumers are unlikely to change their energy-use patterns, and the U.S. energy portfolio will not significantly change.

Appendix 1: Comparison of DOE's Fiscal Year 2008 Appropriations with Its Fiscal Year 2009 Budget Request

Millions of dollars

Program	Fiscal year 2008 appropriation	Fiscal year 2009 budget request	Percentage change
Energy Efficiency and Renewable Energy[a]			
Biomass and Biorefinery Systems	$198.2	$225.0	14
Solar	168.5	156.1	(7)
Wind	49.5	52.5	6
Geothermal	19.8	30.0	51
Water Power	9.9	3.0	(70)
Hydrogen Technology (Hydrogen Fuel Initiative)[b]	94.5	66.9	(29)
Subtotal	**$540.4**	**$533.5**	**(1)**
Fossil Energy			
Oil	5.0	0.0	(100)
Natural gas	19.8	0.0	(100)
Coal			
Clean Coal Power Initiative	69.4	85.0	22
FutureGen	74.3	156.0	110
Fuels and Power Systems	324.9	372.7	15
Fuels (Hydrogen Fuel Initiative)[b]	24.8	10.0	(60)
Clean Coal Technology	(58.0)	0	(100)
Cooperative R&D	5.0	0	(100)
Subtotal	**$465.2**	**$623.7**	**34**
Nuclear energy[c]			
Nuclear Power 2010	133.8	241.6	81
Generation IV[d]	114.9	70.0	(39)
Advanced Fuel Cycle Initiative/ Global Nuclear Energy Partnership[d]	179.4	301.5	68
Nuclear Hydrogen Initiative (Hydrogen Fuel Initiative)[b]	9.9	16.6	68
Subtotal	**$438.0**	**$629.7**	**44**
Office of Science			
High energy physics	689.3	805.0	17
Nuclear physics	432.7	510.1	18
Biological and environmental research	544.4	568.5	4

Basic energy sciences	1,269.9	1,568.2	23
Advanced scientific computing research	351.2	368.8	5
Fusion energy sciences program	286.5	493.1	72
Science laboratories infrastructure	66.9	110.3	65
Safeguards and security	75.9	80.6	6
Science program direction	177.8	203.9	15
Workforce development for teachers and scientists	8.0	13.6	70
Congressionally directed projects	123.6	0	(100)
Small business innovation research	0	0	0
Use of prior year balances and other adjustments	(53.2)	0	
Subtotal	**$3,973.0**	**$4,722.1**	**19**
Total	**$5,416.6**	**$6,509.0**	**20**

Source: DOE.

Note: Dollar amounts for the fiscal year 2009 budget request are not adjusted for inflation. Differences may exist due to rounding.

[a]Excludes budget authority for Vehicle Technologies, which includes the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership. The Vehicle Technologies R&D program focuses on improving the energy efficiency of vehicles by developing lightweight materials, advanced batteries, power electronics, and electric motors for hybrid and plug-in hybrid vehicles, and advanced combustion engines and fuels.

[b]The Hydrogen Fuel Initiative is funded separately through DOE's Offices of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy, and Science and the Department of Transportation. In addition to Hydrogen Technology R&D, Energy Efficiency and Renewable Energy funds Fuel Cell Technology R&D, which historically has been an energy efficiency program. The fiscal year 2008 appropriation for Fuel Cell Technology R&D is $116.6 million, and DOE's request for fiscal year 2009 is $79.3 million The Hydrogen Fuel Initiative received a total of $283.5 million in budget authority in fiscal year 2008; the administration is requesting $236 million for the initiative in fiscal year 2009. During fiscal year 2008, Energy Efficiency and Renewable Energy transferred some of the Hydrogen Fuel Initiative activities to its Vehicle Technologies R&D program.

[c]Excludes the Mixed Oxide Fuel Fabrication Facility, which received $278.8 million in fiscal year 2008. DOE is requesting $487 million for fiscal year 2009.

[d]During fiscal year 2008, R&D on the sodium-cooled fast reactor was transferred from the Generation IV program to the Accelerated Fuel Cycle Initiative/Global Nuclear Energy Partnership Program.

Contacts and Acknowledgments

For further information about this testimony, please contact me at *gaffiganm@gao.gov*. Richard Cheston, Robert Sanchez, Kerry Lipsitz, MaryLynn Sergent, and Anne Stevens made key contributions to this statement.

BIOGRAPHY FOR MARK E. GAFFIGAN

Mark Gaffigan is currently serving as an Acting Director for the U.S. Government Accountability Office's (GAO) Natural Resources and Environment team. His current responsibilities include leadership of GAO's work on energy related issues. Mr. Gaffigan began his career with GAO in 1987 and has worked on a variety of reviews of federal programs with an emphasis on budget and program reviews of the U.S. Department of Energy. Mr. Gaffigan earned a BA in Economics and a MA in Public Administration from the University of Illinois. He is also a CPA in the State of Maryland.

Chairman LAMPSON. Thank you, Mr. Gaffigan.

And from Stanford, Dr. Bienenstock.

STATEMENT OF DR. ARTHUR BIENENSTOCK, PRESIDENT, AMERICAN PHYSICAL SOCIETY; SPECIAL ASSISTANT TO THE PRESIDENT FOR FEDERAL RESEARCH POLICY, STANFORD UNIVERSITY; PROFESSOR, STANFORD SYNCHROTRON RADIATION LABORATORY AND DEPARTMENTS OF APPLIED PHYSICS AND MATERIALS SCIENCE AND ENGINEERING

Dr. BIENENSTOCK. Mr. Chairman, Mr. Inglis, Members of the Subcommittee, you have my written testimony. Let me summarize it briefly.

In doing so I will address two issues: the extraordinary damage done by the 2008 Omnibus bill to DOE science, and the balance between DOE's basic research and technology programs.

My one chart, which shows GDP deflated appropriations for the Office of Science, shows that for more than two decades the GDP corrected funding for science has been almost flat for DOE science. However, the deflator for scientific R&D generally runs about one to two percent above the GDP deflator. Using these numbers we estimate that the Office of Science has lost approximately one-third of its budget capacity over the last two decades.

In Fiscal Year 2006 alone the program suffered a real reduction of about 7.5 percent, and to date the programs have not recovered. The '07 and '08 budget requests were designed to address this issue, but the appropriations failed to materialize.

This year the consequences have been enormous. Four of the many major impacts are, first, the budget for the U.S. commitment to ITER was zeroed out, reneging on our commitment to this international project and severely damaging our reputation as an international scientific partner. That will make it much more difficult in future years for us to engage in other international efforts that will become very important as major scientific facilities grow increasingly expensive.

Next is high energy physics. The reduction of R&D funding for the International Linear Collider and the zeroing out of the neutrino project, NOνA make the future of the field very bleak. Five hundred people at Fermilab and the Stanford Linear Accelerator Center (SLAC) are being laid off. An additional 10 percent of Fermilab's staff is being furloughed. The loss of expertise at these labs will hurt science broadly, and the message to any young American scientist is to avoid the field or seek a position elsewhere in the world.

Third is the operation of basic energy sciences user facilities. These facilities support a broad range of scientific and technological research from structural biology to semiconductor processing with users from academic, government, and corporate labs. Even though they are typically doubly oversubscribed when operating at full capacity, they will suffer operating reductions of up to 20 percent. The impact will be felt throughout the U.S. scientific and technological communities.

Finally, the 2008 budget has resulted in the rejection of 700 proposals in energy research the Department had hoped to fund. Scientific advances will be delayed, and there will be significant layoffs of students and post docs in the Nation's universities as a consequence. Young people will turn away from scientific careers just when the Nation needs them.

It is vital that the damage done by the '08 Omnibus bill be reversed, at least partially. I urge you to provide a supplemental appropriation of at least $300 million to the Office of Science and allow it to contribute to ITER.

Now let me turn to the '09 budget request. I strongly support the request and particularly if the supplementary appropriation is provided. With that budget DOE can fund the academic programs, it can operate its facilities full-time, and instrument the magnificent new facilities coming on line.

Second, I believe that the Administration's budget for the energy efficiency and renewable energy account is insufficient, and Congress must rectify it.

However, Congress must not offset the increases to EERE by reductions in funding for the Office of Science. Tempting as it might be to put off for tomorrow the funding of long-term scientific discovery for the sake of achieving short-term technological gains today, we must resist doing so. Otherwise the scientific basis for future technologies will be severely undermined.

Thank you for your attention.

[The prepared statement of Dr. Bienenstock follows:]

PREPARED STATEMENT OF ARTHUR BIENENSTOCK

Mr. Chairman, Mr. Inglis, Members of the Committee, thank you for the opportunity to testify today. I am President of the American Physical Society whose 46,000 members work in academia, industry and national laboratories. At Stanford University I am a special assistant to President John Hennessy for federal research policy, and I have previously served as director of the Stanford Synchrotron Radiation Laboratory, one of four major X-ray user facilities supported by the Department of Energy. As a disclaimer, I need to stress that my testimony today only reflects my opinions, although in many cases they are consistent with positions held by Stanford University and the American Physical Society.

In the limited time I have, I will address two issues: (1) The extraordinary damage done by the Fiscal Year 2008 Omnibus appropriations bill to several DOE Science programs and the consequent need to remedy the damage as soon as possible; and (2) The balance between long-term basic science research and short-term technology programs in the DOE's energy portfolio and how that is reflected in the FY 2009 budget request.

To put the FY 2008 DOE Science appropriation in perspective, I want to call your attention to the historic trend of federal support for the program. As the chart illustrates, for more than two decades, the funding has been almost flat when measured in GDP-deflator corrected dollars.

However, salaries and, at big facilities, electricity bills are prime drivers of the cost of performing research. As a consequence, the GDP-deflator understates the inflation associated with research. In the case of biomedicine, for example, the BIRDPI—officially known as the Biomedical Research and Development Price Index—generally runs about one to two percent above the GDP deflator, according to the Office of Management and Budget, which calculates the index annually. There is no reason to believe that research costs in other science areas behave any differently.

Using these numbers as a guide, we estimate that the DOE Office of Science has lost approximately one third of its budget capacity over the last two decades. In FY 2006, alone, the programs suffered a real reduction of about 7.5 percent, and to date, the programs have not recovered. Indeed, the FY 2007 and 2008 budget requests were designed to address the issue, but the appropriations failed to materialize. This year, the Department has finally been forced to take extreme measures to balance its books. Although many parts of the science budget were affected, four deserve special mention.

- First, the budget for the U.S. commitment to ITER, which is the centerpiece of the world fusion energy effort, was reduced to zero. The project involves an international agreement among the European Union nations, Russia, China, Japan, India the Republic of Korea and the United States. By reneging on our commitment, which was supposed to be $160 million for FY 2008,

we have severely damaged our reputation as a reliable international scientific partner, and that will make it much more difficult in future years for us to engage in other international efforts. Yet, international collaboration is likely to become increasingly important as major scientific facilities grow increasingly expensive.

- A second area severely affected is high-energy physics, long one of the flag ship fields of American science and one that gave us the World Wide Web, as well as accelerator capabilities used in medical treatment and synchrotron radiation-based advanced materials and pharmaceutical research. The reduction of R&D funding for the International Linear Collider project and the zeroing out of the neutrino project NOνA make the future of the field very bleak. Already 500 scientists and engineers at Fermilab and the Stanford Linear Accelerator Center have been notified that they will lose their jobs, and an additional 10 percent of Fermilab's staff is being furloughed. The message to any young American scientist is to avoid the field or seek a position elsewhere in the world.
- The operation of DOE user facilities is a third area badly damaged. The facilities, which in the aggregate have cost well more than $10 billion to construct, are gems in the American scientific enterprise. The facilities support a very broad range of scientific and technological research with users from academic, government and corporate laboratories. They are typically over-subscribed when operating at full capacity. They will, however, suffer reductions of 20 percent in operations. For American industrial users, the message is to move R&D laboratories abroad, where similar facilities can provide more reliable access. Academic and government laboratories users will face a marked decrease in effectiveness and productivity.
- Finally, the FY 2008 budget has resulted in the rejection of 700 proposals in energy research the Department had hoped to fund as part of our nation's effort to gain energy security. Scientific advances will be delayed. There will be significant layoffs of students and post-docs in the Nation's universities as a consequence. Young people will turn away from scientific careers when the Nation needs them.

It is vital that the damage done by the FY 2008 Omnibus appropriations bill be reversed partially through a supplemental appropriation that provides at least $300M of additional funding to the DOE Office of Science.

This last point provides a segue to my observations about the FY 2009 budget request, which for brevity I will restrict to two points. First, if appropriated, the funds requested by the Administration for the DOE Office of Science would move this nation forward markedly in energy sciences and reverse the trend towards declining budget capacity that characterizes most of the past two decades. I strongly support the request, and particularly if the supplementary appropriation discussed above is provided so that valuable people and skills are not lost from our national laboratories and academia.

Our nation must move aggressively to reduce carbon emissions and our dependence on foreign oil and gas. To achieve these twin goals requires investment in both near-term technological research and long-term scientific research. We cannot afford to sacrifice one for the other.

I believe that the Administration's budget for the Energy Efficiency and Renewable Energy account is not nearly aggressive enough and Congress, as it did last year, must rectify it. However, Congress must not travel down the same road it did last year, when it offset the increases to EERE by reductions in the planned commitments to the Office of Science. Tempting as it might be to put off for tomorrow the funding of long-term scientific discovery for the sake of achieving quick, visible short-term technological gains today, we must resist doing so. Otherwise the scientific basis for future technologies will be severely undermined.

BIOGRAPHY FOR ARTHUR BIENENSTOCK

Arthur Bienenstock, the President of the American Physical Society, is Special Assistant to the President for Federal Research Policy at Stanford University, where he is also a Professor at the Stanford Synchrotron Radiation Laboratory and in the Departments of Applied Physics and Materials Science & Engineering. From September 2003 to November 2006, he served as the Vice Provost and Dean of Research and Graduate Policy.

From November, 1997 through January, 2001, while on leave from Stanford, he was the Associate Director for Science of the White House Office and Science and

Technology Policy (OSTP). At OSTP, Dr. Bienenstock sought to gain general recognition of the interdependencies of the sciences and the need for the country to maintain broad scientific and technological strength. He also focused on ensuring that the United States has a scientific and technological workforce, at all levels, to meets the Nation's 21st Century needs. He led a Task Force on the Government-University Research Partnership aimed at strengthening the relationship, and championed an Interagency Educational Research Initiative to fund large-scale, interdisciplinary research on teaching and learning.

For the 20 years prior to his going to OSTP, Dr. Bienenstock directed the Stanford Synchrotron Radiation Laboratory at the Stanford Linear Accelerator Center, leading SSRL's transition from a scientific project to a major facility. Prior to that, he served as Stanford's first Faculty Affirmative Action Officer and as Vice Provost for Faculty Affairs.

From 1963 to 1967, he was on the faculty of Harvard University's Division of Engineering and Applied Physics.

Throughout the 1963–97 period, he maintained an active research group in the general areas of solid-state physics, amorphous materials and synchrotron radiation. He has published over 100 scientific papers in these areas.

Dr. Bienenstock received a B.S. (1955) and M.S. (1957) degree from the Polytechnic Institute of Brooklyn. He received his Ph.D. from Harvard University in 1962. In addition, he was a recipient of a Ph.D. (honorary) from Polytechnic University in 1997 and from Lund University in June, 2006.

In 1968, Dr. Bienenstock was the first recipient of the Pittsburgh Diffraction Society's Sidhu Award for his work in x-ray diffraction and crystallography. He received the Distinguished Alumnus Award of the Polytechnic Institute of New York Alumni Association in 1977 and the Distinguished Service Award of the Department of Energy in 2005. He is the President and a fellow of the American Physical Society and a fellow of the American Association for the Advancement of Science.

DISCUSSION

Chairman LAMPSON. Thank you, Dr. Bienenstock.

We will now move to our question period. I recognize myself as Chairman for the first five minutes.

SECTION 999 OF THE ENERGY POLICY ACT

Mr. Isakowitz, I am concerned that obstructive tactics by the Office of Management and Budget have impeded and unnecessarily delayed the implementation of Section 999 of the Energy Policy Act. We do not need burdensome governmental processes and intergovernmental wrangling to slow the benefits for American consumers.

When will the research dollars that Congress has provided for the program begin to flow more than the trickle that we have seen so far?

Mr. ISAKOWITZ. You mentioned earlier the Administration's proposal to repeal Section 999, but in this fiscal year we understand and we are operating under the statute to go forward with the program. And so, indeed, we are moving forward at this time, having put out a competitive solicitation and do plan to make awards shortly with regards to this program.

Chairman LAMPSON. I know that recommendations for research awards have been made to the Department, and the researchers are simply waiting for a decision as to whether the projects are approved or not. But when can we expect DOE to approve or disapprove recommended research projects?

Mr. ISAKOWITZ. I don't have a date for you, but my understanding is we are on pace to do something soon with this program, and it is our intention to award these dollars.

Chairman LAMPSON. Is there anything that Congress can do to help expedite the process?

Mr. ISAKOWITZ. No. I think at this time we have what we need to undertake this program in this fiscal year.

Chairman LAMPSON. It is my understanding that the annual plans that have been developed by RPSE and submitted to the Department of Energy have been developed with the input of thousands of scientists, geologist, and experts. I am concerned, however, that OMB has slowed the ultimate approval of the 2007 annual plan and may well slow the approval of the 2008 annual plan.

Does OMB have the technical expertise to evaluate the proposed annual plan?

Mr. ISAKOWITZ. Well, you know, as you know it is part in putting together the research plan as you said, through committees we have reached out to the community, done a thorough review, and of course, we coordinate within the Administration for getting the job done. We believe that the research plan that we have provided previously and we will be providing in the future should adequately provide the kind of information necessary to implement this program.

Chairman LAMPSON. I think the real answer to that is no, it should reside with the advisory committee.

Does OMB have any authority to review the annual plan before it is approved?

Mr. ISAKOWITZ. On many matters that go before the Congress we do, in fact, coordinate with OMB in advance of submission of that material.

Chairman LAMPSON. The answer is no. Right?

Mr. ISAKOWITZ. Well, on this matter we do coordinate with OMB.

Chairman LAMPSON. Okay. The answer is no. Why would OMB insert itself in the annual plan review process at all?

Mr. ISAKOWITZ. Because on matters dealing with how money is going to be spent in various areas, we do coordinate, you know, within the Administration to ensure that there is consistency, and we are not over-promising or obligating the Administration in future years.

Chairman LAMPSON. Section 999 provides for the establishment and operation of a technical committee that among other duties will ensure that the research activities of NETL and RPSE are not duplicative. Has a technical committee been established? And what are the roles of the DOE and RPSE on that committee?

Mr. ISAKOWITZ. Frankly, sir, I am not aware of that committee. I would have to get you an answer back for the record.

[The information follows:]

INSERT FOR THE RECORD

The technical committee required by Section 999(H) has been established. Most of the members have been confirmed and additional members are being sought in order to provide full coverage of all the technical areas in the program. Planning and organization continue with an expectation that the committee will review NETL's complementary R&D program in June 2008. DOE and NETL staff are not members of the technical committee. NETL staff may be considered *ex officio* members with roles to inform the committee about its research, to engage in dialogue, and to respond to committee recommendations, as appropriate. A RPSEA representative is participating on the committee in order to provide information on RPSEA's

activities and to participate in the committee's discussions on the complementary nature of RPSEA and NETL research.

Chairman LAMPSON. Could there not be a greater degree of communication between NETL and RPSE and perhaps even including establishing a small NETL office near RPSE, and perhaps I should say I don't think that NETL has collaborated with RPSE on this matter. Would you want to make any comment on it?

Mr. ISAKOWITZ. Sir, we are happy to sit down with you and your staff as to how you feel there are better ways we can work between the various organizations. We think we are trying our best with regards to reaching out to the various organizations and getting their input so, in fact, we do have a good program.

Chairman LAMPSON. I think instead of us sitting down with it, the law said a specific statement of—and even appropriated the money. It just seems to me that the Executive Branch has a responsibility of following the law. Maybe instead of us sitting down and discussing it, that we need to revisit what Congress said or you all need to revisit what Congress said in the laws it had passed and the President signed.

That being said, I am going to stop at this point and yield to the Ranking Member for his five minutes of questions.

Mr. Inglis.

Mr. INGLIS. Thank you, Mr. Chairman.

Mr. Isakowitz. Am I pronouncing that right?

Mr. ISAKOWITZ. Isakowitz.

Mr. INGLIS. Isakowitz. Okay.

Mr. ISAKOWITZ. Yeah. It is a tough one.

BREAKING DEPENDENCE ON OIL THROUGH ALTERNATIVE ENERGY

Mr. INGLIS. Thank you for being here and a question for you is, I see the budget proposal has cuts for hydrogen, solar, and nuclear infrastructure. I think it has an increase for the biomass program. Other than that biomass program can you highlight any significant lines that might indicate long-term investments to breaking our dependence on oil?

Mr. ISAKOWITZ. Yeah. I think it is important to look at it, you know, certainly in its totality. You know, with regards to the overall renewable budget, it is true that there are some areas that are going up and some areas that are going down. We have set out very aggressive paths with regard to implementing a lot of the technologies, you know, in the various areas. You do mention in the case of biomass, that is an area that is going up. We propose increases in wind and geothermal and building technologies, and there are good reasons why you see changes in some of the other areas.

I think it is also important to note that when one views the renewable budget, that we have another program that is important for the Department of Energy, our Loan Guarantee Program, that is also an effective means by which we can help to bring a lot of these research efforts out of the laboratories and working with industry to actually see them implemented with regards to industry in the marketplace.

Mr. INGLIS. Those are—that is helpful to know about, so you are highlighting biomass, wind, geothermal, and building technology. Those are——

Mr. ISAKOWITZ. Uh-huh.

Mr. INGLIS.—key areas to focus on. What was the rationale for reducing hydrogen, solar, and nuclear?

Mr. ISAKOWITZ. As you had mentioned in your opening comments, the President did commit to spend $1.2 billion over five years, from 2004 to 2008, in a Hydrogen Initiative. That having been said, the Department of Energy does not view the end of that five-year period being the 2009 budget as in any way a sunset for that activity. I think instead we view it as a maturing of that activity, where we have learned a lot in terms of things that are going well and things that need more work.

I think if you look at the overall funding for hydrogen across the Department, the funding does drop from the '08 enacted by about $13 million, and a lot of that is coming out of the Office of Energy Efficiency and Renewable Energy.

The other thing you need to keep in mind is we have significant increases in the Office of Science. In fact, we have a $24 million increase in hydrogen in the 2009 budget. I believe that reflects that things that we have learned and opportunities that we see that require longer term, more fundamental research to ensure the success of the initiative.

Also, I would add that we have tried to within the funding with EERE to make sure we focus on those things that meet the date of 2015 in terms of addressing critical path technologies.

Mr. INGLIS. Of course, the $24 million increase in hydrogen, for example, in the Office of Science, that is nice. It didn't compare very favorably to $1.2 billion.

Mr. ISAKOWITZ. Yeah, and again, when I talk $24 million, that is just going from '08 to '09, $1.2 billion is a grand total across five years of the project. So for example, in '09 we are proposing $266 million, which a sizable portion of that is from the Office of Science.

Mr. INGLIS. Two-hundred and sixty-six million for——

Mr. ISAKOWITZ. Overall for hydrogen across the Department of Energy.

Mr. INGLIS. For '09?

Mr. ISAKOWITZ. For '09.

Mr. INGLIS. Okay. And what is the impact of earmarks on that, the money that has been spent in that $1.2 billion?

Mr. ISAKOWITZ. I can't speak specifically with regards to the earmarks within the Hydrogen Initiative. I can speak more broadly with regards to the Department of Energy. You know, we have seen a very worrisome growth the number of earmarks across the Department and a lot of our critical areas. In fact, if we look at the level of earmarks between 2002 and 2008, we have had a total of $3.8 billion in earmarks within the Department of Energy. And when you consider all the things we have talked about, $1.2 billion for a Hydrogen Initiative, that is a substantial amount of money, and that is an area of increasing concern for the Department in order for it to accomplish its mission.

Mr. INGLIS. What I have heard, and tell me if you agree with this, is that the earmarks, especially in hydrogen for demonstration projects let us say that really don't demonstrate a whole lot except maybe the ability of a Member of Congress to bring home some bacon, really have eroded some of the punch that could have been delivered in hydrogen. Is that correct?

Mr. ISAKOWITZ. Yeah. I think what we had proposed, I believe, is a very tight but highly-prioritized budget with regards to hydrogen, and we do think to the extent that other things are crowding that out, that we are having a less-than-optimal budget. Yes.

Mr. INGLIS. And Mr. Bienenstock, did you have some comments you wanted to add about that, about the earmarks especially?

Dr. BIENENSTOCK. Well, there is no question that the $124 million of earmarks in the Office of Science budget had an enormous impact. I wouldn't have been speaking about these other matters if that money had gone to the Office of Science, and I assure you that within the academic community I am working to get the universities to show more discipline in their requests through the Association of American Universities and the Council on Government Relations.

Mr. INGLIS. Thank you. Thank you, Mr. Chairman. My time is up.

Chairman LAMPSON. Ms. Giffords, you are recognized for five minutes.

SOLAR RESEARCH AND DEVELOPMENT FUNDING

Ms. GIFFORDS. Thank you, Mr. Chairman, and I want to thank the panelists for being here today.

I come from a very sunny state, the State of Arizona, so most of my questions are going to be on solar energy. The President's request for solar research and development funding have not only failed to increase during the recent years but they have also failed to keep pace with inflation. This is inspite of the case that solar energy is growing stronger with each passing year, not just in the southwest, but in states across the country and countries across the world.

And solar is increasingly becoming a viable solution to some of the greatest challenges our nation faces in terms of our dependency on foreign energy, in cases of global warming and climate change and U.S. competitiveness as well. It also is becoming more competitive in terms of a cost standpoint with coal-fired electricity.

So I would like to ask Mr. Isakowitz specifically why the President is not committed to spending more resources on solar energy when this opportunity is presenting itself?

Mr. ISAKOWITZ. We fully agree with you over the importance of solar energy with regards to a national strategy on energy. I think it is important to view our investments in the research part of solar energy as part of a bigger investment that is being made nationwide, and when we often look at our investments, we look at where the technologies are, and in fact, what is industry investing in these areas. I think solar is one of the areas that we are seeing an increasing amount of industry and private sector investment going in that area. So we tried to be much more pinpointing in terms of the investments we make within solar.

We do have a Solar America Initiative, which is very important which continues on track in terms of achieving its goals. I mentioned earlier that we have a loan guarantee program of which right now we are negotiating with two firms that are trying to bring online some very innovative ideas on, one for concentrating solar power at a rather large scale, and another one where we are working on some innovative ideas with regard to thin film technologies on photovoltaic. And those efforts are actually quite considerable, and if you look at the volume of the dollars we are talking about there, they certainly surpass just the research part of it.

So in addressing it we have to consider all those things, the research dollars, what we can do in the loan program, what the private sector is doing, but we feel that the investments we are making are adequate to meet those needs.

Ms. GIFFORDS. You mentioned concentrated solar power. I am curious, does the CSP budget contain an increased funding for thermal energy storage? And if so, what amount?

Mr. ISAKOWITZ. I would have to get back to you on that one. I don't have that at my fingertips.

[The information follows:]

INSERT FOR THE RECORD

Out of the approximately $30 million appropriated for Concentrating Solar Power (CSP) in FY 2008, $10 million is being directed at thermal energy storage, for R&D at the national labs and in preparation for an upcoming solicitation this fiscal year directed at thermal energy storage at both universities and private industry. Although the overall FY 2009 budget request for CSP is $19 million, DOE hopes to provide funding for thermal storage at the FY 2008 funding level.

SOLAR WORKFORCE TRAINING

Ms. GIFFORDS. If you would. And the other issue that I wanted to bring up is this workforce training, where this Congress has had a chance to authorize workforce training because that is something that we hear from the installers in the field, and we hear from people around the country. They are interested in solar, but we do not have enough qualified, trained installers.

Again, Congress moved forward to authorize this training, and it has not been put in the President's budget. So could you please address that?

Mr. ISAKOWITZ. Yes. I mean, I think this is something that is true across the board, whether you are talking the nuclear, solar, or the various other different technologies, and we recognize this is a critical area. I believe it was in the America COMPETES Act that call for investment in this area and identified some amount of funding that should be set aside to address that, and we are in the process now of doing a crosscut to make sure that we are making adequate investments in this area.

That having been said, we also recognize that our national labs are a great attraction to students coming out of school and an opportunity to do research. So in more recent years we have tried to get more aggressive out at our national labs working with faculty and students to try to encourage them to pursue critical careers in these needed skills.

SOLAR POWER GOALS

Ms. GIFFORDS. A couple questions I have. The wind program in DOE's Office of Energy Efficiency and Renewable Energy has articulated a specific goal of wind power providing 20 percent of the electricity in the United States. I want to know whether or not there is a comparable goal for solar.

Mr. ISAKOWITZ. There is a goal, and I will probably have to get back for the record on that one, but I think the goal that they have primarily set is that by, I believe the date was 2015, they tried to have solar to be cost competitive against the other technologies that are out there.

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Contributing 20 percent of electricity from wind is not a goal, but rather a recognition of the potential for wind energy in the United States. The specific DOE goals for solar energy are for PV to be cost-competitive in residential and commercial markets by 2015 and for CSP to be cost-competitive in intermediate power markets by 2015 and baseload power markets by 2020.

Ms. GIFFORDS. If you could get back to me on that. And one last question. Mr. Bartlett had been working with us on his interest in solar technology, and in terms of an amendment offered by Representative Bartlett on solar lighting and also solar air conditioning, I notice that the President had failed to include that in the funding. And I was just curious why the President has not taken, again, those initiatives brought forward by Congress into consideration.

Mr. ISAKOWITZ. As in with every type budget, you know, there is a lot of exciting opportunities of things we can fund, and oftentimes in a tight budget we just have to set some priorities.

Ms. GIFFORDS. I know, but Mr. Bartlett has been here a very long time and is one of our smartest Members on the Committee, so you know, if you could please bring back that consideration to the President, I would appreciate that.

Thank you.

Chairman LAMPSON. Thank you, Ms. Giffords.

And I recognize Dr. Bartlett for five minutes.

LONG-TERM ENERGY SECURITY INTERESTS

Mr. BARTLETT. Thank you very much.

Dr. Bienenstock, your concern about the decrease in basic research and R&D funding is very appropriate. Cutting funds in those areas is the exact equivalent of the farmer eating his seed corn.

I represent a rural area. I have a lot of farmers. Not one of them is dumb enough to eat their seed corn, and I think that they are quite surprised that our government is dumb enough to eat its seed corn in this area. So thank you very much for your concern and your counsel.

Mr. Gaffigan, you note that fossil fuels are finite. You made that statement. Help me understand how our long-term interests are served if, in fact, these fossil fuels are finite and our present objective is to go out and find the remaining reserves as quickly as we possibly can and consume them as quickly as we possibly can. How is that in our long-term security interests?

Mr. GAFFIGAN. Thank you. And I would say we have invested in this infrastructure. You know, we have bought into fossil fuels and it so hard to change off that course because they have been relatively cheap, relatively inexpensive, and it is very hard to change course—it is kind of a dramatic change unless there is some realization that we are going to address the environmental impacts—try to establish some type of mandates or standards that say that that dependence on fossil fuels is a bad idea. Again, that is a policy decision. But I think ultimately it is hard to get off of an investment we have made in fossil fuels. And I think to some extent fossil fuels are still going to be part of our picture going forward. Everyone I have talked to says it is going to be part of it.

Mr. BARTLETT. It will be a part of it. We are kind of like as the President observed, the cocaine addict that just has to have another fix. We are hooked on oil, addicted to it. He is exactly right.

U.S. INTEREST IN HYDROGEN

Mr. Isakowitz, why are we interested in hydrogen?

Mr. ISAKOWITZ. I think hydrogen, like fusion research, I think represents those sort of holy grails out there that if we are successful in these areas of——

Mr. BARTLETT. If we are successful in what areas?

Mr. ISAKOWITZ. In the areas like hydrogen. If we can move towards an economy that can support——

Mr. BARTLETT. Then why are we interested in hydrogen?

Mr. ISAKOWITZ. Well, because it reduces our dependency on other forms of energy such as——

Mr. BARTLETT. How is it going to do that? How is it going to do that since hydrogen is not an energy source? We always will use less—more energy producing hydrogen than we get out of it. So the more hydrogen you use, the less usable energy you have, unless we have some improvements in fuel cells. Is that not correct? That the only justifiable reason for a heavy investment in hydrogen is if we have fuel cells for which it is a great candidate. Because burning it in the reciprocating engine doesn't make a whole lot of sense because you could have burned the thing you were making the hydrogen from in the reciprocating engine and gotten more energy from it because the second law of thermodynamics assures that. Does it not?

Mr. ISAKOWITZ. I defer to your expertise on this matter, sir, but I will just suffice it to say that the Department does recognize that there—it is an important issue with regards to how you go about producing the hydrogen. That is why as part of our, for example, in our nuclear program, we have efforts to look at how, through the conduct of nuclear energy, we can find more affordable ways from which to produce the hydrogen that can, in fact, support a hydrogen economy.

Mr. BARTLETT. If we have a big increase in the nuclear electricity generation, the hydrogen makes some sense, because think of it, sir, in terms of a battery. It is a convenient way to carry energy from one place to another. It is not an energy source. It is not a silver bullet. It will not solve our problem.

There is an enormous amount of irrational exuberance in this whole area. There was a lot on hydrogen. Today the irrational exu-

berance is on biomass and cellulosic ethanol. I would encourage you to pull up and read a speech given 51 years ago, the 14th day of May, by Hyman Rickover, the father of our nuclear submarine, and he wisely warns that you probably shouldn't be burning your food. We learned that with our silly expansion of corn ethanol which doubled the price of corn, raised the price of wheat and soybeans worldwide, and created what one U.N. official said was a crime against humanity.

He also warned that you probably shouldn't be burning the biomass. It will go back to increase the detilt of your soils and then assure their fertility.

Thank you very much, Mr. Chairman.

Chairman LAMPSON. Thank you.

Mr. BARTLETT. I yield back.

Chairman LAMPSON. And I recognize Mr. Lipinski for five minutes.

REPROGRAMMING REQUEST FOR HIGH ENERGY PHYSICS LABORATORIES

Mr. LIPINSKI. Thank you, Mr. Chairman. I want to thank the witnesses for their testimony and good to see you again, Dr. Bienenstock. I was out there at Stanford last year, and I also toured SLAC, and I have great concerns about the cuts to high energy physics and the impact that that has not only on SLAC but on Fermi in my home State of Illinois.

All the cuts, the layoffs that are taking place at both Fermi and SLAC are, you know, very troubling. The impact that this is going to have on the United States' position in terms of high energy physics obviously, you know, I know as a former academic that if you cut off the funding, people are going to leave. First, you are not going to get interest in students coming in and studying that in the future, but you are also, you are going to have all these scientists leave our country, go elsewhere.

And we have great hopes for the International Linear Collider at Fermilab, and certainly I don't see—unless something is done right now, I just don't see that moving forward as high energy physics really is left in a lurch here in the United States.

I want to ask Mr. Isakowitz if there are any plans that the Administration has for submitting a reprogram request or supplemental request to address the 2008 funding shortfall in high energy physics.

Mr. ISAKOWITZ. With regard to high energy physics, we are not planning to send up a reprogramming in that area. We have sent up with regards to ITER, because that is a program that is an important international program that has been zeroed out. We are deeply concerned and with regards to our international commitments on that effort and our obligations. The reprogramming that we sent up does not offset what was lost in the '08 appropriations but will provide us with the funding needed to at least keep the project office open so that we can continue to work with our international partners on this important effort.

And we are, hopefully we will achieve that reprogramming soon so, in fact, we can keep the office open, which I think we have funding currently only through the end of March.

Mr. LIPINSKI. I think ITER is also a very important program. It is good to hear that, but Dr. Bienenstock, what impact do you think this is going to have on high energy physics in the United States?

Dr. BIENENSTOCK. Oh, as I stressed in my testimony I think it is a disaster for high energy physics and more than that. We are going to see a loss of accelerator physicists, and you think of accelerator physicists primarily for high energy physics, but they are the people who have made possible the new Spallation Neutron Source at Oak Ridge. They are the people who originally made possible the synchrotron facilities like the one that I operated that was originally a high energy physics accelerator and then became a synchrotron facility.

We will need them for the next generations of the X-ray-free electron lasers based on what is going on at SLAC, and I fear that they will disperse to Europe and elsewhere, and we will lose enormous capability where we were world leaders.

FUTUREGEN CONCERNS

Mr. LIPINSKI. And I share your great concern about that.

One other issue I wanted to address was FutureGen. I am very unhappy with the decision that was made on FutureGen. In March of 2007, DOE signed these cooperative agreements with industry to build FutureGen, and then the announcement being made essentially that, you know, DOE was reneging on the commitment that it had made. And right now it doesn't look like—it is not that there is money being saved even, but my great concern is I think FutureGen and what we are trying to do with FutureGen is very critical to our energy needs and the environmental concerns that we have now with global warming.

But, you know, why should anyone believe DOE is a worthy partner when they see DOE back out of FutureGen like this?

Mr. ISAKOWITZ. I assume that is directed to me.

Mr. LIPINSKI. Yes.

Mr. ISAKOWITZ. First, to be clear, the Department is completely and fully committed to the FutureGen and the goals of the FutureGen, and we fully, as you have articulated, recognize the importance of being able to demonstrate carbon capture and sequestration at a large scale as being critical for the industry.

That having been said, the Department often is faced with the situation that although committed to a goal, must also watch out for the taxpayer. And the feeling was that under the current arrangement that there was a better way to go forward than the arrangement that we had driven by two factors. One is the significant cost growth that we have seen in the program, and the concern that even though we had a number now that was a lot bigger than we started with, we started with $900, now it is $1.8 billion, we were concerned that that number would continue to grow.

Second factor to keep in mind was a significant change in the marketplace itself. When we started this program, a lot of effort with regards to IGCC, Integrated Gasification and Combined Cycle plans, was more of a research effort. Today it is not just a research effort. We actually have the private sector making important investments in this area. In fact, under our loan program we had two

companies that have come in, in fact, we are in negotiations with now, with regards to pursuing an IGCC plant.

And we are seeing increasing numbers of other companies wanting to pursue it in this uncertain regulatory environment that we see in a number of states.

So the critical component for us has been the CCS, the carbon capture and sequestration. So what we have tried to establish is a program that allows us to potentially award more than one site to demonstrate this in a variety of areas and to get it out in the commercial marketplace, potentially faster than we otherwise would have done when we were treating it as a research program.

So it was really driven by these two factors. One was the concern that we wouldn't be able to control costs in its current configuration, and second, we saw a major change in the marketplace.

Mr. LIPINSKI. I know my time is up, but I just wonder about how the DOE can go and choose a site and then so quickly all of a sudden say, okay, after all that we really are not moving forward with this after the site is chosen, the announcement is made. I have great concerns about that, but I know that my time is up and——

Chairman LAMPSON. The gentleman's time has expired, and we do want to move on because we have got votes that we are going to run out to, and I recognize Ms. Biggert for five minutes.

MAINTAINING AMERICA'S COMPETITIVE ADVANTAGE

Ms. BIGGERT. Thank you, Mr. Chairman.

I would like to thank the Department of Energy for remaining committed to the American Competitiveness Initiative and the spirit of the *America COMPETES Act* in the Fiscal Year 2009 budget request.

Despite the failure by this Congress to fully fund related R&D programs in each of the last two years, and I know that the DOE was particularly hit hard by the Fiscal Year 2008 Omnibus, and as a prior speaker said, we have been hit by the fallout in the suburbs of Chicago with the premature shutdown and reduced operation of the user facility at Argonne and the furloughs and layoffs at Fermilab, which I am so upset about.

But I would like to look at just broader first of all. One half of the growth of the GDP since World War II has been attributed to science and technology innovation. And we are not competing as a country, and we are losing ground to so many other countries and the ability for us to be able to compete economically is based on this physical research and development.

And we are sitting here talking about all these little things, but we are not as a nation really looking to push this. Our committee needs to do this, and we have been doing this on a bipartisan basis, but I think we really have to—our Committee and our Congress has to follow through on our commitment to increase the funding for basic research. We have asked for doubling and now it has gone down. We have seen from both Dr. Bienenstock's charts and Dr. Gaffigan's charts that we are not making any progress practically at all.

And, you know, we are all singing on the same page, but we are not in key, and if we don't find a way to make this a priority, we talk about it, we have got an R&D caucus, we have got all kinds

of things where we talk about this. And I really thought that our Members were all on the same sheet, and yet then we find the appropriators cutting in the Omnibus bill or the leadership, however that happened.

It is making such a mistake, and we see, you know, we are talking about ethanol, but if we don't progress on our nuclear energy and our reprocessing, it takes a long time to do that, and we have to use every means and alternative energy to proceed. And we just keep backsliding.

So that said, one of the questions is, you know, what are the consequences to American businesses in reducing the operation of DOE's user facilities by 20 to 25 percent? You know, at Argonne that is going to happen. And have the, have businesses raised concerns about this? And does American industry have the option of taking their research overseas? And what is the likelihood that these industrial users will ever bring back the research to the U.S. if that is true, if maybe Mr. Isakowitz, you could—I don't have much time. We are going to vote. If you could answer that briefly.

Mr. ISAKOWITZ. Yes. I think you raised two very important points. Our funding in the Office of Science I think it is interesting that it is under an initiative with the title, the American Competitiveness Initiative. I think too often people associate funding in basic research as not necessarily tied to the economy and the competitiveness. We do. We take it very seriously.

In fact, in our '09 budget proposal we have identified a number of areas where areas in basic research teamed up with our applied side of the house to make funding in a number of areas such as energy storage, carbon capture, dealing with advanced plasma technologies, as a way to insure that the basic research we do, in fact, is inspired to ultimately make its way into the marketplace.

FUNDING FOR RARE ISOTOPE BEAMS

Ms. BIGGERT. And I have just got one more statement, and I am going to run out of time, so I will cut you off.

I commend the DOE again for issuing the funding opportunity announcements for the construction and operation of a facility for the rare isotope beams. We call it kind of a real light, but now it is called FRIB I guess is the new name, but this is welcome progress and a project that has been identified as critical to maintaining the U.S. leadership in nuclear physics and nuclear science.

So this project isn't new. It has been on the drawing board, but I hope that you will commit to sticking to the timetable of this project, and I don't think that the Department has had a very good track record when it comes to, you know, to these projects and the commitment, whether we are talking about RFPs for REA in 2005, or FutureGen. So I hope that you will prevent this project from slipping any further.

And with that I would just like to thank Dr. Bienenstock for bringing up the Fermi and Argonne and all of those projects that are so important, and I hope that we all will, you know, continue to really push for this research and development. Thank you all for being here.

Chairman LAMPSON. Thank you, Ms. Biggert.

Ms. BIGGERT. Yield back.

Chairman LAMPSON. I want to thank all of you for appearing before the Subcommittee this afternoon. I will apologize for the way that we started our session out. Those of you who are not from the government, it was the government's fault. All of us.

Under the rules of the Committee, the record will be held open for two weeks for Members to submit additional statements and any questions that they might have for the witnesses. We will submit our additional questions. We will not come back following the votes.

We thank you all very much. This hearing is now adjourned.

[Whereupon, at 12:00 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Steve Isakowitz, Chief Financial Officer, Department of Energy

Questions submitted by Chairman Nick Lampson

Q1. The America COMPETES bill established an Advanced Research Projects Agency for Energy, or ARPA–E. Has there been an organized effort within the DOE to gather views on how a tool like ARPA–E can be utilized for energy research? If so, how would you characterize the findings of this effort?

A1. Yes, the Under Secretary for Science requested a review, which determined that many of the goals of ARPA–E have largely been met by ongoing energy research efforts within the Department.

Q2. The Industrial Technologies Program at DOE has had a long and successful history of conducting collaborative research with industry to improve the efficiency and emissions of industry. Yet, the Administration has repeatedly cut this program, leaving it at one third the level of funding it had as recently as 2000.

Q2a. Given the proven successes of the ITP, and the enormous potential for energy savings and emissions reductions, why does the Department continue to propose cuts to this program?

A2a. The Department recognizes the significant opportunity for improving energy efficiency within industry. The Department requests $62.1 million in FY 2009 for ITP, nearly a 35 percent increase over the FY 2008 request, reflecting the important role of ITP in the Department's portfolio.

Q2b. If industry was really capable of doing this research on its own, would record high energy prices, global competition, and tougher emissions regulations not already be enough incentive to do it?

A2b. Rising energy costs caused by higher global oil prices and growing global competition are challenges faced by industries around the world, including in the U.S. The Industrial Technologies Program is working with industry in cost-sharing partnerships to develop real-world energy solutions to help industry improve its efficiency.

Q3. A large fraction of the DOE federal workforce has been there for decades. Yet, there does not appear to be a significant effort to make it easier to bring in top talent and pass on institutional knowledge before these folks retire in the next few years.

a. Does the Administration have any plans to address this issue?

b. Is the Administration conducting a wholesale review of recruiting and hiring practices to ensure a free-flowing pipeline of top talent into federal research agencies?

A3. The Department is cognizant of the importance of succession planning and has implemented initiatives to ensure a sustainable workforce throughout the "retirement tsunami" which is anticipated as the baby boomers enter the retirement era. As part of the Human Capital Initiative of the President's Management Agenda the Department has focused on improving several succession planning strategies to keep in step with, or ahead of, attrition in both the SES and the GS ranks.

In 2006, a strategy was implemented to streamline the hiring processes throughout the Department with results reported to the senior managers. Since the inception of this strategy, hiring times have improved dramatically. Currently, our non-SES hires are completed in 38 days, well below the OPM standard of 45 days, and our v SES hiring time has improved by 64.4 percent over hiring in 2006.

Replacement percentages have likewise improved and kept abreast of attrition in 2006 and, in fact, well ahead of attrition in 2007, as illustrated below:

FY	Start of Year	Number of Separations	Attrition Percentage	Number of Hires	Replacement Percentage
FY2006	15,085	1,208	8.0%	1,135	94.0%
FY2007	15,027	1,149	7.6%	1,212	105.5%

These statistics are an indication of our continued improvement in human capital management, with practices in place to monitor both SES and non-SES hiring on a monthly basis. In addition, annual Workforce Plans and quarterly updates are prepared throughout the Department which set goals and track results of a variety of human capital initiatives, including succession planning and projecting workforce requirements for the future.

The Department is continually monitoring trends in attrition and retirements and incorporates those projections into Workforce Planning. In addition to progress in the hiring process, the Department has identified mission critical occupations and conducts a systematic evaluation of current strengths/gaps in these areas, projecting needs for the next five years. The Department is currently implementing an automated Workforce Planning Model to streamline this process and provide even more accurate forecasts.

The Department places high emphasis on maintaining a sustainable and talented workforce, and senior management will continue to monitor progress.

The Department has also implemented professional development programs to enhance learning and knowledge sharing. Strategies to reach this goal are being implemented corporately throughout the Department. These strategies include: the Mentoring Program, Senior Executive Service Career Development Program, and development programs for entry and mid-level employees. Collectively, these programs support an adequate workforce pipeline, effective strategic recruitment activities, and successful continuity and succession planning throughout the Department.

The Department of Energy is working with groups such as the Partnership for Public Service to find best strategies to recruit from colleges and universities and is also serving on many pilot projects in an effort to find better approaches and solutions to the dilemma of an aging workforce and mass retirements in the near future.

Q4. Can you provide an assessment of the impact that cuts in the recent Omnibus to the ITER and International Linear Collider R&D budgets are having on our international research collaborations overall? How have our domestic fusion and high energy physics research communities been impacted?

A4. The FY 2008 appropriations reduced U.S. credibility as a partner in international scientific collaborations in general; and especially so with ITER, since there is a formal agreement among the seven partners to build it and it is currently under construction. I expect many future science projects will require international collaboration and cost sharing due to their cost and scope. If the U.S. is perceived as an unreliable partner, it may limit our ability to participate in world-class scientific collaborations in the future. The unwillingness to deliver on U.S. financial commitments to ITER and wavering support for International Linear Collider (ILC) R&D could have profound international impacts. It is possible that there could be retaliation from international partners in ongoing efforts such as the International Space Station, the Large Hadron Collider, and the Global Nuclear Energy Partnership.

The reduction to the funding for ILC R&D severely limited all international collaborations and domestic programs in this research area. Because most of the funds had already been costed at the time of the appropriation, almost all U.S. ILC R&D programs were halted and the workforce shifted to other programs, furloughed or released. The international community adjusted by revising and extending its plan for ILC R&D by several years. A more limited role is now planned for the U.S., with efforts focused on those areas in which the U.S. has unique capabilities. The United States' leadership role in the international ILC R&D effort has been significantly diminished.

The FY 2008 funding shortfall for the U.S. Contributions to ITER Project has had only a modest impact on the overall U.S. fusion community because most of the people lost from the U.S. ITER Project team were able to be transferred onto other programs in their home institutions (Oak Ridge, Savannah River, and Sandia National Laboratories, and Princeton Plasma Physics Laboratory). Several staff from the Magnet Group at the Massachusetts Institute of Technology, however, may eventually lose their jobs.

Q5. A late addition to this budget regarding the Office of Science was the creation of "Energy Frontier Research Centers," which will focus on important applications-oriented research including electrical energy storage, solar energy, and carbon sequestration. However, there was little description on how they will function and none on how much they'll cost. Would you please provide more details on this?

A5. The Energy Frontier Research Centers (EFRCs) are a funding mechanism, modeled after NSF's Physics Frontier Centers, used to attract the very best scientists and engineers to address our country's energy needs. The EFRC program will pro-

vide substantial, long-term support for 20 to 30 groups of multiple investigators in a dynamic research environment necessary to inspire, train, and support scientists of the future who will have an appreciation for global energy challenges. EFRC awards are each expected to be in the $2 to $5 million range annually for a five-year period, resulting in an initial overall EFRC effort of approximately $100 million in FY 2009, pending appropriations. This additional commitment of funds and duration-of-effort will permit an EFRC to achieve a critical mass of researchers and students having a diverse range of experience, skills, and talents. The magnitude of the funding, and the five-year minimum commitments are important aspects of the program.

The EFRCs will address energy and science grand in a broad range of research areas that have been defined through a series of more than one dozen workshops conducted over the past five years. Included in this series were workshops devoted to identifying critical basic research needs in: solar energy utilization, the hydrogen economy, superconductivity, solid state lighting, advanced nuclear energy systems, clean and efficient combustion of transportation fuels, geosciences for energy systems, electrical energy storage, materials under extreme environments, and catalysis for energy applications. EFRC proposals are being solicited through a Funding Opportunity Announcement (FOA) on Grants.gov, which opened on April 4, 2008 and closes on October 1, 2008 (RE: *http://www.grants.gov/search/search.do?oppId=1738&mode=VIEW*). This solicitation provides an open competition among all researchers for the very best ideas to address the fundamental questions of how nature works and to help solve some of our most critical real-world challenges. The selection of awards in will depend on the quality of the proposals received and the peer review outcomes of the FOA competition. The EFRCs will address key scientific issues that limit transformational advances needed for future energy technologies.

Q6. The DOE Office of Science is the steward for several very large-scale experimental and scientific facilities around the country, some of which can cost hundreds of millions or more to build, and tens of millions in annual operational costs. But, these facilities are often used for non-energy research by other agencies such as NIH, DOD, NSF, and private industry.

Q6a. Given the President's Science Advisor's calls to diversify funding sources for research, is the current scheme adequate for the dual goals of encouraging diverse, productive use of these facilities and covering significant operational costs?

A6a. In the Office of Science, we employ a steward-partner model for operating large user facilities for the Nation and find this model provides stability and continuity of operations while promoting the use of the facilities by a broad group of stakeholders for the advancement of science and innovation. Under this model, as the steward the Office of Science funds the core facility aspects (such as an accelerator complex for a synchrotron light source) while simultaneously encouraging our partners to use and invest in supporting facility aspects (such as instruments, beamlines, and upgrades of a light source).

The National Academy of Sciences endorsed this steward-partner model in a 1999 report, *Cooperative Stewardship: Managing the Nation's Multi-disciplinary User Facilities with Synchrotron Radiation, Neutrons, and High Magnetic Fields.* The report noted if core operations and maintenance of a facility become dependent on dispersed funding, the entire facility operation may be threatened by the reduction or withdrawal of support by a single component.

The Office of Science explores partnerships of all kinds: interagency; international; Federal-State; and government-private sector. For example, the Office of Science and the National Institutes of Health equally funded the upgrade of the Stanford Synchrotron Radiation Laboratory. We are pursuing the Joint Dark Energy Missions jointly with NASA. Non-DOE domestic and foreign funding sources have invested in instruments at some of our newest facilities, such as the Spallation Neutron Source at Oak Ridge National Laboratory. And the Office of Science forged international partnerships for some of the largest facilities such as the Large Hadron Collider and ITER. These types of partnerships leverage investments from diverse sources, enable stable facility operations, and encourage diverse, productive facility use.

Q6b. Is there a requirement of "total cost recovery" if a private company wishes to retain intellectual property rights for work conducted on these facilities, and do you have a sense on whether this has prevented a significant number of American companies from making good use of them?

A6b. The Department's policy is to provide access to the facilities without charge to all qualified researchers, including those from the private sector, whose intention is to publish in the open literature. Researchers with proprietary interests may seek enhanced intellectual property rights, which include the right to keep research results secret. Researchers desiring such enhanced intellectual property rights are charged user fees at rates designed to recover the full cost of providing the service of operating our scientific user facilities. Private companies retain ownership of new inventions they make as users, regardless of whether they provide "total cost recovery." The vast majority of users does not seek enhanced rights and gain access to the facilities without charge after their proposals have passed peer review.

We believe this cost recovery policy encourages American companies to use our facilities. Many industrial users of our facilities publish in the open literature and use the facility without charge, and the full-cost recovery policy for proprietary research gives researchers a mechanism to retain enhanced intellectual property rights for work at the facilities.

Charging user fees for non-proprietary work would discourage industrial use of facilities. Significant industrial contributions to beam line fabrication, instrumentation, and user support would diminish or cease, thus denying the Department's leveraged use of these non-federal investments for federal as well as non-federal use.

Q7. The nuclear R&D programs received a significant proposed increase from $458 million in fiscal year 2008 to $629 million in the fiscal year 2009 request. A big part of that increase is in the Advanced Fuel Cycle Initiative which includes the Administrations Global Nuclear Energy Partnership program.

a. Given that the National Academies October 2007 report recommended that the GNEP program not go forward, but instead should be replaced by less aggressive fuel cycle research, what achievements can you share with us regarding GNEP that warrant such a significant increase in funding?

A7. No response given.

Q8. Under a cooperative agreement the U.S. and Russia are jointly developing a Gas Turbine Module Helium Reactor for the disposition of excessive weapons-grade plutonium. This fiscal year this joint U.S./Russian program has been moved from the National Nuclear Security Administration to the Office of Nuclear Energy.

a. Could you please describe what the Office of Nuclear Energy is doing to ensure that this program continues uninterrupted?

A8. No response given.

Q9. Given that a significantly expanded marine and hydrokinetic energy R&D program was authorized in the energy bill passed just a few months ago, please explain why the Administration cut this funding by 70 percent to just $3 million in its proposed FY09 budget.

A9. Funds provided by Congress in FY 2008 to conduct resource and technology assessments are sufficient to carry out these activities well into FY 2009. The $3 million request for FY 2009 will be sufficient to continue critical activities during the remainder of the fiscal year.

Q10. Section 999 provides for the establishment and operation of a technical committee that, among other duties, will ensure that the research activities of NETL and RPSEA are not duplicative.

a. Has a technical committee been established and what are the roles of the DOE and RPSEA on that committee?

b. Should there not be a greater degree of communication between NETL and RPSEA, perhaps even including establishing a small NETL office near RPSEA?

A10. No response given.

Q11. Does the FY09 budget for concentrating solar power include increased funding for research in thermal energy storage?

A11. Out of the approximately $30 million appropriated for Concentrating Solar Power (CSP) in FY 2008, $10 million is being directed at thermal energy storage, for R&D at the national labs and in preparation for an upcoming solicitation this fiscal year directed at thermal energy storage at both universities and private industry. Within the FY 2009 budget request for CSP, DOE will continue to fund thermal storage R&D activities.

Q12. The wind program in DOE's Office of Energy Efficiency and Renewable Energy has articulated a specific goal of wind power providing 20 percent of the electricity in the United States. Is there a comparable goal for solar?

A12. Contributing 20 percent of electricity from wind is not a goal, but rather a recognition of the potential for wind energy in the United States. The specific DOE goals for solar energy are for PV to be cost-competitive in residential and commercial markets by 2015 and for CSP to be cost-competitive in intermediate power markets by 2015 and baseload power markets by 2020.

Questions submitted by Representative Daniel Lipinski

Q13. When Congress restored funding to many programs the President proposed to cut or eliminate in the FY 2008 omnibus appropriations bill, there was not enough money to fund the ACI. DOE's High Energy Physics program, which funds Fermilab, was cut by eight percent below the FY 2007 level—a real cut with real consequences. On February 1st, Fermilab began unpaid rolling furloughs of its 1900 scientists, engineers, technicians and support staff. On February 5, Fermilab began the process of laying off 200 people from the lab given the budget for FY 2008 and outlook into FY 2009. We are losing the best and brightest scientists and sending a chilling message to our university students choosing a career path when we need more scientists.

What is the Administration doing internally to help minimize the impacts of the final FY 2008 appropriations bill on Fermilab?

A13. Specified reductions for the HEP program in the FY 2008 appropriations bill were directed at initiatives that supported a significant number of staff members at Fermilab and the Stanford Linear Accelerator Center (SLAC). The magnitude of the reductions, and the fact that they occurred a quarter into the fiscal year, necessitated reductions in staff and curtailment of planned facility operations. The Office of Science worked with Fermilab and SLAC management to mount a scientifically productive program while retaining the most critically needed staff. Funding was allocated to optimize scientific output by running a curtailed four month program at the B–Factory at SLAC and the full scheduled program of the Tevatron Collider and neutrino beams at Fermilab in FY 2008. This allowed the students, post-docs, and researchers in the international collaborations at these two facilities to obtain important scientific results without negatively impacting their careers. Although reductions in staff were unavoidable, this plan reduced the number that were required, by reducing the payroll burden through the use of the "rolling furloughs" at Fermilab. These furloughs allow for the retention of many highly skilled staff, who would otherwise have to be laid off, and indicate the value and importance of these staff to Fermilab and the Office of Science.

Q14. Dr. Orbach, High Energy Physics is an international field with great collaboration. The field will soon be focused on the Large Hadron Collider coming into operation in Switzerland and operations at the Tevatron at Fermilab will wind down by the end of the decade.

The future for Fermilab belongs in new projects, which must be accelerated, including the NOvA neutrino program done jointly with Fermilab and the State of Minnesota and a new project (project X) which will pave the way to develop the technology for the proposed International Linear Collider. The FY 2008 omnibus appropriations bill essentially halted investment in future projects at Fermilab.

Does the Administration expect to submit a reprogramming request or a supplemental request to address the FY 2008 funding shortfall for High Energy Physics? What can we do together to reduce the serious impacts on Fermilab and our other research laboratories and facilities?

A14. There has been no administration decision to request supplemental FY 2008 funding within the Office of Science. In light of significant FY 2008 impacts throughout the Office of Science, and standing Congressional guidance on reprogrammings that they should not be used to change program allocations specifically limited by Congress, no reprogramming into High Energy Physics from other Office of Science funding is planned. We have worked to optimize activities within the overall allocation for High Energy Physics consistent with the limitations imposed by the FY 2008 omnibus appropriations bill. We urge your support of the FY 2009 request, which, among other priorities, strongly supports Fermilab and other Office of Science facilities.

Q15. Does the Administration have any flexibility internally to keep the research teams on these new projects at Fermilab together and working toward these new initiatives? What is the Administration's commitment to these future programs for Fermilab in the FY 2009 budget?

A15. The NOvA project management team has been kept together, using FY 2007 carryover funds, to prepare a new project schedule that fits the funding profile developed for the FY 2009 budget. While these funds should be sufficient to complete the technical, cost, and schedule baseline required for approval of DOE Critical Decision 2, progress beyond CD–2 cannot be made within the FY 2008 funding allocation. While some R&D activities have continued on future initiatives such as "Project X," the significant reduction in developing infrastructure for testing superconducting RF accelerator structures, important for this project, has limited progress.

The FY 2009 Budget Request supports the fabrication of NOvA and provides sufficient funding for superconducting RF and general accelerator development R&D to make significant progress towards a future neutrino accelerator program at Fermilab.

Q16. It is widely recognized that there is great urgency in proving the viability of near-zero emission coal-fueled power including carbon capture and sequestration. Your alternative plan throws away nearly five years of excellent work and builds in an extra three years of delay (based on your official announcement). How do justify such delays?

A16. No response given.

Q17. In March of 2007, DOE signed a cooperative agreement with industry to build FutureGen. That's a contract. DOE reviewed the project cost estimate before signing the agreement, and the costs have not changed a single dollar since you signed the agreement. By choosing to restructure, DOE is essentially reneging on its commitment. Why should anybody believe DOE is a worthy partner?

A17. No response given.

Q18. By attempting to reinvent FutureGen, DOE is telling companies that operate on six continents to take your money and go home—we were just kidding. Industry was contributing approximately $400 million dollars with zero expectation of profit. The project was global flagship and numerous foreign governments were interested in becoming involved. DOE's proposal conveys to them "we are switching horses," and we are not reliable partners.

The very same week DOE proposed killing FutureGen, the Bush Administration at the Meeting of Major Economies was trying to convince other countries that international collaboration on climate technology is important. How do you explain this seeming contradiction? I think DOE is in the process of embarrassing us in front of the world and undermining our ability to build future partnerships.

A18. No response given.

Q19. DOE has asserted it wants to control costs, yet your new proposal is advertised as having the same or higher costs. The DOE fact sheet suggests $1.313 in appropriations will be required by the new plan. When asked by a reporter what guarantees your department can provide that costs of the alternative plan won't skyrocket, no guarantees could be offered. What is your real motivation for attempting to terminate FutureGen? It doesn't seem to be cost.

A19. No response given.

Q20. The department has extensive detail on FutureGen costs, as currently configured. What detail do you have on the proposed cost of $1.313 for your alternative plan?

A20. No response given.

Questions submitted by Representative Roscoe Bartlett

Q21. In order for the United States to expand the use of commercial nuclear power, an expansion which I strongly support, it will be necessary to increase the number of trained and certified nuclear engineers and technicians. That is why I was extremely disappointed when the Department of Energy chose two years ago to propose termination of the existing University program within the Office

of Nuclear Energy. While the department continued providing applied R&D funding to universities through its GNEP program, the lack of basic stewardship support and organizational accountability has had a tangibly negative impact on nuclear engineering programs and research reactors around the United States, including at the University of Maryland, College Park.

In its FY 2009 budget submission, the department has apparently rethought the need to be a steward of the U.S. University-based nuclear education enterprise. The FY 2009 budget again recommends elimination of funding for the University Reactor Infrastructure and Education Assistance program. However, it also includes directions to the Office of Nuclear Energy, through its Energy Research Initiative process, to designate at least 20 percent of the R&D appropriated funds for purposes of supporting R&D activities at university research institutions through competitive awards focused on advancing nuclear energy technology.

The budget justifications also highlight the department's intention to support investigator-initiated basic research, fellowships and young faculty awards, and infrastructure and equipment upgrades for University-based research reactors and laboratories.

a. Who within the Office of Nuclear Energy will be responsible for management of DOE-funded R&D activities at university research institutions?

b. How does the department intend to allocate these funds?

c. Will there be University-specific solicitations?

d. Will these solicitations be peer-reviewed?

e. How much of the 20 percent will be dedicated to mission-specific applied R&D?

A21. No response given.

Appendix 2:

Additional Material for the Record

STATEMENT OF CLARENCE H. "BUD" ALBRIGHT, JR.
UNDER SECRETARY
U.S. DEPARTMENT OF ENERGY

Chairman Lampson and Ranking Member Inglis, and Chairman Gordon and Ranking Member Hall, and Members of the Committee, I am pleased to be before you today presenting the President's fiscal year (FY) 2009 budget proposal for the Department of Energy's applied science research and development programs. The strength and prosperity of America's economy is built on the security of our nation and the reliability of energy sources. Since 2001, the Administration has committed $183 billion through the Department of Energy (DOE) to help drive America's economic growth, provide for our national security, and address the energy challenges that face our nation. The FY 2009 budget was developed to continue to meet these goals and does so in part through funding applied science and energy research and development.

With a request of $3.2 billion, a 24 percent annual increase of $623 million above the FY 2008 enacted $2.5 billion appropriation, the President's Advanced Energy Initiative (AEI) will continue to support clean energy technology breakthroughs that will help improve our energy security through diversification and help to reduce our dependence on foreign oil. The FY 2009 budget for AEI includes funding to promote the licensing of new nuclear power plants as well as research on an advanced nuclear fuel cycle. Also, the AEI's diverse energy portfolio includes investment in making solar power cost-competitive with conventional sources of electricity by 2015 and supports a robust vehicle technology program that includes developing lithium-ion batteries, plug-in hybrids, and drive-train electrification.

The Department is also requesting funds to improve our conventional sources of energy. We are partnering with industry to commercialize coal gasification and carbon sequestration processes and systems, and we are working to modernize the electricity delivery system, enhance the security and reliability of America's energy infrastructure, and to facilitate recovery from disruptions to energy supply.

It is important to remember that scientific breakthroughs and innovative solutions to our energy challenges cannot simply be mandated, produced and bought. They must be cultivated from a rich array of interdisciplinary knowledge. The scientists and engineers at the Department's applied science and energy laboratories and programs have this knowledge, and their work to discover tomorrow's efficient and clean and secure technologies, and the science that produce them, must be understood unique capability that is unparalleled. Funding these laboratories and the programs they work with at the President's request is vitally important if we are to overcome America's energy challenges.

The 2009 AEI Budget includes:

- $588 million for the Coal Research Initiative, R&D focused on coal gasification and carbon sequestration processes and systems, including $156 million for the restructured FutureGen program to demonstrate these technologies;
- $543 million for the GNEP and Nuclear Power 2010 initiatives to demonstrate advanced fuel cycle technologies, to expand the domestic use of nuclear power, and to provide for safe, environmentally responsible global nuclear energy systems that support nonproliferation objectives;
- $225 million for biomass science and technology R&D to help enable cellulosic ethanol to become practical and competitive;
- $156 million for solar science and technology R&D to accelerate development of cost-effective photovoltaic materials;
- $146 million for R&D on hydrogen fuel cells and affordable hydrogen-powered cars;
- $103 million for R&D of hybrid electric systems including $49 million for high-energy, high-power batteries for hybrid-electric and "plug-in" hybrid vehicles;
- $53 million for wind energy research to help improve the efficiency and lower the costs of wind technologies for use in low-speed wind environments;
- $30 million for geothermal research.

APPLIED SCIENCE ENERGY PROGRAMS

A. OFFICE OF NUCLEAR ENERGY (NE)

The Office of Nuclear Energy leads the government's efforts to develop, in cooperation with industry, new nuclear energy generation technologies to meet energy and climate goals; develop advanced, nuclear fuel cycle technologies that maximize energy from nuclear fuel and strengthen the nuclear nonproliferation regime; and maintain and enhance the national nuclear infrastructure. A key mission of DOE's nuclear energy research and development program is to lead in the planning, conducting, and deploying the next generation of nuclear technologies.

The President's commitment to nuclear power stems from its role as one of the most feasible near-term options for producing significant amounts of carbon-free, baseload electricity. The expansion of nuclear power will play a key role in our decisions to find viable solutions to address the challenges posed by greenhouse gas emissions, climate change, and energy security.

It is significant to note that this Administration has increased its funding request for nuclear energy in every year, and in total, the FY 2009 request represents a 330 percent increase in funding for nuclear energy since President Bush took office seven years ago. In FY 2009, a total of $1.4 billion is requested for nuclear energy activities, an increase of $385 million over the FY 2008 appropriation, including $487 million for the Mixed Oxide Fuel Fabrication Facility.

Today, 104 nuclear reactors produce nearly 20 percent of our total electricity—this 20 percent share represents over 70 percent of all non-carbon emitting electricity production. In the United States, seventeen utility companies are projected to build thirty-one new reactors, when completed, these new nuclear power plants will provide over 41 GWe of electricity, enough to power 30 million homes.

Worldwide, 31 countries operate 439 reactors totaling 372 GWe of electricity capacity. Thirty-four new nuclear power plants are under construction worldwide, and when completed will add an estimated 28 GWe of new electricity. This new construction is taking place or being considered in every major region in the world including Africa, Asia and the Indian subcontinent, Europe, the Middle East, South America, and North America. Nuclear power's ongoing expansion around the world that requires us to address the used fuel and proliferation challenges that confront the global use of nuclear energy. To ensure that the United States plays a significant role in global nuclear energy policy we must foster domestic actions that support a significant role for nuclear power in our energy future, a robust nuclear research and development program, and a cutting-edge nuclear technology infrastructure and international actions that support reliable nuclear fuel services to countries that forego the development and deployment of enrichment and reprocessing technologies. To meet these challenges, the President initiated the Global Nuclear Energy Partnership (GNEP). The domestic component of GNEP promotes the accelerated development and deployment of advanced fuel cycle technologies, while the international component encourages cooperation among nations that share the common vision of the necessity of the expansion of nuclear energy for peaceful purposes worldwide in a safe and secure manner.

We have made progress in every one of our program areas, but much remains to be done. Our FY 2009 budget request moves us in the right direction, allowing the Department and the Office of Nuclear Energy to take the lead in spurring the nuclear renaissance in the United States. I would now like to take the time to highlight our program areas and their corresponding budget requests. 1Nuclear Power 2010

A key component of our work and one of our most successful programs at the Department of Energy is the Nuclear Power 2010 program or NP 2010. This program was initiated by President Bush in 2002 and has produced significant results toward its goal of reducing the technical, regulatory, and institutional barriers to the deployment of new nuclear power plants. DOE and the President have increased our commitment to cross the finish line by nearly doubling its 2009 budget, calling on Congress to provide $241.6 million for NP 2010 to help ensure this important program can complete its work.

NP 2010 supports industry through cost-sharing near-term technology development and regulatory demonstration activities focused on enabling an industry decision to build a new nuclear plant by 2010.

Of the six Construction and Operation License (COL) applications that have been submitted to the Nuclear Regulatory Commission (NRC), five COL applications have been officially accepted for review by the NRC. And of these five, two applications—TVA's application for two Westinghouse AP1000 reactors at the Bellefonte site in Alabama, and Dominion Energy's application for a General Electric-Hitachi Economic Simplified Boiling Water Reactor at the North Anna site in Virginia—were

developed through the NP 2010 cost-share program. In total, the NRC expects to receive twenty COL applications for thirty-one new reactors by seventeen different utility companies. Of these 20 COL applications, eight will reference either the Bellefonte or North Anna license applications. This simplification in the licensing process is expected to reduce the license application and review time these reference COLAs by up to 50 percent.

Three early site permits have been approved for Exelon's Clinton site in Illinois, Entergy's Grand Gulf site in Mississippi, and the North Anna site, all a part of the NP 2010 cost share program, and a fourth ESP permit is pending. In addition, two new reactor design certifications have been approved by the NRC, the ABWR and the AP1000, and DOE is continuing with on-going first-of-a-kind design finalization activities for the standardized AP1000 and ESBWR designs, including: preparation of engineering analyses and calculations, design criteria documents, and total cost and schedule estimates necessary for an industry purchase of a new nuclear plant.

The NP 2010 program will continue to develop generic application preparation guidance for fifteen COL applications expected in 2008 to help resolve regulatory issues that could potentially delay or derail NRC approval.

Advanced Fuel Cycle Initiative and GNEP

President Bush announced the Global Nuclear Energy Partnership (GNEP) as part of his Advanced Energy Initiative in February 2006. The Advanced Fuel Cycle Initiative (AFCI) is the domestic technology development and deployment component of GNEP. The AFCI program aims to develop and demonstrate advanced fuel cycle technologies for recycling used reactor fuel to develop an integrated used fuel recycling plan, and support on-going research efforts with the goal of reducing the amount of material that needs disposal in a geologic repository and maximizing our use of energy resources.

In effort to further this important work, our budget request includes $301.5 million in Fiscal Year 2009 funding for AFCI. This request supports research and development activities that will advance the economic and sustained production of nuclear energy while reducing waste and satisfying requirements for a controlled nuclear materials management system that helps strengthen the nuclear nonproliferation regime. The request also supports on-going international activities to establish a framework for ensuring reliable international fuel services and the availability of grid-appropriate reactors, and the continued utilization of industry for schedule, cost, and technology developments for eventual recycling facility deployment.

Long-term goals of AFCI/GNEP include the partitioning of used fuel and recycling of long-lived radioactive isotopes for destruction through transmutation in liquid metal-cooled fast neutron spectrum reactors for actinide consumption and nuclear resource sustainability.

AFCI/GNEP funding also provides support for a large number of universities involved in fuel cycle research and development, which both ensures that the U.S. has the intellectual capital needed to sustain our nuclear fuel cycle for the future and provides the important research needed for today's fuel cycle activities. Recycling used nuclear fuel rather than permanently disposing of it in a repository would result not only in utilizing more of the energy, but would also reduce the amount of high-level waste that needs disposal in a repository, thereby greatly enhancing the potential capacity of any geological repository. This increased efficiency in the fuel supply could ensure that even with the expansion of nuclear energy, the potential capacity of any geological repository would be greatly enhanced.

Generation IV

The Generation IV program is focused on very high temperature reactor technologies for use in a Next Generation Nuclear Power Plant (NGNP) to produce electricity, process heat, and hydrogen. Generation IV also is readying technologies that will further improve the economics and safety performance of existing Light-Water Reactor and advanced Generation IV reactor concepts.

The FY 2009 budget request includes $70 million for the Generation IV program. The *Energy Policy Act of 2005* (EPACT) authorized the Department to create a two-phased NGNP Project at the Idaho National Laboratory (INL). The Department is presently engaged in Phase I of the EPACT-defined scope of work, which includes: developing a licensing strategy, selecting and validating the appropriate hydrogen production technology, conducting enabling research and development for the reactor system, determining whether it is appropriate to combine electricity generation and hydrogen production in a single prototype nuclear reactor and plant, and establishing key design parameters. Phase I will continue until 2011, at which time the Department will evaluate the need for continuing into the design and construction activities called for in Phase II.

Additionally, this request supports component and material aging and degradation research and development that will provide the basis for extending the operating license period for existing nuclear reactors beyond 60 years, and will also enable the design of advanced reactor concept plants with longer operating life spans.

Hydrogen Initiative

Nuclear energy has the potential to produce large quantities of hydrogen efficiently without producing greenhouse gases and could play a significant role in hydrogen production for transportation and industrial sectors. Considerable progress in hydrogen combustion engines and fuel cells is bringing hydrogen-powered transportation close to reality. The goal of the Nuclear Hydrogen Initiative (NHI) is to demonstrate hydrogen production technology at increasingly larger scales through the use of nuclear energy that would be technically and economically suited for commercial deployment in concert with a nuclear power plant.

$16.6 million dollars has been requested for the NHI to continue hydrogen production systems operation and testing, evaluation of process improvements, and assessment of long-term process stability, operability, and component durability. Furthermore, results from the integrated laboratory-scale experiments will be analyzed to identify cost drivers with an end goal of supporting a hydrogen technology selection by 2011.

Nuclear Facilities

The Department of Energy supports nuclear science and technology through one of the world's most comprehensive research infrastructures. The Office of Nuclear Energy has requested $222 million dollars to maintain and operate infrastructure at Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Brookhaven National Laboratory (BNL), and Oak Ridge National Laboratory (ORNL). $104.7 million is dedicated to Idaho National Laboratory's facilities management. INL conducts science and technology research across a wide range of disciplines, INL's core missions include: development of advanced, next generation fuel cycle and reactor technologies; promotion of nuclear technology education, and applying technical skills to enhance our nation's security.

Additionally, $38.7 million is requested to maintain a wide range of nuclear and radiological facilities and their associated infrastructures in an operational, safe, secure, and environmentally compliant manner at LANL, BNL, and ORNL. This infrastructure supports national priorities, including the provision of radioisotope power systems for national security uses and space exploration.

Other Defense Activities

Included in the Office of Nuclear Energy Fiscal Year 2009 request, under Other Defensive activities, is $487 million for activities associated with the continued construction of the Mixed Oxide Fuel Fabrication Facility and $78.8 million for sitewide safeguards and security activities at the Idaho National Laboratory to protect the assets and infrastructure from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts that may cause unacceptable adverse impacts on national security, program continuity, or the health and safety of employees, the public, or the environment.

University Funding

Our FY 2009 budget request continues our commitment to fostering the expansion of nuclear engineering programs at our universities and research institutions. Specifically, the budget request for the Office of Nuclear Energy explicitly states that we "will continue to support R&D activities at universities and research institutions through competitive awards focused on advancing nuclear energy technologies," and we have committed to "designate 20 percent of funds appropriated to its R&D programs for work to be performed at university and research institutions." These funds will support basic research and mission-specific applied R&D activities, as well as human capitol development activities, such as fellowships and infrastructure and equipment upgrades for university-based research reactors and laboratories. At the level set forth in the President's Budget Request for FY 2009, 20 percent provides almost $77 million for this work. This commitment of 20 percent of appropriated funds will serve as a catalyst for success in achieving the objectives of the President's American Competitiveness Initiative and the *America COMPETES Act.*

It is critical to note that the growth of nuclear power is only possible if we continue to develop a responsible path for disposing of spent nuclear fuel. Therefore, $494.7 million is requested in FY 2009 for the continued development of the geologic waste repository at Yucca Mountain, Nevada, and to support the defense of the License Application that we will submit in 2008 to the Nuclear Regulatory Commission for authorization to construct the repository.

B. OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY (EE)

The Office of Energy Efficiency and Renewable Energy (EERE) conducts research, development, and deployment activities in partnership with industry to advance a diverse supply of energy efficiency and clean power technologies and practices. The FY 2009 budget request continues to support research on alternatives that can help decrease our nation's dependence on foreign oil and accelerate development of clean electricity supply options.

EERE's FY 2009 request of $1.255 billion, approximately $19 million higher than the FY 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 to that can help increase the amount of clean energy produced in the U.S.; advance energy efficiency technologies and practices to sustainably decouple energy demand from economic growth; and promote deployment of these clean energy technologies.

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 multi-pronged approach to energy solutions.

BIOMASS PROGRAM

In FY 2009, the Department is requesting $225 million for the Biomass Program, an increase of $26.8 million from the FY 2008 appropriation. The Biomass Program's funding supports the Biofuels Initiative that was launched in 2006 as part of 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.

The Biomass Program's funding request for technology development and demonstration supports timely achievement of the goal of cost-competitiveness by 2012. The Biomass 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 Biomass 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 Biomass Program will continue to emphasize cellulosic ethanol and expand the focus on other renewable biofuels, such as biobutanol and green diesel.

VEHICLE TECHNOLOGIES PROGRAM

The FY 2009 Vehicle Technologies (VT) Program's request is $221.1 million, an $8 million increase over the FY 2008 appropriation.

The 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 FY 2009, emphasis will increase R&D for PHEVs, such as high energy storage batteries.

The VT 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. For more traditional vehicles, the program conducts research and development on improving advanced combustion engine systems and fuels and on reducing vehicle parasitic losses. The Vehicle Technologies budget is modified in the FY 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 VT Program, and combining them within one program enables management efficiencies.

The VT Program will continue FY 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 mate-

rials impacts. These efforts help support existing mandates and the President's 20 in 10 plan.

HYDROGEN TECHNOLOGY PROGRAM

The Hydrogen Technology Program's FY 2009 budget request is $146.2 million, $64.8 million less than the FY 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, funding for hydrogen production from renewables has been eliminated, and systems analyses continues at a somewhat reduced funding levels.

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. All storage R&D funding will be conducted through competitively selected 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 FY 2009 request significantly increases funding for Fuel Stack Components R&D. Our R&D efforts have made progress in this area and will continue to work toward our stated goals. One notable achievement has been the 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 FY 2009 budget request for the Solar Energy Program is $156.1 million, $12.3 million less than the FY 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 by conducting R&D to support 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 Solar 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 FY 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 FY 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 FY 2008, funds will be provided for Phase I of these contracts with the more promising contracts moving into Phase II in FY 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 FY 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 FY 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 FY 2009 request is $52.5 million, an increase of $3.0 million from the FY 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. The Wind Program's R&D efforts will focus on improving the performance of turbines, blades, and related components.

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 undermine the growth potential of wind energy in the U.S. by focusing on improving cost, performance, and reliability of large scale land-based technology.

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.

In 2009 the Wind Program will also work on grid integration to help maximize wind energy resource utilization, thereby beginning to address a barrier to increasing the domestic wind energy supply while also 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 FY 2008. The program needs to evaluate the results of its FY 2008 R&D projects and technology assessments (which will continue into FY 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 with key collaborative international activities.

GEOTHERMAL TECHNOLOGY PROGRAM

The FY 2009 request for the Geothermal Technology Program is $30 million, which is an increase of $10.2 million from the FY 2008 appropriation. The Geothermal Program focuses on the innovative technology of Enhanced Geothermal Systems (EGS) which are engineered reservoirs created to produce energy from geothermal resources. 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 viable production rates and lifetimes. The Department's approach will to concentrate initially on reservoir-related technological issues. This strategy involves research as well as work 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.

BUILDING TECHNOLOGIES PROGRAM

The Building Technologies (BT) Program's FY 2009 request is $123.8 million, an increase of $14.8 million from the FY 2008 appropriation. The BT Program develops technologies, techniques, and tools for making residential and commercial buildings more energy efficient 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 BT 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 BT Program aim to transform the carbon footprint of the built environment through Zero Energy Buildings. The residential-focused Building America subprogram focuses on reducing total energy use in a new home by 60 to 70 percent. During FY 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 BT Program's activities in the commercial sector are focused on alliances of leading market companies with national portfolios of buildings.

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 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 U.S. consumption of primary energy was about 103 quads). Between FY 2005 and FY 2007, the Department identified and carried out significant enhancements to rule-making activities. The Department has made a commitment to clear the backlog of delayed actions that accumulated during prior years, while simultaneously implementing two new requirements of the *Energy Policy Act of 2005* (EPACT). The *Energy Independence and Security Act* significantly increased the number of efficiency standards and test procedures DOE must develop. The Department will continue to implement productivity enhancements that will allow multiple rule-making activities to proceed simultaneously, while maintaining the rigorous technical and economic analysis required by statute. Energy conservation standards for 10 products were initiated in FY 2006 and 2007 that will continue in FY 2009. In FY 2008, efficiency standards rule-makings were initiated on four additional products. In FY 2008, DOE is proceeding simultaneously on rule-makings for 15 products and 10 test procedures. In FY 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 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 BT 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 BT 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 (IT) 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. The program works to increase dissemination of energy efficiency technologies and operating practices. The FY 2009 Budget request for the IT Program is $62.1 million, which is $2.3 million less than the FY 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 cross-cutting and higher impact R&D activities will allow the IT Program to develop advanced, energy-efficient technologies to serve a broader set of industries.

The IT 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.

Building on this success, the IT Program 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.

C. OFFICE OF FOSSIL ENERGY (FE)

The Office of Fossil Energy (FE) conducts research, development and demonstration activities in partnership with industry to enhance U.S. economic, environmental and energy security by using conventional hydrocarbon sources of fuel. To further this mission, the Office is developing technological capabilities that could dramatically reduce carbon emissions to achieve near-zero atmospheric emissions power production. FE's budget request of $1.127 billion for FY 2009 is an increase of $223 million over the FY 2008 appropriation, of which $754 million supports research and development and $373 million supports petroleum reserves.

The Department's energy portfolio recognizes the abundance of coal as a domestic energy resource and remains committed to research and development to promote its clean and efficient use. Since coal in the United States accounts for 25 percent of the world's coal resources, the FY 2009 request focuses on carbon capture and storage.

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

The Department's Fossil Energy Research and Development (FERD) program is directed at electric power generation from coal, our most abundant and lowest cost domestic fossil fuel. Coal today accounts for nearly one-quarter of all the energy—and about half the electricity—consumed in the United States.

FERD supports many Presidential initiatives and priorities including the Coal Research Initiative, Hydrogen Fuel Initiative, and FutureGen. FERD also supports the Climate Change Technology Program, which is a priority for the Department.

FUTUREGEN

FutureGen promotes advanced, full-scale integration of integrated gasification combined cycle (IGCC) and carbon capture and storage technology to produce electric power from coal while capturing and sequestering carbon dioxide (CO_2), resulting in near-zero atmospheric emissions coal energy systems. The Department is restructuring FutureGen in a way that accelerates the commercial demonstration and deployment of carbon capture and storage technologies.

The new approach proposes multiple 300–600 Megawatt (MW) commercial-scale demonstration clean coal power plants—as opposed to a single, 275 MW R&D facility—each producing electricity and capturing and safely sequestering at least an estimated annual one million metric tons of CO_2. In the FY 2009 budget proposal, FutureGen receives an $81.7 million funding increase over the FY 2008 appropriation.

CLEAN COAL POWER INITIATIVE

The Clean Coal Power Initiative (CCPI) is a cooperative, cost-shared program between the government and industry to demonstrate advanced coal-based power generation technologies. CCPI is now focused on projects to help accelerate development and deployment of coal technologies that could economically capture carbon dioxide, including increasing the efficiency and reliability of carbon capture technologies. CCPI allows the Nation's power generators, equipment manufacturers, and coal producers to help identify the most critical barriers to coal use and the most promising advanced technologies to use coal cleanly, affordably, and with higher efficiencies that reduce carbon intensity.

The CCPI budget request for FY 2009 is $85 million, a $15.6 million increase over the FY 2008 appropriation. In FY 2009 will complete the third round of project solicitations, proposal evaluations, and project selections of advanced technology systems that capture carbon dioxide for sequestration or beneficial reuse.

CARBON SEQUESTRATION

The FY 2009 budget request of $149 million for carbon sequestration, one of the key components of the Fuel and Power Systems program, is an increase of $30 million over the $119 million provided in the FY 2008 appropriation.

The increase should help develop economical ways to separate and permanently store (sequester) greenhouse gas emissions from the combustion of fossil fuels. The technologies will help existing and future fossil fuel power generating facilities by reducing the cost of electricity impacts and also providing protocols for carbon capture and storage demonstrations to capture, transport, store, and monitor the CO_2 injected in geologic formations.

The increase will support site selection and characterization, regulatory permits, community outreach, and completion of site operations plan for large-scale, geologic, carbon storage tests. It will also fund large-scale injections and remaining infrastructure development.

HYDROGEN

The budget request of $10 million in FY 2009 for hydrogen from coal—a clean fuel for future advanced power technologies such as fuel cells and transportation systems—is down nearly $15 million from the FY 2008 appropriation. The decrease is due to the elimination of integrated coal-biomass processing for carbon emissions research (which is generally advanced through the gasification program), elimination of substitute natural gas and coal-to-liquids production research (which are mature industries and do not provide the high-return investment that FE focuses on), and a right-sizing of the effort level for early engineering and design studies on hydrogen production modules in near-zero atmospheric emissions coal plants.

GASIFICATION TECHNOLOGY

The Integrated Gasification Combined Cycle (IGCC) budget request for FY 2009 is $69 million, a $15.5 million increase over the FY 2008 appropriation. The IGCC program develops advanced gasification-based technologies aimed at reducing the cost of coal-based IGCC plants, improving thermal efficiency, and achieving near-zero atmospheric emissions of all pollutants. These technologies will be an integral part of the carbon capture and storage demonstration projects.

FUEL CELLS

Flexible fuel cell systems that can operate in central coal-based power systems and with applications for electric utility, industrial and commercial/residential markets, receive a funding request of $60 million in FY 2009—a $4.5 million increase over the FY 2008 appropriation of $55.5 million. This activity enables the generation of highly efficient, cost-effective electricity from domestic coal with near-zero atmospheric emissions of carbon and air pollutants in central station applications. The technology also provides the technology base to permit grid-independent distributed generation applications.

OIL AND NATURAL GAS TECHNOLOGY

Oil and gas R&D activities are more appropriate for the private-sector industry to perform. Consistent with the budget requests for Fiscal years 2006, 2007 and 2008, the Petroleum-Oil Technology and Natural Gas Technologies research and development programs are being terminated in FY 2009.

The Ultra-Deepwater and Unconventional Gas and Other Petroleum Research Fund was created by the *Energy Policy Act of 2005* (Public Law 109–58) as a mandatory program beginning in FY 2007. The program is funded from mandatory federal revenues from oil and gas leases. Consistent with the Fiscal Year 2007 and 2008 budget requests, the FY 2009 budget proposes to repeal the program through a legislative proposal.

D. OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY (OE)

The mission of the Office of Electricity Delivery and Energy Reliability (OE) is to lead national efforts to modernize the electricity delivery system, enhance the security and reliability of America's energy infrastructure, and facilitate recovery from disruptions to energy supply. These functions are vital to the Department's strategic goal of protecting our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally responsible energy.

The President's FY 2009 budget includes $134 million for OE in FY 2009, which is a decrease of $4.6 million from the FY 2008 appropriation. This includes $14.1 million for Operations and Analysis activities (an increase of $2.7 million from the FY 2008 appropriation), and $19.7 million for Program Direction (an increase of $2.1 million from the FY 2008 appropriation).

ELECTRICITY DELIVERY RESEARCH AND DEVELOPMENT

In FY 2009, the Department is requesting $100.2 million for Research and Development activities, a decrease of $9.3 million from the FY 2008 appropriation. Effort is focused in four critical areas: High Temperature Superconductivity; Visualization & Controls; Renewable & Distributed Systems Integration; and Energy Storage & Power Electronics.

Our High Temperature Superconductivity activities continue to support second generation wire development as well as research on dielectrics, cryogenics, and cable systems. This activity is being refocused to address a near-term critical need within the electric system to not only increase current carrying capacity, but also to relieve

overburdened cables elsewhere in the local grid. The superconductivity industry in the United States is now at the critical stage of moving from small business development to becoming a part of our manufacturing base. The FY 2009 funding request for High Temperature Superconductivity is $28.2 million, an increase of $0.3 million from the FY 2008 appropriation.

Enhanced security for control systems used by the transmission grid is critical to the development of a more reliable and resilient modern grid. The Visualization and Controls Research & Development activity focuses on improving our ability to measure and address the vulnerabilities of controls systems, detect cyber intrusion, implement protective measures and response strategies, and sustain cyber security improvements over time.

This activity is also developing the next generation system control and data acquisition (SCADA) system that features GPS-synchronized grid monitoring, secure data communications, custom visualization and operator queuing, and advanced control algorithms. Advanced visualization and control systems will allow operators to detect disturbances and take corrective action before problems cascade into widespread outages. The need to improve electric power control systems security is well-recognized by both the private and public sectors. The FY 2009 funding request for Visualization & Controls is $25.3 million, an increase of $0.2 million from the FY 2008 appropriation.

The Energy Storage & Power Electronics activities support the development of new and improved energy storage devices and systems at utility scale, which will be incorporated in DOE's Basic Energy Science basic research results. The Department will also work to achieve substantial improvements in seeking lifetime, reliability, energy density, and cost of energy storage devices. Through this, highly leveraged prototype testing and utility demonstration projects will be expanded with State energy office participation focusing on areas of greatest utility need. The increase will also serve to focus on enhanced research in Power Electronics to improve material and device properties needed for transmission-level applications. The FY 2009 funding request for the Energy Storage and Power Electronics program is $13.4 million, an increase of $6.7 million from the FY 2008 appropriation.

Large scale, megawatt-level electricity storage systems, or multiple, smaller distributed storage systems, could significantly reduce transmission system congestion, manage peak loads, make renewable electricity sources more dispatchable, and increase the reliability of the overall electric grid. The FY 2009 funding request for Energy Storage & Power Electronics is $13.4 million, an increase of $6.7 million from the FY 2008 appropriation.

The Renewable and Distributed Systems Integration activities will develop and demonstrate Smart Grid technologies for an integrated and intelligent electric transmission and distribution network in accordance with the *Energy Independence and Security Act;* will demonstrate distributed energy systems as a resource to decrease peak electric load demand, increase asset utilization, and defer electric system upgrades; and in coordination with EERE, will develop renewable energy grid integration technologies and methods to facilitate increased deployment of renewables and other clean energy sources. The FY 2009 funding request for Renewable & Distributed Systems Integration is $33.3 million, an increase of $7.8 million from the FY 2008 appropriation.

CONCLUSION

I appreciate the opportunity to appear before you to present the Department of Energy's FY 2009 budget proposal for the applied energy programs' research and development efforts. I will be happy to take any questions that Members of the Subcommittee may have.

STATEMENT OF DR. RAYMOND L. ORBACH
UNDER SECRETARY FOR SCIENCE
U.S. DEPARTMENT OF ENERGY

Thank you Mr. Chairman, Ranking Member Inglis, 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. The President's budget request for FY 2009 is a strong demonstration of his 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 of 2005* (EPAct) and in following up with both the *America COMPETES Act* and the *Energy Independence and Security Act of 2007* (EISA).

EPAct 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. 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 U.S. 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 will enable revolutionary gains in production efficiencies and cost reduction.

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 FY 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 dis-

coveries which will fundamentally alter our approaches to energy production and use, and they will come from the next generation of scientists, mathematicians, and engineers—many trained through Office of Science-funded research and using world-leadership scientific research facilities we build and operate for the scientific community.

The Office of Science is accelerating the pace of discovery and innovation to address the Nation's energy needs through our multi-faceted 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 FY 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 U.S. 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 decision-makers 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, laboratories, 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 experi-

ment 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, increases 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 built and operated by the Office of Science 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 U.S. 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 ten, than any other neutron source in the world for research of materials and biological complexes. 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 FY 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 information that follows is an in-depth examination of the funding and activities of the Office of Science for FY 2009.

The following programs are supported in the FY 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
FY 2009 PRESIDENT'S REQUEST
SUMMARY BY PROGRAM

(dollars in thousands)

	FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request to Congress	FY 2009 Request to Congress vs. FY 2008 Approp.	
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*	23,794	70,435	——	-70,435	——
Total, Office of Science	3,836,613	3,973,142	4,721,969	+748,827	+18.8%

* Adjustments include SBIR/STTR funding transferred from other DOE offices (FY 2007 only), a charge to reimbursable customers for their share of safeguards and security costs (FY 2007 and FY 2008), Congressionally-directed projects and a rescission of a prior year Congressionally-directed project (FY 2008 only), and offsets for the use of prior year balances to fund current year activities (FY 2007 and FY 2008).

BASIC AND APPLIED RESEARCH & DEVELOPMENT COORDINATION

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 six areas are highlighted in the FY 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 life cycle; and power grid control. Such research could increase the likelihood for success 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 re-

quired 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 sub-surface 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 multiscale systems for ultra-long times.

High Energy Density Laboratory Plasmas: The Fusion Energy Sciences (FES) program supports basic reach 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 FY 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)

	FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request	FY 2009 vs. FY 2008	
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%

	(dollars in thousands)				
	FY 2007 Approp.	FY 2008 Approp.	FY 2009 Request	FY 2009 vs. FY 2008	
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 Radioactive 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%
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 Collaborations	195,433	248,742	415,108	166,366	+66.9%

OFFICE OF SCIENCE LABORATORY APPRAISALS

In 2006, the Office of Science revised the appraisal process it uses each year to evaluate the scientific, management, and operational performance of the contractors who manage and operate each of its 10 national laboratories. This new appraisal process went into effect for the FY 2006 performance evaluation period and provides a common structure and scoring system across all 10 Office of Science laboratories. The performance-based approach evaluates the contractor's performance against eight Performance Goals (three Science and Technology Goals and five Management and Operations Goals). Each goal is composed of two or more weighted objectives. The new process has also incorporated a standardized five-point (0–4.3) scoring system, with corresponding grades for each Performance Goal, creating a "Report Card" for each laboratory.

The FY 2007 Office of Science laboratory report cards have been posted on the SC website (*http://www.science.doe.gov/News_Information/News_Room/2007/Appraisa_%20Process/index.htm*).

SCIENCE PROGRAMS

BASIC ENERGY SCIENCES

FY 2008 Appropriation—$1,269.9 Million; FY 2009 Request—$1,568.2 Million

The Basic Energy Sciences (BES) program supports research that advances the core disciplines of basic energy sciences—materials sciences, chemistry, geosciences, and physical biosciences. The scientific discoveries at the frontiers of these disciplines impact energy resources, production, conservation, efficiency, and the mitigation of adverse impacts of energy production and use—discoveries that will help accelerate progress toward long-term energy security, economic growth, and a sustainable environment. Research in materials sciences will lead to the development of materials that improve efficiency, economy, environmental acceptability, and safety of energy generation, conversion, transmission, storage, and use. Research in chemistry will lead to the development of advances such as efficient combustion sys-

tems with reduced emissions of pollutants; new solar photo-conversion processes; improved catalysts for the production of fuels and chemicals; and better separations and analytical methods for applications in energy processes, environmental remediation, and waste management. Research in geosciences results in advanced monitoring and measurement techniques for reservoir definition and understanding the dynamics of complex fluids through porous and fractured subsurface rock. Research into the molecular and biochemical nature of photosynthesis aids the development of solar photo-energy conversion.

In FY 2009, BES will support expanded efforts in innovative basic research to accelerate scientific breakthroughs needed to create advanced energy technologies for the 21st century. Central to this effort is the initiation of Energy Frontier Research Centers that will pursue fundamental basic research areas such as solar energy utilization; catalysis for energy; electrical energy storage; geosciences related to long-term storage of nuclear waste and carbon dioxide; advanced nuclear energy systems; hydrogen production, storage, and use; solid state lighting; superconductivity; combustion of 21st century transportation fuels; and materials under extreme environments. The Office of Science seeks to engage the Nation's intellectual and creative talent to address the scientific grand challenges associated with determining how nature works and to lead the scientific community into a new era of science—where we are able to direct and control matter at the quantum, atomic, and molecular levels and harness this new knowledge and capability for some of our most critical real-world challenges. BES anticipates making awards to 20 to 30 Energy Frontier Centers in FY 2009, each supported at two to five million dollars per year for an initial period of five years.

BES also provides the Nation's researchers with world-class research facilities, including a reactor- and two accelerator-based neutron sources, four operating light sources plus two additional next-generation light sources under construction in FY 2009, five nanoscale science research centers, and three electron beam micro-characterization centers. These facilities provide important capabilities for fabricating, characterizing, and transforming materials of all kinds from metals, alloys, and ceramics to fragile bio-inspired and biological materials. The next steps in the characterization and the ultimate control of materials properties and chemical reactivity are to improve spatial resolution of imaging techniques; to enable a wide variety of samples, sample sizes, and sample environments to be used in imaging experiments; and to make measurements on very short time scales, comparable to the time of a chemical reaction or the formation of a chemical bond. With these tools, we will be able to understand how the composition of materials affects their properties, to watch proteins fold, to see chemical reactions, and to understand and observe the nature of the chemical bond. For FY 2009, BES scientific user facilities will be scheduled to operate an optimal number of hours.

The Spallation Neutron Source (SNS)—a next-generation, accelerator-based, short-pulse neutron source—completed its first full year of commissioning and operations in FY 2007. In FY 2009, fabrication and commissioning of SNS instruments will continue, funded by BES and other sources including non-DOE sources. Two Major Items of Equipment are funded in FY 2009 that will allow the fabrication of nine additional instruments for the SNS, thus nearly completing the initial suite of 24 instruments that can be accommodated in the high-power target station. SNS and the High Flux Isotope Reactor at Oak Ridge National Laboratory together provide capabilities unavailable anywhere else in the world for study of the position and motion of atoms in materials.

All five Nanoscale Science Research Centers will be fully operational in FY 2009: the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory, the Molecular Foundry at Lawrence Berkeley National Laboratory, the Center for Nanoscale Materials at Argonne National Laboratory, the Center for Integrated Nanotechnologies at Sandia and Los Alamos National Laboratories, and the Center for Functional Nanomaterials at Brookhaven National Laboratory. In FY 2009, funding for research at the nanoscale increases for activities spanning materials sciences, chemistry, geosciences, and physical biosciences.

The Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) will continue construction in FY 2009. Full support of the operation of the SLAC linac is provided by BES in FY 2009, completing the transition of linac funding from the High Energy Physics program to BES. The LCLS project will provide laser-like radiation in the x-ray region of the spectrum that is 10 billion times greater in peak power and peak brightness than any existing coherent x-ray light source and that has pulse lengths measured in attoseconds—the timescale of electronic and atomic motions. The LCLS will be the first such facility in the world for groundbreaking research in the physical and life sciences. Funding is provided separately for design and fabrication of instruments for the facility. Construction of the

Photon Ultra-fast Laser Science and Engineering (PULSE) building renovation continues in FY 2009. PULSE is a new center for ultra-fast science at SLAC focusing on ultra-fast structural and electronic dynamics in materials sciences, the generation of attosecond laser pulses, single-molecule imaging, and understanding solar energy conversion in molecular systems.

Support is provided for PED, R&D, and initiation of construction of the National Synchrotron Light Source–II (NSLS–II). NSLS–II will be a new synchrotron light source, highly optimized to deliver ultra-high brightness and flux with exceptional beam stability. This will enable the study of material properties and functions with a spatial resolution of one nanometer (nm), an energy resolution of 0.1 millielectron volt (meV), and the ultra-high sensitivity required to perform spectroscopy on a single atom, achieving a level of detail and precision never possible before. NSLS–II will open new regimes of scientific discovery and investigation.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

FY 2008 Appropriation—$351.2 Million; FY 2009 Request—$368.8 Million

The Advanced Scientific Computing Research (ASCR) program is expanding the capability of world-class scientific research by advancing fundamental mathematics and computer science research that enables simulation and prediction of complex physical, chemical, and biological systems; providing the forefront computational capabilities needed by researchers to enable them to extend the frontiers of science; and delivering the fundamental networking research and facilities that link scientists across the Nation to the Department-sponsored computing and experimental facilities. ASCR supports fundamental research and integrates the results of these efforts into tools and software that can be used by scientists in other disciplines. The applied mathematics research activity enables scientists to accurately model physical and natural systems, and provides the algorithms computers require to manipulate that representation of the world effectively. Computer science research provides the link between the mathematics and the actual computer systems. Scientific discovery results from simulations conducted on advanced computers. High performance networks and network research provide the capability to move the millions of gigabytes of data that SC's experimental and computational tools generate to the scientists' desktops. All of these elements supported by ASCR advance the frontiers of simulation and scientific discovery. ASCR and its predecessors have been leaders in the computational sciences for several decades and its activities are essential for research programs across SC and the Department.

In FY 2009, increases in core research in Applied Mathematics and Computer Science will be targeted on long-term research needs, including support for a new joint Applied Mathematics-Computer Science Institute to focus on the challenges of computing at extreme scales that blur the boundaries between these disciplines, a new effort in the mathematics of large data sets, areas of long-term research most relevant to meeting the challenges of computing at extreme scales, and risk assessment in complex systems. ASCR will also support a new basic research effort in cyber security for open science in FY 2009.

The Scientific Discovery through Advanced Computing (SciDAC) program is a set of coordinated investments across all SC mission areas with the goal of using computer simulation and advanced networking technologies to achieve scientific breakthroughs that would be impossible using theoretical or laboratory studies alone, and fully realizing the potential of emerging terascale and petascale for advancing scientific discovery. The research and development activities supported under SciDAC extend key results from applied mathematics and computer science research to develop integrated software tools that computational scientists can use in high performance scientific applications. SciDAC enables new areas of science to take advantage of computation and simulation through Scientific Application Partnerships; Centers for Enabling Technologies at universities and national laboratories; and university-led SciDAC Institutes that complement the activities of the Centers and provide training for the next generation of computational scientists.

In addition to its research activities, ASCR plans, develops, and operates supercomputer and network facilities that are available 24 hours a day, 365 days a year to researchers working on problems relevant to DOE's scientific missions. The National Energy Research Scientific Computing Center (NERSC) provides the core scientific computing capacity needed by the research community and complements the capabilities of the Leadership Computing Facilities (LCFs). NERSC serves over 2,500 users working on about 900 projects. The NERSC Cray XT–4 system will provide 100–150 teraflops of peak computing capacity in FY 2009. In FY 2009, the Oak Ridge National Laboratory LCF will continue to provide world-leading high-performance sustained capability to researchers with the acquisition of a one petaflop Cray

Baker system by the end of 2008, which will enable further scientific advancements in areas such as combustion simulation for clean coal research, simulation of fusion devices that approach ITER scale, and quantum calculations of complex chemical reactions. In addition, further diversity within the LCF resources will be realized with the high performance IBM Blue Gene/P system at Argonne National Laboratory, which will achieve a peak capability of 250–500 teraflops in FY 2008. The Argonne LCF will bring enhanced capability to accelerate scientific understanding in areas such as molecular dynamics, catalysis, protein/DNA complexes, and aging of material. Access by the scientific community, including industry, to the LCF and NERSC resources will continue through the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program. INCITE is not only engaging universities and the national laboratories to advance SC's mission through simulation in areas like systems biology, chemical catalysis, climate modeling, and accelerator R&D, but also enabling industry to dramatically reduce the time for product and technology development. Beginning in FY 2009, the ASCR computing facilities will develop and implement a unified approach to supporting and maintaining software, languages, and tools that are critical to continued effective utilization of the machines.

The demands of today's facilities, which generate millions of gigabytes of data per year, now outstrip the capabilities of the current Internet design and push the state-of-the-art in data storage and utilization. But the evolution of the telecommunications market, including the availability of direct access to optical fiber at attractive prices and the availability of the next generation of flexible optical telecommunications hardware, gives SC the possibility of exploiting these technologies to provide scientific data where needed at speeds commensurate with the new data volumes. Investments in the Energy Science Network (ESnet) provide the DOE science community with capabilities not available through commercial networks or the commercial Internet to manage increased data flows from petascale computers and experimental facilities. In FY 2009, ESnet, in partnership with Internet2, will continue to implement a next generation optical network structure for U.S. science and deliver 40–60 gigabits per second to SC laboratories.

Advancing high performance computing, computation, and advanced networking is a highly coordinated interagency effort. ASCR has extensive partnerships with other federal agencies and the National Nuclear Security Administration (NNSA). Activities are coordinated with other federal efforts through the Networking and Information Technology R&D (NITR&D) Subcommittee of the National Science and Technology Council Committee on Technology. The subcommittee coordinates planning, budgeting, and assessment activities of the multi-agency NITR&D enterprise. DOE has been an active participant in these coordination groups and committees since their inception. ASCR will continue to coordinate its activities through these mechanisms and will lead the development of new coordinating mechanisms as needs arise such as the development of a Federal Plan for Advanced Networking R&D.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

FY 2008 Appropriation—$544.4 Million; FY 2009 Request—$568.5 Million

Biological and Environmental Research (BER) supports basic research in genomics and systems biology of microbes and plants aimed at harnessing their capabilities for energy and environmental solutions; environmental measurement and the development of models to predict climate over decades to centuries; research to understand contaminant fate and transport and to develop science-based methods for the cleaning up environmental contaminants; molecular, cellular, and tissue-based low dose radiation research to provide regulators with a stronger scientific basis for developing future radiation protection standards; and advanced research in radiochemistry and imaging instrumentation. Results from this fundamental research will have broad impacts on our energy future, our environment, and our health.

In FY 2009, BER continues to support the Genomics: GTL research program. This program pursues systems biology approach that spans the biological, physical, and computational sciences to determine the diverse biochemical capabilities of microbes, microbial communities, and plants, with the goal of tailoring and translating those capabilities into solutions for DOE mission needs. By understanding complex biological systems, developing computational tools to model and predict their behavior, and developing methods to harness nature's capabilities; biotechnology solutions are possible for DOE energy, environmental, and national security challenges. Development of a global biotechnology-based energy infrastructure requires substantial fundamental scientific understanding that enables scientists to control or redirect

genetic regulation and redesign specific proteins, biochemical pathways, and even entire plants or microbes. Renewable biofuels could be produced using plants, microbes, or isolated enzymes or through novel production strategies, such as engineered systems based on processes found in natural biological systems. Such strategies might include, for example, defined mixed microbial communities or consolidated biological processes. Within the GTL program, BER supports basic research aimed at developing the understanding needed to advance biotechnology-based strategies not only for new methods of producing renewable, carbon-neutral bioenergy compounds, but also for understanding how the capabilities of microbes can be applied to environmental remediation and carbon sequestration.

To accelerate the scientific breakthroughs necessary to develop novel, efficient, and cost-effective methods for producing biofuels from plant materials, BER awarded three new Bioenergy Research Centers in FY 2007. FY 2009 will be their second full year of operations. The three centers—the Joint BioEnergy Institute at Lawrence Berkeley National Laboratory, the Great Lakes Bioenergy Research Center at the University of Wisconsin at Madison, and the BioEnergy Science Center at Oak Ridge National Laboratory—consist of diverse teams of researchers from universities, national laboratories, and industry; and conduct comprehensive, multi-disciplinary research programs focused on systems biology on microbes and plants. The Centers serve as catalysts for innovation and the development of transformational science for bioenergy solutions, and their research activities complement research funded within the broader GTL program.

An ability to predict long-range and regional climate, including the effects of energy-related emissions of greenhouse gases and aerosols on future climate, enables effective planning for future needs in energy, agriculture, and land and water use. Likewise, understanding the global carbon cycle and the associated role and capabilities of microbes and plants can lead to solutions for reducing carbon dioxide concentrations in the atmosphere. DOE, in conjunction with its interagency partners under the U.S. Climate Change Science Program (CCSP), continues to focus climate change research in CCSP priority areas. These areas include abrupt climate change, advanced climate modeling, critical climate processes (including effects of clouds, aerosols, and water vapor on the atmospheric radiation balance), carbon cycling, atmospheric composition (with a focus on greenhouse gas concentrations and the effects of aerosols), the effects of climate change on important terrestrial ecosystems, and the development and evaluation of tools for assessing environmental costs and benefits of climate change and the different potential options for mitigation and adaptation to such change.

BER's Climate Change Research program enables both scientifically based predictions and assessments of the potential effects of greenhouse gases and aerosol emissions on climate and the environment, and the development of approaches for enhancing carbon sequestration in terrestrial ecosystems. Research supported by the climate program is focused on understanding the physical, chemical, and biological processes affecting the Earth's atmosphere, land, and oceans, and how these processes may be affected by changes in radiative forcing of climate resulting from carbon dioxide and aerosol emissions from energy production and use. BER support for climate modeling increases in FY 2009 to leverage the Department's leadership class computing facilities to improve both resolution and model physics, including modeling ice sheets, in a fully coupled climate model simulating historic climate and projecting future potential climate change at regional to global scales. BER also continues to support research on abrupt climate change and continues SciDAC partnership efforts with ASCR.

Research on climate forcing under the Atmospheric Radiation Measurement (ARM) program will continue to focus on resolving the largest sources of scientific uncertainty in climate change prediction—the effects of clouds and aerosols. ARM research supports individual investigators at universities and research teams at DOE laboratories. Continued support is provided for the ARM Climate Research Facility (ACRF) which consists of three stationary facilities, an ARM Mobile Facility, and the ARM Aerial Vehicles Program. The ACRF provides the data collection infrastructure needed for studies investigating atmospheric processes and properties and for the development and evaluation of climate process models. BER also continues to support AmeriFlux in FY 2009, which is a network of research sites where the net exchange of carbon dioxide, energy, and water between the atmosphere and major terrestrial ecosystems in North America is continuously measured. The AmeriFlux Network research sites provide extensive measurements of terrestrial carbon sink properties, including biological and soil processes, which provide insight into carbon cycling and inform the development of climate models. BER supports 20 of the approximately 70 sites in the network. The remaining AmeriFlux sites are funded by other federal agencies. BER also supports research on ecosystem function

and response to understand the potential effects of climate change anticipated during the coming 50100 years on the health of important terrestrial ecosystems in the United States.

Understanding the complex role of biology, geochemistry, and hydrology beneath the Earth's surface will lead to improved decision-making and solutions for contaminated DOE weapons sites. Research emphasis within BER's environmental remediation sciences research will focus on issues of subsurface cleanup, such as defining and understanding the processes that control contaminant fate and transport in the environment and providing opportunities for use or manipulation of natural processes to alter contaminant mobility. In FY 2009, BER will support three field research sites which provide opportunities to validate laboratory findings under field conditions. The resulting knowledge and technology will assist DOE's environmental clean-up and stewardship missions. Support for the William R. Wiley Environmental Molecular Sciences Laboratory at Pacific Northwest National Laboratory in FY 2009 maintains operations at full capacity.

Understanding the biological effects of low doses of radiation can lead to the development of science-based health risk policy to better protect workers and citizens. Both normal and abnormal physiological processes—from normal human development to cancer to brain function to cellular processes in microbes and plants—can be understood and improved using radiotracers and advanced imaging instruments. BER research continues on the biological effects of low dose radiation and for radiochemistry and imaging technologies. Building on DOE capabilities in physics, chemistry, engineering, biology, and computation, BER supports fundamental imaging research and maintains core infrastructure for imaging research and the development of new technologies. Funding is provided for Ethical, Legal, and Societal Issues (ELSI) associated with activities applicable to the Office of Science, including research on the ecological and environmental impacts of nanoparticles resulting from nanotechnology applied to energy technologies.

HIGH ENERGY PHYSICS

FY 2008 Appropriation—$689.3 Million; FY 2009 Request—$805.0 Million

The High Energy Physics (HEP) program provides over 90 percent of the federal support for the Nation's high energy physics research. This research advances understanding of the basic constituents of matter, deeper symmetries in the laws of nature at high energies, and mysterious phenomena that are commonplace in the universe, such as dark energy and dark matter. HEP uses particle accelerators and very sensitive detectors to study fundamental particle interactions at the highest possible energies, as well as non-accelerator studies of cosmic particles using experiments conducted deep underground, on mountains, or in space. The research facilities and basic research supported by HEP advance our knowledge not only in high energy physics, but increasingly in other fields as well, including particle astrophysics and cosmology. Research advances in one field often have a strong impact on research directions in another. Technology that was developed in response to the pace-setting demands of high energy physics research has also become indispensable to other fields of science and has found wide applications in industry and medicine, often in ways that could not have been predicted when the technology was first developed.

In FY 2009, HEP places a high priority on the operations, upgrades, and infrastructure of the two major HEP user facilities, the Tevatron Collider and the Neutrinos at the Main Injector (NuMI) beam line at Fermilab. After a very successful eight-year run, operation of the SLAC B-factory is completed in FY 2008. Funding is provided in FY 2009 to support significant analysis of data collected at the B-factory and for safe ramp-down of the facility. With completion of the scientific missions of the B-factory and Tevatron Collider by the end of this decade, the longer-term HEP program continues support for the development of new cutting-edge facilities in targeted areas like neutrino physics that will establish a U.S. leadership role in these areas in the next decade; when the centerpiece of the world HEP program will be at the Large Hadron Collider (LHC) at CERN (the European Organization for Nuclear Research).

As the LHC accelerator nears its turn-on date in 2008, support of an effective role for U.S. research groups in LHC discoveries will continue to be a high priority of the HEP program. In FY 2009, HEP increases funding for university and laboratory based research to support U.S. researchers participating in the physics discoveries enabled by the LHC and continues to provide support for operations and maintenance of the U.S.-built systems that are part of the LHC detectors. R&D for possible future upgrades to the LHC accelerator and detectors will also be pursued. A U.S. leadership role in the discoveries enabled by the LHC will require effective integra-

tion of U.S. researchers in the LHC detector calibration and data analysis efforts, and implementation and optimization of the U.S. data handling and computing capabilities needed for full participation in the LHC research program.

Support for International Linear Collider (ILC) R&D continues, but the U.S. role in the global R&D effort is reduced, resulting in a more focused but still robust program that emphasizes technical areas where the U.S. has unique or world-leading capabilities. The request positions the U.S. to play a significant role in the ILC, if governments decide to proceed with the project. In other accelerator technology R&D areas, funding is increasing to begin implementation of a strategic plan for technology R&D. Specific areas targeted for increased support are short-term R&D focused on development of high-intensity proton sources; mid-term R&D directed at development of superconducting radio frequency structures, in view of their potential for a wide range of applications; and long-term R&D on advanced accelerator technologies with the potential to provide transformational changes. The latter effort includes fabrication of a new test facility for advanced particle acceleration concepts.

With Tevatron improvements completed, much of the accelerator development effort at Fermilab in FY 2009 will focus on the neutrino program to study the universe's most prolific particle. The Neutrinos at the Main Injector (NuMI) beam allows studies of the fundamental physics of neutrino masses and mixings using the proton source section of the Tevatron complex. The NuMI beam has begun operations and will eventually put much higher demands on that set of accelerators. A program of enhanced maintenance, operational improvements, and equipment upgrades is being developed to meet these higher demands, while continuing to run the Tevatron. Fabrication of the NuMI Off-axis Neutrino Appearance (NOνA) detector ramps up in FY 2009 and will utilize the NuMI beam. This project includes improvements to the proton source to increase the intensity of the NuMI beam. Meanwhile, fabrication continues for the Reactor Neutrino Detector at Daya Bay, China and two small neutrino experiments, the Main Injector Experiment ν-A (MINERνA) in the Main Injector Neutrino Oscillation Search (MINOS) near detector hall at Fermilab and the Tokai-to-Kamioka (T2K) experiment using the Japanese JPARC neutrino beam.

The HEP Non-Accelerator Physics subprogram supports fundamental research for U.S. leadership in the study of those topics in particle physics that cannot be investigated completely with accelerators, or are best studied by other means. Some of the non-accelerator-based particle sources used in this research are neutrinos from the sun, galactic supernovae, terrestrial nuclear reactors, and cosmic rays striking the Earth's atmosphere. Experimental facilities and research utilizing these particle physics techniques are often located at remote sites, such as deep underground laboratories, on mountain tops, or in space, either as satellites or as instruments attached to International Space Station. In FY 2009, HEP, in partnership with NASA, will operate the Large Area Telescope (LAT) scheduled to be launched from the Kennedy Space Center in mid-2008. The LAT, a primary instrument on NASA's Gamma Ray Large Area Space Telescope (GLAST) mission, will observe and provide insights into understanding the highest energy gamma rays observed in nature. This activity complements the ground-based VERITAS Telescope Array supported by HEP, which studies the astrophysical sources of high energy gamma rays.

HEP continues the fabrication of the Dark Energy Survey (DES) project in FY 2009, which will provide the next step in determining the nature of dark energy. HEP continues support for R&D for a large double beta decay experiment to measure the mass of a neutrino. These efforts are part of a coordinated neutrino program developed from an American Physical Society study and a joint High Energy Physics Advisory Committee/Nuclear Sciences Advisory Committee sub-panel review. HEP supports concept studies for a Joint Dark Energy Mission (JDEM), a joint DOE and NASA space-based satellite, leading to a mission concept selection in 2009 and a planned FY 2010 fabrication start. Support for R&D on other near-term and next-generation ground- and space-based dark energy concepts continues in FY 2009. These experiments should provide important new information about the nature of dark energy, leading to a better understanding of the birth, evolution, and ultimate fate of the universe.

HEP also supports major thrusts in theoretical physics, astrophysics, and particle physics grid technology, including activities supported through the SciDAC program in FY 2009, as well as proposals in accelerator modeling and design. These projects will allow HEP to use computational science to obtain significant new insights into challenging problems that have the greatest impact in HEP mission areas.

NUCLEAR PHYSICS

FY 2008 Appropriation—$432.7 Million; FY 2009 Request—$510.1 Million

The Nuclear Physics (NP) program is the major sponsor of fundamental nuclear physics research in the Nation, providing about 90 percent of federal support. Scientific research supported by NP is aimed at advancing knowledge and providing insights into the nature of energy and matter and, in particular, investigating the fundamental forces which hold the nucleus together and determining the detailed structure and behavior of the atomic nuclei. NP builds and supports world-leading scientific facilities and state-of-the-art instrumentation to carry out its basic research agenda—the study of the evolution and structure of nuclear matter from the smallest building blocks, quarks and gluons, to the stable elements in the Universe created by stars, to unique isotopes created in the laboratory that exist at the limits of stability and possess radically different properties from known matter. NP is central to the development of various technologies relevant to nuclear energy, nuclear medicine, and national security. The highly trained scientific and technical personnel in fundamental nuclear physics who are a product of the program are a valuable human resource for many applied fields, including those relevant to the Department's missions in energy, nuclear-related national security, and environmental quality.

Key aspects of the NP research agenda include understanding how quarks and gluons combine to form nucleons (protons and neutrons), what the properties and behavior of nuclear matter are under extreme conditions of temperature and pressure, and what the properties and reaction rates are for atomic nuclei up to their limits of stability. Results and insight gained from these studies are relevant to understanding how the universe evolved in its earliest moments, how the chemical elements were formed, and how the properties of one of nature's basic constituents, the neutrino, influences astrophysics phenomena such as supernovae. Knowledge and techniques developed in pursuit of fundamental nuclear physics research are also extensively utilized in our society today. The understanding of nuclear spin enabled the development of magnetic resonance imaging for medical use. Radioactive isotopes produced by accelerators and reactors are used for medical imaging, cancer therapy, and biochemical studies. Advances in cutting-edge instrumentation developed for nuclear physics experiments have relevance to technological needs in combating terrorism.

The FY 2009, NP will support the operations of four National User Facilities and research at universities and national laboratories, and make investments in new capabilities to address compelling scientific opportunities and to maintain U.S. competitiveness in global nuclear physics efforts. When the Universe was a millionth of a second old, nuclear matter is believed to have existed in its most extreme energy density form called the quark-gluon plasma. Experiments at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory are searching to find and characterize this new state and others that may have existed during the first moments of the Universe. These efforts will continue in FY 2009. The NP program, in partnership with NASA, will continue construction of an Electron Beam Ion Source to provide RHIC with more cost-effective and reliable operations than the current Tandem Van de Graaff accelerator, as well as new research capabilities. Support for participation in the heavy ion program at the Large Hadron Collider (LHC) at CERN allows U.S. researchers the opportunity to search for new states of matter under substantially different initial conditions than those provided at RHIC. The interplay of the different research programs at the LHC and the ongoing RHIC program will allow a detailed tomography of the hot, dense matter as it evolves from the "perfect fluid" (a fluid with minimum viscosity) discovered at RHIC.

Operations of the Continuous Electron Beam Accelerator Facility (CEBAF) at Thomas Jefferson National Accelerator Facility (TJNAF) in FY 2009 will continue to advance our knowledge of the internal structure of protons and neutrons. By providing precision experimental information concerning the quarks and gluons that form protons and neutrons, the approximately 1,200 experimental researchers who use CEBAF, together with researchers in nuclear theory, seek to provide a quantitative description of nuclear matter in terms of the fundamental theory of the strong interaction, Quantum Chromodynamics (QCD). In FY 2009, the accelerator will provide beams simultaneously to all three experimental halls and funding is provided for the initiation of construction of the 12 GeV CEBAF Upgrade Project. This upgrade is one of the highest priorities for NP and would allow for a test of a proposed mechanism of "quark confinement," one of the compelling, unanswered puzzles of physics.

Efforts at the Argonne Tandem Linear Accelerator System (ATLAS) at Argonne National Laboratory and the Holifield Radioactive Ion Beam Facility (HRIBF) at Oak Ridge National Laboratory will be supported in FY 2009 to focus on investigating new regions of nuclear structure, studying interactions in nuclear matter

like those occurring in neutron stars, and determining the reactions that created the nuclei of the chemical elements inside stars and supernovae. Fabrication continues for the GRETINA gamma-ray detector array, which will revolutionize gamma ray detection technology and offer dramatically improved capabilities to study the structure of nuclei at ATLAS, HRIBF, and elsewhere.

The Fundamental Neutron Physics Beamline (FNPB) under fabrication at the Spallation Neutron Source will provide a world-class capability to study the fundamental properties of the neutron, leading to a refined characterization of the weak force. Support continues in FY 2009 for the fabrication of a neutron Electric Dipole Moment experiment, to be sited at the FNPB, in the search for new physics beyond the Standard Model. Funds are provided in FY 2009 to continue U.S. participation in the fabrication of an Italian-led neutrino-less double beta decay experiment, the Cryogenic Underground Observatory for Rare Events (CUORE). Neutrinos are thought to play a critical role in the explosions of supernovae and the evolution of the cosmos. A successful search for neutrino-less double beta decay will determine if the neutrino is its own antiparticle and provide information about the mass of the neutrino.

In 2008, NP plans to conduct a design solicitation and make a site selection for a Facility for Rare Isotope Beams (FRIB). This U.S. facility will enable world-leading research opportunities in nuclear structure, nuclear astrophysics, and fundamental studies, and will complement the programs of high capability radioactive ion beam facilities elsewhere in the world. Following a site selection, funds are provided in FY 2009 for R&D and to begin conceptual design activities for FRIB.

Theoretical research is important in all program areas, and NP supports the nuclear data program, which collects, evaluates, and disseminates nuclear physics data. NP increases support in FY 2009 for basic research in the characterization of radioactive waste through advanced fuel cycle activities. NP also continues to support SciDAC efforts in nuclear astrophysics, grid computing, Lattice Gauge (QCD) theory, low energy nuclear structure and nuclear reaction theory, and advanced accelerator design.

Beginning in FY 2009, NP assumes responsibilities for research, development, and production of stable and radioactive isotopes previously under the DOE Office of Nuclear Energy. A major objective of this subprogram within NP, entitled Isotope Production and Applications, is to improve the availability and reliability of research isotopes at predictable prices needed for medical, national security, and industrial applications. A portfolio of research isotopes will be established with guidance from scientific advisory committees, in consultation with BER, the National Institutes of Health, and all segments of the research community and other federal agencies interested in using stable and radioactive isotopes.

FUSION ENERGY SCIENCES

FY 2008 Appropriation—$286.5 Million; FY 2009 Request—$493.1 Million

The Fusion Energy Sciences (FES) program advances the theoretical and experimental understanding of plasma and fusion science needed to develop fusion energy. Advances in plasma physics and associated technologies will bring the U.S. closer to making fusion energy a part of the Nation's energy solution. To enable fundamental research into the nature of fusion plasmas, FES supports the operation of a set of unique and diversified domestic experimental facilities and close collaborations with international partners on specialized facilities abroad. Results from these facilities provide the data to test our theoretical understanding of fusion plasmas and extend our computer models?ultimately leading to improved predictive capabilities for fusion plasmas. The FES research program, including experiments on major facilities, theory, and computer modeling activities, will emphasize burning plasma research to prepare for the ITER scientific program. FES leads U.S. participation in ITER, an experiment to study and demonstrate the scientific and technical feasibility of fusion power.

A defining feature of the FES program is its emphasis on developing the underlying science of potential fusion energy systems. This effort consists of campaigns to develop the requisite understanding of several critical issues, including integrated burning plasma properties; macroscopic equilibrium and stability of plasmas; multiscale transport of energy and particles; plasma boundary interfaces between a hot plasma and the surrounding material surfaces; interaction of electromagnetic waves with plasma electrons and ions; high energy density implosion physics; and fusion engineering science. In FY 2009, the FES program will begin to identify critical scientific issues and missions for the next stage in the U.S. fusion research program during the ITER era, which will keep it at the forefront of fusion and plasma sciences in the future.

Through its participation in the international ITER project, the magnetic fusion energy sciences program will begin to explore the burning plasma regime. The achievement of a burning plasma regime in ITER, wherein much more fusion energy is released than is used to heat the plasma fuel, will provide a fundamental demonstration of the viability of magnetic fusion as a potential new energy source. Our participation in the international ITER project began in FY 2006 through the U.S. Contributions to ITER Major Item of Equipment project. In FY 2008, U.S. ITER project activities are minimized because of significantly reduced funding relative to requested levels. The extent of the resulting cost and schedule impacts is still being assessed. With full funding in FY 2009, as requested, the U.S. Contributions to the ITER project will resume activities to provide for the U.S. "in-kind" hardware contributions, U.S. personnel to work at the ITER site, and funds for the U.S. share of common expenses such as infrastructure, hardware assembly, installation, and contingency.

In FY 2009, FES continues to support the operation of three major experimental facilities that provide scientists with the means to test and extend our theoretical understanding and computer models for fusion science: the DIII–D tokamak at General Atomics in San Diego, California, the Alcator C–Mod tokamak at the Massachusetts Institute of Technology in Cambridge, Massachusetts, and the National Spherical Torus Experiment at Princeton Plasma Physics Laboratory (PPPL) in Princeton, New Jersey. Experiments on these major facilities, along with theory and computer modeling activities, will support final design decisions for ITER and assist in developing operating scenarios for the ITER research program.

Funding is currently provided for continued fabrication of the National Compact Stellarator Experiment (NCSX) at PPPL; however, a final decision on the project's future will be made in FY 2008, since the project's cost and schedule have changed significantly since the initial project baseline was established. Several reviews of NCSX were conducted by the Office of Science and Princeton University in 2007 including a scientific and programmatic review by the Fusion Energy Sciences Advisory Committee which concluded that the NCSX should be completed to maintain U.S. interests in this field. These reviews plus upcoming technical, cost, and schedule reviews by DOE will provide the necessary input to allow the Department to make the decision either to re-baseline the project or to cancel it.

FES will initiate detailed planning for a Fusion Simulation Project (FSP) in FY 2009, taking advantage of the many recent improvements in computational and computing capabilities, as well as a significant amount of preparatory work that has already been done by FES's SciDAC activities. The FSP will be directed at developing a world-leading predictive integrated plasma simulation capability that can be applied to burning plasmas of the type that will be necessary for fusion energy producing power plants. As such, the FSP will represent the embodiment of the goal of developing the knowledge base for a fusion energy system. The FSP is expected to be completed by FY 2024, but there will also be key deliverables targeted at the end of five and ten years.

FES increases support for efforts in the area of high energy density laboratory plasmas (HEDLP) as part of the HEDLP Joint Program with the National Nuclear Security Administration. In FY 2009, a rolling series of competitive solicitations will be started to identify initiatives to be supported under the HEDLP Joint Program that are consistent with the missions of both FES and NNSA. These solicitations will cover a number of exciting HEDLP research areas such as inertial fusion energy sciences, warm dense matter, and magnetized high energy density plasmas, including plasma jets, laser-plasma interactions, compressible hydrodynamics, and laboratory astrophysics.

WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS

FY 2008 Appropriation—$8.0 Million; FY 2009 Request—$13.6 Million

The Department of Energy has played a role in training America's scientists and engineers for more than 60 years, making contributions to U.S. economic and scientific preeminence. The Nation's current and future energy and environmental challenges may be solved in part through scientific and technological innovation and the development of a highly skilled scientific and technical workforce. The Workforce Development for Teachers and Scientists (WDTS) program helps to ensure that DOE and the Nation have a sustained pipeline of highly trained scientists, mathematicians, and engineers in the workforce. That workforce includes DOE federal employees, the DOE national laboratories, and more broadly, the university and private sector institutions that perform the science and technology required for DOE to achieve its goals in energy, environment, national security, and basic discovery. WDTS accomplishes its mission primarily by providing hands-on science and tech-

nology learning experiences to the Nation's students and educators of science, technology, engineering, and mathematics (STEM). WDTS programs create a foundation for DOE's national laboratories to provide a wide range of educational opportunities to more than 280,000 educators and students on an annual basis.

WDTS supports experiential learning opportunities that compliment classroom curriculum and (1) build links between the national laboratories and the science education community by providing funding, guidelines, and evaluation of mentored research experiences at the national laboratories to K–12 teachers and college faculty to enhance their content knowledge and research capabilities; (2) provide mentor-intensive research experiences at the national laboratories for undergraduate and graduate students to inspire commitments to the technical disciplines and to pursue careers in STEM; and (3) encourage and reward middle and high school students across the Nation to excel in math and the sciences, and introduce these students to the national laboratories and the opportunities available to them when they go to college.

In FY 2009, WDTS activities are implemented through three new subprograms: Student Programs, Educator Programs, and Program Administration and Evaluation. Student Programs provide experiential learning opportunities to enhance student understanding of science and to increase their interest in pursuing STEM careers. Included within this subprogram in FY 2009 are Science Undergraduate Laboratory Internship (SULI), Community College Institute (CCI), Pre-Service Teachers (PST), and the National Science Bowl (NSB).

The DOE National Science Bowl is a nationally recognized, prestigious academic event for high school and middle school students. It has attained its level of recognition and participation through a grass-roots design, which encourages the voluntary participation of professional scientists, engineers, and educators from across the Nation. Students answer questions in scientific topics, including astronomy, biology, chemistry, mathematics, and physics, in a highly competitive, "Jeopardy-style" format. Since 1991, more than 150,000 students have participated in the regional and national competitions. The 2008 NSB High School Finals will be held in Washington, DC from May 1–6, 2008, and the Middle School Finals will be held in Golden, CO from June 19–22, 2008—you are all welcome to attend these exciting events.

The WDTS Educator Programs make the world-class intellectual and physical assets of the Department available to the U.S. education community. Included within this newly restructured subprogram in FY 2009 are DOE Academies Creating Teacher Scientists (ACTS), Faculty and Student Teams (FaST), and the Albert Einstein Distinguished Educator Fellowship.

The WDTS Program Administration and Evaluation activities leverage resources and partnerships with other federal agencies, industry, academic institutions, and professional associations to build expertise in workforce development. These activities also include developing and deploying rigorous evaluation methods for all WDTS programs; developing longitudinal workforce studies that track students and educators who participate in DOE programs; and improving outreach efforts to communicate to the broader public the role the Department plays in STEM education and the opportunities provided to students and educators.

SCIENCE LABORATORIES INFRASTRUCTURE

FY 2008 Appropriation—$66.9 Million; FY 2009 Request—$110.3 Million

The mission of the Science Laboratories Infrastructure (SLI) program is to enable the conduct of DOE research missions at the Office of Science laboratories by funding line item construction projects and the clean up for reuse or removal of excess facilities to maintain the general purpose infrastructure. The program also supports Office of Science landlord responsibilities for the 24,000 acre Oak Ridge Reservation and provides Payments in Lieu of Taxes (PILT) to local communities around Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), and Oak Ridge National Laboratory (ORNL).

In FY 2009, SLI proposes to initiate an Infrastructure Modernization Initiative. The goal of this initiative is to, by FY 2019, have facilities and infrastructure at the SC laboratories that:

- Offer a safer, healthier, and more secure work environment for employees and visitors;
- Ensure laboratory infrastructure will support world-class science;
- Meet or exceed DOE sustainability goals and are more efficient to operate and maintain; and
- Support worker productivity and facilitate effective interaction with colleagues.

Increases in construction funding proposed in FY 2009 will fund three new projects under the proposed SC Infrastructure Modernization Initiative. These are the Interdisciplinary Science Building, Phase I project at Brookhaven National Laboratory; the Seismic Life-Safety, Modernization, and Replacement of General Purpose Buildings, Phase II project, at the Lawrence Berkeley National Laboratory; and the Technology and Engineering Development Facility project at the Thomas Jefferson National Accelerator Facility. Also included under this Initiative is one project started in FY 2008, the Modernization of Laboratory Facilities project at Oak Ridge National Laboratory. Additional on-going line-item construction projects include the Physical Sciences Facility at Pacific Northwest National Laboratory and additional renovations and upgrades at the Brookhaven and Lawrence Berkeley National Laboratories.

SCIENCE PROGRAM DIRECTION

FY 2008 Appropriation—$177.8 Million; FY 2009 Request—$203.9 Million

Science Program Direction (SCPD) enables a skilled and highly-motivated federal workforce to manage and support basic energy-related and science-related research disciplines, diversely supported through research programs, projects, and facilities under the Office of Science's leadership. This budget request addresses the overall corporate strategy and eliminates the previous subprograms of Program Direction and Field Operations.

The headquarters federal staff is responsible for Office of Science-wide issues, operational policy, scientific program development, and management functions supporting a broad spectrum of scientific disciplines and program offices. Additionally, support is included for management of workforce program direction and infrastructure through policy, technical and administrative support staff responsible for budget and planning; general administration; information technology; infrastructure management; construction management; Safeguards and Security; and Environment, Safety, and Health within the framework set by the Department. Additionally, Program Direction includes funding for the Office of Scientific and Technical Information, which collects, preserves, and disseminates DOE research and development information for use by DOE, the scientific community, academia, U.S. industry, and the public to expand the knowledge base of science and technology.

Field personnel are responsible and directly accountable for implementing the SC program within the framework established by headquarters policy and guidance. Site Office personnel are responsible for the day-to-day oversight of Management and Operating contractor performance supporting Office of Science laboratories and facilities. In addition, the Integrated Support Center, operated in partnership by the Chicago and Oak Ridge Operations office personnel, provides best-in-class business, administrative, and specialized technical support across the entire Office of Science enterprise and to other DOE programs. In FY 2009, Program Direction funding increases by 14.7 percent from the FY 2008 appropriated level. Most of the increase will support an additional 42 FTEs, to manage the increase in the SC research investment and the Committee of Visitors recommendations for all of the SC basic research programs.

SAFEGUARDS AND SECURITY

FY 2008 Appropriation—$75.9 Million; FY 2009 Request—$80.6 Million

The Safeguards and Security (S&S) program ensures appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of DOE assets and hostile acts that may cause adverse impacts on fundamental science, national security, or the health and safety of DOE and contractor employees, the public, or the environment. The Office of Science's Integrated Safeguards and Security Management strategy uses a tailored approach to safeguards and security. As such, each site has a specific protection program that is analyzed and defined in its individual Security Plan. This approach allows each site to design varying degrees of protection, commensurate with the risks and consequences described in their site-specific threat scenarios. The FY 2009 S&S budget includes funding necessary to protect people, property, and information. In FY 2009, increased funding is provided for cyber security to respond to significantly increased risks and government-wide requirements by the *Federal Information Security Management Act* (FISMA) in this area and in security systems to replace and upgrade aging and obsolete systems.

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 FY 2009 budget request for the Office of Science.

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