# THE DEPARTMENT OF ENERGY FISCAL YEAR 2008 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

FIRST SESSION

MARCH 7, 2007

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**March 7, 2007**

**Appendix: Answers to Post-Hearing Questions**

# THE DEPARTMENT OF ENERGY FISCAL YEAR 2008 RESEARCH AND DEVELOPMENT BUDGET PROPOSAL

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**WEDNESDAY, MARCH 7, 2007**

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

The Subcommittee met, pursuant to call, at 9:37 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

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**Subcommittee on Energy and Environment**

Hearing on

***"The Department of Energy Fiscal Year 2008 Research and Development Budget Proposal"***

2318 Rayburn House Office Building
Washington, D.C.

Wednesday, March 7, 2007
9:30 AM – 12:00

**WITNESS LIST**

**Dr. Ray Orbach**
*Under Secretary for Science, Department of Energy*

**Mr. Alexander Karsner**
*Assistant Secretary for Energy Efficiency and Renewable Energy, Department of Energy*

**Mr. Thomas Shope**
*Assistant Secretary for Fossil Energy, Department of Energy*

**Mr. Dennis Spurgeon**
*Assistant Secretary for Nuclear Energy, Department of Energy*

**Mr. Kevin Kolevar**
*Director, Office of Electricity Delivery and Energy Reliability, Department of Energy*

HEARING CHARTER

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

# The Department of Energy Fiscal Year 2008 Research and Development Budget Proposal

WEDNESDAY, MARCH 7, 2007
9:30 A.M.–11:30 A.M.
2318 RAYBURN HOUSE OFFICE BUILDING

**Purpose**

On Wednesday, March 7, 2007 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 2008 Budget Request for research and development programs.

**Witnesses**

**Dr. Ray Orbach** is the Under Secretary for Science at DOE, where he has directed the Office of Science since 2002. Prior to joining the Department, Dr. Orbach served as Chancellor of the University of California at Riverside.

**Mr. Dennis Spurgeon** is the Assistant Secretary for Nuclear Energy at DOE. Mr. Spurgeon was recently designated as the Acting Under Secretary for Energy, taking the place of David Garman.

**Mr. Alexander Karsner** is the Assistant Secretary for Energy Efficiency and Renewable Energy at DOE. Previously, Mr. Karsner served in the private sector as an international infrastructure developer and entrepreneur in a wide range of energy technology fields.

**Mr. Kevin Kolevar** is the Director of the Office of Electricity Delivery and Energy Reliability at DOE. Prior to his appointment Mr. Kolevar served as Chief of Staff to then-Deputy of Energy Kyle McSlarrow.

**Mr. Thomas D. Shope** is the Principal Deputy Assistant Secretary for Fossil Energy. Mr. Shope is testifying in place of Assistant Secretary Jeffrey Jarrett who recently announced his resignation.

Fiscal Year 2006, 2007 and 2008 for DOE non-defense R&D

| DOE Overview | FY06 approps | FY07 request | FY07 approps* | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|---|
| Science | $ 3,632,044 | $ 4,101,710 | $3,796,393 | $4,397,876 | $ 765,832 | 21.1% |
| EERE | $ 1,162,747 | $ 1,176,421 | $1,473,844 | $1,236,199 | $ 73,452 | 6.3% |
| EDER | $ 158,178 | $ 124,928 | | $ 114,937 | $ (43,241) | -27.3% |
| Nuclear Energy R&D | $ 221,068 | $ 347,132 | | $ 567,745 | $ 346,677 | 156.8% |
| Fossil Energy R&D | $ 580,669 | $ 469,686 | | $ 566,801 | $ (13,868) | -2.4% |
| Loan Guarantee Program | $ - | $ - | $ 7,000 | $ 8,390 | $ | |
| **Total** | **$ 5,754,706** | **$ 6,219,877** | | **$6,891,948** | **$1,137,242** | **19.8%** |

- FY07 appropriations for Science, EERE, and the Loan Guarantee Program are stipulated in the Joint Funding Resolution, H.J. Res 20, passed on 2/15/07. FY07 appropriations for the other categories are unavailable.
- Amounts listed in thousands of dollars.

The $7.2 billion request for DOE civilian energy R&D funding in FY08 is divided among the five offices represented at this hearing. The Office of Science (SC) funds basic research at universities and 10 national laboratories, and is the single largest federal supporter of physical sciences research. The other four offices focus on applied research and technology development in the fields of Energy Efficiency and Re-

newable Energy, Fossil Energy, Nuclear Energy, and Electricity Delivery. Appearing for the first time in the President's budget is the Innovative Technology Loan Guarantee Program which would provide loan guarantees for advanced technology projects that avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases, and have a reasonable prospect of repaying the principal and interest on their debt obligations.

| Office of Science | FY06 approps | FY07 request* | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|
| HEP | $ 698,238 | $ 775,099 | $782,238 | $ 84,000 | 12.0% |
| NP | $ 357,756 | $ 454,060 | $ 471,319 | $ 113,563 | 31.7% |
| BER | $ 564,077 | $ 510,263 | $ 531,897 | $ (32,180) | -5.7% |
| BES | $ 1,110,148 | $ 1,420,980 | $1,498,497 | $ 388,349 | 35.0% |
| ASCR | $ 228,382 | $ 318,654 | $ 340,198 | $ 111,816 | 49.0% |
| Lab Infrastructure | $ 41,684 | $ 50,888 | $ 78,956 | $ 37,272 | 89.4% |
| FES | $ 280,683 | $ 318,950 | $ 427,850 | $ 147,167 | 52.4% |
| **Subtotal** | **$ 3,280,968** | **$ 3,848,894** | **$4,130,955** | **$ 849,987** | **25.9%** |
| Other | $ 351,076 | $ 252,816 | $ 266,921 | $ (84,155) | -24.0% |
| **Total** | **$ 3,632,044** | **$ 4,101,710** | **$4,397,876** | **$ 765,832** | **21.1%** |

- The Joint Funding Resolution, H.J. Res 20, passed on February 15, 2007, appropriated a total of $3,796,393,000 for the Office of Science in FY07, but did not stipulate how that amount should be allocated.
- Amounts listed in thousands of dollars.

Abbreviations: HEP=High Energy Physics; NP=Nuclear Physics; BER=Biological and Environmental Research; BES=Basic Energy Sciences; ASCR=Advanced Scientific Computing Research; FES=Fusion Energy Science

**OFFICE OF SCIENCE (Witness—Dr. Ray Orbach)**

As part of the President's American Competitiveness Initiative (ACI), the FY 2008 budget request for the DOE Office of Science is $4.4 billion. This represents an increase of approximately $600 million, or 16 percent over the FY 2007 enacted level. However, this falls $189 million short of the funding levels authorized in Title IX of the *Energy Policy Act of 2005.* It is important to note that the FY 2007 Joint Funding Resolution (H.J. Res. 20) appropriated $3.8 billion for the Office of Science, roughly $200 million more than the 2006 enacted amount, but far short of the $4.1 billion requested for 2007. The resolution requires that DOE report back to the Congress within 30 days on how the additional $200 million will be spent within the Office of Science. Otherwise no direction is given as to increases or decreases for specific programs, making program comparisons between years difficult for the purposes of this analysis.

The FY 2008 request for **Basic Energy Sciences (BES)** is $1.5 billion, an increase of $388 million, or 35 percent above the FY06 enacted. As the largest program with within the Office of Science, BES conducts research primarily in the areas of materials sciences and engineering. In FY 2008 BES will support approximately 10,000 researchers in synchrotron light source and neutron scattering facilities, as well as $279 million for the construction and operation of five Nanoscale Science Research Centers.

The budget would provide $340 million for the **Advanced Scientific and Computing Research (ASCR)**, an increase of $112 million, or 49 percent over the FY06 appropriations. This includes funding to continue upgrading the Leadership Class Facility (LCF) at Oak Ridge National Lab to peta-scale operations, making it the world's largest civilian high performance computing system.

**Biological and Environmental Research (BER)** would receive $532 million, a decrease of approximately $32 million from FY06 enacted levels. This decrease reflects the omission of several congressionally directed projects in the BER budget. In addition to the role of BER in areas such as genomics and climate change research, the FY08 request supports the startup of three bioenergy research centers to investigate biological processes for developing and deploying large scale, environmentally sound biotechnologies to produce ethanol from cellulosic biomass (plant materials).

The FY08 funding request for **High Energy Physics (HEP)** is $ 782.2 million, which is $84 million or 12 percent more than the FY 2006 enacted level, but only a one percent increase over the FY 2007 request. This program funds fundamental

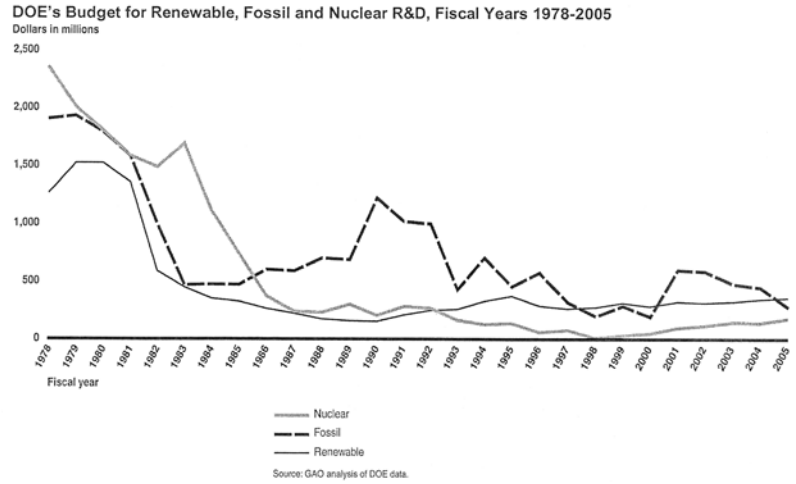
research in elementary particle physics and accelerator science and technology. Approximately $80 million is requested for R&D leading to the International Linear Collider (ILC), a project which could cost over $7 billion and may be sited in the U.S.

**Fusion Energy Sciences (FES)** receives $428 million, a substantial increase of $147 million, or 52 percent above the FY 2006 enacted. Of this amount, $160 million would be dedicated to support the U.S. role in the International Thermonuclear Experimental Reactor (ITER).

Also of note, **Nuclear Physics (NP)** receives $471.3 million, an increase of $113.5 million, or 31.7 percent, over the FY06 enacted amount. The request for **Science Laboratories Infrastructure** is approximately $80 million.

**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 varied greatly according to Administration and Congressional priorities as the chart below indicates.




Despite heavy investments in wind, solar and geothermal energy, the large bulk of the Nation's renewable energy portfolio comes from hydropower and still comprises only six percent of total electricity generation. 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. Coal will make up most of this growth and continue to provide the largest part of U.S. electricity generation for the foreseeable future. It is expected that, short of a very aggressive resurgence in nuclear capacity, new nuclear plants will only serve to replace aging existing plants in terms of overall electricity market share.

| Energy Efficiency & Renewable Energy (EERE) | FY06 approps | FY07 request* | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|
| Hydrogen technology | $ 153,451 | $ 195,801 | $ 213,000 | $ 59,549 | 38.8% |
| Biomass and biorefinery systems R&D | $ 89,776 | $ 149,687 | $ 179,263 | $ 89,487 | 99.7% |
| Solar | $ 81,791 | $ 148,372 | $ 148,304 | $ 66,513 | 81.3% |
| Wind | $ 38,333 | $ 43,819 | $ 40,069 | $ 1,736 | 4.5% |
| Geothermal technology | $ 22,762 | $ - | $ - | $ (22,762) | -100.0% |
| Hydropower | $ 495 | $ - | $ - | $ (495) | -100.0% |
| Vehicle technologies | $ 178,351 | $ 166,024 | $ 176,138 | $ (2,213) | -1.2% |
| Building technologies | $ 68,190 | $ 77,329 | $ 86,456 | $ 18,266 | 26.8% |
| Industrial technologies | $ 55,856 | $ 45,563 | $ 45,998 | $ (9,858) | -17.6% |
| Federal energy management program | $ 18,974 | $ 16,906 | $ 16,791 | $ (2,183) | -11.5% |
| Facilities and infrastructure | $ 26,052 | $ 5,935 | $ 6,982 | $ (19,070) | -73.2% |
| Weatherization | $ 316,886 | $ 225,031 | $ 204,904 | $ (111,982) | -35.3% |
| **Subtotal** | **$ 1,050,917** | **$ 1,074,467** | **$1,117,905** | **$ 66,988** | **6.4%** |
| Other | $ 111,830 | $ 101,954 | $ 118,294 | $ 6,464 | 5.8% |
| **Total EERE** | **$ 1,162,747** | **$ 1,176,421** | **$1,236,199** | **$ 73,452** | **6.3%** |

- The Joint Funding Resolution, H. J. Res. 20, passed on February 15, 2007, appropriated a total of $1,473,844,000 for EERE in FY07, but did not stipulate how that amount should be allocated.
- Amounts listed in thousands of dollars.

**Energy Efficiency and Renewable Energy (EERE) (Witness—Alexander Karsner)**

EERE is requesting $1.2 billion for FY08, a 6.3 percent increase over the FY06 appropriated level. However, the request is significantly less than the amount appropriated for FY07 in the joint funding resolution passed on February 15, 2007, which increased appropriate funds more than $300 million over the FY06 level to approximately $1.5 billion. As a result, the FY08 request actually represents a $237 million cut from the FY07 appropriated amount. As with the Office of Science, it is not yet known how the Assistant Secretary for EERE will allocate the additional $300 million. These allocations must be determined no later than 30 days after the date of passage of the joint funding resolution. Since these allocations are yet to be determined, the rest of this analysis is based on a comparison of the FY08 request and the FY06 appropriated amount.

Funding for priority programs continues to come at the expense of other lower-profile programs where significant technological gains can still be made. The FY08 request contains large cuts for **Weatherization Programs, the Industrial Technologies Program, and the Federal Energy Management Program (FEMP),** despite a Presidential call for increasing efficiency in all three of these areas. The Vehicle Technologies Program also suffers a slight decrease. The FY 2008 request also proposes to eliminate two important renewable energy R&D programs—Geothermal Technologies and Hydropower Technologies.

**Biomass and Biorefinery Systems** would receive $179 million, almost a 100 percent increase over FY06 funding. This large increase is intended to address the President's goal of making cellulosic ethanol cost-competitive with corn-derived ethanol by 2012, and also enabling a supply of 35 billion gallons of alternative fuels annually in accordance with the Twenty in Ten initiative—a reduction of U.S. gasoline usage by 20 percent in the next ten years—as outlined in the 2007 State of the Union address. While the general goal of increasing the Nation's supply of alternative fuels is widely supported, there is some concern, expressed both by parties within DOE and in the renewable fuels community, that the level of commercial scale investment is too much too soon, given that the science of unlocking cellulosic ethanol is still uncertain. Some argue that some of that funding would be better spent in the short-term investments to decrease our overall energy demand, such as technologies to increase vehicle fuel efficiency.

**Solar energy** would receive $148 million, an increase of 81 percent over FY06 appropriations. This funding supports the President's Solar America Initiative (SAI), which seeks to make electricity from photovoltaic cells cost competitive by 2015. **Wind energy** is slated for $40 million, essentially even with FY06 levels.

As in the 2007 budget request, the Administration would eliminate R&D in **Geothermal Power** technologies. However, a comprehensive study released in January

by the Massachusetts Institute of Technology found that the large amounts of heat stored in the Earth's crust could supply a substantial portion of the United States' future electricity requirements with minimal environmental impact and probably at competitive prices. The primary obstacle to commercial development of this resource was identified as lack of federal R&D support.

**Hydropower R&D** would also be eliminated, a category that includes funding for ocean energy R&D (e.g., wave, tides, currents, etc.) despite explicit authorization in EPACT 2005 for R&D in these technologies. According to the Office of EERE, in the Pacific Northwest alone, it is feasible that wave energy could produce 40–70 kilowatts (kW) per meter (3.3 feet) of coastline, yet the President's budget requests no funds for R&D into this vast, clean, and renewable resource.

The Administration continues the inconsistent treatment of Energy Efficiency programs. In addition to the Federal Energy Management Program and the Weatherization program several cuts are made throughout the budget. Despite mounting concerns about the role vehicles play in the country's reliance on foreign oil the FY08 request for **Vehicle Technologies R&D** would be reduced by $2.2 million over FY06, which includes funding for technologies for plug-in hybrid vehicles, lightweight vehicle materials, and engine technologies. The **Industrial Technologies** program, which aims to reduce the energy intensity of the U.S. economy by improving the energy efficiency of the Nation's industrial sector, would decrease by $9.9 million, a decrease of almost 18 percent. However, **Building Technologies** would rise by $18.3 million compared to the FY06 level, a 27 percent increase. While attempting to pursue a balanced approach to developing clean energy technologies, the EERE budget seems to exhibit a pattern of defunding valuable programs to fund a few presidential priority projects, often with long-time horizons and uncertain payoffs.

| Nuclear Energy | FY06 approps | FY07 request | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|
| Research & Development | | | | | |
| Nuclear Power 2010 | $ 65,340 | $ 54,031 | $ 114,000 | $ 48,660 | 74.5% |
| Generation IV Nuclear Energy Systems Initiative | $ 53,263 | $ 31,436 | $ 36,145 | $ -17,118 | -32.1% |
| Nuclear Hydrogen Initiative | $ 24,057 | $ 18,665 | $ 22,600 | $ -1,457 | -6.1% |
| Advanced Fuel Cycle Initiative (GNEP) | $ 78,408 | $ 243,000 | $ 395,000 | $ 316,592 | 403.8% |
| **Total Nuclear Energy R&D** | **$ 221,068** | **$ 347,132** | **$ 567,745** | **$ 346,677** | **156.8%** |

- Amounts listed in thousands of dollars.

**Office of Nuclear Energy (Witness—Dennis Spurgeon)**

Nuclear Energy (NE) receives $568 million for research and development, with a large portion of that dedicated to the Global Nuclear Energy Partnership (GNEP). For the Nuclear office, this represents an increase of $347 million (157 percent) above the FY 2006 Congressionally appropriated amount.

The Administration unveiled the Global Nuclear Energy Partnership (GNEP) in 2006 as a plan to develop advanced, proliferation-resistant nuclear fuel cycle technologies that would maximize the energy extracted from nuclear fuels and minimize nuclear waste. GNEP has been very controversial in Congress, with little support in the House where only token funding has been approved. For instance, the Administration requested approximately $250 million in FY 2007 for GNEP (through the Advanced Fuel Cycle Initiative—AFCI) but GNEP will likely only receive roughly $80 million for FY 2007 under the joint funding resolution. Nonetheless, the President's FY 2008 request for GNEP is $395 million.

Chief among the concerns about GNEP is the cost of implementing the program (up to $40 billion) and then deploying a fleet of the required technologies on a commercial scale (more than $200 billion), and whether such a program warrants the costs. There are also issues with premature selection of technologies before the completion of a full system-wide analysis of what would be required. Many are concerned that DOE has not adequately demonstrated an ability to carry out large scale construction and operation of such a project without major cost and schedule overruns.

Finally, the Nuclear Power 2010 program also would receive a considerable boost with an FY08 request of $114 million, which is almost double the FY06 appropriation. The increase is intended to continue activities in new reactor designs and li-

censing applications with the Nuclear Regulatory Commission to support an industry decision to build a new power plant by 2009.

| Electricity Delivery and Energy Reliability (EDER) | FY06 approps | FY07 request | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|
| Total, Research and Development | $ 132,589 | $ 95,636 | $ 85,994 | $ (46,595) | -35.1% |
| High Temperature Superconductivity R&D | $ 48,649 | $ 45,468 | $ 28,186 | $ (20,463) | -42.1% |
| Transmission Reliability R&D* | $ 12,516 | $ - | $ - | $ (12,516) | -100.0% |
| Electricity Distribution Transformation R&D* | $ 58,453 | $ - | $ - | $ (58,453) | -100.0% |
| Energy Storage R&D* | $ 2,889 | $ - | $ - | $ (2,889) | -100.0% |
| GridWise* | $ 5,267 | $ - | $ - | $ (5,267) | -100.0% |
| GridWorks* | $ 4,815 | $ - | $ - | $ (4,815) | -100.0% |
| Visualization and Controls* | $ - | $ 17,551 | $ 25,305 | $ 25,305 | |
| Energy Storage and Power Electronics | $ - | $ 2,965 | $ 6,803 | $ 6,803 | |
| Renewable and Distributed Systems Integration | $ - | $ 29,652 | $ 25,700 | $ 25,700 | |
| Electricity Restructuring | $ 12,276 | $ - | $ - | $ (12,276) | -100.0% |
| Operations and Analysis | $ - | $ 12,009 | $ 11,556 | $ 11,556 | |
| Program Direction | $ 13,313 | $ 17,283 | $ 17,387 | $ 4,074 | 30.6% |
| **Total EDER** | **$ 158,178** | **$ 124,928** | **$ 114,937** | **$ (43,241)** | **-27.3%** |

- All projects in Transmission Reliability R&D, Energy Storage R&D, GridWise, GridWorks, and most projects in Electricity Distribution Transformation R&D programs are transferred to the Visualization and Controls sub-account as of FY07.
- Amounts listed in thousands of dollars.

**Office of Electricity Delivery and Energy Reliability (Witness—Kevin Kolevar)**

The Office of Electricity is requesting $115 million for FY08, a 27 percent reduction from the FY06 appropriation. Of the total for this office the Administration proposes $86 million for R&D, a $46.5 decrease from FY06 Appropriations. This continues a downward trend of cutting R&D to improve the reliability, efficiency and security of the Nations electrical grid system, improve access to the grid, and decrease price volatility in electricity delivery.

Many of the EDER programs are being regrouped and consolidated under a new account called Visualization and Controls. This includes Transmission Reliability R&D, Energy Storage R&D, GridWise, and GridWorks. This regrouping hides the fact that most of these programs are being cut significantly.

**Innovative Technology Loan Guarantee Program (LGP)**

The FY 2008 budget proposes $8.4 million to fund the Office of Loan Guarantees, which will administer the Innovative Technology Loan Guarantee Program (LGP), a $1.4 million increase above the FY 2007 enacted amount. The program was established in the *Energy Policy Act of 2005* to provide loan guarantees for renewable energy, energy efficiency, clean coal, advanced nuclear, and other innovative energy projects. The FY 2008 budget request assumes a loan volume of $9 billion for such projects. Of this, $4 billion is set aside for large electric power generation projects such as advanced nuclear and coal gasification with carbon sequestration. An additional $4 billion is set aside to promote biofuels and clean transportation fuels, and $1 billion for new technologies in electricity transmission and renewable power systems.

| Fossil R&D | FY06 approps | FY07 request | FY08 request | $ change from FY06 level | % increase from FY06 level |
|---|---|---|---|---|---|
| Coal | $ 366,762 | $ 330,119 | $ 426,602 | $ 59,840 | 16.3% |
| Clean Coal Power Initiative | $ 48,135 | $ 4,957 | $ 73,000 | $ 24,865 | 51.7% |
| FutureGen | $ 17,326 | $ 54,000 | $ 108,000 | $ 90,674 | 523.3% |
| Fuels & Power Systems | $ 240,529 | $ 207,810 | $ 183,577 | $ (56,952) | -23.7% |
| Other | $ 60,772 | $ 63,352 | $ 62,025 | $ 1,253 | 2.1% |
| Natural gas technologies | $ 31,801 | $ - | $ - | $ (31,801) | -100.0% |
| Petroleum - Oil technologies | $ 30,805 | $ - | $ - | $ (30,805) | -100.0% |
| **Subtotal** | **$ 429,368** | **$ 330,119** | **$ 426,602** | **$ (2,766)** | **-0.6%** |
| Other | $ 151,301 | $ 139,567 | $ 140,199 | $ (11,102) | -7.3% |
| **Total Fossil R&D** | **$ 580,669** | **$ 469,686** | **$ 566,801** | **$ (13,868)** | **-2.4%** |

- Amounts listed in thousands of dollars.

**Fossil Energy R&D (Witness—Thomas Shope)**

Fossil Energy R&D would receive $567 million in FY 2008, a decrease of almost $14 million or 2.5 percent compared to FY 2007 appropriations. Funding increases would go exclusively to coal R&D, including the **Clean Coal Power Initiative** which aims to develop technologies that will increase efficiency of coal-fired power plants, reduce mercury and $NO_X$ emissions, and prove carbon capture and sequestration technologies. The **FutureGen** project, to demonstrate near-zero atmospheric emissions electricity production, sees a substantial increase to $108 million, 500 percent above the FY06 appropriated amounts. However, **Fuels and Power Systems,** which includes R&D on advanced coal technologies and carbon sequestration, actually decreases to $184 million, 24 percent less than the FY06 appropriated amount.

While the carbon sequestration program received a small increase, the request proposes conducting demos in only three or four sites across the country as opposed to doing a large scale demonstration in each of the seven regional sequestration partnerships. Many in the industry believe that, while federal investments have increased in recent years, funding for this program and the Clean Coal Power Initiative may be woefully inadequate to address the scale of challenges facing coal as it continues to provide approximately half of the Nation's electricity. Potentially forthcoming greenhouse gas regulations may adversely affect the coal industry and some other sectors of the economy. Yet it is not clear that technologies are available to cost effectively reduce carbon dioxide emissions from the use of coal, and sequester carbon dioxide on the scales required for a national greenhouse gas reduction program.

The FY 2008 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 to everyone.

I want to welcome you all to today's hearing, entitled *"The Department of Energy Fiscal Year 2008 Research and Development Budget Proposal."*

We changed the timing of this meeting this morning because of a presentation for the Joint Houses at 11:00, and we wanted to make sure that we had adequate time for you to get your presentations in, and hopefully, adequate number of questions.

I will proceed with my opening statement, and ask unanimous consent that when the Ranking Member comes in, that we interrupt what proceedings are going on, if it is appropriate, to have his opening remarks. Seeing no objection, that will stand.

I would like to extend a warm welcome to all five witnesses. Thank you for being here today, and testifying before the Subcommittee on Energy and Environment. The focus of our inquiry today is the President's 2008 budget request for research and development programs in the Department of Energy.

Now, I know I don't have to remind anyone in this room just how high energy prices and costs for action to mitigate climate change have propelled energy to the forefront of public debate in the last few years. Our nation's energy challenges are momentous and incredibly diverse, and I am pleased to see that the President's budget request for fiscal year 2008 takes a number of important steps, and even some grand leaps in pursuit of technological solutions to these challenges.

However, one can't help but notice serious gaps in R&D funding for certain programs. While resources are lavished on some high profile research areas, other valuable programs are left to languish. In a time of intense challenge, it is important that we keep all possibilities on the table. For instance, in the President's budget, hydrogen, solar, and cellulosic ethanol are beneficiaries of major funding increases. This is encouraging, but this encouraging trend is offset by large cuts and flat funding of equally valuable programs in areas such as geothermal, hydropower, ocean wave power, advanced grid technologies, and even oil and gas research.

Furthermore, the Administration continues its trend of slashing funds for valuable energy efficiency programs, that help states, low income consumers, industries, vehicle manufacturers, and even the Federal Government use energy more efficiently. Efficiency must be regarded as another valuable source of energy. After all, the cheapest, cleanest, most secure, and most domestic energy is the energy you never have to produce at all. Enormous opportunities exist to increase the efficiency, intelligence, and security of the Nation's electricity grid without simply erecting more towers and stringing more wire. However, the Nation has not deployed these technologies widely yet, and research and development funding in many of these related programs has been cut in this budget request.

The Administration requests a very aggressive increase in funding for nuclear energy, primarily to fund the Global Nuclear Energy Partnership, GNEP. Carbon-free nuclear energy may very well play a vital role in addressing our climate crisis, and it is clear that issues of waste disposal have to be resolved, but the Department

must convince this Congress and the public that the billions it will cost to implement the program and deploy a fleet of these technologies is warranted, and conduct full systems analysis for GNEP.

I am particularly disappointed to see that for the second year in a row, the Administration insists on ignoring EPAct 2005 by failing to carry out vital research and development into ultra-deepwater and unconventional drilling technologies. This illustrates a fundamental misunderstanding both of what the program is intended to do and the need to expand domestic resources of fossil fuels.

I would like to acknowledge the special role of the Office of Science within DOE. Although sometimes overlooked in the greater energy debate, the Office of Science, as the leading federal sponsor of research in the physical sciences, plays a critical part in our nation's scientific and technological competitiveness.

The Office of Science has a longstanding role as steward of large, world-class scientific research facilities. However, construction and operation of facilities has come at the expense of funding for actual research at these facilities. I am glad to see Dr. Orbach plans to put this back on track.

Furthermore, as the Department pursues plans for additional large-scale scientific facilities, demonstrable measures should be taken to assure due diligence in the areas of cost estimates and design. This gives everyone a higher level of comfort when multi-billion dollar research machines, such as the ILC, are proposed to Congress.

The fiscal year 2008 request makes a commitment to the Office of Science that is essential to maintaining our economic competitiveness, drawing a new generation into the physical sciences, and successfully meeting future challenges, whether they be energy-related or otherwise.

In the end, it is encouraging that the President's Fiscal Year 2008 budget request for DOE R&D programs takes a solid step forward. However, it is important that that step forward benefit all worthwhile programs, not just a few high-profile, exciting ones.

Today's witnesses find themselves at the crossroads of intense political pressures, and the technological cutting edge, and probably spend much of their time trying to reconcile the two, never an easy task. Again, we thank them all, and look forward to hearing their testimony today.

And at this time, I will call on Ranking Member Mr. Inglis for his opening statement.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

I would like to extend a warm welcome to all five witnesses. Thank you for being here today and testifying before the Subcommittee on Energy and Environment. The focus of our inquiry today is the President's 2008 Budget Request for research and development programs in the Department of Energy.

I know I don't have to remind anyone in this room just how much high energy prices and calls for action to mitigate climate change have propelled "energy" to the forefront of public debate in the last few years.

Our nation's energy challenges are momentous and incredibly diverse, and I am pleased to see that the President's budget request for FY08 takes a number of important steps, and even some grand leaps, in pursuit of technological solutions to these challenges.

However, one can't help but notice serious gaps in R&D funding for certain programs. While resources are lavished on some high-profile research areas, other valu-

able programs are left to languish. In a time of intense challenge, it is important that we keep all possibilities on the table.

For instance, in the President's budget, Hydrogen, Solar and Cellulosic ethanol are beneficiaries of major funding increases. But this encouraging trend is offset by large cuts and flat-funding of equally valuable programs in areas such as geothermal, hydropower, ocean wave power, advanced grid technologies, and even oil & gas research.

Furthermore, the Administration continues its trend of slashing funds for valuable energy efficiency programs that help states, low-income consumers, industries, vehicle manufacturers and even the Federal Government use energy more efficiently. Efficiency must be regarded another valuable "source" of energy. After all, the cheapest, cleanest, most secure, and most domestic energy is the energy you never have to produce at all.

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The FY08 request makes a commitment to the Office of Science that is essential to maintaining our economic competitiveness, drawing a new generation into the physical sciences, and successfully meeting future challenges, whether they be energy-related or otherwise.

In the end, it is encouraging that the President's FY08 budget request for DOE R&D programs takes a solid step forward. However, it is important that that step forward benefit all worthwhile programs, not just a few, high-profile, exciting ones.

Today's witnesses find themselves at the crossroads of intense political pressures, and the technological cutting edge, and probably spend much of their time reconciling the two—never an easy job. Again, we thank them and look forward to hearing their testimony today.

Mr. INGLIS. Thank you, Mr. Chairman.

I got released from the American Legion, and now I am here, and thank you for holding this hearing, and thank the witnesses for being here.

There is a difference, seems to me, between simple spending and thoughtful investing, and that is what I hope we are here to discuss today. Simple spending just doesn't—it is maybe good, it creates an immediate impact, but investing creates returns in the future. And so I am very grateful for the work of the Department of Energy in—on these kind of investments. It really could change the game for us.

So, as we discuss the R&D budget today, we are really acting more as investors here, investors who are looking at alternative fuel industries, for example, and seeing the payoffs that they could produce for us, and we realize that we have a great need to break free of an addiction to oil, and some of the work that you all are doing could help make that happen.

So, we are certainly not there yet. Obviously, more commitment is needed, and we are going to need to spend good money to accomplish the objectives that we have set out. I think that many of us want to see the market make some of these decisions about what fuels work and that sort of thing, and I trust markets mostly. It is also true that some basic research needs to be done, and the people that are going to do that are in the Department of Energy and places like that, so we thank you for your work.

I am particularly excited that the Chairman mentioned we don't want to focus on just the high profile ones, but one favorite one is the President's Hydrogen Initiative, because what a triple play opportunity, to do three things all at once that every American, I think, wants to do. One is improve the national security of the United States by no longer being dependent on the Middle East. Second, clean up the air, because the emissions would be water. And third, create jobs as we do that.

And of course, South Carolina probably isn't thought of as a car producing state, but that is what we are now, and we have got a wonderful company, BMW, that stands for Bubba Makes Wheels, and so, Bubba is making a lot of wheels in South Carolina, and we hope that the BMW H7 starts sweeping the country, and if it does, who knows, maybe we will make some of those in South Carolina.

But it is an example of what exciting things can happen when people put money into research, and so, we are looking forward to hearing your suggestions about how to do that.

Thank you, Mr. Chairman.

[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 for appearing here today to discuss funding for vital research and development projects.

As we discuss the proposed R&D budget today, I think we all realize that we aren't accountants sitting around just talking numbers—we're investors. The alternative fuel industry is a start-up business opportunity that promises huge payoffs for our nation's security, environment, and our economy. We have the ability and opportunity to partner with this promising enterprise and lend federal resources to help establish the alternative energy industry.

We haven't yet reached a place of energy security, nor have we scratched the surface of what economic benefits will come from energy advancements, but we don't have to look far to see great payoffs from today's investments. For that reason, we must stay committed to providing our scientists, national labs, and other R&D programs with adequate funding to continue the progress already made, and ensure our nation's energy security.

We should focus funding on a vast array of alternatives—hydrogen, biofuels, wind, solar, and nuclear. If we are true investors, we will use discretion as certain alternatives prove to be more valuable than others. For now, there are many roads for our engineers, inventors, and scientists to follow, and we should not close those roads. On that note, I have specific concerns I will address regarding the future of the President's Hydrogen Fuel Initiative. For example, what exactly does the proposal mean when it says that the budget request "completes the President's commitment of $1.2 billion over five years for this initiative?" I hope that you agree with me that $1.2 billion is a good start and certainly not the end of our efforts.

Thank you for the Department of Energy's past, present, and future commitments to research and develop tomorrow's energy solutions.

Chairman LAMPSON. I thank the Ranking Member. If there are other Members who wish to submit additional opening statements, your statements will be added to the record.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good morning. I want to thank the witnesses for appearing before our subcommittee to examine the Department of Energy's (DOE) fiscal year 2008 (FY08) Budget request for Research and Development Programs.

I am privileged to represent the 12th Congressional District of Illinois, a region rich in coal reserves and a proud mining tradition. Coal plays a vital role as an energy source, and the industries involved in the mining, transportation and utilization of coal provide thousands of jobs for Illinoisans and economic stability to many communities across the State. Further, the Clean Coal Research Center at Southern Illinois University (SIUC), the State of Illinois and its energy industries are committed to the development and application of technologies for the environmentally sound use of Illinois coal. In addition, they have several programs, such as the Illinois Coal Competitiveness Program, the Illinois Coal Education Program, and the Illinois Coal Research Center, to further this mission.

As a senior Member of the House Science and Technology Committee and the Energy and Environment Subcommittee, I have been a strong advocate for federal coal initiatives and programs. I am focused on increasing the funding levels for Clean Coal Research and Development (R&D) Programs for FY08 because coal is going to be the mainstay for electricity generation well into the future. While federal investments have increased slightly in recent years for Coal Research and Development (R&D), I am concerned that overall funding for several coal programs are woefully inadequate to address the scale of challenges facing coal as it continues to provide approximately half of the Nation's electricity.

I believe clean coal technology is part of the solution to achieving U.S. energy independence, continued economic prosperity and improved environmental stewardship. FutureGen, a 275-megawatt coal fueled power plant, is an example of an important DOE clean coal R&D and demonstration project designed to turn coal into both electricity and hydrogen fuel with minimal air pollution. To address climate change, FutureGen would also bury its heat-trapping carbon dioxide emissions deep underground. No project of this magnitude is in operation anywhere in the world at a commercial scale. That is why I am concerned the President's proposed budget seeks to rescind $149 million from the Clean Coal Technology account, acting against prior congressional intent to defer and designate the un-obligated Clean Coal Technology funds for FutureGen.

Another important coal program in the President's Coal Research Initiative that complements FutureGen and seeks to drive down the cost of clean coal technologies is the Clean Coal Power Initiative (CCPI). CCPI is a cooperative, cost shared program between the government and industry to rapidly demonstrate emerging technologies in coal-based power generation to help accelerate their commercialization. While CCPI received a slight increase in the President's proposed FY08 budget, the funding level is not sufficient. If Congress passes legislation to regulate carbon dioxide, advanced clean coal technologies must be successfully demonstrated and commercialized. This is the goal of the CCPI program and Congress and the Administration must work together to increase its funding to achieve its stated purpose. Further, I believe several large scale demonstrations of efficiency improvements and carbon capture technologies that can be applied to the existing fleet are critical to continued coal use if we are going to achieve meaningful reductions of carbon dioxide emissions in this country.

Finally, the Administration's carbon sequestration program within the DOE is developing a portfolio of technologies that hold great potential to reduce greenhouse gas emissions. The Regional Carbon Sequestration Partnership, of which we have one for the Illinois Basin, are providing the critical data that the U.S. needs to support carbon dioxide sequestration as a strategy for addressing global climate change. The DOE had put out a request for proposals for Phase III large scale field testing of geological sequestration in December but then canceled it when the President's FY08 budget came in with lesser funds than needed to support these tests. This is not the time to limit the amount of activities DOE should be undertaking in the coal program. The budget for carbon reducing technologies must be realistic if Congress is going to take a hard-fast look at regulating greenhouse gases in this coun-

try. Therefore, it is essential that a robust budget to develop clean coal technologies and reduce carbon dioxide must be provided for FY08.

I look forward to hearing from our panel of witnesses.

Chairman LAMPSON. And at this time, I would like to introduce our witnesses: Dr. Raymond Orbach, Under Secretary for Science with the Office of Science; Mr. Alexander Karsner, Assistant Secretary for Energy Efficiency and Renewable Energy; Mr. Thomas Shope, Assistant Secretary for Fossil Energy; Mr. Dennis Spurgeon, who is the Assistant Secretary for Nuclear Energy; and finally, Mr. Kevin Kolevar, Director of the Office of Electricity Delivery and Energy Reliability at the Department of Energy.

As our witnesses should know, spoken testimony is limited to five minutes each, and after which the Members of the Committee will have five minutes to ask questions, and we will start with Dr. Orbach.

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

Mr. ORBACH. Thank you, Chairman Lampson. Mr. Chairman, Congressman Inglis, Members of the Committee, I am grateful for the opportunity this morning to discuss the President's Fiscal Year 2008 budget request for the Office of Science. I want to thank you, Mr. Chairman, Mr. Inglis, for your kind remarks about basic research and the Office of Science.

The DOE Office of Science is the primary agency in the Federal Government for energy-related basic research. The Office interfaces with the Department of Energy's Applied Research programs, represented by my colleagues here this morning, upon which our nation relies for both energy security and national defense. Our goal is to underpin the applied research programs with the finest basic science, and at the same time, to energize our basic research with insights and opportunities from advanced applied research.

Transformational basic science discoveries are essential to the success of the Department's efforts in hydrogen, solar power, and biofuels. We are one department, and we have been working very hard together on strengthening the relationship between the Department's basic and applied research programs.

Let me say a few words this morning about the critical role that basic science plays in addressing our nation's energy challenge. Two examples. The first is cellulosic ethanol. To make this biofuel cost-effective, we must produce ethanol from cellulose directly. The problem is that the lignins that surround the cellulose in plants inhibit currently available enzymes from breaking down the cellulose into sugars that can be fermented into ethanol.

The Office of Science will be deploying three innovative new bioenergy research centers, studying both microbes and plants, developing new methods on processes actually found in nature to create the breakthroughs that we need. For example, our DOE Joint Genome Institute announced this week, in conjunction with the U.S. Forest Service, that identification of the metabolic pathways in a fungus found in the bowels of insects that holds the secret to effective fermentation of the sugar xylose, a key to making cellulosic ethanol cost-effective.

Second, consider intermittent sources of energy, such as wind and solar and tidal. The key to base load electrical contributions from these renewable sources is electric energy storage. In April of this year, we will bring together leading scientists and people from industry for a major workshop to chart a transformational path forward for electrical energy storage. We shall be considering supercapacitors and other innovative approaches based on the latest advances in materials and nanotechnology, to change the way we think about electrical storage. Solving this problem is an enabling key for renewable energy to make major contributions to electric base load generation.

These are examples of our mission in the Office of Science, investment in basic research to generate transformational scientific breakthroughs for our nation. Supporting transformational research also means providing cutting edge scientific facilities through our ten National Laboratories that will allow scientists from universities and the private sector to do the analysis that will give them advantages over their colleagues in other countries, thereby contributing to American competitiveness. It means educating, training, and sustaining a world-class scientific workforce, thousands strong, 25,500 supported by the Office of Science in our fiscal year 2008 budget in laboratories and universities across our nation for the sake of our country's future.

We are not doing this in a vacuum. Other nations are increasing their investment in basic science, because they know that those who dominate science will dominate the Twenty First Century global economy. To remain competitive, we cannot afford to fall behind other nations in R&D. To remain competitive, the President's Fiscal Year 2008 budget request for the Office of Science is $4.4 billion, an increase of seven percent over the fiscal year 2007 request. It is an important milestone on the path to doubling federal support for basic research in the physical sciences over the next ten years, and an indispensable investment in our nation's energy security and America's continued competitiveness in the global economy.

Thank you, and I will be pleased to answer questions.

[The prepared statement of Dr. Orbach follows:]

PREPARED STATEMENT OF RAYMOND L. ORBACH

Mr. Chairman and Members of the Committee, thank you for the opportunity to testify today on the Office of Science's Fiscal Year (FY) 2008 budget request. I appreciate your support for the Office of Science and basic research in the physical sciences, Mr. Chairman, and your understanding of the importance of this research to our nation's energy security and economic competitiveness. I also want to thank the Members of the Committee for their support. I believe this budget will enable the Office of Science to deliver on its mission and enhance U.S. competitiveness through our support of transformational science, national scientific facilities, and the scientific workforce for the Nation's future.

The Office of Science requests $4,397,876,000 for the FY 2008 Science appropriation, an increase of $600,582,000 over the FY 2007 appropriated level. The FY 2008 budget request for the Office of Science represents the second year of the President's commitment to double the federal investment in basic research in the physical sciences by the year 2016 as part of the American Competitiveness Initiative. It also represents a continued commitment to maintain U.S. leadership in science and recognition of the valuable role research in the physical sciences plays in technology innovation and global competitiveness.

With the FY 2008 budget request the Office of Science will continue to support transformational science—basic research for advanced scientific breakthroughs that

will revolutionize our approach to the Nation's energy, environment, and national security challenges. The Office of Science is the Nation's steward for fields such as high energy physics, nuclear physics, heavy element chemistry, plasma physics, magnetic fusion, and catalysis. It also supports unique components of U.S. research in climate change and geophysics.

Researchers funded through the Office of Science are working on some of the most pressing scientific challenges of our age including: 1) Harnessing the power of microbial communities and plants for energy production from renewable sources, carbon sequestration, and environmental remediation; 2) Expanding the frontiers of nanotechnology to develop materials with unprecedented properties for widespread potential scientific, energy, and industrial applications; 3) Pursuing the breakthroughs in materials science, nanotechnology, biotechnology, and other fields needed to make solar energy more cost-effective; 4) Demonstrating the scientific and technological feasibility of creating and controlling a sustained burning plasma to generate energy, as the next step toward making fusion power a commercial reality; 5) Using advanced computation, simulation, and modeling to understand and predict the behavior of complex systems beyond the reach of some of our most powerful experimental probes, with potentially transformational impacts on a broad range of scientific and technological undertakings; 6) Understanding the origin of the universe and nature of dark matter and dark energy; and 7) Resolving key uncertainties and expanding the scientific foundation needed to understand, predict, and assess the potential effects of atmospheric carbon dioxide on climate and the environment.

U.S. leadership in many areas of science and technology depends in part on the continued availability of the most advanced scientific facilities for our researchers. The Office of Science builds and operates national scientific facilities and instruments that make up the world's most sophisticated suite of research capabilities. The resources available for scientific research include advanced synchrotron light sources, the new Spallation Neutron Source, state-of-the-art Nanoscale Science Research Centers, supercomputers and high-speed networks, climate and environmental monitoring capabilities, particle accelerators and detectors for high energy and nuclear physics, and genome sequencing facilities We are in the process of developing new tools such as an X-ray free electron laser light source that can image single large macromolecules and measure in real-time changes in the chemical bond as chemical and biological reactions take place, a next generation synchrotron light source for x-ray imaging and capable of nanometer resolution, and detectors and instruments for world-leading neutrino physics research. SC will also select and begin funding in FY 2007 for three Bioenergy Research Centers to conduct fundamental research on microbes and plants needed to produce biologically-based fuel

Office of Science leadership in support of the physical sciences and stewardship of large national research facilities is directly linked to our historic role in training America's scientists and engineers. In addition to funding a diverse portfolio of research at more than 300 colleges and universities nationwide, we provide direct support and access to research facilities for thousands of university students and researchers. Facilities at the national laboratories provide unique opportunities for researchers and their students from across the country to pursue questions at the intersection of physics, chemistry, biology, computing, and materials science. About half of the annual 21,000 users of the Office of Science's scientific facilities come from universities. The FY 2008 budget will support the research of approximately 25,500 faculty, postdoctoral researchers, and graduate students throughout the Nation, an increase of 3,600 from FY 2006, in addition to supporting undergraduate research internships and fellowships and research and training opportunities for K–14 science educators at the national laboratories.

The approximate $600 million increase in FY 2008 from the FY 2007 appropriated level will bring manageable increases to the Office of Science programs for long planned for activities. The FY 2008 request will allow the Office of Science to increase support for high-priority DOE mission-driven scientific research and new initiatives; maintain optimum operations at our scientific user facilities; continuing major facility construction projects; and enhance educational, research, and training opportunities for the Nation's future scientific workforce. The budget request will also support basic research that contributes to Presidential initiatives such as the Hydrogen Fuel Initiative and the Advanced Energy Initiative, the Climate Change Science and Technology Programs, and the National Nanotechnology Initiative.

The following programs are supported in the FY 2008 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 2008 PRESIDENT'S REQUEST**
**SUMMARY BY PROGRAM**

(dollars in thousands)

| | FY 2006 Approp. | FY 2007 Request | FY 2007 Approp.† | FY 2008 Request | FY 2008 Request vs. Request | FY 2008 Request vs. Approp. |
|---|---|---|---|---|---|---|
| Basic Energy Sciences | 1,110,148 | 1,420,980 | | 1,498,497 | +77,517 | |
| Advanced Scientific Computing Research | 228,382 | 318,654 | | 340,198 | +21,544 | |
| Biological and Environmental Research | 564,077 | 510,263 | | 531,897 | +21,634 | |
| High Energy Physics | 698,238 | 775,099 | | 782,238 | +7,139 | |
| Nuclear Physics | 357,756 | 454,060 | | 471,319 | +17,259 | |
| Fusion Energy Sciences | 280,683 | 318,950 | | 427,850 | +108,900 | |
| Science Laboratories Infrastructure | 41,684 | 50,888 | | 78,956 | +28,068 | |
| Science Program Direction | 159,118 | 170,877 | | 184,934 | +14,057 | |
| Workforce Development for Teachers and Scientists | 7,120 | 10,952 | | 11,000 | +48 | |
| Safeguards and Security | 68,025 | 70,987 | | 70,987 | — | |
| SBIR/STTR | 116,813 | — | | — | — | |
| Total, Office of Science | 3,632,044 | 4,101,710 | 3,797,294 | 4,397,876 | +296,166 | +600,582 |

† FY 2007 program allocation plan not yet finalized.

### FY 2008 SCIENCE PRIORITIES

The challenges we face today in energy and the environment are some of the most vexing and complex in our history. Our success in meeting these challenges will depend in large part on how well we maintain this country's leadership in science and technology because it is through scientific and technological innovation and a skilled workforce that these challenges will be solved.

President George W. Bush made this point in his State of the Union Message on January 23, 2007, when he stated,

> *"It's in our vital interest to diversify America's energy supply—the way forward is through technology. . .. We must continue changing the way America generates electric power, by even greater use of clean coal technology, solar and wind energy, and clean, safe nuclear power. We need to press on with battery research for plug-in and hybrid vehicles, and expand the use of clean diesel vehicles and biodiesel fuel. We must continue investing in new methods of producing ethanol—using everything from wood chips to grasses, to agricultural wastes. . ..*
>
> *"America is on the verge of technological breakthroughs that will enable us to live our lives less dependent on oil. And these technologies will help us to be better stewards of the environment, and they will help us confront the serious challenge of global climate change."*

In 2006, the President announced a commitment to double the budget for basic research in the physical sciences at key agencies over ten years to maintain U.S. leadership in science and ensure continued global competitiveness. This commitment received bipartisan support in both the House of Representatives and the Senate and the FY 2008 budget request for the Office of Science represents the second year of this effort. Through the FY 2008 budget, the Office of Science will build on its record of results with sound investments to keep U.S. research and development

at the forefront of global science and prepare the scientific workforce we will need in the 21st century to address our nation's challenges.

Determining and balancing science and technology priorities across the Office of Science programs is an ongoing process. Several factors are considered in our prioritization, including scientific opportunities identified by the broader scientific community through Office of Science sponsored workshops; external review and recommendations by scientific advisory committees; DOE mission needs; and national and departmental priorities. In FY 2008, we will support the priorities in scientific research, facility operations, and construction and laboratory infrastructure established in the past few years and outlined in the Office of Science Strategic Plan and Twenty-year Facilities Outlook, in addition to national and departmental priorities and new research opportunities identified in recent workshops.

National initiatives in hydrogen fuel cell and advanced energy technologies will be supported through our contributions to basic research in hydrogen, fusion, solar energy-to-fuels, and production of ethanol and other biofuels from cellulose. We will also continue strong support for other Administration priorities such as nanotechnology, advanced scientific computation, and climate change science and technology.

The Office of Science will support three Bioenergy Research Centers in FY 2008 as part of the broader Genomics: GTL program. These centers, to be selected in FY 2007 and fully operational by the end of 2008, will conduct comprehensive, multidisciplinary research programs focused on microbes and plants to drive scientific breakthroughs necessary for the development of cost-effective biofuels and bioenergy production. The broader GTL program will also continue to support fundamental research and technology development needed to understand the complex behavior of biological systems for the development of innovative biotechnology solutions to energy production, environmental mitigation, and carbon management.

The Office of Science designs, constructs, and operates facilities and instruments that provide world-leading research tools and capabilities for U.S. researchers and will continue to support next generation tools for enabling transformational science. For example, the Spallation Neutron Source (SNS), the world's forefront neutron scattering facility, increases the number of neutrons available for cutting-edge research by a factor of ten over any existing spallation neutron source in the world. SNS was completed and began operations in 2006 and in FY 2008 full operations are supported and additional experimental capabilities continue to be added.

When it comes on line, the Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) will produce X-rays 10 billion times more intense than any existing X-ray source in the world, and will allow structural studies on individual nanoscale particles and single biomolecules. Construction of LCLS continues in FY 2008.

A next generation synchrotron light source, the National Synchrotron Light Source-II (NSLS–II), would deliver orders of magnitude improvement in spatial resolution, providing the world's finest capabilities for X-ray imaging and enabling the study of material properties and functions, particularly at the nanoscale, at a level of detail and precision never before possible. Its energy resolution would explore dynamic properties of matter as no other light source has ever accomplished. Support for continued R&D and project engineering and design (PED) are provided in FY 2008.

All five of DOE's Nanoscale Science Research Centers (NSRCs) will be operating in FY 2008. These facilities are the Nation's premier nanoscience user centers, providing resources unmatched to the scientific community for the synthesis, fabrication, and analysis of nanoparticles and nanomaterials.

We will fully fund the programs for advanced scientific computing, including: continued support for high-performance production computing at the National Energy Research Scientific Computing Center (NERSC), which will increase capacity to 100–150 teraflops in FY 2007; support for advanced capabilities for modeling and simulation of scientific problems in combustion, fusion, and complex chemical reactions at Oak Ridge National Laboratory's Leadership Computing Facility, which should deliver 250 teraflops computing capability by the end of FY 2008; and support for the upgrade to 250–500 teraflop peak capacity of the IBM Blue Gene P system at Argonne National Laboratory's Leadership Computing Facility to extend architectural diversity in leadership computing.

The Office of Science continues to be a partner in the interagency Climate Change Science Program focusing on understanding the principal uncertainties of the causes and effects of climate change, including abrupt climate change, understanding the global carbon cycle, developing predictive models for climate change over decades to centuries, and supporting basic research for biological sequestration of carbon. We also continue to support research in geosciences and environmental remediation to-

wards the development of scientific and technological solutions to long-term environmental challenges.

The Office of Science will continue to actively lead and support the U.S. contributions to ITER, the international project to build and operate the first fusion science facility capable of producing a sustained burning plasma to generate energy on a massive scale without environmental insult.

The historic international fusion energy agreement to build ITER with six other international partners was signed in November 2006.

We continue strong support for experimental and theoretical high energy physics and the study of the elementary constituents of matter and energy and interactions at the heart of physics. Full operations at the Tevatron Collider at Fermilab and the B-factory at SLAC are supported to maximize the scientific research and data derived from these facilities. Full operation of the neutrino oscillation experiment at Fermilab and start of fabrication of a next generation detector are supported to provide a platform for a world-leading neutrino program in the U.S. International Linear Collider (ILC) R&D and superconducting radio frequency technology R&D are supported to enable the most compelling scientific opportunities in high energy physics in the coming decades.

Our research programs in nuclear physics continue to receive strong support. Operations at the Relativistic Heavy Ion Collider (RHIC) and additional instrumentation projects for RHIC are supported for studies of the properties of hot, dense nuclear matter, providing insight into the early universe. We will also support operations at the Continuous Electron Beam Accelerator Facility (CEBAF), the world's most powerful "microscope" for studying the quark structure of matter, and project engineering and design and R&D for doubling the energy of the existing beam at CEBAF to 12 gigaelectron volts (GeV). Support for R&D to develop advanced rare isotope beam capabilities for the next generation U.S. facility for nuclear structure and astrophysics is also provided.

The standard of living we enjoy and the security of our nation now and in the future rests on the quality of science and technology education we provide America's students from elementary through graduate school and beyond. The FY 2008 budget will provide support for over 25,500 Ph.D.s, graduate students, engineers, and technical professionals, an increase of 3,600 over the number supported in FY 2006. The Office of Science will also support the development of leaders in the science and mathematics education community through participation of K–14 teachers in the DOE Academies Creating Teacher Scientists program, formerly the Laboratory Science Teacher Professional Development program. This immersion program at the national laboratories is an opportunity for teachers to work with laboratory scientists as mentors and to build content knowledge, research skills, and lasting connections to the scientific community, ultimately leading to more effective teaching that inspires students in science and math. The year 2008 will also mark the 18th year of DOE's National Science Bowl® for high school students. National Science Bowl® events for high school and middle school students, which will involve 17,000 students across the Nation this year, provide prestigious academic competitions that challenge and inspire the Nation's youth to excel in math and science.

**SCIENCE ACCOMPLISHMENTS**

For more than 50 years, the Office of Science (SC) has balanced basic research, innovative problem-solving, and support for world-leading scientific capabilities, enabling historic contributions to U.S. economic and scientific preeminence. American taxpayers have received good value for their investment in basic research sponsored by the Office of Science; this work has led to significant technological innovations, new intellectual capital, improved quality of life, and enhanced economic competitiveness. The following are some of the past year's highlights:

*Nobel Prize in Physics.* The 2006 Nobel Prize in physics was awarded to Dr. George Smoot (DOE Lawrence Berkeley National Laboratory and University of California, Berkeley) and Dr. John Mather (NASA Goddard Space Flight Center) for their discovery of "the blackbody form and anisotropy of the cosmic microwave background radiation," the pattern of minuscule temperature variations in radiation which allowed scientists to gain better understanding of the origins of galaxies and stars. These two American scientists led the teams of researchers who worked on the historic 1989 NASA COBE satellite. The results of their work provided increased support for the "Big Bang" theory of the universe and marked the inception of cosmology as a precise science. SC supported Dr. Smoot's research during the period in which he worked on the COBE experiment, and continues to support his research today. One of the principal instruments used to make the discoveries was built at SC-supported facilities at Lawrence Berkeley National Laboratory and

DOE's National Energy Research Scientific Computing Center supercomputers were used to analyze the massive amounts of data and produce detailed visual maps.

*Advancing Science and Technology for Bioenergy Solutions.* Harnessing the capabilities of microbes and plants holds great potential for the development of innovative, cost-effective methods for the production of biofuels and bioenergy. Sequencing of the poplar tree genome was completed as part of a DOE national laboratory-led international collaboration; the information encoded in the poplar genome will provide researchers with an important resource for developing trees that produce more biomass for conversion to biofuels and trees that can sequester more carbon from the atmosphere. The DOE Joint Genome Institute (JGI) marked a technical milestone this year with the 100th microbe genome sequenced; *Methanosarcina barkeri fusaro* is capable of living in diverse and extreme environments, produces methane from digesting cellulose and other complex sugars, and provides greater understanding of potential new methods for producing renewable sources of energy. A chemical imaging method developed using a light-producing cellulose synthesizing enzyme allowed researchers to observe the enzyme as it deposited cellulose fibers in a cell, providing greater understanding of the mechanism for cellulose formation.

*Delivering Forefront Computational and Networking Capabilities for Science.* Several 2006 advances in computing, computational sciences, and networking enabled greater opportunities for computational research and effective management of data collected at DOE scientific user facilities. NERSC began to increase its peak capacity by a factor of 100 and the Oak Ridge National Laboratory (ORNL) Leadership Computing Facility doubled its capability to 54 teraflops to provide additional resources for computationally intensive, large-scale projects. The Energy Sciences Network expanded in 2006 to include the Chicago and New York-Long Island metropolitan area networks (MANs), bringing dual connectivity at 20 gigabits per second and highly reliable, advanced network services to accommodate next-generation scientific instruments and supercomputers. Chemistry software using parallel-vector algorithms developed by researchers at ORNL has enabled computations 40 times more complex and 100 times faster than previous state-of-the-art codes. The development of a multi-scale mathematical framework for simulating the process of self-organization in biological systems has led to the discovery of a previously unidentified cluster state, providing possible applications to modeling microbial populations.

*Advances in Basic Science for Energy Technologies.* Current and future national energy challenges may be partially addressed through scientific and technological innovation. Some recent accomplishments in basic science that may contribute to future energy solutions include the following. Basic research on the molecular design and synthesis of new polymer membranes has lead to the discovery of a new fuel cell membrane that is longer lasting and three times more proton conductive than the current gold standard for proton exchange membrane fuel cells. Computational studies showing that in titanium-coated carbon nanotubes a single titanium atom can adsorb four hydrogen molecules opens new ways that the control of matter on the nanoscale can lead to the creation of novel materials for hydrogen storage. Recent work demonstrating that visible light can split carbon dioxide into carbon monoxide and a free oxygen atom, the critical first reaction in sunlight-driven transformation of carbon dioxide into methanol, makes it feasible to consider harnessing sunlight to drive the photocatalytic production of methanol from carbon dioxide. Demonstration of the effect known as carrier multiplication in which a single photon creates multiple charge carriers during the interaction of photons with a nanocrystalline sample could lead to substantial increases in solar cell conversion efficiency.

*Maintaining World-leading Research Tools for U.S. Science.* The Office of Science continues to construct and maintain powerful tools and research capabilities that will accelerate U.S. scientific discovery and innovation. The following highlight a few recent accomplishments. Construction and commissioning of the Spallation Neutron Source (SNS), an accelerator-based neutron source that will provide the most intense pulsed neutron beams in the world for scientific research and industrial development, was completed and began operations. Full operation of four of the five DOE Nanoscale Science Research Centers began in 2006, providing resources unmatched anywhere in the world for the synthesis, fabrication, and analysis of nanoparticles and nanomaterials. A nanofocusing lens device at the Advanced Photon Source at Argonne National Laboratory has set a world's record for line size resolution produced with a hard x-ray beam and enables such capabilities as three-dimensional visualization of electronic circuit boards, mapping impurities in biological and environmental samples, and analyzing samples inside high-pressure or high-temperature cells. A new record for performance, a 77 percent increase in peak luminosity in 2006 from the previous year, was achieved at the Tevatron, the world's most powerful particle collider for high energy physics research at Fermilab. Evi-

dence of the rare single top quark was observed at Fermilab in 2006, bringing researchers a step closer to finding the Higgs boson. The Large Area Telescope (LAT), a DOE and NASA partnership and the primary instrument on NASA's GLAST mission, was completed in 2006 and will be placed in orbit in the fall of 2007 to study the high energy gamma rays and other astrophysical phenomena using particle physics detection techniques. During the 2006 operation of the Relativistic Heavy Ion Collider (RHIC), polarized protons were accelerated to the highest energies ever recorded—250 billion electron volts—for world-leading studies of the internal quark-gluon structure of nucleons.

**PROGRAM OBJECTIVES AND PERFORMANCE**

The path from basic research to technology development and industrial competitiveness is not always obvious. History has taught us that seeking answers to fundamental questions can ultimately result in a diverse array of practical applications as well as some remarkable revolutionary advances. Working with the scientific community, the Office of Science invests in the promising research and sets long-term scientific goals with ambitious annual targets. The intent and impact of our performance goals may not always be clear to those outside the research community. Therefore the Office of Science has created a website (*www.sc.doe.gov/measures*) to better communicate to the public what we are measuring and why it is important.

Further, the Office of Science has 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 focuses the evaluation of the contractor's performance against eight Performance Goals (three Science and Technology Goals and five Management and Operation 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 2006 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 2007 Request—$1,421.0 Million; FY 2008 Request—$1,498.5 Million

Basic research supported by the Basic Energy Sciences (BES) program touches virtually every aspect of energy resources, production, conversion, efficiency, and waste mitigation. Research in materials sciences and engineering leads to the development of materials that may improve the efficiency, economy, environmental acceptability, and safety of energy generation, conversion, transmission, and use. Research in chemistry leads to the development of advances such as efficient combustion systems with reduced emission 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 contributes to the solution of problems in multiple DOE mission areas, including reactive fluid flow studies to understand contaminant remediation and seismic imaging for reservoir definition. Research in the molecular and biochemical nature of photosynthesis aids the development of solar photo-energy conversion and biomass conversion methods. BES asks researchers to reach far beyond today's problems in order to provide the basis for long-term solutions to what is one of society's greatest challenges—a secure, abundant, and clean energy supply. In FY 2008, the Office of Science will support expanded efforts in basic research related to transformational energy technologies. Within BES, there are increases to ongoing basic research for the hydrogen economy and effective solar energy utilization. The FY 2008 budget request also supports increased research in electric-energy storage, accelerator physics, and X-ray and neutron detector research.

BES also provides the Nation's researchers with world-class research facilities, including reactor- and accelerator-based neutron sources, light sources (soon to include an X-ray free electron laser), nanoscale science research centers, and electron beam micro-characterization centers. These facilities provide outstanding capabilities for imaging and characterizing materials of all kinds from metals, alloys, and ceramics to fragile biological samples. The next steps in the characterization and the ultimate control of materials properties and chemical reactivity are to improve spatial resolu-

tion 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 2008, BES scientific user facilities will be scheduled to operate at an optimal number of hours.

Construction of the Spallation Neutron Source (SNS) was completed in FY 2006 ahead of schedule, under budget, and meeting all technical milestones. In FY 2008 fabrication and commissioning of SNS instruments will continue, funded by BES and other sources including non-DOE sources, and will continue to increase power towards full levels. Two Major Items of Equipment are funded in FY 2008 that will allow the fabrication of approximately nine to ten additional instruments for the SNS, thus nearly completing the initial suite of 24 instruments that can be accommodated in the high-power target station.

All five Nanoscale Science Research Centers will be fully operational in FY 2008: 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 National Laboratories and Los Alamos National Laboratory, and the Center for Functional Nanomaterials at Brookhaven National Laboratory. In FY 2008, funding for research at the nanoscale increases for activities related to the hydrogen economy and solar energy utilization.

The Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) will continue construction at the planned levels in FY 2008. Funding is also provided for primary support of the operation of the SLAC linac. This marks the third year of the transition of linac funding from the High Energy Physics program to the Basic Energy Sciences program. The purpose of the LCLS Project is to 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 femtoseconds—the timescale of electronic and atomic motions. The LCLS will be the first such facility in the world for ground-breaking research in the physical and life sciences. Funding is provided separately for design and fabrication of instruments for the facility. Project Engineering and Design (PED) and construction for the Photon Ultra-fast Laser Science and Engineering (PULSE) building renovation begins in FY 2008. 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 continues for PED and R&D for the National Synchrotron Light Source-II (NSLS–II), which would be a new synchrotron light source, highly optimized to deliver ultra-high brightness and flux and exceptional beam stability. This would 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 would open new regimes of scientific discovery and investigation.

The Scientific Discovery through Advanced Computing (SciDAC) program is a set of coordinated investments across all Office of Science mission areas with the goal of using computer simulation to achieve breakthrough scientific advances that are impossible using theoretical or laboratory studies alone. The SciDAC program in BES consists of two activities: (1) characterizing chemically reacting flows as exemplified by combustion and (2) achieving scalability in the first-principles calculation of molecular properties, including chemical reaction rates.

**ADVANCED SCIENTIFIC COMPUTING RESEARCH**

FY 2007 Request—$318.7 Million; FY 2008 Request—$340.2 Million

The Advanced Scientific Computing Research (ASCR) program is expanding the capability of world-class scientific research through advances in mathematics, high performance computing and advanced networks, and through the application of computers capable of many trillions of operations per second (terascale to petascale computers). Computer-based simulation can enable us to understand and predict the behavior of complex systems that are beyond the reach of our most powerful experimental probes or our most sophisticated theories. Computational modeling has greatly advanced our understanding of fundamental processes of nature, such as fluid flow and turbulence or molecular structure and reactivity. Soon, through mod-

eling and simulation, we will be able to explore the interior of stars to understand how the chemical elements were created and learn how protein machines work inside living cells to enable the design of microbes that address critical energy or waste cleanup needs. We could also design novel catalysts and high-efficiency engines that expand our economy, lower pollution, and reduce our dependence on foreign oil. Computational science is increasingly important to making progress at the frontiers of almost every scientific discipline and to our most challenging feats of engineering. Leadership in scientific computing has become a cornerstone of the Department's strategy to ensure the security of the Nation and success in its science, energy, environmental quality, and national security missions.

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 flexible dense wave division multiplexing (DWDM) products gives SC the possibility of exploiting these technologies to provide scientific data where needed at speeds commensurate with the new data volumes. To take advantage of this opportunity, the Energy Science Network (ESnet) has entered into a long-term partnership with Internet 2 to build the next generation optical network infrastructure needed for U.S. science. To fully realize the potential for science, however, significant research is needed to integrate these capabilities, make them available to scientists, and build the infrastructure which can provide cyber security. ASCR is leading an interagency effort to develop a Federal Plan for Advanced Networking R&D. This plan will provide a strategy for addressing current and future networking needs of the Federal Government in support of science and national security missions and provide a process for developing a more detailed roadmap to guide future multi-agency investments in advancing networking R&D.

ASCR supports core research in applied mathematics, computer sciences, and distributed network environments. The applied mathematics research activity produces fundamental mathematical methods to model complex physical and biological systems. The computer science research efforts enable scientists to perform scientific computations efficiently on the highest performance computers available and to store, manage, analyze, and visualize the massive amounts of data that result. The networking research activity provides the techniques to link the data producers with scientists who need access to the data. Results from enabling research supported by ASCR are used by scientists supported by other SC programs. This link to other DOE programs provides a tangible assessment of the value of ASCR's core research program for advancing scientific discovery and technology development through simulations. In FY 2008 expanded efforts in applied mathematics will support critical long-term mathematical research issues relevant to petascale science, multi-scale mathematics, and optimized control and risk analysis in complex systems. Expanded efforts in computer science will enable scientific applications to take full advantage of petascale computing systems at the Leadership Computing Facilities.

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. Investments in the ESnet will 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 2008 ESnet will deliver a 10 gigabit per second (gbps) core Internet service as well as a Science Data Network with 20 gbps on its northern route and 10 gbps on its southern route. Delivery of the next generation of high performance resources at the National Energy Research Scientific Computing Center (NERSC) is scheduled for FY 2007. This NERSC–5 system is expected to provide 100–150 teraflops of peak computing capacity. The NERSC computational resources are integrated by a common high performance file storage system that enables users to use all machines easily. Therefore the new machine will significantly reduce the current oversubscription at NERSC which serves nearly 2,000 scientists annually.

In FY 2008, the Oak Ridge National Laboratory (ORNL) Leadership Computing Facility (LCF) will continue to provide world leading high performance sustained capability to researchers through the Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program. The acquisition of a 250 teraflop Cray Baker system by the end of FY 2008 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 with the LCF resources will be realized with an acquisition by Argonne National Laboratory (ANL) of a high performance IBM Blue Gene/P with low-electrical power requirements and a peak capability of up to 100

teraflops in 2007, and further expansion to 250–500 teraflops in FY 2008 will bring enhanced capability to accelerate scientific understanding in areas such as molecular dynamics, catalysis, protein/DNA complexes, and aging of material. With the ORNL and ANL LCF facilities SC is developing a multiple set of computer architectures to enable the most efficient solution of critical problems across the spectrum of science, ranging from biology to physics and chemistry.

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 breakthrough scientific advances via that are impossible using theoretical or laboratory studies alone. In FY 2006 ASCR recompeted its SciDAC portfolio, with the exception of activities in partnership with the Fusion Energy Sciences program that were initiated in FY 2005. The new portfolio, referred to as SciDAC–2, enables new areas of science through Scientific Application Partnerships; Centers for Enabling Technologies (CET) at universities and national laboratories; and University-led SciDAC Institutes to establish centers of excellence that complement the activities of the CETs and provide training for the next generation of computational scientists.

Advancing high performance computing and computation 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 ongoing development of a Federal Plan for Advanced Networking R&D.

**BIOLOGICAL AND ENVIRONMENTAL RESEARCH**

FY 2007 Request—$510.3 Million; FY 2008 Request—$531.9 Million

Biological and Environmental Research (BER) supports basic research with broad impacts on our energy future, our environment, and our health. 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. An ability to predict long-range and regional climate enables effective planning for future needs in energy, agriculture, and land and water use. 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. 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. 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—can be understood and improved using radiotracers, advanced imaging instruments, and novel biomedical devices.

The FY 2008 BER request continues expansion of the Genomics: GTL program. This program employs a systems approach to biology at the interface of 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. In FY 2005 BER engaged a committee of the National Research Council (NRC) of the National Academies to review the design of the Genomics: GTL program and its infrastructure plan. The NRC committee report, *Review of the Department of Energy's Genomics: GTL Program* was released in FY 2006 and provided a strong endorsement of the GTL program, recommending that the program's focus on systems biology for bioenergy, carbon sequestration, and bioremediation be given a "high priority" by DOE and the Nation. The report also recommended that the program's plan for new research facilities be reshaped to produce earlier and more cost-effective results by focusing not on particular technologies, but on research underpinning particular applications such as bioenergy, carbon sequestration, or environmental remediation.

In response, SC revised its original single-purpose user facilities plan to instead develop and support vertically-integrated GTL Research Centers to accelerate systems biology research. BER will support the development of three Bioenergy Re-

search Centers to be selected and initiated in FY 2007, and fully operational by the end of 2008. All three centers will conduct comprehensive, multidisciplinary research programs focused on microbes and plants to drive scientific breakthroughs necessary for the development of cost-effective biofuels and bioenergy production. These centers will not only possess the robust scientific capabilities needed to carry out their broad mission mandates, but will also draw upon the broader GTL program for technology development and foundational research. The vertically-integrated GTL Research Centers will not require construction of facilities. Moreover, the competition to establish and operate them is open to universities, non-profit research organizations, the national laboratories, and the private sector—an approach that is new for the Department. The first three research centers will focus on bioenergy research. The Department announced the solicitation for Bioenergy Research Centers in August 2006, and proposals were due on February 1, 2007.

Development of a global biotechnology based energy infrastructure requires a science base that will enable 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. Understanding the biological mechanisms involved in these energy producing processes will allow scientists and technologists to design novel biofuel production strategies involving both cellular and cell free systems that might include defined mixed microbial communities or consolidated biological processes. Within the Genomics: GTL program, BER supports basic research aimed at developing the understanding needed to advance biotechnology-based strategies for biofuel production, focusing on renewable, carbon-neutral energy compounds like ethanol and hydrogen, as well as understanding how the capabilities of microbes can be applied to environmental remediation and carbon sequestration.

In 2003, the Administration launched the Climate Change Research Initiative (CCRI) to focus research on areas where substantial progress in understanding and predicting climate change, including its potential causes and consequences, is possible over the next five years. In FY 2008, BER will contribute to the CCRI by focusing on (1) helping to resolve the North American carbon sink question (i.e., the magnitude and location of the North American carbon sink); (2) deployment and operation of a mobile ARM facility to provide data on the effects of clouds and aerosols on the atmospheric radiation budget in regions and locations of opportunity where data are lacking or sparse; (3) using advanced climate models to simulate potential effects of natural and human-induced climate forcing on global and regional climate and the potential effects on climate of alternative options for mitigating increases in human forcing of climate, including abrupt climate change; and (4) developing and evaluating assessment tools needed to study costs and benefits of potential strategies for reducing net carbon dioxide emissions.

In FY 2008, BER will continue to support research aimed at advancing the science of climate and Earth system modeling by coupling models of different components of the earth system related to climate and by significantly increasing the spatial resolution of such models. SciDAC-enabled activities will allow climate scientists to gain unprecedented insights into interactions and feedbacks between, for example, climate change and global cycling of carbon, the potential effects of carbon dioxide and aerosol emissions from energy production and their impact on the global climate system. BER will also add a SciDAC component to GTL and Environmental Remediation research. GTL SciDAC will initiate new research to develop mathematical and computational tools needed for complex biological system modeling and for analysis of complex data sets, such as mass spectrometry metabolomic or proteomic profiling data. Environmental Remediation SciDAC will provide an opportunity for subsurface and computational scientists to develop and improve methods of simulating subsurface reactive transport processes on "discovery class" computers.

Research emphasis within BER's Environmental Remediation Sciences subprogram 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 2008, BER will support the development of two additional field research sites (for a total of three), providing opportunities to validate laboratory findings under field conditions. The resulting knowledge and technology will assist DOE's environmental clean-up and stewardship missions. Funding for the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) at Pacific Northwest National Laboratory (PNNL) will be increased in FY 2008 to maintain operations at full capacity.

Also continuing in FY 2008 is BER support for fundamental research in genomics, medical applications and measurement science, and the health effects of low dose radiation in FY 2008. Resources are developed and made widely available for deter-

mining protein structures at DOE synchrotrons, and for DOE—relevant high-throughput genomic DNA sequencing. Building on DOE capabilities in physics, chemistry, engineering, biology and computation, BER supports fundamental imaging research, maintains core infrastructure for imaging research and develops new technologies to improve the diagnosis and treatment of psycho-neurological diseases and cancer and to improve the function of patients with neurological disabilities like blindness. Funding for Ethical, Legal, and Societal Issues (ELSI) associated with activities applicable to SC, increases to support research on the ecological and environmental impacts of nanoparticles resulting from nanotechnology applied to energy technologies.

**HIGH ENERGY PHYSICS**

FY 2007 Request—$775.1 Million; FY 2008 Request—$782.2 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 our 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. Research at these frontiers of science may uncover new particles, forces, or undiscovered dimensions of space and time; explain how matter came to have mass; and reveal the underlying nature of the universe. HEP supports 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. These research facilities and basic research supported by HEP advance our knowledge not only in high energy physics, but increasingly in other fields was 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 2008 HEP supports core experimental and theoretical research to maintain strong participation in the Tevatron, Large Hadron Collider (LHC) at CERN (the European Organization for Nuclear Research), and B-factory physics program, and supports research activities associated with development of potential new initiatives such as International Linear Collider (ILC) R&D, neutrinos, dark energy, and dark matter. HEP places a high priority on maximizing scientific data derived from the three major HEP user facilities: the Tevatron Collider and Neutrinos at the Main Injector (NuMI) beam line at Fermilab, and the B-factory at SLAC. HEP will continue to lead the international scientific community with these world-leading user facilities at Fermilab and SLAC in FY 2008, but these facilities will complete their scientific missions by the end of the decade. Thus, the longer-term HEP program supported in FY 2008 begins to develop new cutting-edge facilities in targeted areas (such as neutrino physics) that will establish U.S. leadership in these areas in the next decade, when the centerpiece of the world HEP program will reside at CERN.

In FY 2008 HEP continues to support software and computing resources for U.S. researchers participating in the LHC program at CERN as well as pre-operations and maintenance of the U.S.-built systems that are scientific components of the LHC detectors. R&D in support of the proposed ILC is maintained in FY 2008 to support U.S. participation in a comprehensive, coordinated international R&D program and to provide a basis for U.S. industry to compete successfully for major subsystem contracts, should the ILC be designed and then built. The long-term goal of this effort is to provide robust cost and schedule baselines to support design and construction decisions for an international electron-positron linear collider. The ILC would provide unprecedented power, clarity, and precision to unravel the mysteries of the next energy frontier, which we will just begin to discover with the LHC. In 2006 the ILC Reference Design Report was completed, and in FY 2007 further work toward the design, including some site-specific studies and detector studies, will be performed. In FY 2008 further work on both accelerator systems and detector studies will be performed.

To provide a nearer-term future HEP program, and to preserve future research options, R&D for accelerator and detector technologies, particularly in the growing area of neutrino physics, will continue in FY 2008. With Tevatron improvements completed, much of the accelerator development effort at Fermilab in FY 2008 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, which was originally proposed as a line item construction project in FY 2007 under the generic name of Electron Neutrino Appearance (EνA) Detector, is funded in FY 2008 and will utilize the NuMI beam. This project includes improvements to the proton source to increase the intensity of the NuMI beam. Meanwhile, fabrication will begin for the Reactor Neutrino Detector and two small neutrino experiments, the Main Injector Experiment ν-A (MINERνA) in the MINOS near detector hall at Fermilab and the Tokai-to-Kamioka (T2K) experiment using the Japanese J–PARC neutrino beam. R&D will continue 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 HEPAP/Nuclear Sciences Advisory Committee (NSAC) subpanel review.

To exploit the unique opportunity to expand the boundaries of our understanding of the matter-antimatter asymmetry in the universe, a high priority is given to continued operations and infrastructure support for the B-factory at SLAC. Final upgrades to the accelerator and detector are scheduled for completion in FY 2007, and B-factory operations will conclude in FY 2008. HEP support of SLAC operations decreases in FY 2008 as the contribution from BES increases for SLAC linac operations in preparation for the Linac Coherent Light Source (LCLS).

As the Large Hadron Collider (LHC) accelerator nears its turn-on date in 2007, U.S. activities related to fabrication of detector components will be completed and new activities related to commissioning and pre-operations of these detectors, along with software and computing activities needed to analyze the data, will ramp-up significantly. Support of an effective role for U.S. research groups in LHC discoveries will continue to be a high priority of the HEP program. R&D for possible future upgrades to the LHC accelerator and detectors will also be pursued.

Enhanced support for R&D on ground- and space-based dark energy experimental concepts, begun in FY 2007, will be continued in FY 2008. 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. For example, the Super Nova/Acceleration Probe (SNAP) will be a mission concept proposed for a potential interagency-sponsored experiment with NASA, and possibly international partners: the Joint Dark Energy Mission (JDEM). DOE and NASA are jointly funding a National Academy of Sciences study to determine which of the proposed NASA "Beyond Einstein" missions should launch first, with technical design of the selected proposal to begin at the end of this decade. JDEM is one of the candidate missions in this study. In FY 2008, fabrication for the Dark Energy Survey Project will begin.

The HEP program re-competed its SciDAC portfolio in FY 2006. Major thrusts in theoretical physics, astrophysics, and particle physics grid technology will be supported through the SciDAC program in FY 2008, as well as proposals in accelerator modeling and design to be selected in FY 2007. 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 2007 Request—$454.1 Million; FY 2008 Request—$471.3 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, at 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 also trains a workforce needed to underpin the Department's missions for nuclear-related national security, energy, and environmental quality.

Key aspects of NP research agenda include understanding how the quarks and gluons combine to form the nucleons (proton and neutron), what the properties and behavior of nuclear matter are under extreme conditions of temperature and pres-

sure, and what the properties and reaction rates are for atomic nuclei up to their limits of stability. Results and insight 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 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.

The FY 2008 budget request supports operations of the four National User Facilities and research at universities and laboratories, and makes investments in new capabilities to address compelling scientific opportunities and to maintain U.S. competitiveness in global nuclear physics efforts. In FY 2008 support continues for R&D on rare isotope beam development, relevant to the next-generation facilities that will provide capabilities for forefront nuclear structure and astrophysics studies and for understanding the origin of the elements from iron to uranium.

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 (BNL) 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 2008. The NP program, together with the National Aeronautics and Space Administration (NASA), will continue construction of a new Electron Beam Ion Source (EBIS) to provide RHIC with more cost-effective, reliable, and versatile operations. Research and development activities, including the development of an innovative electron beam cooling system for RHIC, are expected to demonstrate the feasibility of increasing the luminosity (or collision rate) of the circulating beams by a factor of ten, which would increase the long-term scientific productivity and international competitiveness of the facility. 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 zero viscosity) discovered at RHIC.

Operations of the Continuous Electron Beam Accelerator Facility (CEBAF) at Thomas Jefferson National Accelerator Facility (TJNAF) in FY 2008 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 2008, the accelerator will provide beams simultaneously to all three experimental halls and funding is provided for engineering design activities for 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 ANL and the Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL will be supported in FY 2008 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. The GRETINA gamma-ray tracking array, which continues fabrication in FY 2008, 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 SNS 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 2008 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 2008 to initiate U.S. participation in the fabrication of an Italian-led neutrino-less double beta decay experiment, the Cryogenic Underground Observatory for Rare Events (CUORE). A successful search for neutrino-less beta decay will determine if the neutrino is its own antiparticle and provide information about the mass of the neutrino. 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 beta decay will determine if the neutrino is its own antiparticle and provide information about the mass of the neutrino.

Following the re-competition of SciDAC projects in FY 2006, NP currently supports efforts in nuclear astrophysics, grid computing, Lattice Gauge (QCD) theory, and low energy nuclear structure and nuclear reaction theory. NP is also supporting R&D in an international effort to develop a larger, more sensitive neutrino-less beta decay experiment.

**FUSION ENERGY SCIENCES**

FY 2007 Request—$319.0 Million; FY 2008 Request—$427.9 Million

The Fusion Energy Sciences (FES) program advances the theoretical and experimental understanding of plasma and fusion science, including a close collaboration with international partners in identifying and exploring plasma and fusion physics issues through specialized facilities. The FES program supports research in plasma science, magnetically confined plasmas, advances in tokamak design, innovative confinement options, non-neutral plasma physics and high energy density laboratory plasmas (HEDLP), and cutting edge technologies. FES also leads U.S. participation in ITER, an experiment to study and demonstrate the sustained burning of fusion fuel. This international collaboration will provide an unparalleled scientific research opportunity with a goal of demonstrating the scientific and technical feasibility of fusion power. Fusion is the energy source that powers the sun and stars. Fusion power could play a key role in U.S. long-term energy plans and independence because it offers the potential for plentiful, safe, and environmentally benign energy. On November 21, 2006, the DOE signed the ITER agreement with its counterparts in China, the European Union, India, Japan, the Republic of Korea and the Russian Federation, formalizing this historic arrangement for international scientific cooperation.

The U.S. Contributions to ITER project is being managed by the U.S. ITER Project Office (USIPO), established as an Oak Ridge National Laboratory (ORNL)/ Princeton Plasma Physics Laboratory (PPPL) partnership. The FY 2008 request for the U.S. Contributions to ITER project reflects a significant increase in procurement, fabrication activities, and delivery of medium- and high-technology components, assignment of U.S. personnel to the International ITER Organization abroad, and the U.S. share of common costs at the ITER site in Cadarache, France, including installation and testing. These costs are part of the Total Estimated Cost (TEC) for the U.S. Contributions to ITER project. There is a second category of costs, Other Project Costs (OPC), which is for the supporting research and development activity for our U.S. Contributions. Together the TEC and OPC make up the overall Total Project Cost which is $1,122,000,000.

In support of ITER and U.S. Contributions to ITER, FES has placed an increased emphasis on its national burning plasma program—a critical underpinning to the fusion science in ITER. FES has enhanced burning plasma research efforts across the U.S. domestic fusion program, including: carrying out experiments on our national FES facilities that are exploring new modes of improved or extended ITER performance with diagnostics and plasma control that can also be extrapolated to ITER; developing safe and environmentally attractive technologies that could be used in future upgrades of ITER; exploring fusion simulation efforts that examine the complex behavior of burning plasmas in tokamaks; and integrating all that is learned into a forward-looking approach to future fusion applications. The U.S. Burning Plasma Organization has been established to coordinate these efforts.

Section 972(c)(5)(C) of the *Energy Policy Act (EPAct) of 2005,* required the Secretary of Energy to provide "a report describing how United States participation in the ITER will be funded without reducing funding for other programs in the Office of Science (including other fusion programs). . .." This report as well as all the other requirements for FES in EPAct have been or are in the process of being completed. The Department's FY 2008 budget provides for modest increases for all programs within the Office of Science and supports the ITER request of $160,000,000 from new funds in the FES budget request.

FES supports the operation of a set of experimental facilities. These facilities provide scientists with the means to test and extend our theoretical understanding and computer models—leading ultimately to improved predictive capabilities for fusion

science. Research and facility operations support for the three major facilities is maintained in FY 2008. Experimental research on tokamaks is continued with emphasis on physics issues of interest to the ITER project. The DIII–D tokamak at General Atomics will operate for 15 weeks in FY 2008 to conduct research relevant to burning plasma issues and topics of interest to the ITER project as well as maintain the broad scientific scope of the program. The Alcator C–Mod at the Massachusetts Institute of Technology will operate for 15 weeks and the National Spherical Torus Experiment (NSTX) at the Princeton Plasma Physics Laboratory (PPPL) will operate for 12 weeks. Fabrication of the major components of the National Compact Stellarator Experiment (NCSX) at PPPL continues and assembly of the entire device will be completed in FY 2009.

Funding for the FES SciDAC program continues in FY 2008 for the development of tools that facilitate international fusion collaborations and initiate development of an integrated software environment that can accommodate the wide range of space and time scales and the multiple phenomena that are encountered in simulations of fusion systems. Within SciDAC, the Fusion Simulation Project is a major initiative involving plasma physicists, applied mathematicians, and computer scientists to create a comprehensive set of models of fusion systems, combined with the algorithms required to implement the models and the computational infrastructure to enable them to work together.

FES will issue a joint solicitation in FY 2008, with the National Nuclear Security Administration (NNSA), focused on academic research in high energy density laboratory plasmas, which supports the Department's programmatic goals in inertial confinement fusion science.

**WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS**

FY 2007 Request—$10.9 Million; FY 2008 Request—$11.0 Million

The Department of Energy has played a role in training America's scientists and engineers for more than 50 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 a highly skilled scientific and technical workforce. The Workforce Development for Teachers and Scientists (WDTS) program acts as a catalyst within the DOE for the training of the next generation of scientists. 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's mission is to provide a continuum of educational opportunities to the Nation's students and teachers of science, technology, engineering, and mathematics (STEM).

WDTS supports experiential learning opportunities that compliment curriculum taught in the classroom 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 science, technology, engineering, and mathematics, thereby helping our national laboratories and the Nation meet the demand for a well-trained scientific/technical workforce; and (3) encourage and reward middle and high school students across the Nation to share, demonstrate, and 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 2008, the DOE Academies Creating Teacher Scientists (DOE ACTS) program, formerly the Laboratory Science Teacher Professional Development (LSTPD) program, will support the participation of approximately 300 teachers. All 17 of DOE's national laboratories will participate in this program. Each national laboratory can elect to implement either or both of the two types of teacher professional development models in DOE ACTS: (1) Teachers as Investigators (TAI) is geared towards novice teachers typically in the elementary to intermediate grade levels; and (2) Teachers as Research Associates (TARA) for teachers with a stronger background in science, mathematics, and engineering.

The Science Undergraduate Laboratory Internship (SULI) program, which provides mentor intensive research experiences for undergraduates at the national laboratories, will support approximately 340 students in FY 2008. The Albert Einstein Distinguished Educator Fellowships, the College Institute of Science and Technology (CCI) program, the Pre-Service Teacher activity for students preparing for teaching careers in a STEM discipline, and the National and Middle School Science Bowls will all continue in FY 2008.

**SCIENCE LABORATORIES INFRASTRUCTURE**

FY 2007 Request—$50.9 Million; FY 2008 Request—$79.0 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 ANL, BNL, and ORNL.

In FY 2008, SLI will fund four construction subprojects: Seismic Safety Upgrade of Buildings, Phase I, at the Lawrence Berkeley National Laboratory (LBNL); Modernization of Building 4500N, Wing 4, Phase I, at ORNL; Building Electrical Services Upgrade, Phase II, at ANL; and Renovate Science Laboratory, Phase I, at BNL. Funding for FY 2008 includes $35,000,000 held in reserve pending resolution of issues related to capability replacement and renovation at PNNL. If the issues are resolved, DOE will initiate a reprogramming request to use these funds to replace and/or upgrade mission-critical facilities currently located in the Hanford Site 300 Area. The SLI program continues funding for demolition of the Bevatron at LBNL in FY 2008, and funding is also provided for the demolition of several small buildings and trailers at ORNL.

**SCIENCE PROGRAM DIRECTION**

FY 2007 Request—$170.9 Million; FY 2008 Request—$184.9 Million

Science Program Direction (SCPD) enables a skilled, highly motivated federal workforce to manage the Office of Science's basic and applied research portfolio, programs, projects, and facilities in support of new and improved energy, environmental, and health technologies. SCPD consists of two subprograms: Program Direction and Field Operations.

The Program Direction subprogram is the single funding source for the Office of Science federal staff in headquarters responsible for managing, directing, administering, and supporting the broad spectrum of Office of Science disciplines. This subprogram includes planning and analysis activities, providing the capabilities needed to plan, evaluate, and communicate the scientific excellence, relevance, and performance of the Office of Science basic research programs. Additionally, Program Direction includes funding for the Office of Scientific and Technical Information (OSTI) which collects, preserves, and disseminates DOE research and development (R&D) information for use by DOE, the scientific community, academia, U.S. industry, and the public to expand the knowledge base of science and technology. The Field Operations subprogram is the funding source for the federal workforce in the Field responsible for management and administrative functions performed within the Chicago and Oak Ridge Operations Offices, and site offices supporting the Office of Science laboratories and facilities.

In FY 2008, Program Direction funding increases by 8.2 percent from the FY 2007 request. Most of the increase will support an additional 29 FTEs, to mange the increase in the SC research investment that is a key component of the President's American Competitiveness Initiative; four new FTEs to support NSLS–II, and ITER project office activities; and 35 FTEs—the staff of the New Brunswick Laboratory—transferring from the Office of Security and Safety Performance Assurance. Twenty-four FTEs are reduced across the SC complex in FY 2008 consistent with SC's corporate workforce planning strategy. The SCPD FY 2008 increase also supports a 2.2 percent pay raise; an increased cap for SES basic pay; other pay related costs such as the government's contributions for employee health insurance and Federal Employees' Retirement System (FERS); escalation of non-pay categories, such as travel, training, and contracts; and increased e-Gov assessments and other fixed operating requirements across the Office of Science complex.

**SAFEGUARDS AND SECURITY**

FY 2007 Request—$71.0 Million; FY 2008 Request—$71.0 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 vary-

ing degrees of protection commensurate with the risks and consequences described in their site-specific threat scenarios. The FY 2008 budget includes funding necessary to protect people and property at the 2003 Design Basis Threat (DBT) level. In FY 2008, funding for the Cyber Security program element addresses the promulgation of new National Institute of Standards and Technology (NIST) requirements that are statutorily required by the Federal Information Security Management Act (FISMA) to improve the Federal and Office of Science laboratory cyber security posture.

**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 U.S. competitiveness. On behalf of DOE, I am pleased to present this FY 2008 budget request for the Office of Science.

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

BIOGRAPHY FOR RAYMOND L. ORBACH

Raymond Lee Orbach was sworn in by Secretary Samuel W. Bodman as the Department of Energy's first Under Secretary for Science on June 1, 2006. President Bush nominated Dr. Orbach for the new position, created by the *Energy Policy Act of 2005,* on December 13, 2005, and he was unanimously confirmed by the U.S. Senate on May 26, 2006.

As Under Secretary for Science, Dr. Orbach serves as the Secretary's advisor on science policy as well as on the scientific aspects of all that DOE does, from basic research, to nuclear energy, to the environmental clean-up of Cold War legacy sites, to defense programs. Dr. Orbach is responsible for planning, coordinating and overseeing the Energy Department's research and development programs and its 17 national laboratories, as well as the department's scientific and engineering education activities.

Secretary Bodman has tasked Dr. Orbach with the department's implementation of the President's American Competitiveness Initiative, will help drive continued U.S. economic growth. Dr. Orbach continues to serve as the 14th Director of the Office of Science (SC) at the Department of Energy (DOE), a position he has held since the Senate confirmed him and he was sworn in in March 2002. In this capacity, Dr. Orbach manages an organization that is the third largest federal sponsor of basic research in the United States, the primary supporter of the physical sciences in the U.S., and one of the premier science organizations in the world.

The SC fiscal year 2006 budget of $3.6 billion funds programs in high energy and nuclear physics, basic energy sciences, magnetic fusion energy, biological and environmental research, and computational science. SC, formerly the Office of Energy Research, also provides management oversight of 10 DOE non-weapons laboratories, supports researchers at more than 300 colleges and universities nationwide, and builds and operates the world's finest suite of scientific facilities and instruments used annually by more than 19,000 researchers world-wide to extend the frontiers of science.

From 1992 to 2002, Dr. Orbach served as Chancellor of the University of California (UC), Riverside. Under his leadership, UC–Riverside doubled in size, achieved national and international recognition in research, and led the University of California in diversity and educational opportunity. In addition to his administrative duties at UC–Riverside, sustained an active research program; worked with postdoctoral, graduate, and undergraduate students in his laboratory; and taught the freshman physics course each year. As Distinguished Professor of Physics, Dr. Orbach set the highest standards for academic excellence.

Dr. Orbach began his academic career as a postdoctoral fellow at Oxford University in 1960 and became an Assistant Professor of applied physics at Harvard University in 1961. He joined the faculty of the University of California, Los Angeles (UCLA) two years later as an Associate Professor, and became a Full Professor in 1966. From 1982 to 1992, he served as the Provost of the College of Letters and Science at UCLA.

Dr. Orbach's research in theoretical and experimental physics has resulted in the publication of more than 240 scientific articles. He has received numerous honors as a scholar including two Alfred P. Sloan Foundation Fellowships, a National Science Foundation Senior Postdoctoral Fellowship at Oxford University, a John Simon Guggenheim Memorial Foundation Fellowship at Tel Aviv University, the Joliot Curie Professorship at the Ecole Superieure de Physique et Chimie Industrielle de la Ville de Paris, the Lorentz Professorship at the University of

Leiden in the Netherlands, the 1991–1992 Andrew Lawson Memorial Lecturer at UC–Riverside, the 2004 Arnold O. Beckman Lecturer in Science and Innovation at the University of Illinois at Urbana-Champaign, and the Outstanding Alumni Award from the California Institute of Technology in 2005.

Dr. Orbach is a fellow of the American Physical Society and the American Association for the Advancement of Science. Dr. Orbach has also held numerous visiting professorships at universities around the world. These include the Catholic University of Leuven in Belgium, Tel Aviv University, and the Imperial College of Science and Technology in London. He also serves as a member of 20 scientific, professional, and civic boards.

Dr. Orbach received his Bachelor of Science degree in Physics from the California Institute of Technology in 1956. He received his Ph.D. degree in Physics from the University of California, Berkeley, in 1960 and was elected to Phi Beta Kappa.

Dr. Orbach was born in Los Angeles, California. He is married to Eva S. Orbach. They have three children and seven grandchildren and three step-grandchildren.

Chairman LAMPSON. Thank you, Dr. Orbach. Mr. Spurgeon.

**STATEMENT OF MR. DENNIS R. SPURGEON, ASSISTANT SECRETARY FOR NUCLEAR ENERGY, U.S. DEPARTMENT OF ENERGY**

Mr. SPURGEON. Thank you, Chairman Lampson, Ranking Member Inglis, Chairman Gordon, and Members of the Subcommittee. It is a pleasure to be here to discuss the fiscal year 2008 budget request for the Department of Energy's Office of Nuclear Energy.

The Office of Nuclear Energy has made a great deal of progress in the last several years in advancing our nation's energy security and independence, in support of the Department's strategic plan. It is my near-term highest priority to enable industry to deploy a new generation of nuclear power plants. We have also made steps forward in developing advanced nuclear reactor and fuel cycle technologies while maintaining a critical national nuclear infrastructure.

Today, 103 nuclear reactors generate roughly 20 percent of America's electricity. U.S. electricity demand is anticipated to grow by 50 percent over the next 25 years, the equivalent of 45 to 50 one-thousand megawatt nuclear reactors must be built just to maintain that 20 percent share. The U.S. is at a critical juncture in the future of nuclear power in the United States. Unlike many of our international research partners, our nuclear industry has not been heavily supported financially or politically over the past 30 years. Today, the need for increased electric generating capacity is clear, and hopefully undisputed. Fortunately, we do have a growth option that allows us to have a diversified electric generation portfolio that includes a significant carbon emissions free component, and that is nuclear power.

To support near-term domestic expansion of the nuclear industry, the fiscal year 2008 budget requests $114 million for the Nuclear Power 2010 program to support continued cost-share efforts with industry to reduce the barriers to deployment of new nuclear power plants in the United States. We anticipate the NRC will soon vote—actually, I think it is tomorrow—on approval of the early site permit for the Exelon Generation Company's Clinton site in central Illinois, which represents a major accomplishment in the Energy Department's efforts to address the barriers and stimulate deployment of new nuclear power plants in the United States.

With nuclear power as the only proven base load producer of electricity that does not emit greenhouse gases, it is vital that our

current fleet of reactors be expanded in order to meet our needs for carbon-free, dependable, and economic electric power.

Any serious effort toward expanding global use of nuclear energy will inevitably require us to address the spent fuel and proliferation challenges that accompany such an expansion. To meet these challenges, President Bush initiated the Global Nuclear Energy Partnership, or GNEP, a comprehensive approach to enable an expansion of nuclear power in the United States and around the world, to promote nonproliferation goals, and to help resolve the nuclear waste issues.

Domestically, GNEP provides a solution to the ever-growing issue of spent nuclear fuel. In conjunction with Yucca Mountain, GNEP provides a solution which outlines a closed fuel cycle, where energy is harvested from the spent fuel before the end product is disposed of in a permanent repository. The spent fuel will be recycled in a manner that will be more proliferation-resistant than current processes used around the world. A closed fuel cycle will also alleviate some of the burden placed on Yucca Mountain, and will possibly eliminate the need for a second geologic repository throughout the remainder of this century. We reiterate, though, that no fuel cycle scenario will eliminate the need for a permanent geologic repository such as Yucca Mountain.

Internationally, GNEP promises to address the growing global energy demand in an environmentally friendly way. A global regime of countries able to provide a complete portfolio of nuclear fuel services, including Russia, France, and possibly Japan, China, and Britain, will provide these services to countries wanting to use nuclear power to meet their domestic growth and electricity demand without the cost and risk associated with nuclear fuel cycle infrastructure. By providing these services to other countries, we hope to dissuade future states from developing domestic enrichment capabilities like we are encountering with Iran today.

The fact is the U.S. is not currently positioned to be an active member of this global regime. We have limited enrichment capabilities and no back-end fuel cycle capabilities. Creating capabilities needed to provide—to participate in the global expansion of nuclear power will take 15 to 20 years, meaning that in order to become an active participant of the global nuclear expansion, we need to begin now. Taking those steps necessary enables us to better assure that the imminent expansion will be safe, beneficial, and will not promote the proliferation of nuclear weapons. If we fail to act, we will have little to say in the process.

The Department requests $405 million in fiscal year 2008 to begin work on developing a detailed roadmap for implementing all aspects of the GNEP vision.

Mr. Chairman, we appreciate the support that we have received from the Committee as we seek to address the challenges surrounding the global expansion of nuclear power. We remain confident and optimistic about the role of nuclear energy in providing a solution to our nation's energy stability and independence.

I would be pleased to answer your questions. Thank you.

[The prepared statement of Mr. Spurgeon follows:]

PREPARED STATEMENT OF DENNIS R. SPURGEON

Chairman Lampson, Ranking Member Inglis, and Members of the Committee, it is a pleasure to be here to discuss the Fiscal Year (FY) 2008 budget request for The Department of Energy's (DOE) Office of Nuclear Energy.

The Department of Energy's strategic plan portrays a long-term vision of a zero-emission future, free from the reliance on imported energy. A portfolio of nuclear programs is provided for in this plan for near-term, medium-term, and long-term sustained advances in nuclear technology.

The Office of Nuclear Energy has made a great deal of progress in the last several years in advancing our nation's energy security and independence in support of the Department's strategic plan. The Department remains committed to enabling industry to deploy a new generation of nuclear power plants. We have also made steps forward in developing advanced nuclear reactor and fuel cycle technologies while maintaining a critical national nuclear infrastructure.

Today, 103 nuclear reactors generate roughly 20 percent of America's electricity. U.S. electricity demand is anticipated to grow 50 percent over the next 25 years—the equivalent of 45 to 50 one-thousand megawatt nuclear reactors must be built to maintain that 20 percent share. With nuclear power as the only proven base load producer of electricity that does not emit greenhouse gases, it is vital that our current fleet of reactors be expanded in order to meet our needs for carbon-free, dependable and economic electric power.

Any serious effort to stabilize greenhouse gases in the atmosphere, while providing the increasing amounts of energy needed for economic development and growth, requires the expanded use of nuclear energy. This will inevitably require us to address the spent fuel and proliferation challenges that confront the expanded, global use of nuclear energy. To meet these challenges, the Department initiated the Global Nuclear Energy Partnership (GNEP), a comprehensive approach to enable an expansion of nuclear power in the U.S. and around the world, promote non-proliferation goals, and help minimize the amount of nuclear waste disposal.

GNEP is a perfect example of where global cooperation is required to address a changing global energy landscape. The United States has a unique opportunity to influence global energy policy, and more specifically global nuclear energy policy. However, for the U.S. to have influence abroad, we must have an established domestic policy supportive of a significant role for nuclear power in our energy future, an aggressive nuclear research and development program, and a viable nuclear technology infrastructure. Through the GNEP program, we are pursuing in parallel the development of the policies, technologies, and facilities necessary for the U.S. to be a global leader in the nuclear energy enterprise and to ensure our energy security and national security objectives.

The Department's FY 2008 budget request proposes an $874.6 million investment in nuclear research, development and infrastructure for the Nation's future. This budget request supports the President's priorities to enhance the Nation's energy security while enabling significant improvements in environmental quality. Our request supports development of new nuclear generation technologies and advanced energy products that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance.

While we have made great progress in all program areas, much remains to be done. Our FY 2008 request moves us in the right direction and I will now provide you a full report of our activities and explain the President's request for nuclear energy in detail.

**NUCLEAR POWER 2010**

To support near-term domestic expansion of nuclear energy, the FY 2008 budget requests $114 million for the Nuclear Power 2010 program to support continued cost-shared efforts with industry to reduce the barriers to the deployment of new nuclear power plants in the U.S. The technology focus of the Nuclear Power 2010 program is on Generation III+ advanced, light water reactor designs, which offer advancements in safety and economics over the Generation III designs certified in the 1990s by the Nuclear Regulatory Commission (NRC). To reduce the regulatory uncertainties and enable the deployment of new Generation III+ nuclear power plants in the U.S., it is essential to demonstrate the untested federal regulatory processes for the siting, construction, and operation of new nuclear plants. In addition, design finalization of two standard plant designs and NRC certification of these Generation III+ advanced reactor concepts are needed to reduce the high initial capital costs of the first new plants so that these new technologies can be competitive in the deregulated electricity market and deployable within the next decade.

The FY 2008 budget request continues the licensing demonstration activities started in previous years. Activities include completion of the last Early Site Permit demonstration projects and continuation of the New Nuclear Plant Licensing Demonstration projects that will exercise the untested licensing process to build and operate new nuclear plants and complete and obtain certification of two advanced Generation III+ advanced reactor designs. Engineering activities in support of the submission of two combined Construction and Operating License (COL) applications to the NRC will continue. In addition, two reactor vendors will continue first-of-a-kind design activities for two standard nuclear plants.

We anticipate the NRC will soon vote on approval of the Early Site Permit for the Exelon Generation Company's Clinton site in central Illinois, which culminates a four-year, cost-shared project between DOE and the Chicago-based Exelon Corporation. NRC approval of the Clinton Early Site Permit would represent a major accomplishment in the Energy Department's effort to address the barriers and stimulate deployment of new nuclear power plants in the United States.

The project teams, Dominion Energy and NuStart Energy Development LLC, involved in the licensing demonstration projects represent power generating companies and reactor vendors that operate more than two-thirds of all the U.S. nuclear power plants in operation today. As a result of the Nuclear Power 2010 program and Energy Policy Act of 2005 financial incentives (e.g., standby support), fourteen power companies have announced their intentions to apply for combined construction and operating licenses. Several have specifically stated that they are building on work being done in the Nuclear Power 2010 program as the basis for their applications.

The U.S. is at a critical juncture in the future of nuclear power in the United States. Unlike many of our international research partners, our nuclear industry has not been heavily supported financially and politically over the past thirty years. Today the need for increased electrical generating capacity is clear and hopefully undisputed. We have only one growth option that allows us to have a diversified electrical generation portfolio that includes a significant carbon emissions-free component, and that is nuclear power. To realize this option, we are asking private companies to build plants whose collective cost will likely exceed their net worth. This represents an enormous financial risk, the same risk that caused many U.S. companies to go into bankruptcy in the past.

If one accepts the fact that we need more electrical generation capacity, and if one desires to have a component of that new capacity that is carbon free, and one recognizes the financial considerations associated with such a large private investment in technologies that we have not supported in thirty years, then the importance of this program to our future energy security is self-evident. These companies will be building new generating capacity in the very near future, but the question they must first answer is whether this generation will come from clean, safe, nuclear technologies or not.

If widely deployed in the U.S., these new technologies will create significant business opportunities and will support the rapid growth of heavy equipment fabrication, high technology and commercial construction industries in this country. Moreover, these American technologies and industrial capabilities will be highly competitive internationally and would support our leadership role in the global expansion of safe, clean nuclear power.

**ADVANCED FUEL CYCLE INITIATIVE**

One of the most important and challenging issues affecting future expansion of nuclear energy in the U.S. and worldwide is dealing effectively with spent nuclear fuel and high-level waste. For the medium-term, the Advanced Fuel Cycle Initiative (AFCI) will develop fuel cycle technologies that will support the economic and sustained production of nuclear energy while minimizing waste in a proliferation-resistant manner. To support the development of these technologies, the FY 2008 Budget request includes $395.0 million for AFCI.

AFCI's near-term goals are to develop and demonstrate advanced, proliferation-resistant fuel cycle technologies for treatment of commercial light water reactor spent fuel, to develop an integrated spent fuel recycling plan, and to provide information and support on efforts to minimize the amount of material that needs disposal in a geologic repository. AFCI conducts research and development of spent fuel treatment and recycling technologies to support an expanding role for nuclear power in the U.S. and to promote world-wide expansion of nuclear energy in a proliferation-resistant manner as envisioned for the Global Nuclear Energy Partnership (GNEP). AFCI is the U.S. technology component of the GNEP.

Specifically, in FY 2008, the Department intends to complete industry-led conceptual design studies for the nuclear fuel recycling center and the advanced recycling

reactor Demonstration Analysis. Additionally, DOE will continue start-to-finish demonstrations of recycling technologies, which are expected to produce separated transuranics for use in transmutation fuel development, as well as conduct systems analysis and advanced computing and simulation activities focused on a variety of deployment system alternatives and supporting technology development. As part of GNEP Technology Development, the Department also intends to evaluate small, proliferation-resistant reactors for potential U.S. manufacture and export to reactor user nations.

GNEP seeks to bring about a significant, wide-scale use of nuclear energy, and to take actions now that will allow that vision to be achieved while decreasing the risk of nuclear weapons proliferation and effectively addressing the challenges of nuclear waste disposal. GNEP will advance the nonproliferation and national security interests of the United States by reinforcing its nonproliferation policies and limiting the spread of enrichment and reprocessing technologies, and will eventually eliminate excess civilian plutonium stocks that have accumulated. The AFCI budget request supports the Department's goal of realizing the GNEP vision. AFCI activities in FY 2007 and FY 2008 are focused on developing a detailed roadmap for implementing all aspects of the GNEP vision and informing a Secretarial decision in June 2008 on the path forward for GNEP.

Long-term goals for AFCI/GNEP will develop and demonstrate an advanced, proliferation-resistant closed nuclear fuel cycle system involving spent fuel partitioning and recycling of actinides and other long-lived radioactive elements for destruction through transmutation in fast reactors that could result in a significant increase in the effective capacity of the planned Yucca Mountain repository. This increase would come principally from the destruction of actinides that generate the heat that limits repository capacity that the Yucca Mountain repository would have. This capacity increase would ensure enough capacity to accommodate all the spent fuel generated in the United States this century from any reasonably conceivable deployment scenario for nuclear energy. Yet, under any fuel cycle scenario a geologic repository is necessary. Therefore, GNEP and Yucca Mountain are proceeding on parallel tracks.

**GENERATION IV NUCLEAR ENERGY SYSTEMS INITIATIVE**

The FY 2008 budget request includes $36.1 million to continue development of next-generation nuclear energy systems within the Generation IV program. For the long-term, the Generation IV program will develop new nuclear energy systems that can compete with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of options that are economical, reliable, safe, secure, and environmentally acceptable. In particular, the Next Generation Nuclear Plant (NGNP) reactor concept will be capable of providing high-temperature process heat for various industrial applications, including the production of hydrogen in support of the President's Advanced Energy Initiative.

The NGNP, with an investment of $30 million within the Generation IV Nuclear Energy Systems Initiative, will utilize a Generation IV Very High Temperature Reactor configured for production of high temperature process heat for the generation of hydrogen, electricity, and other industrial commodities. 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 1 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.

The FY 2008 budget request maintains critical R&D that will help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economical challenges and risks is needed before a decision can be made to proceed with a demonstration of a next-generation reactor.

**NUCLEAR HYDROGEN INITIATIVE**

Hydrogen offers significant promise as a future energy technology, particularly for the transportation sector. The use of hydrogen in transportation will reduce U.S. dependence on foreign sources of petroleum, enhancing our energy security. The FY 2008 budget request for the Office of Nuclear Energy includes $22.6 million to continue to develop enabling technologies, demonstrate nuclear-based hydrogen produc-

tion technologies, and study potential hydrogen production strategies to support the President's vision for a future hydrogen economy.

Currently, the only economical, large-scale method of hydrogen production involves the conversion of methane into hydrogen through a steam reforming process. This process produces ten kilograms of greenhouse gases for every kilogram of hydrogen, defeating a primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using electricity. Electrolysis is typically used for small production quantities and is inherently less efficient because electricity must first be produced to run the equipment used to convert the water into hydrogen. Additionally, the environmental benefits of electrolysis are negated unless a non-emitting technology, such as nuclear or renewable energy, is used to produce the electricity. The Nuclear Hydrogen Initiative is developing processes that operate across a range of temperatures for the various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative. These processes, coupled with advanced nuclear reactors, have the potential for high-efficiency, large-scale production of hydrogen.

The objective of this program is to demonstrate the technologies at increasingly larger scales ultimately culminating in an industrial scale that would be technically and economically suited for commercial deployment. FY 2005 and FY 2006 activities were focused on the validation of individual processes and components; FY 2007 and FY 2008 are focused on the design, construction and operation of integrated laboratory scale experiments. In FY 2008, the Department will complete construction of integrated laboratory-scale system experiments and begin testing to enable the 2011 selection of the technology that could be demonstrated in a pilot scale hydrogen production experiment.

**RADIOLOGICAL FACILITIES MANAGEMENT**

The Office of Nuclear Energy's FY 2008 budget request also includes $53.0 million to maintain critical research and production facilities for medical isotopes and radioisotope power systems at the Idaho National Laboratory, the Oak Ridge National Laboratory, the Los Alamos National Laboratory, the Sandia National Laboratory, and the Brookhaven National Laboratory. This request also includes funding for University Research Reactors.

These funds assure that the infrastructure for the facilities meet essential safety and environmental requirements and are maintained at operable user-ready levels. Programmatic activities, including production and research, are funded either by other DOE programs, by the private sector, or by other federal agency users.

The Department seeks $14.9 million to maintain one-of-a-kind facilities at the Idaho, Oak Ridge, Brookhaven, and Los Alamos National Laboratories for isotope production and processing. These isotopes are used to help improve the accuracy, effectiveness, and continuation of medical diagnoses and therapy, enhance homeland security, improve the efficiency of industrial processes, and provide precise measurement and investigative tools for materials, biomedical, environmental, archaeological, and other research. Actual operations, production, research or other activities are funded either by other DOE programs, by the private sector, or by other federal agency users.

The Department also maintains unique facilities and capabilities at the Idaho, Oak Ridge, and Los Alamos National Laboratories that enable the Department to provide the radioisotope power systems for space exploration and national security applications. The FY 2008 budget requests $35.1 million to maintain the basic facilities and associated personnel whereas mission specific development or hardware fabrication costs are provided by the user agencies. This arrangement is essential in order to preserve the basic capability regardless of periodic fluctuations in the demand of the end product users.

Finally, the Department requests $2.9 million in FY 2008 to provide research reactor fuel to universities and dispose of spent fuel from university reactors. Currently, there are 27 operating university research reactors at 27 institutions in the U.S. Many of these facilities have permanent fuel cores and therefore do not require regular fuel shipments. However, DOE supplies approximately a dozen universities with fresh fuel and shipments of spent fuel as needed.

**IDAHO FACILITIES MANAGEMENT**

The Department is working to transform Idaho National Laboratory into one of the world's foremost nuclear research laboratories. As such, the FY 2008 budget request seeks $104.7 million for the Idaho Facilities Management Program to maintain and enhance the laboratory's nuclear energy research infrastructure.

The Idaho Facilities Management Program operates and maintains three main engineering and research campuses and the Central Facilities Area at the Idaho Na-

tional Laboratory. The three main engineering and research campuses are: (1) the Reactor Technology Complex which houses the world-renown Advanced Test Reactor, (2) the Materials and Fuels Complex, and (3) the Science and Technology Campus. As the Idaho National Laboratory landlord, the Office of Nuclear Energy also operates and maintains the Central Facilities Area at Idaho National Laboratory, providing site-wide support services and from which various site infrastructure systems and facilities, such as electrical utility distribution, intra-laboratory communications systems, and roads are managed and maintained. Also included within the Central Facilities Area is the Radiological and Environmental Sciences Laboratory operated by the Office of Nuclear Energy.

**IDAHO SITE-WIDE SAFEGUARDS & SECURITIES**

The mission of the Idaho Site-wide Safeguards and Security program is to protect the assets and infrastructure of the Idaho National Laboratory 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.

The FY 2008 Budget Request includes $72.9 million to provide protection of nuclear materials, classified matter, Government property, and other vital assets from unauthorized access, theft , diversion, sabotage, espionage, and other hostile acts that may cause risks to national security, the health and safety of DOE and contractor employees, the public or the environment.

**UNIVERSITY REACTOR INFRASTRUCTURE AND EDUCATIONAL ASSISTANCE**

While the University Educational Assistance program has concluded, funding will continue to be provided to the Nation's nuclear science and engineering universities through our applied research and development programs by means of our Nuclear Energy Research Initiative (NERI). NERI funds are competitively awarded to support research objectives of the Advanced Fuel Cycle Initiative, the Generation IV Energy Systems Initiative and the Nuclear Hydrogen Initiative. By increasing the opportunities for university participation in our research programs, the Department seeks to establish an improved education and research network among universities, laboratories, industry and government. Approximately $62 million in funding for universities is included in the research programs for FY 2008, a 21 percent increase over the FY 2007 request.

**CONCLUSION**

This concludes my prepared statement. Your leadership and guidance has been essential to the progress the program has achieved thus far and your support is needed as we engage the task ahead of investing in our energy security.

I would be pleased to answer any questions you may have.

BIOGRAPHY FOR DENNIS R. SPURGEON

Dennis Spurgeon was sworn in on April 3, 2006, as the first Assistant Secretary for Nuclear Energy (NE) at the Department of Energy in more than a decade. In this capacity, Mr. Spurgeon is the senior nuclear technology official in the U.S. Government.

Mr. Spurgeon is responsible for the Department's nuclear energy enterprise, including nuclear technology research and development, management of the Department's nuclear technology infrastructure, and support to nuclear education in the United States. NE's nuclear technology infrastructure is comprised of hot cells, test reactors, accelerators and other highly specialized facilities that support nuclear research and development, materials testing, and production of isotopes for medicine and radioisotope power systems for space and national security users. He is responsible for execution of a $536 million annual federal budget (FY 2006).

Mr. Spurgeon leads the recently-announced Global Nuclear Energy Partnership, a comprehensive strategy aimed at accelerating the demonstration of a more proliferation resistant closed fuel cycle and bringing the benefits of nuclear energy to the world in a safer and more secure manner, reducing the possibility that nuclear energy could be used for non-peaceful purposes. GNEP is part of the President's *Advanced Energy Initiative.*

Most recently, Assistant Secretary Spurgeon served as Executive Vice President and Chief Operating Office for USEC, Inc. an international supplier of enriched uranium for nuclear plants. Prior to that, he served as Chairman, Chief Executive Officer and principal owner of Swiftships, an international leader in shipbuilding for commercial and military markets.

Assistant Secretary Spurgeon held posts in the Ford administration, including an assignment as Assistant Director for Fuel Cycle in the U.S. Energy Research and Development Administration. He was a member of the White House task force that developed President Ford's nuclear policy. Earlier in his career, as a U.S. Naval officer, he served as technical assistant to Commissioner Tommy Thompson and later to Dr. Glenn Seaborg, Chairman of the Atomic Energy Commission and predecessor agency of the department.

He also held executive positions at the former United Nuclear Corporation, where as Chief Operating Officer he managed the manufacturing of reactor cores for the Navy and operation of the Department's former N-reactor, located at the Hanford Reservation. He previously worked for the General Atomic Company, where he assisted in the development of nuclear reactor plants for electric power generation. He served in the U.S. Navy, achieving the rank of Captain.

Mr. Spurgeon graduated with distinction from the U.S. Naval Academy. He holds a Masters of Science in nuclear engineering and the degree of Nuclear Engineer from the Massachusetts Institute of Technology.

Chairman LAMPSON. Thank you very much, Mr. Spurgeon. Mr. Karsner, you are recognized for five minutes.

**STATEMENT OF MR. ALEXANDER KARSNER, ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY**

Mr. KARSNER. Thank you, Mr. Chairman. Mr. Chairman, Ranking Member Inglis, and Members of the Committee, thank you for the opportunity to testify on the President's fiscal year 2008 budget request for the Office of Energy Efficiency and Renewable Energy.

The request includes $1.24 billion for EERE, approximately $60 million more than the fiscal year 2007 request to Congress. To be clear, my testimony today on the fiscal year 2008 budget request is presented in comparison to the Administration's fiscal year 2007 request, not the final amounts that were eventually appropriated in the 2007 Continuing Resolution. The Department of Energy is in the process of preparing an operating plan for submittal to Congress, as required. EERE received an increase in funding under the CR, as you know, and I am grateful to Congress for its strong commitment to energy efficiency and renewable energy programs.

The budget request addresses pressing energy security, economic, and environmental challenges facing our country today. Accelerating the development of renewable energy and energy efficiency technologies will maximize rational utilization of our resources and clean energy production. Much of EERE's funding is integral to the President's Advanced Energy Initiative. The AEI, launched in 2006, aims to confront our addiction to oil, reducing our dependence on foreign sources of energy, and commercializing emission-free sources of power generation. The technology investment is meant to change the way we power our homes, offices, and vehicles.

In his 2007 State of the Union address, the President raised the bar further by challenging our country to reduce gasoline consumption by 20 percent within the decade, and advocated the "Twenty in Ten" plan. The budget request increases funding for programs to help the Nation achieve the Twenty in Ten goal, including for example, biomass and biofuels R&D, and expanding the availability of alternative transportation fuels.

We must work to not only accelerate R&D for new energy technologies, but speed the adoption of the technologies into commercial products that can become more widely available into the market-

place at a reasonable cost to all Americans. EERE is taking aggressive steps to catalyze the rapid commercialization and deployment of critical energy advances through innovative partnerships with lenders and investment groups, with our state partners, and with industrial leaders. EERE's overall budget request reflects the funding needed to meet these goals.

The fiscal year 2008 request for Biomass and Biorefinery Systems R&D is $179.3 million, an increase of approximately $30 million. Biomass is the most viable renewable option for producing liquid transportation fuels in the near-term, holding great potential to help reduce our dependence on imported oil. EERE will continue to support cost-share efforts with industry to develop and demonstrate technologies to enable cellulosic biorefineries. The proposed increase will also support cost-share projects with industry for enzyme development to produce low cost sugars from biomass, and for improved organism development, or ethanologens, for converting those sugars into ethanol.

For the Vehicle Technologies Program, the Department is requesting $176.1 million to advance development of increasingly energy-efficient and environmentally friendly flexible platform technologies for our cars and trucks. The program focuses on technologies that use significantly less oil, and enable the auto industry to comply with reformed and modernized CAFE standards. Battery technologies have made significant progress towards our program goals, having reduced the cost of next generation hybrid vehicle batteries in each of the past three years from almost $1,200 per vehicle at the beginning of fiscal year 2004 to $750 per vehicle at the end of fiscal year 2006. We expect to bring that down the cost curve further in the next fiscal year to $625 per vehicle, and to increase our emphasis on batteries specifically optimized for plug-in hybrids. EERE seeks to have battery technology ready no later than 2014 that will enable auto manufacturers to widely and economically produce competitive plug-in hybrid vehicles having a 40 mile all electric range.

Hydrogen is also an important element of the Nation's strategy for energy security and environmental stewardship. The President's $309 million budget request for DOE and the Hydrogen Fuel Initiative fulfills his commitment of $1.2 billion over five years. The portion that is under my purview is $213 million, which reflects a $17.2 million increase over the Fiscal 2007 budget request.

The proposed increase will accelerate and expand the efforts to research and develop hydrogen storage systems and improve performance, and fuel cell materials and components to reduce their cost and improve their durability. Over the past four years, our research has reduced the high volume costs of automotive fuel cells from $275 per kilowatt in 2002 to $107 per kilowatt in 2006, a major step towards the ultimate cost target of $30 per kilowatt for commercial production.

For solar energy, the budget request is $148.3 million, a level that is nearly twice that which was enacted in fiscal year 2006. To lower costs more rapidly and improve performance, the Department's photovoltaic R&D, for example, focuses on those technology pathways that have the greatest potential to reach cost competitiveness and grid parity by or before 2015.

And we are emphasizing efficiency with our Building Technologies Program, which targets a long-term goal of cost-neutral net zero energy buildings, houses that produce as much energy as they use on an annual basis by 2020. And in the near-term, our R&D has helped industry to produce a white Light Emitting Diode, or LED, lamps which set a world record for LED brightness and efficacy in the use of a power chip.

Our Wind Program focuses on reducing wind power costs and removing barriers to resource utilization to enable maximum market penetration of wind energy technology across the U.S., so that domestic emission-free clean energy may one day contribute up to 20 percent of our national generation portfolio.

Our Industrial Technologies Program leverages its innovative technology transfer practices and highly successful partnerships with energy-intensive industries, as well as supporting development of next generation technologies to revolutionize U.S. industrial processes, including those for nanomanufacturing, that ultimately enhance our competitiveness, and deliver dramatic energy and environmental benefits.

My written statement, of course, includes greater detail on these and our other programs, but this concludes my opening remarks, and I would be happy to answer any questions the Committee may have.

[The prepared statement of Mr. Karsner follows:]

PREPARED STATEMENT OF ALEXANDER KARSNER

Mr. Chairman and Members of the Committee, thank you for this opportunity to testify on the President's Fiscal Year (FY) 2008 budget request for the Office of Energy Efficiency and Renewable Energy (EERE).

The President's FY 2008 budget request includes $1.24 billion for EERE, approximately $60 million (five percent) more than the FY 2007 request to Congress. To be clear, my testimony today on the FY 2008 budget request is presented in comparison to the Administration's FY 2007 request—not the final amounts appropriated in the 2007 Continuing Resolution (CR). In accordance with the terms of the 2007 CR, the Department of Energy (DOE) is in the process of preparing an operating plan for submittal to Congress. EERE received an increase in funding under the CR, and I am grateful to Congress for its strong commitment to energy efficiency and renewable energy programs.

The FY 2008 budget request addresses pressing energy and environmental challenges facing our country today by accelerating the development of both renewable energy technologies to increase the amount of clean energy produced in the United States and advanced energy efficient technologies, standards, and practices that use less energy. Much of EERE's funding is an integral part of the President's Advanced Energy Initiative (AEI), launched in 2006 to confront our addiction to oil, lessen dependence on foreign resources, and reduce emissions by developing clean sources of electricity generation. Together, new technologies can help change the way we power our homes, businesses, and automobiles.

In his 2007 State of the Union address, the President raised the bar by seeking legislative action for our country to reduce gasoline consumption by 20 percent in the next 10 years, the "20 in 10" plan. The FY 2008 budget request increases funding for programs that may help the Nation achieve the "20 in 10" goal, including, for example, biomass/biofuels R&D that may help to expand the availability of alternative transportation fuels.

EERE's applied science R&D contributes to the foundation for transforming the Nation's energy options and energy use. For example, one of this year's R&D 100 awards went to the Department's Idaho National Laboratory for its work with Xtreme Xylanase, an enzyme produced by bacteria found in the hot, acidic waters of Yellowstone National Park. Work on Xtreme Xylanase was funded in part by EERE's Biomass Program. The metabolic versatility of this enzyme (it breaks down cellulose and hemicellulose over a broad range of temperatures and acidic pH conditions) could help make cellulosic ethanol more efficiently and economically. In the

field of solar energy, a new world-record 40 percent efficient concentrating photovoltaic solar cell was developed as a result of collaboration between DOE, the National Renewable Energy Laboratory, and Spectrolab. For general lighting applications with solid-state lighting, Cree, Inc., with DOE R&D funding, has released the new XLamp® 7090 power white light-emitting diode (LED), setting a world record for LED brightness and efficacy (at 85 lumens/Watt) in a power chip.

It is essential, however, that, we work not only to accelerate R&D for new energy technologies, but address the accelerated adoption of technologies into commercial products that are widely available at reasonable cost to all Americans. Thus, in addition to its historical role of leading federal applied science on emerging technologies, EERE is taking aggressive steps to catalyze the rapid commercialization and deployment of critical energy advances through innovative partnerships and collaboration with lenders and investment groups, the States, and industry leaders. We seek to help enable and accelerate market transformation toward the use of more efficient and cleaner technologies.

EERE's overall budget request reflects the funding needed to meet our goals. The following EERE programs target and support sectors of energy use and supply that will help lead our nation to a secure energy future:

**BIOMASS AND BIOREFINERY SYSTEMS R&D**

The FY 2008 budget request for Biomass and Biorefinery Systems R&D is $179.3 million, an increase of $29.6 million, almost 20 percent above the FY 2007 request. This proposed funding increase reflects the essential role of the Biofuels Initiative in increasing America's energy security. Biomass is the most viable renewable option for producing liquid transportation fuels in the near-term, with the potential to help reduce our dependence on imported oil.

The focus of the program is to make cellulosic ethanol cost-competitive by 2012. EERE will continue in FY 2008 to support its cost-share efforts with industry to develop and demonstrate technologies to enable cellulosic biorefineries for the production of transportation fuels and co-products. The FY 2008 funding increase also supports the validation of advancing biomass conversion technologies and feedstocks in biorefineries at approximately 10 percent of commercial scale. This effort enables industry to resolve remaining technical and process integration uncertainties for the "next generation" of biorefinery process technologies being examined at a significant, but less-costly scale.

Ultimately, 10 percent scale demonstrations have the potential to reduce the overall cost and risk to industry along with improving the likelihood of obtaining financing for commercial-scale facilities.

The FY 2008 funding increase will also support EERE cost-shared projects with industry for enzyme development for producing low cost sugars from biomass and for improved organism development or "ethanologen" for converting those sugars to ethanol. These two industry cost-share projects address major barriers to meeting the 2012 cost goal. Overall knowledge gained from Section 932 projects, 10 percent validation scale projects, enzyme development, and ethanologen R&D, combined with other key R&D activities, should accelerate industry's ability to produce cost-competitive cellulosic ethanol.

To address biomass resource availability and feedstock infrastructure to reduce the cost and improve the storage of delivered biomass in different geographical areas of the U.S., EERE will continue to support the Regional Feedstock Partnership work with the U.S. Department of Agriculture (USDA) and land grant colleges. These partnerships will help identify the regional biomass supply, growth, and biorefinery development opportunities.

In order to capture and coordinate federal-wide activities supporting the President's goal, the Biomass Program is developing a National Biofuels Action Plan commissioned through the Biomass Research and Development Initiative. The Biomass Program will also establish the framework for an ethanol reverse auction in accordance with Section 942 of EPACT 2005. The auction will award incentives on a per gallon basis of cellulosic biofuels produced.

**VEHICLE TECHNOLOGIES PROGRAM**

In FY 2008, the Department is requesting $176.1 million for the Vehicle Technologies Program to advance development of increasingly more energy-efficient and environmentally friendly, flexible platform technologies for cars and trucks that will use significantly less oil and enable the auto industry to comply with reformed CAFE standards. This request is $10.1 million higher than the FY 2007 request, and will advance the state-of-the-art for energy storage batteries, power electronics and motors, and the hybrid drive systems and testing needed to accelerate manufacturing viability and delivery of plug-in hybrid electric vehicles.

Activities in the Vehicle Technologies Program contribute to two cooperative government/industry activities: the *FreedomCAR and Fuel Partnership* (where CAR stands for Cooperative Automotive Research) and the *21st Century Truck Partnership*. The *FreedomCAR and Fuel Partnership* is a collaborative effort among the U.S. Council for Automotive Research (USCAR—representing the three domestic automobile manufacturers), five energy suppliers, and DOE for cooperative, pre-competitive research on advanced automotive technologies having significant potential to reduce oil consumption. The *21st Century Truck Partnership* focuses on commercial vehicles. The partnership involves key members of the commercial vehicle industry, (truck equipment manufacturers and engine manufacturers) along with three other federal agencies. The R&D centers on improving advanced combustion engine systems and fuels and on reducing vehicle parasitic losses, meaning frictional and aerodynamic losses, extra loads like air conditioning, and other vehicle inefficiencies that increase fuel consumption.

Vehicle Technologies Program activities that support the goals of the *FreedomCAR and Fuel Partnership* focus on high-efficiency and flexible platform vehicle technologies such as advanced combustion engines and their enabling fuels, hybrid vehicle systems (including plug-in hybrids), high-power and high-energy batteries, light-weight materials, and power electronics. These technologies could lead to substantial oil savings if adopted by industry participants and included in their manufacturing plans.

The FreedomCAR goals include reducing the volume production cost of a high-power 25kW battery for use in hybrid passenger vehicles from $3,000 in 1998 to $500 by 2010. In 2006 we projected through the modeling of research data that lithium ion battery cost could be reduced to $750 per 25 kW battery system when produced in mass quantities. This year's request increases the emphasis on plug-in hybrid vehicle component technologies. Cited by the President as a key part of the strategy for reducing America's dependence on oil, these technologies offer the potential to make significant additional improvements in petroleum reduction beyond that achievable with standard hybrid configurations.

Combustion engine efficiency has made good progress over the past three years (2004–2006), with our R&D increasing the efficiency of light-duty passenger vehicle diesel engines from 35 to 41 percent. This means that if manufacturers were to produce these more efficient engines, a car that previously got the CAFE average of 27 miles per gallon on gasoline could potentially get 37 miles per gallon with an advanced, clean diesel. In FY 2008, we expect to reach 43 percent efficiency for passenger vehicle diesel engines, approaching the 2010 goal of 45 percent. These advanced combustion engines have the potential to achieve the efficiency goals for cars and trucks while maintaining cost and durability with near-zero emissions. Battery technologies have also made significant progress toward program goals, having reduced the cost of next-generation hybrid vehicle batteries in each of the past three years, from almost $1,200 per vehicle at the beginning of FY 2004 to $750 at the end of FY 2006. In FY 2008, we expect to bring that down to $625 per vehicle, and to increase our emphasis on batteries specifically optimized for plug-in hybrid vehicles to have battery technology ready by 2014 that will enable automobile manufacturers to economically produce competitive plug-in hybrid vehicles having a 40 mile all-electric range.

R&D programs will also continue to accelerate materials research directed at light, strong vehicle structures to enable the production of lighter vehicles that could result in higher efficiency fleets, and to develop thermoelectric materials for efficient energy recovery from heat. Other activities will focus on expanding efforts to promote the adoption and use of petroleum-reducing fuels, technologies, and practices, principally by working with industry partners, fuel providers, Clean Cities coalitions and their stakeholders, and end-users on activities ranging from using more alternative fuel vehicles and renewable fuel blends to driving smarter, minimizing wasteful idle time, and purchasing vehicles that get better fuel economy. Accordingly, the Vehicle Technologies Deployment budget request (including Clean Cities) will increase by over 100 percent relative to the FY 2007 request.

**HYDROGEN TECHNOLOGY PROGRAM**

Hydrogen is an important element of our nation's long-term strategy for energy security and environmental stewardship. It could enhance our energy security by providing a transportation fuel that may be produced from a variety of domestic resources; and it should serve our environmental interests by allowing vehicles to operate using fuel cells, without generating any tailpipe emissions. The Department's research is focused on pathways that produce and deliver hydrogen from diverse origins including emission-free nuclear, and renewable resources.

The President's $309 million FY 2008 budget request for DOE for the Hydrogen Fuel Initiative fulfills his commitment of $1.2 billion over five years. The portion of this under our purview in EERE is $213 million, which reflects a $17.2 million increase over the FY 2007 budget request. The proposed increase will accelerate and expand efforts to research and develop hydrogen-storage systems to improve performance, and fuel cell materials and components to reduce their cost, and improve durability. It will also support accelerating cost reduction of renewable hydrogen production technologies as well as critical delivery technologies.

Much progress has been made since the announcement of the Hydrogen Fuel Initiative in 2003. The research has reduced the high-volume cost of automotive fuel cells from $275 per kilowatt in 2002 to $107 per kilowatt in 2006—a major step towards the ultimate cost target of $30 per kilowatt. In FY 2008, we will continue projects on fuel cell catalysts and membranes, and cold-weather start-up and operation. In addition to reducing cost and improving performance, this work will help us achieve our 2010 durability target of 5,000 hours, which should enable a vehicle lifetime of 150,000 miles.

We have also achieved our 2006 hydrogen cost goal of $3 per gasoline-gallon-equivalent for hydrogen produced by distributed reforming of natural gas, a potentially economical early market pathway. Our research will sharpen its focus to meet the same objective through renewable pathways—including reforming of bio-derived liquids and electrolysis. We are also working with the Department's Offices of Nuclear Energy, Fossil Energy, and Science to develop nuclear-based hydrogen production, hydrogen from coal—exclusively with carbon sequestration—and longer-term biological and photoelectrochemical hydrogen production pathways.

Our diverse hydrogen-storage portfolio is also showing promising results, with innovative materials being developed in areas such as metal hydrides, chemical hydrides, and carbon-based materials. Research conducted at our "Centers of Excellence," and by independent projects, has continued to increase material storage capacity. Substantial breakthroughs are required to reach our goal of providing consumers with enough storage for a 300-mile driving range, without compromising a vehicle's interior space.

Developing hydrogen technologies that can be manufactured domestically will also improve our economic competitiveness. Our manufacturing R&D effort addresses the need for high-volume fabrication processes for fuel cells and many other components, which are all currently built one-at-a-time. This is essential to lowering the cost of these technologies, and to developing a domestic supplier base.

In addition to these R&D activities, we are addressing other challenges significant to realizing the benefits of hydrogen fuel cells. Our Technology Validation Program has brought together teams of automobile manufacturers and energy companies to operate and evaluate fuel cell vehicles and hydrogen stations under real-world conditions. To date, the program has placed 69 fuel cell vehicles on the road, served by 10 hydrogen fueling stations.

Furthermore, we are working to ensure safe practices, and—through support of existing codes and standards development organizations—we are laying the groundwork for developing technically sound codes and standards, which are essential to implementing hydrogen technologies.

Finally, our education activities focus on overcoming the knowledge barriers inherent in the introduction of new technology. Last month, we released a multimedia web-based course that introduces hydrogen to first responders. In the coming year, we will continue to expand the availability of training and conduct outreach to raise awareness of the technology.

The effects of the Department's broad-based efforts in the Hydrogen Program are being seen nationwide, and progress has been substantial. Investments are not only occurring at the federal level, but also at state and local levels. These diverse investments increase our probability of success in overcoming existing technological barriers, which will allow industry to make fuel cell vehicles that customers will want to buy, and encourage investment in a hydrogen refueling infrastructure that is profitable.

**SOLAR ENERGY PROGRAM**

The Solar Energy Program sponsors research, development, and deployment of solar energy technologies and systems that can help our Nation meet electricity needs and reduce the stress on our electricity infrastructure. Through the Solar America Initiative (SAI), the Solar Program aims to accelerate the market competitiveness of solar electricity as industry-led teams compete to deliver solar systems that are less expensive, more efficient, and highly reliable. The Solar Program supports three technology areas: photovoltaics (PV), concentrating solar power (CSP),

and solar heating and lighting. The FY 2008 budget request for Solar Energy is $148.3 million, a level that is nearly twice the enacted FY 2006 level.

To lower costs more rapidly and improve performance, the Department's PV R&D, budgeted in FY 2008 at $137.3 million, focuses on those technology pathways that have the greatest potential to reach cost-competitiveness and grid parity by or before 2015. Industry-led partnerships with universities, state groups and National Laboratories, known as "Technology Pathway Partnerships," will continue in FY 2008 to address the issues of cost, performance, and reliability associated with each pathway. Work on PV modules, the heart of PV systems, will be conducted, as well as other "balance-of-system" components.

To catalyze market transformation, DOE will promote the expansion of the solar marketplace by seizing opportunities for growth and by lowering barriers to entry. The Department will provide technical outreach to States and utilities, continue pressing work on codes and standards issues, and solicit new applications for its Solar America Cities activity. These market transformation activities help pave the way for technologies developed by our industry partnerships to enter the marketplace.

We will emphasize the importance of interconnection standard procedures and net metering regulations that are designed to accommodate solar and other clean distributed energy systems. A precondition for large-scale solar market penetration in America is to have the proper means for homeowners and businesses to connect solar systems to the grid, as well as to be paid for excess electricity they feed back into the grid. We are working with our colleagues in the Department's Office of Electricity Delivery and Energy Reliability to develop "best practice" recommendations for States to use as they undertake consideration of interconnection procedures and net metering regulations and make implementation decisions pursuant to Sections 1251 and 1254 of EPACT 2005. FY 2008 funding will also be used to offer technical outreach to States and utilities to enhance solar connectivity issues.

Work will continue on the multi-year solicitations launched in FY 2007 that promote adoption of market-ready solar technologies and a new effort will support benchmarking, modeling, and analysis for the systems driven approach, and market, value and policy analysis needed to support the SAI. EERE's PV activities are increasingly coordinated and when possible convergent with solar energy activities in the Building Technologies and the Federal Energy Management programs, and the research activities of the DOE Office of Science.

The FY 2008 budget request for CSP—systems that utilize heat generated by concentrating and absorbing the sun's energy to drive a heat engine/generator to produce electric power—is $9.0 million. The development of advanced thermal energy storage technologies will be expanded, along with continued support to develop next generation parabolic trough concentrators, solar engines, and receivers. For distributed applications, research will focus on improving the reliability of dish systems through the operation and testing of multiple units. Technical assistance will be provided to industry in its development of a 1.0 MW dish system in California that is expected to be the precursor of several much larger plants. Technical support will also be provided to the Western Governors' Association and several southwestern utilities to assist their CSP deployment activities.

The Solar Heating and Lighting program, a $2.0 million request, will focus on R&D to reduce the cost of solar heating in freezing climates. The program will also support collaboration with EERE's Building Technologies programs to integrate photovoltaic systems, solar water heating, and solar space heating into home design and structure. Such deployment efforts will help to seize market expansion opportunities.

**BUILDING TECHNOLOGIES PROGRAM**

Energy use by residential and commercial buildings accounts for over one-third of the Nation's total energy consumption, including two-thirds of the electricity generated in the United States. Addressing that significant sector of energy consumption, the $86.5 million requested this year for the Building Technologies Program represents a $9.1 million increase of 12 percent over the FY 2007 request. The funding supports a portfolio of activities that includes solid state lighting, improved energy efficiency of other building components and equipment and their effective integration using whole-building-system design technique, the development of codes and standards for buildings and appliances, and education and market introduction programs, including ENERGY STAR and EnergySmart Schools.

Funding for Residential Buildings Integration aims to enable residential buildings to use up to 70 percent less energy, and to integrate renewable energy systems into highly efficient buildings to achieve the long-term goal in 2020 of net Zero Energy Buildings—houses that produce as much energy as they use on an annual basis.

During FY 2008, research for production-ready new residential buildings that are 40 percent more efficient will continue for four climate zones.

The $19.3 million request for solid state lighting will advance development of the organic and inorganic LEDs that has the potential to double the efficiency of fluorescent lighting technology. The FY 2008 requested funding will be used to develop general illumination technologies with the goal of achieving energy efficiencies of up to 93 lumens per Watt with improved visual comfort and quality of light and focus on applied research that enables the industrial base to manufacture LEDs.

The FY 2008 request reflects the Department's commitment to clear the backlog of equipment standards and test procedures that had accumulated in the prior 12 years and meet the statutory schedule for rule-makings for new products covered by EPACT 2005. 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.

Funds for the Building Technologies Program will also support development of highly insulating and dynamic window technologies and integrated attic-roof systems needed to achieve long-term zero energy building goals. Efforts to accelerate the adoption of efficient building technologies by consumers and businesses include expanded ENERGY STAR specifications and labels for more products, promotion of advanced building efficiency codes, and public-private partnerships to advance efficient schools, hospitals, commercial lighting, and home building.

**FEDERAL ENERGY MANAGEMENT PROGRAM**

The Federal Energy Management Program (FEMP) assists federal agencies, including DOE, in increasing their use of energy efficiency and renewable energy technologies through alternative financing contract support and technical assistance, and coordinates federal reporting and evaluation of agency progress each year. As the single largest energy consumer in the U.S., the Federal Government must set an example and lead the Nation toward becoming a cleaner, more efficient consumer by using existing energy efficiency and renewable energy technologies and techniques. On January 24, 2007, President Bush signed a new Executive Order to strengthen the environmental, energy, and transportation management of federal agencies which includes a requirement for agencies to reduce their energy intensity by three percent each year until 2015, compared with a 2003 baseline.

The FY 2008 request for FEMP is $16.8 million, a slight decrease of $0.1 million from the FY 2007 request. We are requesting $7.9 million for FEMP alternative financing programs that help agencies access private sector financing to fund energy improvements without the use of current appropriations. We expect to achieve not less than $160 million in private sector investment through Super ESPCs, Energy Savings Performance Contracts, and Utility Energy Service Contracts (UESCs), which will result in about 15 trillion Btus in energy saved over the life cycle of the projects. Furthermore, we are requesting $6.5 million for Technical Guidance and Assistance to help federal energy managers identify, design, and implement new construction and facility improvement projects that incorporate energy efficiency and renewable energy. FEMP will assist federal agencies in meeting the increased energy efficiency goals, established by the new Executive Order, by orienting its Technical Guidance and Assistance, Training, and Outreach activities towards attracting private-sector financing for investment into energy efficiency at federal facilities. In addition to the focus on facility energy consumption, FEMP also tracks alternative fuel use in federal vehicle fleets.

In FY 2008, the Departmental Energy Management Program (DEMP) is being discontinued. FEMP will still provide policy guidance and technical assistance to the Department, but DOE has determined that the management of energy efficiency and renewable investments at its facilities can be more effectively conducted by those facilities. While not reported separately, DOE national labs and other facilities spend significant funding (direct and indirect) on energy efficiency improvements, while also using ESPCs and UESCs where appropriate.

**WIND ENERGY PROGRAM**

The Wind Program focuses on reducing wind power costs and removing barriers to resource utilization of wind energy technology in the United States. The program's FY 2008 request is $40.1 million.

As a result of thirty years of R&D, wind turbines can now provide cost-effective, reliable clean energy in high wind speed areas. While we will continue to do R&D to improve wind energy technologies in low wind speed areas, we are also focusing on near-term actions to remove existing barriers to increasing the use of wind energy, building on the current robust market for wind energy in the U.S. These efforts could help to set the path for the wind industry to accelerate its penetration

of delivered emission-free energy, significantly expanding beyond the roughly one percent of installed electrical generating capacity today.

The program is expanding application and deployment-related activities. The $12.9 million requested for Systems Integration and Technology Acceptance will help wind technologies entering the market to overcome key obstacles such as grid integration, siting, permitting, and environmental barriers. In addition, there will be increased support to address issues of pre-competitive turbine reliability and performance via efforts of National Laboratories and Cooperative Research and Development Agreements or "CRADAs" with industry. The Wind Program will also establish a federal interagency siting group to minimize regulatory delays on wind projects.

The Wind Program is funding a broader effort on distributed wind technologies and applications to advance the full scope of diverse opportunities for wind energy on the distribution side of the electric power system.

A U.S. wind industry-wide roadmapping analysis, being supported by the DOE wind program, is underway to determine the technical feasibility for wind energy to generate 20 percent of our nation's electricity. To achieve this vision it would require grid modernization, expansion, and integration, and removal of other deployment barriers. Success would enable delivery of more than 300 gigawatts of new, clean, affordable, and domestic production capacity to our urban load centers and be a substantial contributor to economic growth, manufacturing, and rural prosperity. EERE will work with DOE's Office of Electricity Delivery and Energy Reliability on several studies aimed at expanding electricity transmission between remote wind resources and urban areas.

**WEATHERIZATION AND INTERGOVERNMENTAL PROGRAM**

In FY 2008, we are requesting $204.9 million for Weatherization and Intergovernmental Activities, a $20.1 million decrease from the FY 2007 request. The reduction is primarily related to the decrease in the amounts requested for the Weatherization Assistance Program, which will enable greater investments in advanced R&D within the EERE portfolio to address national priorities: reducing dependence on foreign oil, accelerating the development of clean, emission-free electricity supply options, and developing highly efficient new technologies, products, and practices for our homes and buildings.

The requested $144 million for the Weatherization Assistance Program will fund energy efficiency audits and upgrades for at least 54,599 low-income homes. DOE works directly with States and certain Native American Tribes that contract with local governmental or non-profit agencies to deliver weatherization services to homes in need of energy assistance.

The $45.5 million requested for the State Energy Program provides financial and technical assistance to State governments, enabling them to target their high priority energy needs and expand clean energy choices for their citizens and businesses. This request includes $10.5 million for a competitive solicitation that will seek regional and state partnerships to replicate smart energy policies and programs among States. The regional context is outlined in EPACT and aligns with our electricity transmission infrastructure.

Clean electricity generation is targeted by the Renewable Energy Production Initiative, which provides financial incentive payment to public and Tribal utilities and not-for-profit electric cooperatives for renewable generation systems that use solar, wind, geothermal, or biomass technologies. The Tribal Energy Program aims to facilitate the installation of 100 MW of renewable energy generation by Native American tribes by 2010.

The Asia Pacific Partnership (APP) for Clean Development and Climate requests funding at the $7.5 million level. This international partnership is an important and innovative accord to accelerate the development and deployment of clean energy technologies among the six member countries: Australia, China, India, Japan, South Korea, and the United States. Representing about half of the world's economy, population, energy use, and emissions, the six countries have agreed to work together and with private sector partners to set and meet goals for energy security, national air pollution reduction, and global warming, employing policies and practices that promote sustainable economic growth and poverty reduction, while addressing the serious challenge of climate change.

**INDUSTRIAL TECHNOLOGIES PROGRAM**

Industry consumes more energy than the residential, commercial, and transportation end-use sectors, and it is also the Nation's second largest emitter of $CO_2$. Advancements in industrial energy-efficient technology could improve U.S. competitiveness, and contribute to our national effort to reduce oil imports, alleviate natural

gas price pressure, and preempt the need for new power plants and consequent emissions.

The FY 2008 budget request for Industrial Technologies is $46.0 million, a $0.4 million increase over the FY 2007 request. The program will leverage its innovative technology transfer practices and partnerships with energy-intensive industries, while shifting toward more crosscutting and higher-impact R&D activities that will bring innovative energy solutions to a much broader group of industrial companies, at a more accelerated pace.

The Industrial Technologies Program (ITP) has a track record for moving innovative technologies from R&D through commercialization and onto the floors of industrial plants. In 2006 alone, eight technologies funded by ITP received prestigious R&D 100 awards. New technologies emerging from ITP's R&D program are being adopted to help solve some of industry's toughest energy and competitiveness challenges. In many cases, this is occurring through the industrial energy assessments that ITP is conducting at 250 of the Nation's largest energy-consuming manufacturing plants as part of Secretary Bodman's "Easy Ways to Save Energy" initiative. We estimate that ITP-sponsored technologies and deployment activities have contributed to industrial energy savings of over $3.1 billion in one year (2004).

The $7.2 million requested for the new activity, Energy-Intensive Process R&D, will support R&D in four crosscutting areas to better deliver technology solutions for the industrial processes that consume the most energy. These four areas are Energy Conversion Systems, Industrial Reaction and Separation, High-Temperature Processing, and Fabrication and Infrastructure. One example of a technology that cuts across the industrial sector to deliver savings is ITP's ultra-high efficiency, ultra-low emissions, industrial steam generation "Super Boiler." Since steam is used in every major sector, the potential benefits are tremendous. The Super Boiler is 10 to 20 percent more efficient than current technology and can reduce $NO_X$ emissions to below five parts per million, which represents an approximately 90 percent reduction in emissions from a conventional boiler.

The $4.9 million request for the new Inter-Agency Manufacturing R&D activity working with the National Science and Technology Council will support the development or adaptation of next-generation technologies that can revolutionize U.S. industrial processes and deliver dramatic energy and environmental benefits. These next-generation technologies, such as entirely new processing routes and supply chains, can have broad application across industry, yet they typically require the type of high-risk, high-return R&D that one industry cannot usually undertake. Our initial research focus will include development of techniques and processes needed for nanomanufacturing. We aim to help transform industrial processes by enabling the mass production and application of nano-scale materials, structures, devices, and systems that provide unprecedented energy, cost, and productivity benefits in manufacturing.

Deployment efforts such as "Best Practices" activities and Industrial Assessment Centers will continue to deliver the results of energy-efficiency R&D and energy-saving practices to industrial plants nationwide. A vehicle for educational outreach, the university-based Industrial Assessment Centers train engineers and scientists in the energy field, providing opportunities for students to conduct energy assessments at no cost to small and medium-sized manufacturing plants in the U.S.

**FACILITIES AND INFRASTRUCTURE**

The FY 2008 budget request of $7.0 million for Facilities and Infrastructure, an increase of $1.0 million from the FY 2007 request, supports the operations and maintenance of the National Renewable Energy Laboratory (NREL) in Golden, CO. NREL is a single-purpose National Laboratory dedicated to R&D for energy efficiency, renewable energy, and related technologies that provides EERE, as well as DOE's Office of Science and the Office of Electricity Delivery and Energy Reliability, with R&D, expert advice, and programmatic counsel.

**PROGRAM DIRECTION AND PROGRAM SUPPORT**

The Program Direction budget supports the management and technical direction and oversight needed to implement EERE programs at both headquarters and the Project Management Center. Areas funded by this request include: federal salaries, information systems and technology equipment, office space, travel, and support service contractors. The FY 2008 budget request for Program Direction totals $105.0 million, a $14.0 million increase over the FY 2007 request. This increase reflects EERE's updated staffing needs, which more closely align critical skills to mission requirements and adds staff to support technical program staffing shortfalls and implementation of the AEI and EPACT 2005 priorities.

The Program Support budget request provides resources for crosscutting performance evaluation, analysis, and planning for EERE programs and for technical advancement and outreach activities. The information developed by the Program Support components provides decision-makers at every level the information they need to make choices related to energy alternatives that can help the Department achieve its goals. The FY 2008 budget request for Program Support activities totals $13.3 million, representing a $2.4 million increase from the FY 2007 budget request. The increase reflects the expansion of EERE's market transformation and commercialization analysis and expanded efforts in the Technology Advancement and Outreach Office.

**CONCLUSION**

Accelerating research, development, and deployment of America's abundant clean sources of energy and making more efficient use of all energy consumed is central to EERE's mission, and to a secure and competitive economic future that enhances our environmental well-being for our nation and our world. We believe the Administration's FY 2008 budget request for energy efficiency and renewable energy programs strategically positions the stepping stones that will continuously catalyze and accelerate new energy sources, technologies, and practices into the marketplace, and hasten the transformation of how our homes, businesses, and vehicles use energy.

This concludes my prepared statement, and I am happy to answer any questions the Committee Members may have.

BIOGRAPHY FOR ALEXANDER KARSNER

Alexander "Andy" Karsner was unanimously confirmed by the Senate as Assistant Secretary for Energy Efficiency and Renewable Energy (EERE) on March 16, 2006 and sworn-in by Secretary of Energy Samuel W. Bodman on March 23, 2006.

Assistant Secretary Karsner manages the Department of Energy's (DOE) $1.17 billion EERE office, which promotes the development and marketplace integration of renewable and environmentally sound energy technologies, as well as the preservation and efficient use of our nation's valuable resources. Assistant Secretary Karsner also helps lead DOE's efforts to carry out the Advanced Energy Initiative (AEI), announced by President Bush in his 2006 State of the Union address, which aims to accelerate breakthroughs in the way we power our cars, homes, and businesses.

Previously, Assistant Secretary Karsner served in the private sector on a wide range of technologies including heavy fuel oil, distillates, natural gas, coal, wood waste/biomass, wind energy and distributed generation based upon renewable technologies. He has been responsible for and taken part in large-scale power projects in North America, Asia, the Middle East, North Africa, including unprecedented projects structuring in the Philippines and Pakistan.

In 2002, Assistant Secretary Karsner led his company, Enercorp, to win a global competition to develop the world's largest private wind farm outside the United States at that time. He has worked with Tondu Energy Systems of Texas, Wartsila Power Development of Finland, and prominent multinational energy firms and developers including ABB of Sweden, RES of the UK, Tacke of Germany (now known as GE Wind), and Vestas of Denmark.

Assistant Secretary Karsner also worked on behalf of the International Protocol for Hydrogen Economy, participating in meetings and ministerials to advance the President's agenda for a new energy economy. He was played an integral role in arranging DOE's U.S.-Morocco bilateral protocols for clean energy policy. Mr. Karsner is currently co-leading the Department's support for the Asia Pacific Pact to address global emissions with market based mechanisms.

Assistant Secretary Karsner graduated with honors from Rice University, and received an MA from Hong Kong University. Mr. Karsner resides with his wife and family in Alexandria, Virginia.

Chairman LAMPSON. Thank you, Mr. Karsner. Mr. Kolevar.

## STATEMENT OF MR. KEVIN M. KOLEVAR, DIRECTOR, OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY, U.S. DEPARTMENT OF ENERGY

Mr. KOLEVAR. Thank you Chairman Lampson and Members of the Committee. Thank you for the opportunity today to testify on

the President's fiscal year 2008 budget request for the Office of Electricity Delivery and Energy Reliability.

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 of Energy'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 budget includes $114.9 million for OE in fiscal year 2008, which represents an eight percent decrease from the fiscal year 2007 request. This includes $86 million for Research and Development activities, $11.6 million for Operations and Analysis activities, and $17.4 million for program direction.

I will primarily address the activities of OE's Research and Development program today. Our request of $86 million for fiscal year 2008 will fund the following four main activities: high temperature superconductivity, visualization and controls; energy storage and power electronics; and renewable and distributed systems integration. The development of these advanced electricity technologies will influence the future of all aspects of the electric transmission and distribution system.

The first activity I would like to highlight is one to which the DOE has made a long-term commitment. This is the science and development of high temperature superconductivity. Superconducting cables transmit electricity through conductors at temperatures approaching absolute zero, thus preventing resistance to electrical voltage, which allows large amounts of electricity to be transmitted over long distances with little line loss. Superconductivity, therefore, holds the promise of alleviating capacity concerns while moving power reliably and efficiently.

Another critical piece of a resilient and reliable modern grid is enhancing the security of our control systems. Our visualization and control activity focuses on improving our ability to measure and address the vulnerability of control systems. The research in this area will allow us to detect cyberintrusion, implement protective measures and response strategies, and sustain cybersecurity improvements over time.

Our energy storage and power electronics activity is a mid-term research endeavor to significantly reduce transmission system congestion, manage peak loads, make renewable electricity sources more dispatchable, and increase the reliability of the overall electric grid. This may be achieved through large-scale megawatt level electricity storage systems, or multiple, smaller, distributed storage systems. Using our understanding from previous energy storage demonstration activities, we are researching and developing new, advanced, higher energy density materials and storage devices for utility scale application. The program also focuses on research in power electronics to improve material and device properties that are needed for transmission level applications.

Finally, in fiscal year 2007, the renewable and distributed systems integration activity completed the transition away from generation technology activities, and will now focus on grid integration

of distributed and renewable systems in fiscal year 2008. This is a logical step in advancing clean energy resources to address future energy challenges.

Mr. Chairman, as you know, OE also carries out mission-critical work within the Operations and Analysis Subprogram. These relate principally to the implementation of EPAct requirements in energy sector facility security and recovery.

In his 2007 State of the Union Address, President Bush emphasized the importance of continuing to change the way America generates electric power, and highlighted the significant progress we have already made in integrating clean coal technology, solar and wind energy, and clean, safe, nuclear energy into the electric transmission system.

Technologies such as power electronics, high temperature superconductivity, and energy storage hold not only the promise of lower costs and greater efficiency, but also directly enhance the viability of clean energy resources by addressing issues such as intermittency, controllability, and environmental impact.

We cannot simply rely on innovative policies and infrastructure investment. We must also invest federal dollars in the research, development, and deployment of new technologies in order to improve grid performance and ensure our energy security, economic competitiveness, and environmental well-being.

This concludes my statement, Mr. Chairman. I look forward to taking questions.

[The prepared statement of Mr. Kolevar follows:]

PREPARED STATEMENT OF KEVIN M. KOLEVAR

Mr. Chairman and Members of the Committee, thank you for this opportunity to testify on the President's Fiscal Year (FY) 2008 budget request for the Office of Electricity Delivery and Energy Reliability.

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 of Energy's (DOE) 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 2008 budget includes $114.9 million for OE in FY 2008, which is an eight percent decrease from the FY 2007 request. This includes $86.0 million for Research and Development activities, $11.6 million for Operations and Analysis activities, and $17.4 million for Program Direction. As DOE is currently preparing a spending plan in accordance with the terms of the 2007 Continuing Resolution, my testimony on the FY 2008 budget request reflects a comparison to the Administration's FY 2007 request.

When Thomas Edison opened the Pearl Street Station in lower Manhattan on September 4, 1884, he could hardly have foreseen of the role electricity would play in the development of American society. Although the demand for electric lighting and power initially drove the station's construction, electricity ultimately stimulated and enabled technological innovations that reshaped America. Today, the availability and access to electricity is something that most Americans take for granted. Most people cannot describe what it is or where it comes from. Yet, it is vital to nearly every aspect of our lives from powering our electronics and heating our homes to supporting transportation, finance, food and water systems, and national security.

The Energy Information Administration has estimated that by the year 2030, U.S. electricity sales are expected to increase by 43 percent from their 2005 level. Although this is a positive indicator of a growing economy, it is also a significant amount of new demand on an electricity infrastructure that is already stressed and aging. With this in mind, OE's FY 2008 budget request reflects a commitment to implement the directives of the *Energy Policy Act of 2005* (EPACT), support re-

search of breakthrough technologies, and coordinate federal response to temporary disruptions in energy supply to ensure a reliable and secure electricity infrastructure for every American in the coming decades.

Meeting our future electricity needs will not be solved by focusing only on expanding our generation portfolio or on energy conservation. Perhaps the greatest challenge today, as it was in Edison's time, is building the elaborate network of wires and other facilities needed to deliver energy to consumers reliably and safely.

**RESEARCH AND DEVELOPMENT**

The FY 2008 budget request of $86.0 million for the Research and Development (R&D) program within OE funds four activities: High Temperature Superconductivity; Visualization and Controls; Energy Storage and Power Electronics; and Renewable and Distributed Systems Integration.

Over the past eighteen years, DOE has invested more than $500 million in the science and development of high temperature superconductivity. Superconductivity holds the promise of addressing capacity concerns by maximizing use of available "footprint" and limited space, while moving power efficiently and reliably. It also supports advanced substation and interconnection designs that allow larger amounts of power to be routed between substations, feeders, and networks using less space and improving the security and reliability of the electric system.

Today, the High Temperature Superconductivity activity continues 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.

Enhanced security for control systems is critical to the development of a 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. The FY 2008 request reflects an increase of $7.75 million related to support this effort.

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 cueing, 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 Energy Storage and Power Electronics activity proposes an increase of $3.80 million in FY 2008 to: 1) leverage understanding gained from previous Energy Storage demonstration activities to research and develop new advanced higher energy density materials and storage devices for utility scale application; and 2) focus on enhanced research in Power Electronics to improve material and device properties needed for transmission-level applications.

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 Renewable and Distributed Systems Integration Research & Development activity completed the transition away from generation technology activities in FY 2007 and will focus on grid integration of distributed and renewable systems in FY 2008, which is a logical step in advancing clean energy resources to address future challenges.

**PERMITTING, SITING, AND ANALYSIS**

In FY 2008, the Department is requesting $5.7 million for the Permitting, Siting, and Analysis (PSA) Office within the Operations and Analysis subprogram, which implements mandatory requirements set by EPACT to modernize the electric grid and enhance reliability of the energy infrastructure by contributing to the development and implementation of electricity policy at the federal and State level. The Permitting Siting and Analysis Office is also tasked with analyzing transmission congestion, proposing energy corridors for the Secretary's consideration, and coordinating federal agency review of applications to site transmission facilities on federal lands.

The Department published its *National Electric Transmission Congestion Study* on August 8, 2006, in compliance with Section 1221(a) of EPACT, which requires

DOE to prepare a study of electric transmission congestion every three years. The study named more than fifteen areas of the Nation with existing or potential transmission congestion problems. The study identifies Southern California and the East Coast from New York City to Washington, D.C., as "Critical Congestion Areas," because transmission congestion in these densely populated and economically vital areas is especially significant.

During the development of the study, which relied on extensive consultation with States and other stakeholders, the Department provided numerous opportunities for discussion and comment by States, regional planning organizations, industry, and the general public. OE intends to supplement the tri-annual Congestion Studies study by publishing annual progress reports on transmission improvements in the congested areas.

Section 1221(a) also requires the Secretary to issue a report based on the August 8 Congestion Study. In this report, if consumers in any geographic area are being adversely affected by electric energy transmission capacity constraints or congestion, the Secretary may, at his discretion, designate such an area as a National Interest Electric Transmission Corridor (National Corridor).

Because of the broad public interest in the implementation of Section 1221(a), the Department invited and received over 400 public comments on the designation of National Corridors. The Department continues to evaluate these comments, and has not yet determined whether, and if so, where, it would be appropriate to propose designation of National Corridors. Prior to issuing a report that designates any National Corridor, the Department will first issue a draft designation to allow affected States, regional entities, and the general public additional opportunities for review and comment.

Another major effort involves the implementation of Section 368 of EPACT, which requires the designation of energy right-of-way corridors on federal lands in the eleven contiguous Western States. An interagency team, with DOE as the lead agency, conducted public scoping meetings concerning the designation of corridors in each of the eleven contiguous Western States. The agencies plan to publish a draft Programmatic Environmental Impact Statement for the designation of the energy corridors in late spring of 2007 and will solicit public comments.

In August 2006, DOE and eight other federal agencies signed a *Memorandum of Understanding* (MOU) that clarifies the respective roles and responsibilities of federal agencies, State and tribal governments, and transmission project applicants with respect to making decisions on transmission siting authorizations. DOE is preparing to implement its responsibilities under the new section 216(h) of the *Federal Power Act* to coordinate with these eight other federal agencies to prepare initial calendars, with milestones and deadlines for the federal authorizations and related reviews required for the siting of transmission facilities. DOE will maintain a public website that will contain a complete record of federal authorizations and related environmental reviews and will work closely with the lead Federal NEPA agency to encourage complete and expedited federal reviews. DOE is currently considering the procedures it will use in carrying out this program.

**INFRASTRUCTURE SECURITY AND ENERGY RESTORATION**

The President has designated the Department of Energy as the Lead Sector Specific Agency responsible for facilitating the protection of the Nation's critical energy infrastructure. The Infrastructure Security and Energy Restoration (ISER) activity of the Operations and Analysis subprogram is responsible for coordinating and carrying out the Department's obligations to support the Department of Homeland Security in this important national initiative. The FY 2008 request is for $5.9 million in funding for Infrastructure Security and Energy Restoration within the Operations and Analysis subprogram.

The Infrastructure Security and Energy Restoration activity fulfills DOE's responsibilities as defined in Homeland Security Presidential Directives 7 and 8 for critical infrastructure identification, prioritization, and protection and for national preparedness. In times of declared emergencies, this Office also coordinates federal efforts under the National Response Plan to assist State and local governments and the private sector in the restoration of electrical power and other energy-related activities.

In the event of a large-scale electrical power outage caused by natural disasters such as hurricanes, ice storms, or earthquakes, DOE personnel will deploy to the affected region to assist in recovery efforts. During the 2005 hurricane season, DOE was specifically deployed to respond to five hurricanes: Dennis, Katrina, Ophelia, Rita and Wilma. In such instances, DOE coordinates all federal efforts to assist local authorities and utilities in dealing with both measures to restore power and to resolve other issues related to fuel supply.

The Infrastructure Security and Energy Restoration Office also fosters greater awareness of the regional scope of energy inter-dependencies by working with States to develop energy assurance plans that address the potential cascading effects of energy supply problems. Exercises are conducted with States and federal partners to help sharpen this focus. Finally, staff work with States and DHS in emergency situations to help resolve issues brought on by temporary energy supply disruptions, such as the winter 2007 propane shortage in Maine.

**CONCLUSION**

In his 2007 State of the Union address, President Bush emphasized the importance of continuing to change the way America generates electric power and highlighted significant progress in integrating clean coal technology, solar and wind energy, and clean, safe nuclear energy into the electric transmission system.

Technologies such as power electronics, high temperature superconductivity, and energy storage hold the promise of lower costs and greater efficiency, and also directly enhance the viability of clean energy resources by addressing issues such as intermittency, controllability, and environmental impact.

Federal investment in the research, development, and deployment of new technology combined with innovative policies and infrastructure investment, is essential to improving grid performance and ensuring our energy security, economic competitiveness, and environmental well-being.

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

BIOGRAPHY FOR KEVIN M. KOLEVAR

In February 2005, Kevin Kolevar was named Director of the Office of Electricity Delivery and Energy Reliability at the United States Department of Energy. As Director, Mr. Kolevar leads the development and implementation of national policy pertaining to electric grid reliability; management of research, development, and demonstration activities for "next generation" electric grid infrastructure technologies; and leads federal efforts to help ensure and secure the reliable flow of energy.

Mr. Kolevar is the Department lead for implementation of the Electricity Title of the *Energy Policy Act of 2005*. His responsibilities have included analysis of electricity congestion, the possible designation of National Interest Electric Transmission Corridors, the coordination of energy corridors across federal lands, and workforce issues related to the electricity utility industry.

On behalf of the Secretary of Energy, Mr. Kolevar coordinated energy response efforts with the energy industry and other federal agencies after Hurricanes Katrina, Rita and Wilma ravaged the Gulf Coast. His office also collected, analyzed, and disseminated vital information to all involved in the response and restoration efforts and served an essential coordinating role for the energy sector.

Before assuming his current position, Kolevar served as Chief of Staff to Deputy Secretary of Energy Kyle McSlarrow from January, 2003 to January, 2005. In this position, he supported and advised the Secretary and Deputy Secretary on policy, regulatory, and legislative matters as well as Departmental program management. In addition to serving as chief of staff to the Deputy Secretary, Kolevar worked as a senior policy advisor to the Secretary of Energy on security and technology issues.

His accomplishments while serving at the Department of Energy included chairing the Department of Energy National Security Working Group and serving as an advisor to the U.S.-Canada Task Force investigating the 2003 blackout. Before joining the Department of Energy, Kolevar spent over ten years serving as U.S. Senate staff in the offices of Senators Spencer Abraham (R–Mich.) and Connie Mack (R–Fla.). He is a graduate of the University of Michigan.

Chairman LAMPSON. Thank you, Mr. Kolevar. Mr. Shope, five minutes.

**STATEMENT OF MR. THOMAS D. SHOPE, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR FOSSIL ENERGY, U.S. DEPARTMENT OF ENERGY**

Mr. SHOPE. Thank you, Mr. Chairman. Mr. Chairman, Members of the Committee, it is my honor to appear before you today to present the Office of Fossil Energy's proposed budget for fiscal year 2008.

Fossil Energy's $863 million budget request for fiscal year 2008 will allow the Office to support the President's top initiatives for energy security, clean air, climate change, and coal research, as well as DOE's strategic goal of protecting our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

Let me begin the presentation of our budget with coal, our most abundant and lowest cost domestic fossil fuel. Coal today accounts for nearly one quarter of all of the energy and more than half of the electricity produced in the United States. Because coal is so important to our energy future, our proposed budget of $448 million for the President's Coal Research Initiative, related fuel cell R&D, and program direction accounts—it accounts for more than half of our total budget.

Our overarching goal is to conduct research and development that will improve the competitiveness of domestic coal in future energy markets, allowing the Nation to tap the full potential of its abundant fossil energy resources in an environmentally sound and affordable manner.

This year's request completes, three years ahead of schedule, the President's commitment to invest $2 billion on clean coal research over ten years. Our Coal Research Initiative is broken down into the following components. We are requesting $73 million for the Clean Coal Power Initiative, a cooperative, cost-shared program between the government and industry to demonstrate emergent technologies in coal-based power generation, so as to help accelerate commercialization. Work on promising technologies selected in two prior solicitations will continue in fiscal year 2008, and we plan to announce a third solicitation during the year.

The first of a kind, high priority FutureGen project will establish the capability and feasibility of co-producing electricity and hydrogen from coal with near-zero atmospheric emissions, including carbon dioxide. FutureGen's proposed budget of $108 million for fiscal year 2008 will be used to support detailed plant design and procurement and other preliminary work.

Technology development supporting FutureGen is embodied in our Fuels and Power Systems program. The program's proposed budget for fiscal year 2008, of $245.6 million, will fund research and development for carbon capture and sequestration, membrane technologies for oxygen and hydrogen separation, advanced combustion turbines, fuel cells, coal-to-hydrogen conversion, and gasifier-related technologies.

The high priority Carbon Sequestration Program, with a proposed budget for fiscal year 2008 of $79 million, is developing a portfolio of technologies with great potential to reduce greenhouse gas emissions. The goal is to achieve substantial market penetration after 2012. In the long-term, the program is expected to contribute significantly to the President's goal of developing technologies to substantially reduce greenhouse gas emissions.

In addition, the network of seven regional carbon sequestration partnerships and the International Carbon Sequestration Leadership Forum, established by DOE in 2003, will continue their important work, including vital, diverse, geologic $CO_2$ storage tests.

Research and development carried out by the Coal-to-Hydrogen Fuels program, funded at a proposed $10 million, will make the future transition to a hydrogen-based economy possible by reducing the costs and increasing the efficiency of hydrogen production from coal.

We have requested $62 million for fiscal year 2008 to continue the important work of the Solid State Energy Conversion Alliance, the goal of which is to develop the technology for low-cost scalable and fuel-flexible fuel cell systems.

Consistent with the 2006 and 2007 budget requests, the Petroleum Oil Technology and Natural Gas Technologies Research and Development programs are proposed to be terminated in fiscal year 2008. However, the Office of Fossil Energy will continue to carry out important responsibilities in the oil and natural gas sector, such as management of the Ultra-Deepwater and Unconventional Resources Research Program mandated by the Energy Policy Act of 2005.

In addition, Fossil Energy will continue to authorize natural gas imports and exports, collect and report data on natural gas trades, operate the Rocky Mountain Oilfield Testing Center, and oversee the Loan Guarantee Program for the Alaska Natural Gas Pipeline.

Mr. Chairman and Members of the Subcommittee, this completes my prepared statement on our research and development activities, and I would be happy to answer any questions.

[The prepared statement of Mr. Shope follows:]

PREPARED STATEMENT OF THOMAS D. SHOPE

Mr. Chairman, Members of the Committee, it's a pleasure for me to appear before you today to present the Office of Fossil Energy's (FE) proposed Budget for Fiscal Year 2008

Fossil Energy's $863 million budget request for Fiscal Year 2008, one of the largest FE requests made by this Administration, will allow the Office to achieve two fundamental objectives: first, to support the President's top priorities for energy security, clean air, climate change and coal research; and second, to support the Department of Energy's strategic goal of protecting our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally-sound energy.

More specifically, the proposed budget emphasizes early initiation of an expansion of the Strategic Petroleum Reserve; rapid development of technologies to manage and dramatically reduce atmospheric emissions of the greenhouse gas carbon dioxide from fossil fuel use in power generation and other industrial activity; and design and other preparatory work on the FutureGen project to combine in one plant the production of electric power and hydrogen fuel from coal with near-zero atmospheric emissions.

**THE PRESIDENT'S COAL RESEARCH INITIATIVE**

I will begin the detailed presentation of our proposed budget with 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. Because coal is so important to our energy future, our proposed budget of $448 million for the President's Coal Research Initiative, related fuel cell R&D and R&D by federal employees within program direction accounts for more than half our total budget.

I should mention here that our FY 2008 Budget focuses our research and development on activities that support the President's Advanced Energy Initiative and key provisions of the *Energy Policy Act of 2005.* These activities will be conducted largely through cost sharing and industry collaboration. As a result of the evaluations under the Research and Development Investment Criteria, and the Program Assessment Rating Tool, activities throughout the program emphasize research and development for technologies that will be used in the FutureGen project.

The goal of the overall coal program, which includes the President's Coal Research Initiative, is to conduct research and development that will improve the competitiveness of domestic coal in future energy markets. The Administration strongly supports coal as an important component of our energy portfolio. This year's budget request completes the President's commitment to invest $2 billion on clean coal research over 10 years, three years ahead of schedule. Our coal budget request is broken down into the following components.

**CLEAN COAL POWER INITIATIVE**

We are requesting $73 million in Fiscal Year 2008 for the Clean Coal Power Initiative (CCPI), a cooperative, cost-shared program between the Government and industry to demonstrate emerging technologies in coal-based power generation so as to help accelerate commercialization. CCPI allows the Nation's power generators, equipment manufacturers and coal producers to help identify the most critical barriers to coal use in the power sector. Technologies to eliminate the barriers are then selected with the goal of accelerating development and deployment of applications that will economically meet environmental standards while increasing plant efficiency and reliability. Work on promising technologies selected in two prior solicitations will continue in Fiscal Year 2008, and we plan to announce a third solicitation during the year, which will focus on advanced technology systems that capture carbon dioxide for sequestration and beneficial reuse.

Some activities of the Clean Coal Power Initiative will help drive down the costs of Integrated Gasification Combined Cycle (IGCC) systems and other technologies for near-zero atmospheric emission plants that are essential to the FutureGen concept.

**FUTUREGEN**

FutureGen is a high-priority project that will establish the capability and feasibility of co-producing electricity and hydrogen from coal with near-zero atmospheric emissions including carbon dioxide. FutureGen is a public/private partnership designed to integrate technologies that ultimately will lead to new classes of plants that feature fuel flexibility, multi-product output, electrical efficiencies of over 60 percent, and near-zero atmospheric emissions. FutureGen's goals include electricity at costs no more than 10 percent above power from comparable plants that are incapable of carbon sequestration. The capture and permanent storage of atmospheric carbon emissions is a key feature of the FutureGen concept, as is the capability to use coal, biomass, or petroleum coke. The project should help retain the strategic value of coal—the Nation's most abundant and lowest cost domestic energy resource. FutureGen's proposed budget of $108 million for Fiscal Year 2008 will be used to support detailed plant design and procurement, as well as ongoing permitting, preliminary design and site characterization work.

To help fund both the CCPI and FutureGen projects in Fiscal Year 2008, our proposed Budget redirects $58 million in unexpended sums and $257 million in deferred appropriations from the original Clean Coal Technology program. Specifically, the Budget proposes to transfer $108 million of the $257 million deferral to the FutureGen project, and cancel the remaining $149 million from the deferral. Of the unobligated balances carried forward at the start of FY 2008, $58 million is transferred to the Clean Coal Power Initiative (CCPI).

**FUELS AND POWER SYSTEMS**

Technology development supporting FutureGen is embodied in the core research and development activity of the Fuels and Power Systems program. The Fuels and Power Systems program's proposed budget for Fiscal Year 2008 is $245.6 million. Of this total amount, $183.6 million will fund research and development for carbon capture and sequestration, membrane technologies for oxygen and hydrogen separation, advanced combustion turbines, coal-to-hydrogen conversion, and gasifier-related technologies. The remaining balance of $62 million will support Fuel Cells.

The program breaks down as follows:

**ADVANCED INTEGRATED GASIFICATION COMBINED CYCLE**

With proposed funding of $50 million for Fiscal Year 2008, the Advanced Integrated Gasification Combined Cycle program will continue to concentrate efforts on gas stream purification to meet quality requirements for use with fuel cells and conversion processes, on impurity tolerant hydrogen separation, on elevating process efficiency, and on reducing the costs and energy requirements for oxygen production through development of advanced technologies such as air separation membranes.

**ADVANCED TURBINES**

A funding request of $22 million will allow the Advanced Turbines program to continue its concentration on the creation of a turbine-technology base that will permit the design of near-zero atmospheric emission IGCC plants and a class of FutureGen-descended plants with carbon capture and sequestration. This research emphasizes technology for high-efficiency hydrogen and syngas turbines and builds on prior successes in the Natural Gas-based Advanced Turbine Systems Program.

**ADVANCED RESEARCH**

The Advanced Research program bridges basic and applied research to help reduce the costs of advanced coal and power systems while improving efficiency and environmental performance. The proposed $22.5 million budget for Advanced Research will fund projects aimed at a greater understanding of the physical, chemical, biological and thermo-dynamic barriers that currently limit the use of coal and other fossil fuels.

**CARBON SEQUESTRATION**

The Carbon Sequestration program, with a proposed budget for Fiscal Year 2008 of $79 million, is developing a portfolio of technologies with great potential to reduce greenhouse gas emissions. This high-priority program's primary concentration is on dramatically lowering the cost and energy requirements of pre-and post-combustion carbon dioxide capture. The goal is to have a technology portfolio by 2012 for safe, cost-effective and long-term carbon mitigation, management and storage, which will lead to substantial market penetration after 2012. In the long-term, the program is expected to contribute significantly to the President's goal of developing technologies to substantially reduce greenhouse gas emissions.

The Carbon Sequestration program's activities in Fiscal Year 2008 will concentrate on research and development projects for carbon dioxide ($CO_2$) capture and storage, as well as measurement, monitoring and verification technologies and processes.

In coordination with the current partnerships, the program will determine the "highest potential" opportunities for the initial expedited round of large scale sequestration tests in saline, coal, and/or oil and gas bearing formations. This work will begin with a physical characterization of the surface and subsurface, reservoir modeling, and NEPA review.

The Partnerships will also move on to the next phase of the Weyburn project, where $CO_2$ is being injected into a producing oil field. Weyburn's success would deliver both decreased carbon emissions and increased domestic oil production.

Finally, DOE formed the international Carbon Sequestration Leadership Forum (CSLF) in 2003 to work with foreign partners on joint carbon sequestration projects, and to collect and share information. That work will in continue in FY 2008.

Several members of the CSLF have also signed on to the FutureGen project, and others have signaled strong interest in joining. FUELS Research and development carried out by the Coal-to-Hydrogen Fuels program, funded at a proposed $10 million, will make the future transition to a hydrogen-based economy possible by reducing the costs and increasing the efficiency of hydrogen production from coal. This program is an important component of both the President's Hydrogen Fuel Initiative and the FutureGen project.

**FUEL CELLS**

Within Fuel Cells, we have requested $62 million for Fiscal Year 2008 to continue the important work of the Solid State Energy Conversion Alliance, the goal of which is to develop the technology for low-cost, scalable and fuel flexible fuel cell systems that can operate in central, coal-based power systems as well as in other electric utility (both central and distributed), industrial, and commercial/residential applications.

**RESEARCH BY FEDERAL STAFF**

In addition to the funding levels reflected for Fuels and Power Systems, there is $20 million provided within the Program Direction account that directly supports the President's Coal Research Initiative, plus $1 million for fuel cells. This funding supports federal staff directly associated with conducting the research activities of specific Fuels and Power Systems subprograms.

**PETROLUEM AND NATURAL GAS TECHNOLOGIES**

Consistent with the FY 2006 and FY 2007 Budget Requests, the Petroleum—Oil Technology and Natural Gas Technologies research and development programs will be terminated in FY 2008.

The Oil and Gas group will manage the Ultra-Deepwater and Unconventional Resources Research Program mandated by the *Energy Policy Act of 2005.* However, I should point out that the 2008 Budget proposes to repeal this legislation, consistent with the FY 2007 Budget Request.

In addition, FE will continue to authorize natural gas imports and exports, collect and report data on natural gas trade, and operate the Rocky Mountain Oil Field Testing Center.

FE will also oversee the loan guarantee program for the Alaska Natural Gas Pipeline.

**STRATEGIC PETROLEUM RESERVE**

The Strategic Petroleum Reserve (SPR) exists to ensure America's readiness to respond to severe energy supply disruptions. The Reserve reached its highest inventory level—700 million barrels of oil—in 2005 the *Energy Policy Act of 2005* directs DOE to fill the SPR to its authorized one billion barrel capacity, as expeditiously as practicable. Additionally, in the 2008 Budget, the President proposed expanding the Reserve's capacity to 1.5 billion barrels.

Our budget request of $332 million for Fiscal Year 2008—almost double last year's request—will fund the Reserve's continued readiness through a comprehensive program of systems maintenance, exercises, and tests, as well as beginning expansion to one billion barrels at existing and new sites and NEPA work to expand to 1.5 billion barrels. DOE will begin immediately to fill the reserve to its current capacity of 727 million barrels through purchases of oil with available balances as well as through placement of the Department of the Interior's royalty in-kind oil into the SPR.

**NORTHEAST HOME HEATING OIL RESERVE**

The Northeast Home Heating Oil Reserve was established in July 2000 when the President directed the Department of Energy to establish a reserve capable of assuring home heating oil supplies for the Northeast states during times of very low inventories and significant threats to immediate supply. The Reserve contains two million barrels of heating oil stored at commercial terminals in the Northeast and is in good condition. The current five-year storage contracts expire in September 2007. A request for bids was issued in February 2007. The proposed FY 2008 budget requests $5.3 million for continued operations.

**NAVAL PETROLEUM AND OIL SHALE RESERVE**

The Fiscal Year 2008 budget request of $17.3 million for the Naval Petroleum and Oil Shale Reserve (NPOSR) will allow it to continue environmental remediation activities and determine the equity finalization of Naval Petroleum Reserve 1 (NPR–1); operate NPR–3 until its economic limit is reached, and while operating NPR–3, maintain the Rocky Mountain Oil Field Test Center.

Because the NPOSR no longer served the national defense purpose envisioned in the early 1900s, the National Defense Authorization Act for FY 1996 required the sale of the Government's interest in Naval Petroleum Reserve 1 (NPR–1). To comply with this requirement, the Elk Hills field in California was sold to Occidental Petroleum Corporation in 1998. Subsequently, the Department transferred two of the Naval Oil Shale Reserves (NOSR–1 and NOSR–3), both in Colorado, to the Department of the Interior's (DOI) Bureau of Land Management. In January 2000, the Department returned the NOSR–2 site to the Northern Ute Indian Tribe. The *Energy Policy Act of 2005* transferred administrative jurisdiction and environmental remediation of Naval Petroleum Reserve 2 (NPR–2) in California to the Department of the Interior. DOE retains the Naval Petroleum Reserve 3 (NPR–3) in Wyoming (Teapot Dome field).

**ELK HILLS SCHOOL LANDS FUND**

The *National Defense Authorization Act for FY 1996* authorized the settlement of longstanding "school lands" claims to certain lands by the State of California known as the Elk Hills Reserve. The settlement agreement between DOE and California, dated October 11, 1996, provides for payment, subject to appropriation, of nine percent of the net sales proceeds generated from the divestment of the Government's interest in the Elk Hills Reserve. Under the terms of the Act, a contingency fund containing nine percent of the net proceeds of the sale was established in the U.S. Treasury and was reserved for payment to California.

To date, DOE has paid $300 million to the State of California. The first installment payment of the settlement agreement was appropriated in FY 1999. While no appropriation was provided in FY 2000, the Act provided an advance appropriation of $36 million that became available in FY 2001 (second installment). The next four installments of $36 million were paid at the beginning of FY 2002, FY 2003, FY

2004, and FY 2005 respectively. A seventh payment of $84 million was made in FY 2006.

The Fiscal Year 2008 budget proposes no funding for the Elk Hills School Lands Fund. The timing and levels of any future budget requests are dependent on the schedule and results of the equity finalization process.

**FOSSIL ENERGY'S BUDGET MEETS THE NATION'S CRITICAL ENERGY NEEDS**

In conclusion, I'd like to emphasize that the Office of Fossil Energy's programs are designed to promote the cost-effective development of energy systems and practices that will provide current and future generations with energy that is clean, efficient, reasonably priced, and reliable. Our focus is on supporting the President's top priorities for energy security, clean air, climate change, and coal research. By re-evaluating, refining and refocusing our programs and funding the most cost-effective and beneficial projects, the Fiscal Year 2008 budget submission meets the Nation's critical needs for energy, environmental and national security.

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

BIOGRAPHY FOR THOMAS D. SHOPE

Thomas D. Shope is Chief of Staff for the U.S. Department of Energy, Office of Fossil Energy. The Office of Fossil Energy is charged with conducting technology research, development and demonstration programs that will ensure that the United States can continue to rely on clean, affordable energy from our traditional fuel resources. Specific responsibilities within Mr. Shope's purview include the management of the Strategic Petroleum Reserve; oil and natural gas research and policy; and the President's $2 billion Coal Research Initiative, which includes the $950 million FutureGen Program, to create a prototype zero-emissions coal fired power plant. In his position, Mr. Shope serves as the principal advisor to Assistant Secretary Jeffrey D. Jarrett.

In July of 2002, Shope began his tour of duty in Washington, DC, serving as the Chief of Staff for the U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement. Shope served as OSM's liaison to Secretary Gale Norton and her senior staff within the Department of the Interior. Mr. Shope guided and directed the operations of the OSM in fulfilling its role of regulating active coal mining operations as well reclaiming old abandoned mine lands. Mr. Shope played a key role in the efforts to reform and reauthorize the Abandoned Mine Land program and in OSM's significant enhancement of its technology transfer activities to State and tribal regulatory authorities and other stakeholders.

A native of Munhall, Pennsylvania, Shope received his B.S. degree in Economics at West Virginia University in Morgantown, WV. He then earned his J.D. degree from Duquesne University School of Law in Pittsburgh. After working with the Allegheny County District Attorney's Office and the Pittsburgh law firm of Friedman & Friedman, Shope joined the Department of the Interior in February of 1991 as an Attorney Advisor in the Solicitor's Office. During his tenure with the Solicitor's Office, Shope's practice centered on various mining and environmental issues. Mr. Shope was extensively involved in the Department's Trusteeship in Natural Resource Damage Assessment and Restoration matters, where he served as the case attorney on various prominent projects including the Nation's largest Superfund related project, the Tri-State Mining District of Missouri, Kansas and Oklahoma. Throughout his career, Shope has been recognized for his ability to maintain and promote sensitive relations with Congress, State and tribal governments, industry and environmental groups.

## DISCUSSION

Chairman LAMPSON. Thank you, Mr. Shope.

At this point, we will open our first round of questions, and I am going to recognize myself for five minutes, but I will yield to the Chairman of the Science Committee, Mr. Gordon.

## THE GLOBAL NUCLEAR ENERGY PARTNERSHIP (GNEP)

Chairman GORDON. Thank you, Mr. Chairman. This is a very good panel, and this is very informative.

Dr. Orbach, you are the only member of the panel I have had a chance to work with, and I want to say that I am impressed with your enthusiasm and knowledge of the job, and I look forward to working with you.

Mr. Spurgeon, I have talked with a variety of folks inside and outside the nuclear industry, and by and large, I get the feeling—well, I don't get the feeling, they have said very specifically that they are not happy with the GNEP program, that they feel like you set—well, I won't say you, but that there have been moving targets set, that there really hasn't been adequate basic research done before the potential to make multi-billion dollar type investments, which might mean that we won't maximize those investments, and don't feel like there is enough emphasis being put on Yucca and storage.

Do you feel that any of that is valid?

Mr. SPURGEON. Well, obviously, the emphasis on Yucca, there is nothing in this program that does anything to take away from the emphasis on Yucca Mountain. Yucca Mountain is critical to any regime that we look at for nuclear energy going forward, as the ultimate repository for nuclear—spent nuclear fuel.

But what we are doing with GNEP is creating a waste form, and removing the long-lived transuranic elements that create the long-term issue of fuel.

Chairman GORDON. So, you think you have done adequate basic research now?

Mr. SPURGEON. Sir, what—we have more research to do, but understand, we have been reprocessing fuel throughout the world for, you know, for 30, 40 years. There are active reprocessing plants, recycle facilities in existence in all of the other fuel cycle nations, so the technology is something that has been commercialized. What we are doing is taking it to the next level, taking it to the next level of efficiency, and taking it to the next level of proliferation resistance. In that, we are still doing research, and that is a big part of what the budget request is all about.

Chairman GORDON. Good. I don't mean to be discourteous. Five minutes doesn't last very long, and I am going to be submitting questions to you and to the other panel members, so that we can better understand what you are doing, and better do our job, and I hope that you will all be prompt in getting us responses.

## EFFICIENCY STANDARDS CONCERNS

Mr. Karsner, in your prepared statement, you acknowledge that the backlog of equipment efficiency standards and the test procedures that has developed over the last 12 years, with a little explanation for why and how this backlog has started, and why it has continued. Over the last 12 years, how many efficiency standards have been promulgated?

Mr. KARSNER. I can return to you the precise number for the record. I think it is under ten over the last 12 years.

Chairman GORDON. What about one?

Mr. KARSNER. Okay.

Chairman GORDON. Does that sound about right? The Central Air Conditioning and Heat Pumps, maybe one out of sixteen.

Mr. KARSNER. My impression was that there were more than a single standard that had been promulgated, but I——

Chairman GORDON. Do you have staff or anyone here that could help you with that?

Mr. KARSNER. We don't have the number for the last 12 years.

Chairman GORDON. Okay.

Mr. KARSNER. We will have to report back for the record.

[The information follows:]

INSERT FOR THE RECORD

Since 1997, the Department of Energy (DOE) has completed 12 energy conservation standards rulemakings, adopting standards for 26 products. One of the 12 rulemakings that adopted standards prescribed by the Energy Policy Act of 2005 (EPACT) is for 15 products. In addition, DOE has completed 25 test procedures rulemakings since March 1995. This includes EPACT 2005 requirements for 11 test procedures adopted en masse (counted as only one because these were prescribed by EPACT 2005). The following table shows the standards history since 1997.

**Appliance Standards History**

| Product Name | DOE Final Rule Date |
|---|---|
| Ceiling Fan Light Kits | Jan-07 |
| 15 products, en Masse | Oct-05 |
| Water-Cooled AC & Water-Source HP (commercial) | Jan-01 |
| Water Heaters (commercial) | Jan-01 |
| Warm Air Furnaces (commercial) | Jan-01 |
| Water Heaters (residential) | Jan-01 |
| Clothes Washers (residential) | Jan-01 |
| Central Air Conditioners and Heat Pumps (residential) | Jan-01 |
| Fluorescent Lamp Ballasts (commercial) | Sep-00 |
| Ranges and Ovens and Microwave Ovens (residential) | Sep-98 |
| Room Air Conditioners (residential) | Sep-97 |
| Refrigerators, Refrigerator-Freezers, and Freezers (residential) | Apr-97 |

Chairman GORDON. Okay. It is my understanding it is one. So, how many more does that leave you to have to promulgate?

Mr. KARSNER. We have submitted a schedule to Congress to promulgate up to 17 over the next five years, and that should deal with both the backlog and the Energy Policy Act requirements.

Chairman GORDON. Now, in that aren't you already well overdue?

Mr. KARSNER. There was recently a GAO report published that said we were overdue on every one of the standards for the 34 that had been prescribed for the last 30 years. So the Department has acknowledged that particular problem, submitted a schedule to deal with that backlog, and since that schedule was sent to Congress last year, we have been 100 percent on time for every deadline that we have submitted.

Chairman GORDON. Mr. Karsner, I am sure you already know this. You know, even without being sworn in, it is a felony to mis-

lead or not tell the truth to a Congressional committee, so let me just ask you, have you felt any pressure, in the short time you have been there, not to move forward and promulgate these rules in an expeditious way?

Mr. KARSNER. I have felt the opposite pressure. It is a top line priority of Secretary Bodman, and it is a top line priority of my Office, and we will continue that pressure to meet those deadlines and——

Chairman GORDON. Has OMB slowed you down any on this?

Mr. KARSNER. There is a procedure to go through concurrence. The process is very time-intensive, and therefore, we have recently submitted legislation to the Hill so that we could shrink and collapse the critical path, particularly where we can cultivate consensus.

Chairman GORDON. So, you are being told full speed ahead, do it as quickly as you can. Is that correct?

Mr. KARSNER. And we are being given the highest priority attention that the—that this program can have by both the Secretary and the Office of General Counsel.

Chairman GORDON. Yet in 12 years, you have only promulgated one rule, you are behind by statute in all the others.

Mr. KARSNER. Yes.

Chairman GORDON. And I think the Energy Policy Act directed the Department to meet statutory timelines, you are behind in those, too, aren't you?

Mr. KARSNER. With all due respect, sir, it is obvious the Department is behind, not just 12 years, 30 years. So something systemic is problematic through multiple generations and Administrations, and we are seeking to fix that.

Chairman GORDON. Well, we hope you can. It is important for the country, and I will also be submitting some questions for you.

How is my time? No, no, no. I don't want to——

Chairman LAMPSON. Go ahead and finish, and we will start the clock over when I start mine.

Chairman GORDON. No, that is okay. If I am over my five minutes, then I will——

Chairman LAMPSON. You are not. Please go ahead.

## BIOENERGY RESEARCH CENTERS

Chairman GORDON. Okay. Dr. Orbach, I am interested in the Bioenergy Research Centers, which I think are important, and I am glad you have moved forward with, but it is sort of a new area for you. It is going from research to actual implementation there.

And you are talking about bringing in private investors. I would like to learn a little more about that. You know, what kind of stakes are they going to get in this, what kind of return are they going to get for their investment, and if it doesn't work out, what is going to happen with these Centers afterwards?

Dr. ORBACH. We are currently actually evaluating the proposals that have come in, which indeed have included the private sector. We have given them a five year commitment for $25 million a year, and the understanding that we have is that after the five years, we will assess whether they have been successful. It is a new concept—you are quite right—for us, and so, we are looking both at

procedures at effectiveness, and whether we can deliver on the investment.

That is the reason why we want the private sector involved. We want this to get to market.

Chairman GORDON. Well, I think it is a type of experiment that we need to be making, and as I said earlier, you seem to be on top of your game, and I hope this will be successful.

Thank you for joining us today.

Dr. ORBACH. Thank you.

Chairman LAMPSON. Thank you, Mr. Chairman. At this time, in the spirit of fairness, I think I will recognize the Ranking Member on the Full Science Committee, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman.

And to Mr. Shope, I don't have my—I can't see that far. I wish you would bring that table a little closer to us, if you would.

Mr. Shope, I have some questions that I need to ask you, sir. I want to talk to you about—do you know what I am about to ask you about?

Mr. SHOPE. I am anxiously awaiting.

## THE ULTRA-DEEPWATER AND UNCONVENTIONAL ONSHORE RESEARCH AND DEVELOPMENT PROGRAM

Mr. HALL. The ultra-deep provision that I put in the last four budgets, I put it in four times as a Democrat, and Republicans accepted it. This last time, I put it in as a Republican, and the Democrats accepted it. We have passed it and sent it to the President. He signed it, and now, there is a move on to take it out of the budget, and to take it out of the budget, you have to have a bill go through here, and I love the President. I would absolutely jump in the fire for him, but every now and then, I don't agree with him, and I think he is wrong in trying to move the ultra-deep legislation and take it off the books, because it doesn't cost anything, it is going to get reserves that are known there. It involves technology from schools and universities. It is more of a research bill that it is an energy bill, but it pays for itself in known quantities of energy that are there. We just can't get them up, but we are going to get the technology to get some up. It doesn't cost anybody anything. It is not a gift to Exxon or the big people, because they are not the ones that really look for it, and they can buy their own technology if they want to. Independents can't, but independents will do most of this work.

And it is just a win-win deal, and I have not been able to impress anybody over the White House with that situation, but everybody else I know pretty well agrees with me.

Now, I guess what I want to ask you, and I know your budget calls for the repeal of the Ultra-Deepwater and Unconventional Onshore Research and Development Program, and that is, I think, is the President's request, and maybe, the gentleman that he got from OMB, that is there advising him. And wonderful guys, admire them, respect them both, but—and I don't hate the sinners, I just hate their sin on this type thing, that is a quote from Billy Graham, it is a pretty good, all old guys are good to quote, you know.

I want to ask you, though, and EI assessment of EPAct concluded that this was one of only a few that would increase supply and pay for itself through increased royalties. I just don't know any way to better, it is going to get over $1 billion more in 12 years than we have to spend for it, and we get maybe 70 years of energy out of it. I cannot understand why anybody would want to repeal this.

They sent it, to of all people, Ed Markey, to repeal it, about three months ago or four months ago or five months ago. Democrats and Republicans alike gathered together and killed that bill, cleared off a place and killed it right there on the floor about four months ago. I hope we are going to do the same thing this time, and I don't think we will have a lot of repercussions from over there, but I just, you know, it pays for itself, and until that happens, it is the law of the land, and it is to be funded on a yearly basis.

Can you please tell me what the status of that funding is at this time?

Mr. SHOPE. Yes, Congressman. And I appreciate and understand your comments.

There is a difference of opinion, however, from the Administration, as to whether there are adequate incentives for the industry to do this research on its own, and there are costs associated, in the sense of foregone revenues, that will be going towards the program.

So, we have submitted legislation to repeal that provision of EPAct once again this year. That being said, we fully intend to comply with the law as it exists, and that currently includes operation of this program. We did issue the contract to RPSEA last year in December. We have established the advisory committees, the two advisory committees that are required. Members are now being appointed to these committees, and the program is moving forward with all due diligence and full force, until it is repealed by this body.

Mr. HALL. Please convey to George Herbert Bush's son that I am trying to help him, you know, like the little Scout helped the lady across the street, but she didn't want to go across the street, but I am trying to help him here, and trying to get a supply of energy that might keep our children, your kids and your grandkids from having to fight a war, because this country will fight for energy, and we don't have to. We have it right here, if we could just reach out there and get it.

I want to read, and I am not being a smart-aleck with you or anything, but Section 99H. Funding, Oil and Gas Lease Income, you are familiar with that section, aren't you? I think there are seven places in there where it uses the word, and we have put it in here this way, and used the word "shall," not "may," or direct that we prefer that they do that. It says, "and after distribution of any such funds as described in subsection (c), $50,000,000 shall be deposited in the Ultra-Deepwater and Unconventional Natural Gas." You know where that is.

Mr. SHOPE. Yes, sir.

Mr. HALL. A little bit on down there later, it says "under this part without fiscal year limitation, to remain available until expended." Even on the next page, it says, in section (d) under Alloca-

tion, from the federal "Fund under subsection (a)(1) in each fiscal year shall be allocated as follows." Later, it says "32.5 percent shall be for activities under section 999A." A little later, "7.5 percent shall be for activities under section"—it is not "may" or precatory words, or we hope you will. It says "shall," and I think we are going to defeat the bill that he has sent over here. It doesn't give me any pleasure to do that. It is painful for me to have to try to do that, but I think we are going to be able to do it, and maybe we get underway with this, and I would like to work with you in working this out, because it might prevent a whole generation of youngsters from having to get on a troopship and go take some energy away from someone when we have got plenty right here at home that is clean.

Thank you, sir. I respect you and I appreciate it. I yield back my time, sir.

Chairman LAMPSON. Thank you, Mr. Chairman. I now yield myself five minutes, and I want to continue that same line, if I may. I don't mean to be piling on either, but RPSEA happens to be in my Congressional district, and it is something that is important to an awful lot of folks there, and I join Mr. Hall.

When he first introduced that legislation many years ago, and also the work to continue the effort now, because we do recognize that it is an important piece of legislation.

Mr. HALL. I am even glad you are back.

Chairman LAMPSON. Thank you very much. I am too.

And obviously, the President thought that it was important, because he did sign it into law, and that is where I wonder about the difference of opinion.

We did receive a letter from the Department and proposed legislation last week, asking that this section of the law be rescinded, and given the enormous hydrocarbon resources in these fields, it is foolish. So, what reasons does the Department have for eliminating the Ultra-Deep program, especially in light of its elimination of oil and gas research?

Mr. SHOPE. Congressman, the Administration believes that there are adequate incentives, particularly with the current price of oil, for industry to invest in this research and development.

While there certainly is a recognition about independent operators, it is always a concern that they don't have the ability to spend these types of dollars. The service industry that supports them certainly does, and the Administration believes that when you have to look at the total availability of dollars, as to where our highest priority work needs to be done with taxpayer funded dollars, this program, certainly, there are other incentives to have that work accomplished, aside from using taxpayer dollars to do it.

Chairman LAMPSON. So, it is the belief that there is an adequate research being done by those companies now. If Congress doesn't rescind this law, and I don't expect it is to do that, you made the comment, and let me ask again, will the Department carry out this research as it is instructed to do so by law?

Mr. SHOPE. Let me be perfectly clear, Congressman. We absolutely will do that. We are currently doing it, as I mentioned. We are fully supportive——

Chairman LAMPSON. Then can you tell me why OMB is holding up the money?

Mr. SHOPE. The money? Well, right now, the RPSEA contract is—money is starting to flow soon, so we have the plan that is in action, RPSEA is preparing the plan for review.

Chairman LAMPSON. Is it the Administration's position that it is complying with the law, then, fully, right now, the OMB has released all the money it is supposed to have?

Mr. SHOPE. It has released adequate funds to begin that process.

Chairman LAMPSON. It hasn't released the funds that the law is saying that it should. The Administration proposes to cancel out oil and gas research, and apparently, the reasoning that this R&D, with the reasoning that it can be done by industry alone, yet given the cost of oil and gas research, only the biggest oil companies can afford to do this research, and deploy the newest technologies in the most technically challenging fields, so how can smaller firms leverage federal resources for oil and gas research?

Mr. SHOPE. Congressman, again, we believe that for independent operators, particularly the service industries that provide those services to not only the independents but larger firms as well, will be able to provide adequate investment, and continue research and development.

Chairman LAMPSON. Can you elaborate on areas where industry maybe isn't currently conducting research, or——

Mr. SHOPE. I don't—no particular—no particulars are coming to mind right now, Congressman. Of course, we——

Chairman LAMPSON. Any real industry effort to explore methane hydrates that you are aware of?

Mr. SHOPE. There are international efforts that are ongoing with respect to methane hydrates. The Department has funded some research in the past, and that research will be coming to a conclusion, and the information that we will be able to yield from that research will further the research and development of hydrates.

Chairman LAMPSON. I hope that you will convey the emphasis that at least Mr. Hall and I have placed on this. We think that it is something that is important. I personally am disappointed with the manner in which it has been handled at this point, and certainly would like to see things change, and change very quickly.

And at this point, I will recognize the Ranking Member, Mr. Inglis, for his questions.

## THE AMERICAN COMPETITIVENESS INITIATIVE

Mr. INGLIS. Thank you, Mr. Chairman.

Dr. Orbach, the—as I recall, the Congress made a commitment to doubling funding within ten years. Is that right? And I am trying to figure out where we are on that schedule.

Several years ago, and I wonder, and this is a seven percent increase, something tells me if it were gradual over that time, it would have to be a 10 percent increase in order to hit the ten years, but—doubling within ten years. Where are we with that commitment?

Dr. ORBACH. The President's commitment to double the funding for the physical sciences is on track. The President's request for '07

was a 14 percent increase, and then, a trajectory out to doubling. And so, the President's request for '08 represents that trajectory.

Mr. INGLIS. So, you think we can get there.

And the Congress made a commitment, too. Not while I was here, but——

Dr. ORBACH. There was, to my knowledge, the Congress and the President signed an authorization for the National Science Foundation——

Mr. INGLIS. Right.

Dr. ORBACH.—to double its budget. The President's initiative, the American Competitiveness Initiative, focuses on the physical sciences, which includes the National Science Foundation, the Office of Science, and also, the core research in NIST.

Mr. INGLIS. Right. So, you are content that we are on schedule. We are——

Dr. ORBACH. Yes, I am.

Mr. INGLIS. Could always use more, I suppose, but for instance—I won't make you answer that.

But now, let us see, the—now, Mr. Karsner spoke of the $1.2 billion, same sort of question. The President's Hydrogen Initiative, we are on track there? We are—have we actually appropriated all of the $1.2 billion, or where do we stand on that?

Mr. KARSNER. This would be the year that we would fulfill the $1.2 billion, and we are on track.

Mr. INGLIS. So, the President's budget request would put us on track.

Mr. KARSNER. Correct.

Mr. INGLIS. The question is whether we follow through here in the House to deliver on that.

Mr. KARSNER. That is correct, sir.

Mr. INGLIS. The $1.2 billion. And of course, here is hoping that that is not the end of the initiative, right? We are not going to be content at $1.2 billion? In other words, we have got to get, we have got to break through, I suppose, as the——

Mr. KARSNER. I wouldn't—it is the end of the initiative, the five year, $1.2 billion, but it is clearly not the end of the hydrogen program, and its robust future, that we expect it to continue growing to meet its technological readiness milestones, which are necessary over the next decade.

Mr. INGLIS. Right. Helpful.

## NUCLEAR POWER

Mr. Spurgeon, what is—what holds us back from nuclear power, really pursuing nuclear power in this country?

Mr. SPURGEON. Well, I think we are doing it at this point. The Energy Policy Act of 2005 was a major breakthrough, relative to starting to eliminate some of the barriers that have been standing in the way of having new nuclear power.

There has been an uncertainty of the regulatory process heretofore, and when you are talking about major $3 to $4 billion investments, you have got to have pretty good certainty that if you start down this path and try to finance this kind of a project, that you are, in fact, going to be able to get a license to construct and eventually operate the facility.

So, the Standby Support Provision in the Energy Policy Act is very important in that. That is basically an insurance policy that protects the sponsor against regulatory and/or litigation delays.

New reactor types, standardization, is something that we have needed in this industry. That is something that we now do have, and we are supporting. What the Department is being is really a catalyst for leveraging our public money to encourage private activity in the nuclear arena. So, we have been operating under the 2010 program as a 50/50 cost-share.

So we are supporting the first plants through the regulatory process. We are also supporting the—both from a standardization, but from the early site permit standpoint, we are trying to get the, some of the environmental issues off the table before the major commitments for funds are made.

And then, finally, the last piece of this puzzle is to provide, eventually, nuclear energy is authorized to be part of the loan guarantee program that would go forward, which looks for ways to then allow plants to be financed, perhaps with a greater degree of debt, as opposed to equity, which lowers the cost to the consumer substantially, for the cost of bus bar electric power.

So, we have the tools now, and those tools are working. We have some 30 new nuclear plants that are in one stage or another of consideration, many of them in your region.

Mr. INGLIS. Yes, sir. Yeah.

Mr. SPURGEON. And we look forward to the first applications for a new nuclear plant this fall.

Mr. INGLIS. Okay. Thank you, sir.

Chairman LAMPSON. Mr. McNerney. Recognized for five minutes.

## ENERGY STORAGE

Mr. MCNERNEY. Thank you, Mr. Chairman.

I want to congratulate the board. Your testimony has been interesting and informative, and I understand the difficulty of producing a budget under these constraints. I have some questions though.

Mr. Kolevar, I heard both you and Dr. Orbach refer to the need for energy storage, for superconductors, and for the distribution of electric power, but your budget shows an eight percent decrease. Now, I clearly understand the need for a good distribution system, both in terms of reliability, as we have seen in the Northeast a couple of times in the last decade, but also in terms of distributing wind energy and solar energy that are intermittent sources. So, how can you reconcile a decrease in the budget with the increasing need for research and development in that area?

And also, is there any plan for construction of distribution systems incorporating this new technology, or is this still a paper exercise?

Mr. KOLEVAR. Congressman, the decrease in the fiscal year 2008 budget is reflected in other programmatic activities, particularly in the High Temperature Superconductivity program. In the Energy Storage program, in that activity within the Office, the fiscal year 2008 budget proposes a doubling of resources. As I mentioned in the testimony for pursuing both large-scale utility size applications and then smaller R&D applications that would benefit principally distributed energy systems and distributed electrical systems.

We do see these technologies in use today in limited applications. There is a lot more work that needs to be done. The Office of Electricity Delivery and the Office of Science collaborate on storage activities. Generally speaking, while we partner on these, you will see the line drawn with respect to the timeframes involved. The work undertaken in Dr. Orbach's program is consistent with his program more of a long-term focus.

The work that we have done in the Office of Electricity Delivery has been really to demonstrate now the feasibility of storage programs, test them into the system, validate their capability, continue to support those applications to increase the feasibility of these applications. And having pushed a couple of these out in demonstration programs over the last two years, I expect that the program will spend more time on research and development, with an eye toward rolling out some newer energy storage systems, such as flow batteries, in the next seven to ten years.

Mr. MCNERNEY. So, is that consistent with the decrease in the budget?

Mr. KOLEVAR. Well, with respect to energy storage, sir, it is consistent with the increase proposed by the President for these activities, a little over a doubling of the moneys involved.

## GEOTHERMAL ENERGY RESEARCH

Mr. MCNERNEY. Okay. I am going to move on.

Mr. Karsner, I am very concerned about the zeroing out of the geothermal studies and research. My understanding is that there is a report from the MIT that shows up to 25 percent of our nation's electrical energy can be produced from geothermal sources in the United States, and this would form a baseline, as opposed to some other forms of renewable energy.

So, what is the justification for zeroing out that part, or that research area?

Mr. KARSNER. Well, the study that you refer to specifically, the Tester study on enhanced geothermal systems, obviously wasn't out or taken into account when this budget was formulated in excess of 20 months ago, but—so to comment further on that, the historic and conventional geothermal technology that has been the focus of the program, as a legacy of a program, is not applied to the enhanced geothermal systems potential identified in that study.

It really amounts to about 15 gigawatts of energy nationwide. That 15 gigawatts is being right now very proactively exploited in the marketplace, very profitably by participants in the marketplace, largely based on Energy Policy Act provisions in policy that induced greater development and exploitation of the convention geothermal.

We will not foreclose on the possibility of emerging technologies, and we are reviewing the results of that study, to see if it is worthy of integrating into future considerations.

Mr. MCNERNEY. How is my time, Mr. Chairman?

Chairman LAMPSON. Thank you very much. Mr. Bartlett from Maryland, five minutes.

## ETHANOL POTENTIAL AND SUSTAINABILITY

Mr. BARTLETT. Thank you very much. Five minutes, five panelists, thank you very much for cooperating with short answers.

I might note, Dr. Orbach, that seven percent exponential growth, does double in ten years, so you are on target.

We are producing enough ethanol to make a minimal contribution to reducing our dependence on gasoline, but it has had an enormous effect on corn prices. They have doubled from $2.11 in September to $4.08 in December. Tortillas are increased in price in Mexico, and they aren't able to buy as many, and my dairymen are dying because of these high prices.

Who is looking at the potential in your bioengineering research and sustainability? Is that your responsibility or somebody else's?

Dr. ORBACH. It is the Department's responsibility, and we——

Mr. BARTLETT. I would just encourage you to look at potential and sustainability, because you know, the fact that you can do it doesn't mean that you are going to have enormous amounts of energy in the future. We still have to eat, and you know, that is going to compete with the need for these, for this energy production.

## MORE ON NUCLEAR POWER

Mr. Spurgeon, how many years do we have to operate a nuclear power plant to get back the fossil fuel energy it took to build it?

Mr. SPURGEON. I don't have that number——

Mr. BARTLETT. If you don't have that number at your fingertips——

Mr. SPURGEON.—right off the top of my head, but it is not that long, sir.

Mr. BARTLETT. Well, could you please get that number for the record, please?

Mr. SPURGEON. I certainly will.

[The information follows:]

INSERT FOR THE RECORD

Mr. Spurgeon, how many years do we have to operate a nuclear power plant to get back the fossil fuel it took to build it?

Senator, this question cannot be answered accurately because there are too many assumptions that would need to be made and there is not consensus in the technical or business communities as to which assumptions are correct. However, it would not be a significant time because an operating nuclear plant has almost no carbon emissions and they routinely operate at high availability producing enormous amounts of power. The ongoing emissions from processing uranium ore are expected to become increasing less polluting as newer, more efficient technologies phase in over the next few years and as the power sources increasingly become cleaner from nuclear and clean energy sources.

Mr. BARTLETT. I get wildly divergent numbers as to how long that takes, and I would like to have it from the experts, what it really is.

Mr. SPURGEON. Be glad to give it to you, sir.

Mr. BARTLETT. Thank you. Thank you very much.

## POWER PLANT SITING

Are you looking at siting future power plants in populated areas, so that we can use the excess heat for district heating and with ammonia cycle cooling for refrigeration in the summertime, rather than rather stupidly siting them where we have to use drinking water and cooling towers to dissipate precious energy?

Mr. SPURGEON. Most of the new plants that are being considered today are located, or designed to be located, or planned to be located, I should say, at the site of existing reactor facilities. Most of our reactor sites were originally designed to accommodate more units than currently exist on those sites. So, this will be the first steps——

Mr. BARTLETT. I hope that when we are really siting new plants, that we look at putting them where people live. By the way, if I sleep four feet from the nuclear power plant in one of our submarines, I have less radiation than if I am laying out on the beach. And we really need to be siting these in populated areas, so we can use the district heat. It is really pretty dumb to use drinking water, evaporate drinking water to dissipate heat that we desperately need in a world that is going to be increasingly energy deficient.

## ENERGY CONSERVATION

Mr. Karsner, I had the privilege of leading a nine Member delegation to China just over the break at Christmas and New Year's. I celebrated New Year's in China. And they began their conversation on energy by talking about post-oil. They seem to get it. We are having trouble getting it. And they have a five point program, the first point of which is conservation. You didn't mention that. Is conservation included in your efficiency, or who has responsibility for promoting conservation in our country?

Mr. KARSNER. Well conservation and efficiency, of course, are very closely linked. Conservation, getting less from less, efficiency, getting more from less. And but the idea is using less in both instances.

So, we do have a responsibility. Our Office was formerly named the Office of Conservation, before it was changed to the Office of Efficiency.

Mr. BARTLETT. Good. Well, you know, conservation is two people riding in the car. Efficiency is using a Prius rather than an SUV. So, they are different, but both of them have the same goal, that is, using less energy, and still live comfortably.

## ELECTRO-MAGNETIC PULSE (EMP) PREPAREDNESS

Mr. Kolevar, you are responsible for energy distribution. How much energy will you be able to distribute after a robust EMP laydown? And I note there was an article just a couple of days ago about the threat from China and EMP laydown. Sir, is the answer none?

Mr. KOLEVAR. The answer would be zero electrical energy.

Mr. BARTLETT. You are correct, sir. And I would submit that this ought to be a very high priority. A single weapon that made it 300 miles high over the center of our country would shut down all electric productivity for the foreseeable future. Am I not correct?

Mr. KOLEVAR. I do not dispute that. I don't know those numbers specifically, but the impact would be dramatic.

Mr. BARTLETT. Yes. Thank you very much.

## POTENTIAL COAL SUPPLY

Mr. Shope, you mentioned coal. We have 250 years of coal. If you just increase, use two percent, which we will have to do better than that, that shrinks to 85 years. If you use some of that energy to convert the coal into a liquid or a gas, you have now shrunk to 50 years, and since energy is now fungible, and it moves on a world market, if we share our 50 years of coal, just two percent increase with the world, that shrinks it to 12.5 years. That is not much, is it?

Mr. SHOPE. I am not sure I understand your question, Congressman.

Mr. BARTLETT. Well, you know, we brag we have 250 years of coal.

Mr. SHOPE. Right.

Mr. BARTLETT. So, then, don't worry about energy for the future. But if you increase its use only two percent, that 250 years shrinks to 85 years. And since you can't fill your chunk of the car with coal

and go down the road, you are going to have to convert it to a liquid or a gas. Now—and if you use the energy to do that from coal, you are now down to about 50 years, and since all energy today moves on a global marketplace, and we are going to share that 50 years of coal with the world, now it shrinks, four into 50, it is 12.5. So, now we are down to 12.5 years.

That doesn't leave me very sanguine that coal is going to solve our energy future. Am I wrong?

Mr. SHOPE. Well, Congressman, of course, with respect to coal, that is one of the main things we are working on, is making it more efficient, the use of it more efficient, and that is what our program is geared towards, is to get more energy out of the coal reserves we have, and we do have ample coal supplies in the United States. I think——

Mr. BARTLETT. You think 12.5 years at only two percent growth is ample, okay? I am not sure it is ample.

Thank you very much, Mr. Chairman.

Chairman LAMPSON. Okay. Thank you. Thank you, Mr. Bartlett. I am apologizing to all of our Members for the timeliness of this, because of this joint session that is about to start, we are going to try to rush through these as quickly as we can.

I will call next on Mr. Lipinski.

## THE INTERNATIONAL LINEAR COLLIDER

Mr. LIPINSKI. Thank you, Mr. Chairman. I would appreciate if the panel members could answer some written questions that I am going to submit.

Right now, I just want to raise three issues. The last one is the only one I will ask a question on, but I just wanted to first say, to Mr. Shope, I am concerned that the $79 million is not enough for carbon sequestration, and I just want to raise that issue, and follow up with some questions on that.

Mr. Karsner, I just wanted to mention that Representative Inglis and I have reintroduced our H Prize Act this year, to authorize the Secretary of Energy to establish monetary prizes for technological advancement in hydrogen energy. I think it is a smart way to go about doing it. I am happy to see that there is a significant increase in hydrogen research also in the budget this year.

But the thing I really wanted to talk about and ask the question is to Dr. Orbach. And I want to thank you and the Department for advocating for the International Linear Collider, specifically housing it there at Fermilab in Illinois. I think this can bring great benefits, and it is very significant for the United States to be able to house this collider in the United States. I have spoken with Congressman Hastert on this issue. Fermilab is located in his district. I talked to Dr. Oddone, who is the Director at Fermilab. Could you elaborate a little bit, briefly, on the progress of bringing ILC to Fermilab, and the significance for our country of doing that?

Dr. ORBACH. Well, it will be very significant if we can bring it here. What we are doing in our '08 budget is doubling the amount of funds for R&D for the superconducting cavities and the other elements that would go into the International Linear Collider. We are in the process of developing an international agreement, or an international relationship that would enable us to correlate our

R&D with the research and development in Asia and in Europe, so that we can make it truly international.

We are just beginning to work out the details of that, and we hope that that will lead in a few years to the availability of the building blocks for the International Linear Collider.

Mr. LIPINSKI. Thank you. I will yield back.

Chairman LAMPSON. Thank you very much, Mr. Lipinski, and now, I will recognize Ms. Biggert, the former Chairman of our subcommittee.

### MORE ON THE GLOBAL NUCLEAR ENERGY PARTNERSHIP (GNEP)

Ms. BIGGERT. Thank you, Mr. Chairman. I have got a couple questions I hope I can get in.

Mr. Spurgeon, you know, I have said many times before that I support the vision of GNEP, namely, to develop and deploy technologies, reduce the volume and toxicity of nuclear waste by recycling and maximizing the energy extracted from our uranium supplies.

I am concerned, and I am not convinced that the Department is proceeding in a way that really is going to build public or Congressional support for this important program, and that really does worry me. As you know, I would be a lot more comfortable with DOE's plans if the Department had completed a comprehensive systems analysis.

And I know that you mentioned in your testimony that you are working on a systems analysis, on a variety of deployments systems alternatives. And you are conducting a program environmental assessment, I know, because there was one that was held in Joliet right near my district.

So, why can't the DOE conduct a similar programmatic systems analysis to help build support for the vision of GNEP, and why do you still believe that the commercial scale demonstration is the best way to proceed, rather than the engineering scale demo, especially since there hasn't been a comprehensive systems analysis?

And I know that, you know, there was a cut in the budget last year by the Appropriations Committee, because there hadn't been this analysis, and we just have to get going. It really concerns me that you say, what, 15 years before we are going to be set, and you know, I think this is so crucial to our energy demands, and to reduce our dependence on foreign oil.

Mr. SPURGEON. I agree with you, ma'am. We do need to get going, and that is the whole point of the program. We are conducting a comprehensive systems analysis. Some of the decisions are relative to precise scale, will be an outcome of that. We are proceeding with the generic environmental impact statement, programmatic environmental impact statement, in order to move the process forward, and we are engaging industry, because there is a great deal of worldwide expertise in this arena.

So, we are underway with cooperative programs currently, with Russia, with France, with Japan, and we intend to exploit the worldwide knowledge in this area, in order to leverage our own program, to be able to take advantage of the technology that does exist, so we don't have to reinvent all of the wheels here locally.

Ms. BIGGERT. Well, I guess we need that, since we are 25 years behind.

Mr. SPURGEON. Yes, sir. Yes, ma'am. We certainly do.

Ms. BIGGERT. But you still haven't answered my question, about——

Mr. SPURGEON. In terms of the scale?

Ms. BIGGERT. Yes.

Mr. SPURGEON. We believe that there are many pieces that need to be demonstrated yet, and that is what the R&D program is all about, associated with this program. There are pieces that need to be demonstrated at the prototypic or demonstration scale, and that is what we intend with part of this budget. And tests that will demonstrate the entire process.

There are other pieces of the program. Because they are so similar to existing facilities, like some that I know you have visited, that are ready for commercial scale deployment. Now, the precise capacity will be determined as a result of our this year's evaluation, and the systems analysis. It can, though, be built, these facilities can be built in a modular fashion that allows us to get started and expand to commercial scale as we go.

So, that is your—the conclusion is not reached. The intent is to move it as fast as we can, consistent with good science.

## THE RARE ISOTOPE BEAM

Ms. BIGGERT. All right. I just want to thank Dr. Orbach for the ACI. I think you and Dr. Bodman have really pursued that, and the research and physical sciences, and thank you so much.

I can't leave this hearing without asking you about RIA or RIA–Lite. I know that it is still in the President's budget. If you could just tell me the status of that.

Dr. ORBACH. We will be, in fiscal year 2008, having a competition for the design of what we now call the Rare Isotope Beam, and that design competition will be the same as the siting. That is, whoever proposes the best design, that is where it will be built.

We have, in—when you receive the outyear budgets, when they go to Congress, you will find PED money in the out years for the beginning the process, but the design right now is in a competitive situation, and that is what we are pursuing.

Ms. BIGGERT. Thank you. I yield back.

Chairman LAMPSON. Thank you. Ms. Giffords.

## SOLAR ENERGY

Ms. GIFFORDS. Thank you, Mr. Chairman.

Mr. Karsner, briefly. I was pleased to see the President's '08 budget when it came to solar. I believe there is about an 81 percent increase, $148 million. Coming from Arizona, a state with an abundance of sunshine, it is certainly very good news.

I am curious about the President's initiative. I am curious if it is on track, the obstacles that possibly you are facing, and whether or not by 2015, we are truly going to have photovoltaic cells that are competitive with other types of power. So, if you could please address that, I would appreciate that.

Mr. KARSNER. I believe it is not only on track. I believe it holds great potential for getting ahead of that 2015 timetable, particularly in places with—where we can unlock solar resources like Arizona and the Southwest, not just through photovoltaics, but you might note that we have also increased funding for concentrated solar power, which can increase base load generation, and shape the power, in collaboration with the expected results from storage capacity that we expect from Dr. Orbach's efforts.

Ms. GIFFORDS. Thank you. I yield back.

Chairman LAMPSON. All done? Thank you very much.

Well, I want to thank everyone, and as we bring this meeting to a close, particularly each and every one of our witnesses for testifying before the Subcommittee. I think it has been a very informational hearing for everyone here, and our witnesses have given this committee a better understanding of DOE's plans and priorities for the coming year.

If there is no objection, the record will remain open for additional statements from the Members, and for answers to any of the follow-up questions that the Committee may ask of the witnesses. Without objection, so ordered.

This hearing is now adjourned.

[Whereupon, at 11:05 a.m., the Subcommittee was adjourned.]

# Appendix:

## Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Raymond L. Orbach, Under Secretary for Science, U.S. Department of Energy*

**Questions submitted by Chairman Nick Lampson**

*Q1. This Committee is concerned about future of U.S. high energy physics and the prospects for siting the International Linear Collider on U.S. soil. While it is of paramount importance that the U.S. maintain its global leadership in this and many other scientific fields, Congress will undoubtedly exercise extreme caution in moving forward with the development of facilities that may cost the taxpayers billions. We need only look back as far as the Superconducting Super Collider to see the pitfalls that must be avoided as the ILC concept ripens.*

*Q1a. Where does the ILC currently rank in the Department's priorities of proposed projects and facilities?*

*A1a.* The Office of Science *Facilities for the Future of Science, A Twenty Year Outlook* report, issued in November 2003, ranked the International Linear Collider (ILC) as the top priority in the mid-term category.

*Q1b. What is DOE'S timeline for development of the ILC, and how does this compare to the timeline laid out by the research community?*

*A1b.* The Department of Energy's Order 413.3A provides a rigorous series of milestones, known as Critical Decisions, to provide checks and balances and controls for the management of construction projects. The Office of Science's success in managing large construction projects like the Spallation Neutron Source has stemmed from rigorous observance of these milestones, enforced by intensive use of both internal and external reviews. The Critical Decisions process is among our key tools for determining the readiness of construction projects, correctly costing and scheduling the projects, and keeping them on time and within budget. The Office of Science takes the requirements of Order 413.3A very seriously.

Briefly, the major milestones are as follows: Critical Decision–0—Approve Mission Need, Critical Decision–1—Approve Alternative Selection and Cost Range, Critical Decision–2—Approve Performance Baseline, Critical Decision–3—Approve Start of Construction, and Critical Decision–4—Approve Start of Operation of Project.

Every construction project must meet requirements for approval of Mission Need, Alternative Selection and Cost Range, and Performance Baseline before a start of construction can be approved.

The ILC has not yet passed the Critical Decision–0 (CD–0) milestone—that is, Mission Need for the ILC has not yet been established. The Department is at a very early stage in this project planning. Several requirements must be met before CD–0/Mission Need can be determined. Among them is an assessment of the scientific opportunities potentially represented by the ILC. This assessment will await analysis of early physics results from the Large Hadron Collider, which are now expected about 2010–2011. The technical feasibility of core technologies will also have to be demonstrated.

The Global Design Group (GDE), a self-organized group drawn from the international research community for the ILC, issued its Reference Design Report in February 2007. This report includes the desired scientific scope of the project and a very early stage cost estimate using international methodology and assuming that construction would occur from 2012 to 2019.

A decision to go forward with the ILC is not imminent. Even assuming an eventual positive decision to build an ILC, its schedule will almost certainly be lengthier than the GDE assumptions. Completing the R&D and engineering design, negotiating an international structure, selecting a site, obtaining firm financial commitments, and building the machine could take us well into the mid-2020s, if not later.

*Q1c. What are the current preliminary cost estimates for the ILC?*

*A1c.* We do not yet have a preliminary cost estimate for the ILC that has been commissioned, reviewed, and validated by the Department. The Global Design Effort (GDE), a self-organized group drawn from the international research community for the ILC, issued a "Reference Design Report" in February 2007. This report includes a very early stage cost estimate based on international methodology which is, however, very different from that used by DOE in costing projects. For example, the GDE estimate does not include cost for detectors at the facility, construction escalation or inflation, contingency, engineering design, or a number of other costs that DOE incorporates into Total Project Cost. While the GDE Report is helpful in pro-

viding the basic outlines of the scientific scope and initial design parameters of the project, it does not provide sufficient information on such key elements as proof of core technology to allow a reliable cost estimate at this time.

*Q1d. Will the Department take steps to record the history of the failed SSC project and develop from that a "Lessons Learned" document?*

*A1d.* There have been a number of "lessons learned" reports on the Superconducting Super Collider (SSC) and other large-scale science projects. The Office of Science is well aware of the lessons from the SSC experience and has identified five areas that need very close attention for any such new project. These five areas include: establishing a fully international basis for the project from the start; securing the broad support of the wider scientific community for the project; establishing agreed upon practices for costing, including how to handle issues like project changes and escalation; and establishing clear and strong management structures with well defined reporting lines. The fifth area is close attention to any larger national or international events that might impact project costs or alliances. These "lessons learned" will be carefully applied in developing the global ILC R&D effort.

*Q1e. What steps have been taken to educate Congress and the public on the relevance of Elementary Particle Physics, and the ILC specifically?*

*A1e.* The call for better public outreach on the goals of particle physics in general and the ILC specifically has been clearly made by Congress and others. The Department has funded a number of publications in this area.

A notable contribution to informed public discussion is the 2006 National Research Council (NRC) report *Revealing the Hidden Nature of Space and Time: Charting the Course for Elementary Particle Physics* (also sometimes known as the "EPP 2010 Report"). The report discusses the reasons in layman's language for maintaining U.S. leadership in elementary particle physics, explains the scientific opportunities potentially represented by an ILC, and recommends U.S. investments in R&D for the ILC.

In addition, several initiatives by the elementary particle physics community have improved and expanded public communication over the past few years.

*Symmetry Magazine* (*http://www.symmetrymagazine.org/cms/*) was founded in 2004 and presents a broad, human account of the aspirations and achievements of high energy physics.

The Quantum Universe report (*http://www.interactions.org/quantumuniverse/qu/*) is an exciting and readable account of the dramatic new questions facing the field. Its sequel, *Discovering the Quantum Universe* (*http://www.interactions.org/quantumuniverse/qu2006/*), lays out the exciting opportunities to be addressed by the ILC and the ILC's relationship to the Large Hadron Collider soon to begin at CERN in Switzerland. The ILC Reference Design Report recently issued by the GDE includes a 30-page illustrated companion document, *Gateway to the Quantum Universe* (*http://media.linearcollider.org/ilc_gatewayquantumuniverse_draft.pdf*), that explains the potential benefits of the ILC in non-technical language and outlines the steps forward to achieve it.

In recognition of the need to explain the scientific basis for the ILC to a wider public, the GDE has set up a network of communicators in the U.S., Europe, and Asia. In addition to the *Gateway* document referred to above, they publish a weekly *ILC Newsline* (*http://www.linearcollider.org/cms/*) that features recent news, advances in the accelerator R&D, and articles of general interest relating to project organization and outreach activities.

*Q1f. What steps have been taken in the development of the ILC plan to include the private industries that will ultimately be contracted to build and operate the ILC? Are you planning to develop an industrialization plan?*

*A1f.* Two years ago, a not-for-profit organization called the Linear Collider Forum of America (LCFOA) was formed by representatives from small and large U.S. companies. LCFOA provides a formal network for committed members to reach out to their counterparts across U.S. industry to educate them about the technologies being developed for the ILC and the potential opportunities for new business. LCFOA holds two to three meetings per year and has recently hosted a symposium and reception in the House Science Committee room to provide information and initiate a dialogue with Members of Congress and their staff.

LCFOA is planning a symposium in mid-May that will bring representatives of industry, government, and the research community together to help identify areas where the accelerator technology can provide benefits that seed new industrial activity, research, and commercial applications. This symposium is organized around five themes: the use of linear accelerators for medicine and industry; applications of the

superconducting accelerating technology; high power radio frequency sources; nanoscale instrumentation; and detector technologies with new imaging applications. The LCFOA symposium is part of a globally coordinated activity to develop partnerships between industry and the research community.

*Q1g. What steps have been or will be taken to assemble a team for a U.S. bid to host the ILC?*

*A1g.* The GDE Reference Design Report assessed the viability of sample sites in the U.S. (near Fermilab), Japan, and Europe. These sites varied in detail, but all were found to be viable and of comparable cost to construct.

The Fermilab site builds upon the extensive infrastructure already in place at the existing laboratory. Fermilab is taking the lead in developing the expertise necessary to prepare a bid to host the ILC, and has established a regional community committee to support the ILC planning process and serve as a local outreach group to describe the benefits and impacts an ILC could bring.

*Q2a. The Office of Science funds some $800 million a year in grants. But it has been said that only one of ten proposals for funding to DOE Office of Science get funded. Do you believe this is the right proportion? If not, where should that proportion be in the next five years?*

*A2a.* The Office of Science grant funding is about $600 million per year primarily to colleges and universities. These grants are awarded through open competitive solicitations for proposals. A rigorous scientific peer review process is the standard practice for the Office of Science in order to ensure the highest quality research is funded. The standard for funding proposals should be the quality of the proposal and not the proportion of proposals funded.

Thirty-two percent of the more than 1,600 new grant proposals received during FY 2005 were funded. Approval rates for grant renewals of funding for the second and third years of three-year grants and for supplemental awards were significantly higher, at about 90 percent. Combined, about half of the proposals received during FY 2005 were funded. While funding decisions for about 20 percent of the more than 1,800 new grant proposals received during FY 2006 are still pending. I anticipate that once all grant decisions are made, approval rates for proposals received during FY 2006 will be similar to those in FY 2005. I believe that this is a healthy, competitive percentage of proposals funded.

*Q2b. How do you balance new construction versus upgrading of existing facilities and university grant funding?*

*A2b.* To ensure that the most scientifically promising research and enabling research tools are supported, each program in the Office of Science engages in long-range planning and prioritization; regular, external, independent review of the supported research and scientific facilities to ensure quality and relevance; and evaluation of program performance through establishment of and subsequent measurement against goals and objectives.

These activities rely heavily on input from external sources; including workshops and meetings of the scientific community, advice from federally chartered advisory committees, intra-DOE and interagency working groups, and reports from other groups such as the National Academy of Sciences. The reports and advice received often include recommendations on new scientific opportunities through research or new instruments and on appropriate levels of funding to develop the plans, priorities, and strategies for the program and to help maintain an appropriate balance among competing program elements, from new construction and upgrades of existing facilities to new research initiatives and university grant funding.

Based on these inputs and other factors, including Department mission need and Administration priorities, each program is responsible for planning and prioritizing all aspects of supported research and facilities and for conducting ongoing assessments to ensure a comprehensive and balanced portfolio.

**Questions submitted by Chairman Bart Gordon**

*Q1. The FY08 budget request proposes the development of three Bio-Energy Research Centers through the Office of Science. Given the Office of Science long-standing role supporting basic research and the physical sciences, this could be considered a big leap into the realm of applied energy technology development. The plan is to run these centers like a "biotech startup" with substantial private investment. Private investors have their own parameters for what they consider to be a worthwhile investment that may or may not be compatible with what the Department envisions for these programs. The Committee would also like to ensure*

*that the centers maintain activities distinct from one another, and do not duplicate existing efforts.*

*Q1a. Why would private investors be compelled to put their "skin in the game"? What kind of return on investment can investors expect to see and in what timeframe? Does this arrangement require negotiating unique intellectual property contracts?*

*A1a.* The three Bioenergy Research Centers will support comprehensive, multi-disciplinary fundamental research that is expected to provide the scientific foundation for development of cost-effective biofuels and bioenergy production. The nature of the basic research to be supported by these centers is believed to be high-risk to the private sector. Its high potential pay-off, however, is expected to attract private investors. The solicitation for proposals for the Centers was announced in August 2006. Proposals were due February 1, 2007 and are currently undergoing peer review. The specific nature of these private investments and the timeframe for a return on investment is not prescribed in the Funding Opportunity Announcement. The Centers will be encouraged to explore collaborative opportunities with private investors through the licensing of technology arising at the Centers and through entering into a variety of partnering agreements according to the contract provisions that will be included in the agreement for the operation of the center.

*Q1b. How would the research at these centers differ from what is conducted at other labs and within industry? How will these centers be distinct from one another?*

*A1b.* These Centers are designed to fill a critical void in the Nation's efforts to develop and deploy cost-effective, commercially viable methods for producing cellulosic ethanol and other biofuels by focusing on basic research. Unlike industry-sponsored research in this area, which typically aims at incremental improvements to current technologies, the Centers are aimed at fundamental breakthroughs. Many experts in this field believe strongly that, absent transformational breakthroughs in basic science, it will be extremely difficult, and probably impossible, to develop a viable biofuels economy. Present-day conversion methods are simply not efficient enough, and incremental improvements will not meet the need. Experts largely agree that until we can produce ethanol from cellulose, ethanol will not be cost-effective. But, breaking down cellulose into sugars is a challenging problem. At the same time, many scientists believe that the biotechnology revolution and today's advanced systems biology at the cutting edge hold out the promise of real solutions.

DOE can provide advanced scientific resources to address the biofuels challenge which no other institution, research organization, or funding agency, private or public, can match.

In the Funding Opportunity Announcement the Department did not specify any particular technology focus for the Bioenergy Research Centers. Rather, we deliberately requested applicants to provide their best scientific roadmap. While we did put a certain emphasis on cellulosic ethanol (and liquid transformation fuels generally), we largely left the research focus open. We are looking to the best scientific minds to identify the best approaches and we will not know the specific focus and approach of each Center until we have selected the three awardees.

Whatever the outcome of the solicitation, however, there are many advantages to deploying multiple Centers. First, the existence of three Centers will create competition in the race for real solutions to our energy security needs-and experience has shown competition to be an enormous incentive for scientific performance and research success. Second, multiple Centers will enable us to make maximum use of the talent available to address this problem and, third, will enable us to explore multiple avenues to a solution at the same time, thereby potentially hastening success. And, finally, even as the Centers compete, they will also be able to learn from one another, especially as we facilitate and review their management with an eye to maximizing "best practices."

*Q1c. What are the long-term prospects for these labs after their initial research goals are met, or deemed otherwise unattainable? Will they cease to operate or continue indefinitely with DOE funding?*

*A1c.* The FOA offers no DOE commitment beyond the initial five-year period and requests that the research program described in the application be limited to this period. Applicants were not allowed to request construction funds and were instructed to plan for having the Center fully operational within one year of the award being made, so that completion of specific short-term objectives could be made during the five years of the award.

*Q1d. Please provide a breakdown of all the teams submitting proposals for the Bioenergy Research Centers and, if possible, the current state of bid selection.*

*A1d.* Applications for the Bioenergy Research Centers are currently undergoing scientific merit review. DOE does not release information on ongoing financial assistance activities, not even the identities of applicants. Once selections are made, expected in summer 2007, the names of the selected applicants will be announced.

*Q2a. Section 1102 of the* Energy Policy Act of 2005 *mandates that the Department set aside 0.3 percent of funds for research, development, demonstration and commercial application for authorized educational activities. It was intent of both the House and Senate that this Fund be established and the funds in it be expended starting in FY 2006. We are now well into FY 2007 and the Department has not dedicated funding, has not been able to tell Congress what is spent on research, development, demonstration, and commercial applications, or what is spent on the allowable science education activities under Section 1102 and 983 of EPACT. Can we expect these activities to be underway in time for teachers to receive training this summer under this program?*

*A2a.* I appreciate your interest and support of the Department's contribution to math and science education in the U.S. We intend to reach the 0.3 percent funding level for authorized educational activities, if in fact we are not already exceeding that amount. We are currently in the process of determining the Department's total funding for research, development, demonstration, and commercial applications activities and also the total amount the Department spends on education activities. We will provide those figures to you as soon as they are available.

*Q2b. If not, what is preventing this program from moving forward?*

*A2b.* DOE is moving forward on the authorized activities contained in Sections 1102 and 983 of the Energy Policy Act that have received appropriated funding from Congress. We are in the process of establishing a plan for the development of new programs that take advantage of the Department's unique capabilities for science education through experiential learning opportunities. Once we have an approved plan in place for new and enhanced programs as well as peer reviewed evaluation of those programs, the Administration will propose an appropriate funding level and, if funded by Congress, programs like those envisioned in the *Energy Policy Act* will move forward.

**Questions submitted by Representative Ralph M. Hall**

*Q1. I understand you are trying to balance funding between facilities and core research, can you please explain what you base your funding decisions on and what your plan is for the out years?*

*A1.* The Office of Science scientific user facilities and its core research programs are inextricably linked. Without balanced investments in both facilities and research, we would run the risk of limiting scientific productivity, missing windows of opportunity to advance areas of scientific research and innovation, and decreasing the Office of Science's effectiveness in addressing DOE mission needs. Therefore, our spending plan attempts to carefully balance priorities in facilities and core research to promote a healthy and productive program.

To help maintain appropriate balance among competing elements of program, such as the balance of funding between facilities and core research program, each program in the Office of Science engages in long range planning and prioritization; regular external independent reviews of the supported research to ensure quality and relevance; and evaluation of program performance through establishment of and subsequent measurement against goals and objectives. These activities rely heavily on input from external sources, including workshops and meetings of the scientific community, advice from the federally chartered advisory committees, intra-DOE and interagency working groups, and reports from other groups like the National Academy of Sciences. The reports and advice provided often include recommendations on appropriate levels of funding to develop research and facility plans, priorities, and strategies.

Each Office of Science program considers these external inputs and is responsible for planning and prioritizing all aspects of supported research, conducting ongoing assessments to ensure a comprehensive and balanced portfolio, supporting the core university and national laboratory programs, and maintaining a strong facility infrastructure to support its mission.

The Office of Science will continue to invest in its world-leading user facilities, which serve as valuable research tools for U.S. science and are critical to the effec-

tive accomplishment of our varied and complex missions. About 50 percent of the users at our facilities come from universities and are funded by the Office of Science or other federal agencies. In the out years, with the growth proposed in the American Competitiveness Initiative, I expect to make substantial progress on many of the new facility and facility upgrade projects outlined in "Facilities for the Future of Science: A Twenty Year Outlook," with the goals of maintaining at least an order-of-magnitude lead in scientific capability over other facilities world-wide, and of operating our suite of user facilities at or near optimum levels. At the same time, I also plan to grow our core research funding steadily at universities and national laboratories and to increase support for existing and promising new research in areas important to DOE mission needs and identified by advisory groups and workshops like the Basic Research Needs workshops which the Office of Science has been conducting for the past several years.

*Q2. What is the status of ITER? How long does our funding commitment last for, and when are we expecting to see results?*

*A2.* The seven ITER Parties, including the United States, signed the ITER Agreement on November 21, 2006. The Agreement provides the legal framework for the ITER phases of construction, operation, deactivation, and decommissioning. U.S. domestic and international ITER activities are well underway to complete the ITER design and prepare for the start of construction. The U.S. Contributions to ITER Project, which supports the construction phase of ITER, has a nine-year funding profile with a cap of $1.122 billion. It is a Major Item of Equipment project that was first introduced in the FY 2006 Budget Request to Congress. International ITER Project activities in FY 2007 and FY 2008 will establish overall design and schedule baselines that may affect the U.S. Contributions to ITER Project. DOE expects to establish the cost and schedule performance baselines for the U.S. Contributions to ITER Project in late FY 2008. The U.S. contributions consist of in-kind equipment, personnel who will work in the international ITER Organization, and cash for the ITER Organization central fund. The preliminary schedule for the U.S. Contributions to ITER Project concludes in FY 2014. Afterward, the ITER Organization is scheduled to complete assembling and commissioning the ITER facility between 2014 and 2016. It is anticipated that research operations at ITER will begin in about 2017 and extend over a 20-year period. Funding for decommissioning would be furnished annually during the 20-year operation period. Deactivation would commence around 2037. The funding for deactivation would be furnished during a five-year period starting when ITER is shutdown around 2037.

*Q3. What do you see as the future of the elementary particle physics program in the United States and future of domestic facilities?*

*A3.* Overall, the U.S. will play a leadership role in the physics of the Large Hadron Collider when it begins producing data in 2008 and in world leading research programs in neutrino physics and dark matter as well as a pivotal role in the development of next generation accelerators through its strong program of technology R&D for future accelerators. This research program will be carried out largely through strong collaborations involving both U.S. universities and the DOE national laboratories. Office of Science High Energy Physics user facilities will be concentrated at Fermilab after the Stanford Linear Accelerator Center (SLAC) B-factory completes operations in 2008.

The current plan is to continue running the Fermilab Tevatron through the end of fiscal year 2009. This is based on input from the Particle Physics Project Prioritization Panel (P5), a sub-panel of the High Energy Physics Advisory Panel, in December 2005. The schedule for turning on the Large Hadron Collider (LHC) continues to evolve, and new results from the Tevatron are regularly being published. P5 will meet this summer to consider whether their recommendation needs to be revised on the basis of new information.

While the Tevatron collider program will be completed by the end of the decade, other accelerator-based facilities at Fermilab will continue. In particular, the accelerator-based neutrino program, which employs Fermilab's powerful proton beam, will continue to be a world-leading center investigating the science of the neutrino. The flagship experiments in this program, MINOS and NOvA, are expected to run well into the later part of the next decade.

As to the longer-term future, although we may eventually be able to make a strong scientific case for the ILC, it is premature to make that determination at this time. While there has been some progress through initial international efforts, much work remains to be done before the U.S. is in a position to make informed evaluations and decisions. Even assuming a positive decision in the future to build an ILC, its schedule and cost will almost certainly exceed the optimistic projections. Com-

pleting the R&D and engineering design, negotiating an international structure, selecting a site, obtaining firm financial commitments, and building the machine could take us well into the mid-2020s, if not later. Within this context, the Department has started to re-engage the U.S. particle physics community in a discussion of the future of particle physics by asking the question: were the ILC not to turn on until the middle or end of the 2020s, what are the right investment choices to ensure the vitality and continuity of the field during the next two to three decades and to maximize the potential for major discovery during this period?

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Dennis R. Spurgeon, Assistant Secretary for Nuclear Energy, U.S. Department of Energy*

**Questions submitted by Chairman Bart Gordon and Subcommittee Chairman Nick Lampson**

*Q1. The Department released the Global Nuclear Energy Partnership (GNEP) Strategic Plan this year. However, neither this plan nor the DOE Budget Request provides sufficient justification for the significant increases in funding requested for GNEP. The plan calls for research and development of advanced reprocessing technologies, commercial deployment of evolutionary reprocessing technologies, and the commercial deployment of a fast reactor. In two years, the Secretary is to make a Record of Decision regarding the path forward to the commercializing of reprocessing and recycling. This is a pretty short period of time.*

*Q1a. How does the Department plan to spend a four fold increase in funding for GNEP in one year?*

*A1a.* The FY 2008 budget request for the Global Nuclear Energy Partnership (GNEP) supports spending primarily in two areas: research and development (R&D) involving experimentation and advanced computation and simulation ($297 million) and, proposed facility definition and conceptual design ($92M).

The R&D category includes funding for university programs supporting GNEP ($48.5M), continued work to improve our knowledge and confidence in advanced fuel cycle technology, including spent fuel separations, transmutation fuel, systems analysis, advanced computer simulation, and nuclear and materials science and engineering.

The facility funding covers laboratory-led conceptual design activities for the Advanced Fuel Cycle Facility, a research facility to be located at a DOE site; and industry-assisted studies on both a consolidated fuel treatment center and an advanced burner reactor. The remaining $6 million of the FY 2008 budget request from the Office of Nuclear Energy for GNEP would go to support transmutation education and other support activities.

*Q1b. What is the balance in funding between the R&D activities and the commercialization activities?*

*A1b.* The Department plans to use $45M of the FY 2008 budget request for industry to complete conceptual design studies of facilities suitable for commercialization; to document cost, schedule, risk, and needed technology; and to develop an economic analysis that shows how costs would be shared between government and business. Of the $297 million requested in FY 2008 for R&D funding, approximately $133M supports work to address scale up and end-to-end testing in order to move from laboratory to commercial scale. This includes funding to invest in both physical and intellectual infrastructure needed to support initiatives for closing the fuel cycle.

*Q1c. In two years, industry can basically perform studies such as environmental impacts for siting these facilities, designing these facilities, and economic analysis for the facilities; how much are we going to spend on studies?*

*A1c.* The Department plans to support multiple industry studies with the $45 million of FY 2008 funds, as outlined above. The ongoing siting studies for potential locations for GNEP facilities will be completed with FY 2007 funds.

*Q1d. GNEP as proposed will spend billions of dollars to develop the Advanced Burner Reactor. Do you envision that this reactor would be a U.S. export product?*

*A1d.* The advanced burner reactor is planned to be developed to destroy transuranics from spent nuclear fuel and simultaneously produce electricity. It is important to note that it is the Department's goal that, through GNEP, that the majority of Advanced Burner Reactor costs would be funded by industry (including development and construction). The Advanced Burner Reactor could be produced as a U.S. export product to other fuel cycle states.

*Q1e. Could the Advanced Burner Reactor envisioned by GNEP ever be converted to a breeder reactor?*

*A1e.* The Advanced Burner Reactor is currently planned to be designed and licensed to consume plutonium and other transuranic elements. As such, it would not be built to breed plutonium. Changing the internal configuration of such a reactor from a burner to a breeder configuration would be difficult, although not impossible. Be-

cause GNEP envisions using this technology only within fuel cycle states where similar technology is already in place, proliferation concerns would be minimal.

*Q2. Some in the DOE have argued that in order to lead the debate on how nuclear technologies are deployed worldwide, the U.S. needs to lead in all aspects of the nuclear fuel cycle. This argument has some merits, but the rate of deployment of nuclear technologies in the U.S. and worldwide needs to be considered. While there is interest on the part of the nuclear industry, not one of these utilities has actually submitted a license application to the Nuclear Regulatory Commission.*

*Q2a. What gives the DOE such confidence that the nuclear industry is going proceed with such a rapid deployment of nuclear power plants that we need to start commercial reprocessing in the very near future, when the industry itself has indicated that a good estimate of the rate of deployment of nuclear power plants will not be known until 2020 at the earliest?*

*A2a.* Since the signing of the *Energy Policy Act of 2005* (EPAct), it is our understanding that the NRC has received letters of intent from 15 companies stating that they plan to submit applications for combined construction and operating licenses (COLs) for up to 33 reactors by 2008. The first COL is expected to be issued by late 2010 and a new advanced light water reactor would be operational by the 2015–2016 timeframe. Based on the success of EPAct incentives in evoking these letters of intent and the completion of the final design tasks through the Nuclear Power 2010 projects, we believe that the power companies will have the confidence they need to begin building the next generation of new nuclear plants.

*Q2b. What indication do you have that the U.S. nuclear industry is committed to commercial reprocessing?*

*A2b.* Several private sector nuclear industry respondents clearly stated that they were interested in participating in the development of domestic commercial reprocessing facilities in response to the Department's August 2006 Request for Expression of Interest in GNEP Facilities.

*Q3. DOE seemingly concluded that fast reactors are the only reactor type that can effectively burn nuclear waste. It is not clear that the Department has thoroughly examined the capability of other technology options such as the high temperature gas cooled reactors.*

*Q3a. Can you please be specific as to how much has been spent and any documentation that has supported the examination of other waste burning technologies such as high temperature gas cooled reactors?*

*A3a.* A wide variety of fuel cycle strategies were investigated as part of the Department's Advanced Fuel Cycle Initiative (AFCl) and predecessor programs with annual funding of roughly $5 million over the time period of 2001–2006. Approximately $3 million in FY 2005 and $2 million in FY 2006 was devoted specifically to examining the gas cooled reactor (GCR) deep burn concept.

Extensive studies were conducted of the waste management impacts of alternative fuel cycle strategies. A key finding of these studies was that the transuranic (TRU) elements (primarily Pu, Am, Np, and Cm) present in light water reactor (LWR) spent nuclear fuel (SNF) are the primary contributors to the waste characteristics that pose the greatest disposal challenges (e.g., long-term heat load, peak repository dose, and radio toxicity). Thus, a critical goal of the Global Nuclear Energy Partnership (GNEP) strategy is to exclude these materials from the waste in its final form. In a closed fuel cycle, the TRU are separated from the SNF and transmuted into fission products with more amenable waste characteristics; this process is commonly called 'actinide burning'.

The Department has evaluated the burning potential of existing LWRs, advanced LWRs, advanced fast reactors (FRs), accelerator-driven systems, and the complete spectrum of Generation-IV reactor concepts (including high temperature gas cooled reactors and fast reactor alternatives). The key distinguishing feature for burning potential is the neutron energy spectrum—thermal or fast.

Extensive studies of multiple recycles in thermal LWRs were conducted in 2001–2005. The general conclusion was that LWRs could be utilized for the initial recycle of plutonium, as currently employed in France. However, each recycle of the TRU becomes progressively more difficult and would be limited by fuel handling issues. A modest heat load/radio toxicity benefit was observed for a variety of LWR recycle strategies, however, a complementary fast spectrum system would still be required to complete the burning mission and yield more significant benefits.

In summary, the burning potential of various reactor systems, including high temperature GCRs, has been evaluated. Thermal recycle systems could achieve partial

burning of recycle TRU, but would require a follow-up fast reactor to complete the burning mission. GNEP continues to investigate these mixed (thermal/fast) technology options as alternate deployment strategies, with concurrent development of a sodium-cooled fast reactor technology as the baseline approach.

*Q3b. Which labs have been involved in this work?*

*A3b.* The U.S. laboratories performing the advanced fuel cycle analyses include Argonne National Laboratory, Brookhaven National Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, and Sandia National Laboratory.

The LWR recycle analysis was conducted in collaboration with the French CEA Laboratory to assure that the most recent international experience with LWR recycle fuels and mixed oxide experience was reflected.

The high temperature gas-cooled thermal reactor fuel cycle analysis was conducted by Argonne National Laboratory and Brookhaven National Laboratory in close collaboration with General Atomics. The Oak Ridge National Laboratory and the Idaho National Laboratory have also been involved in the fuels work for this reactor type.

*Q3c. Should more be spent on further work in this regard?*

*A3c.* The FY 2008 budget request for GNEP supports continued investigation of mixed (thermal/fast) technology options as alternative deployment strategies. The extensive LWR recycle studies previously conducted were motivated by the fact that LWRs will continue to dominate the U.S. nuclear fleet for the next several decades. Using LWRs for a partial burning mission would require the development and demonstration of recycle fuels. Furthermore, some modifications to conventional LWRs would be required to allow widespread application of recycle fuels. If high temperature gas-cooled reactors are deployed extensively for either process heat applications or electricity production, their suitability for a partial burning mission would also be considered.

*Q4. For reasons of balance of trade and U.S. influence on the non-proliferation front, it is important for there to be a healthy U.S. owned nuclear industry. As does DOD, DOE should consider the health of the U.S. owned nuclear industry when making procurement decisions. There is growing concern about DOE issuing nuclear research and development contracts to foreign owned or based nuclear companies that in turn receive research and development contracts from their own respective governments.*

*Q4a. Is reciprocal treatment afforded to U.S. companies?*

*A4a.* Speaking only for the Office of Nuclear Energy (NE), the overwhelming majority of DOE's Nuclear Energy Research and Development (R&D) funding goes to American laboratories and universities. They are free to sub-contract work with foreign entities. NE seeks to ensure that research dollars find their way to the people and facilities that can best do the work at the lowest cost. This tends to favor domestic R&D except in cases where suitable facilities do not exist, such as fast reactor test programs, or where a specific expertise or facility lies outside the United States. A special situation exists in the Generation IV program, where U.S. R&D is augmented by research funded by other countries, with all participating countries sharing the results of the research.

Developing recycling facility concepts and designs requires expertise and practical experience that is in very short supply in the United States, as we have not designed or operated such facilities on a commercial scale in decades. In this case, DOE may rely in part upon foreign-owned companies that are typically subsidized by their governments. Domestic companies may participate in this work and in so doing develop more domestic capability.

*Q4b. What is your assessment of the current state of the U.S. owned nuclear industry?*

*A4b.* With the lack of nuclear plant orders in the United States since 1978, there has been a consolidation in the nuclear industry, and many nuclear plant component manufacturers, suppliers, and construction companies are no longer in that business.

Although the Nuclear Steam Supply System vendors, Westinghouse and General Electric, have continued selling reactors overseas and servicing the currently operating reactors worldwide, many U.S. companies have not been similarly engaged and have not maintained their American Society of Mechanical Engineers N-stamps (quality assurance programs) which are needed for manufacturing nuclear plant

components. A large number of nuclear plant components will have to be procured overseas. The prime example of this situation is that U.S. companies no longer have the domestic capability to make the large ring forgings needed for major nuclear components such as reactor pressure vessels. In fact, there is only one company worldwide that can produce these forgings, The Japan Steel Works.

With announcements by 15 power companies of their intentions to submit applications to the Nuclear Regulatory Commission for combined Construction and Operating Licenses for as many as 33 new nuclear reactors, U.S. manufacturers are getting ready to reacquire, or acquire for the first time, their N-stamps, but it will take some time before the number of domestic companies holding N-stamp certification, in the low one-hundreds today, is as high as when our current nuclear plants were being built, just below 500.

As the market for new reactor orders solidifies and these companies retool, many of the components of nuclear power plants are expected to be built in the United States. Until such manufacturing capacity is expanded domestically, however, components for some of the new U.S. reactor plants, especially large pressure vessels, steam generators, and pumps, will have to be built overseas.

*Q4c. Does NE have any policy of giving U.S. owned companies any preference in competition over R&D contracts?*

*A4c.* Much of DOE's research portfolio is aimed at support or stimulation of a public interest, as opposed to buying R&D for the direct benefit of DOE, and thus is issued as a financial assistance instrument and not as a procurement contract. This differentiates DOE somewhat from DOD, which does R&D for the creation of weapons systems and the like through procurement contracts. More commonly, DOE issues contracts for the management and operation of National Laboratories that conduct research, or DOE issues financial assistance instruments. DOE's National Laboratories are, of course, based in the U.S. and conduct virtually all of their operations in the U.S. We discuss the statutory policies applicable to financial assistance instruments in the next section.

*Q4d. Are there particular laws, regulations or policies that prevent DOE from giving preferential treatment to U.S. owned nuclear firms in procurements?*

*A4d.* There are no laws, regulations, or policies that explicitly prohibit DOE from giving preferential treatment to U.S. firms in procurements for nuclear research and development contracts. However, the *Competition in Contracting Act of 1984* generally requires that agencies procure goods and services using full and open competition, and restrictions must be justified as necessary to meet the agency's needs or as falling within the Act's stated exceptions. With regard to nuclear energy, the Energy Research, Development, Demonstration, and Commercial Application Act of 2005 (Title IX of the *Energy Policy Act of 2005*) contains two provisions that requires DOE, at the very least, to consider foreign participation:

- Section 952(c) of the Act mandates that DOE shall carry out a Nuclear Power 2010 Program. Specifically, Section 952(c)(2)(C) further states that the administration of the program shall include "participation of international collaborators in research, development, and design efforts, as appropriate."
- Section 953 of the Act, Advanced Fuel Cycle Initiative, mandates the conduct of a program to evaluate proliferation-resistant fuel recycling and transmutation technologies. Section 953(c) specifically provides: "In carrying out the program, the Secretary is encouraged to seek opportunities to enhance the progress of the program through international cooperation."

Notably, Section 2306 of the *Energy Policy Act of 1992* (EPAct 92), and its implementing regulations at 10 C.F.R. 600.500 *et seq.*, required an affirmative finding that a financial assistance award is in the economic interest of the United States, and a further finding that the foreign country under whose laws the foreign firm is organized affords U.S. firms comparable participation and investment opportunities and provides adequate protection of U.S. intellectual property rights. However, the *Energy Policy Act of 2005* (EPAct 05) does not contain any similar provision, nor does it prescribe any blanket preference for U.S. firms for research and development programs. Current DOE programs derive most, if not all, of their direction from EPAct 05. Hence, the requirements of Section 2306 of EPAct 92 and its implementing regulations are largely inapplicable to ongoing programs.

In addition, when we issue a research and development financial assistance or procurement award, the Bayh-Dole Act 35 U.S.C. 200 *et seq.* requires that small businesses, university, and non-profit awardees retain ownership of new inventions subject to a preference in any exclusive licensing of companies who agree to substantially manufacture in the United States. For awardees not subject to the Bayh-

Dole Act, DOE owns all new inventions unless a waiver is granted. In negotiating patent waivers, we seek to have provisions that maximize benefit to the U.S. economy such as by seeking U.S. manufacture of any commercial exploitation of the new inventions.

*Q5. The relationship between the Next Generation Nuclear Plant (NGNP) and GNEP is not clear, making it difficult to discern a comprehensive nuclear policy from the department.*

*a. Please outline the relationship between the NGNP project and GNEP?*

*b. Of these which is an industry priority?*

*c. Are you confident that U.S. companies will be willing to assume the cost-share of NGNP?*

*A5.* One of the key objectives of the Global Nuclear Energy Partnership (GNEP) is to make nuclear power an attractive alternative to fossil fuels for developing countries around the world. Because the power generation requirements are limited for these countries, they will likely need smaller reactors. A Very High Temperature Reactor (VHTR), such as the one being developed under the Next Generation Nuclear Plant (NGNP), is a small modular reactor design that could be very well suited to meet the objectives of GNEP for global deployment of nuclear power to developing countries.

In the meantime, a continuing priority of the Department is the Nuclear Power 2010 program which seeks to bring new nuclear reactors online in the very near term. Domestically, NGNP is not currently considered a competitive base load electrical power generation technology. Therefore, continued research and development is needed before it is of greater interest to the nuclear power industry. The petrochemical industry and other energy and product manufacturing industries are the most likely to be interested in NGNP as a heat source for energy intensive processes. At this time, these industries, while expressing interest, have not expressed a willingness to invest equally with the government in the licensing and deployment of NGNP. They are interested in the government's pursuit of this technology with possibly a small percentage cost share. The Department remains committed to the timeframe laid out in the *Energy Policy Act of 2005* for development of the NGNP and is seeking to increase industry cooperation.

**Questions submitted by Representative Ralph M. Hall**

*Q1. You point out that 45–50 1,000 megawatt nuclear reactors must be built over the next 25 years to maintain nuclear's 20 percent share of electricity generation.*

*Q1a. Will our current fleet last this long?*

*A1a.* Most of the existing 103 U.S. nuclear plants are expected to continue operating for the next 25 years. As of today, forty-eight of these nuclear reactors have received license renewals for an additional twenty years of operation with another eight currently under review by the Nuclear Regulatory Commission (NRC).

Should the entire fleet of currently operating nuclear plants receive only a single twenty-year license renewal, the first retirement would be expected in 2029. By 2032, 12 reactors totaling 8,000 megawatts of capacity will have been retired leaving in place 92 of the original 104 reactors with 94,000 megawatts of capacity. The rate of reactor retirements then accelerate in subsequent years with half of the current nuclear fleet retired by 2040 and only a handful of nuclear plants operating in 2050.

*Q1b. Will we have to build 45–50 new plants and, in addition, replace our current 103?*

*A1b.* The "45–50" gigawatts (GW) range does not include additional new plants needed to replace retiring nuclear plants. The 45–50 new plants address the increase in electricity demand over the next 25 years (through 2032). Additional new plants will be needed to replace the current operating plants when they are retired in order to maintain nuclear's share of electricity generation.

*Q2. Is the Nuclear Power 2010 program on-schedule? Between this program and EPACT, are they sufficient to bring on-line the necessary nuclear generation we need?*

*A2.* The Nuclear Power 2010 program is on schedule. This program and the incentives from the *Energy Policy Act of 2005* will help offset the technical and financial risks facing the "first movers" in building new nuclear power plants, and offer a significant catalyst to get power companies to build new nuclear capacity. Over a dozen power companies have announced their intentions to apply for combined Construc-

tion and Operating Licenses (COLs) for over 30 nuclear units. The reactor designs chosen, all being greater than 1,000 megawatts, represent as much as 46 gigawatts of new capacity.

While it remains uncertain how many new nuclear plants will be built, as new nuclear plants are successfully placed into service on schedule and within projected budgets, we can expect more orders to follow. However, these new orders are always contingent on market conditions including factors such as the rate of growth in electricity demand, fossil fuels costs, manufacturing and construction infrastructure capability, and relevant environmental regulations.

Bringing 50–60 reactors on line before 2032 would dictate a pace of as many as five per year over a 10–15 year period. Such a pace could be challenging, especially if there is a delay in follow-on orders, as utilities await successful start-up of the first few reactors and expansion of the United States manufacturing and construction infrastructure.

*Q3. One of the goals of the Advanced Fuel Cycle Initiative is to provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel.*

*Q3a. Is this program creating this technology or does it already exist and this program is expanding on it?*

*A3a.* The basis for a proliferation-resistant fuel cycle are the separations processes for light water reactor spent nuclear fuel that do not isolate pure plutonium; fabrication of fuels and targets from the separated actinides for fast reactor transmutation; and recycle of spent fast reactor fuel, again without separating pure plutonium.

The technologies described above for a proliferation-resistant fuel cycle have been demonstrated only in small-scale tests conducted at the national laboratories, but the results are encouraging. AFCI is not limiting the technology to domestic use; if applied world-wide, international proliferation risks would be greatly reduced.

*Q3b. Is the 80 percent reduction in the volume of waste an accurate estimate?*

*A3b.* The 80 percent reduction in waste volume resulting from application of the advanced fuel cycle technologies under development in AFCI/GNEP is a reasonable estimate based on current knowledge and experience, as well as numerous assumptions regarding the nature of the wastes and the waste management processes used.

*Q3c. Would this waste require the same conditions for burial at Yucca as the waste that is currently slotted to go there?*

*A3c.* Assuming deployment of GNEP technologies and facilities as currently envisioned, it is expected that the volume, heat load and radio-toxicity of waste to be disposed in a geologic repository will be reduced. The conditions for disposal of this waste have not yet been analyzed in detail, although it is possible the waste packages could be smaller and, because of reduced heat content, more densely concentrated.

**Question submitted by Representative Daniel Lipinski**

*Q1. Argonne National Laboratory in Illinois receives a significant portion of the funds for GNEP. Can you elaborate on the Department's plan to utilize the research at Argonne Lab to support GNEP as it moves forward?*

*A1.* From its earliest beginning with the first nuclear pile at Stagg Field at the University of Chicago in 1942, the history of the U.S. civilian nuclear power program has been supported and driven by the technical expertise at the Argonne National Laboratory (ANL) and its associated facilities. The ANL expertise has been involved in virtually all U.S. reactor concepts built, or envisioned, up to this time. In particular, ANL is currently supporting the Global Nuclear Energy Partnership's (GNEP) advanced spent fuel reprocessing and reactor design projects. ANL currently receives about ten percent of the GNEP funds in FY 2007 to support these important areas. In addition, ANL is home to the Advance Fuel Cycle Initiatives' national technical director for separations and the campaign manager for advanced waste forms and waste management. ANL's participation and contribution to the GNEP effort is planned to evolve as the GNEP program is implemented.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Alexander Karsner, Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy*

**Questions submitted by Subcommittee Chairman Nick Lampson**

*Q1. Administration support for renewable electricity technologies, such as solar PV and wind, is much appreciated as concerns about foreign energy dependence and climate change continue to increase. However, there is concern that the administration seems to be picking winners, rather than providing broad-based support across the entire spectrum of renewables technologies.*

*Section 931 of EPACT 2005 specifically directs DOE to conduct a program of research, development, demonstration, and commercial application for geothermal energy.*

*Why don't the Department's FY07 and FY08 budget requests reflect the directions given in EPAct for geothermal energy?*

*A1.* Since the 1970s, the Department of Energy has conducted a research and development program in geothermal technology valued in excess of $1.3 billion. That investment has helped to produce the strong market for geothermal energy we see today. Projects under construction, or which have both Power Purchase Agreements and are undergoing production drilling, amount to 489 megawatts in eight western states. Also, the industry now benefits from provisions in EPACT providing tax credits and a streamlined leasing process.

*Q2. The Department's 2003 Strategic plan included geothermal energy research as part of its efforts to "improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy. . ." Geothermal power was part of DOE's "long-term vision of a zero-emission future in which the nation does not rely on imported energy." But more recently, the Department of Energy seems to not agree with this assessment.*

*Q2a. What has happened in the past three years to apparently change the Department's views of the geothermal resource base and its potential?*

*A2a.* In recent years, the Department's Geothermal Program has achieved key research objectives for conventional hydrothermal technology development. Geothermal power production from high-temperature, shallow resources is now a relatively mature energy technology. Projects under construction, or which have both Power Purchase Agreements and are undergoing production drilling, amount to 489 megawatts (mw) in eight western states. Additionally, the Western Governors Association geothermal task force recently identified over 100 sites with an estimated 13,000 MW of near-term power development potential.

*Q2b. The Department indicated in 2003 that there were many technological challenges to achieving production from the vast geothermal resource base. Does the Department now consider these challenges are solved [sic], have new information that indicates its prior assessments of geothermal resources are incorrect [sic], or has the Department concluded that federal efforts and technology development cannot overcome them?*

*A2b.* Our geothermal program has achieved its key research objectives for conventional hydrothermal technology, and has provided substantial incentives that support the near-term development of the technology and deployment of the large geothermal resource base.

The Department believes that recent substantial incentives, many authorized by the *Energy Policy Act of 2005* (EPACT), will do more to support development of the conventional hydrothermal resources than technology development efforts. For example, geothermal now has both an investment tax credit and a production tax credit that will improve the technology's competitive position. (Qualifying facilities can claim one or the other, but not both.) EPACT also contains provisions that streamline and accelerate the geothermal leasing process.

*Q3. The recent MIT report, "The Future of Geothermal Energy" has generated significant interest in the potential for Enhanced Geothermal Systems. During the DOE budget hearing on March 7, 2007, you mentioned that DOE had not had the benefit of the MIT report in formulating the FY08 budget request.*

*Q3a. Having now had the opportunity to review the MIT report, does it in any way change DOE's assessment of the potential benefits to be gained from geothermal R&D?*

*A3a.* The MIT report, titled, "The Future of Geothermal Energy," specifically points to the potential benefits of Enhanced Geothermal Systems (EGS) as a long-term energy option for the Nation and it is a significant and important academic contribution. On June 7&8, EERE conducted a workshop with industry, also entitled "The Future of Geothermal Energy," to consider the findings of the report and hear from stakeholders on research & development trends in the industry.

*Q3b. How does DOE view the potential of geothermal resources, especially EGS resources now? Does DOE believe EGS merits the R&D funding support recommended by the MIT report?*

*A3b.* The Department is using some of the FY 2007 geothermal funding to conduct a technology assessment of EGS to help industry prioritize its technology needs.

*Q4. Congress recognized the need for R&D and deployment of new advanced hydropower technologies, when in Section 931 of EPAct 2005, it directed [sic] Secretary to conduct a program of research, development, demonstration and commercial application for Advanced hydropower technologies to enhance environmental performance and yield greater energy efficiencies.*

*Q4a. Why don't the Department's FY07 and FY08 budget requests reflect the directions given in EPAct for hydropower?*

*A4a.* The hydropower industry has demonstrated the ability to achieve efficiency optimization, and fish survivability performance targets without further DOE direct investment. In the fiscal year 2006 Appropriations Conference Report, the conferees recommended $495,000 for hydropower research and directed the Department to "complete integration studies and close out outstanding contracts in advanced hydropower technology."

*Q4b. At a time when the U.S. is looking to maximize all of its renewable resources because of the growing effect of climate change, why has the Department terminated the hydropower R&D program?*

*A4b.* The Department terminated its hydropower program in fiscal year 2005, consistent with congressional direction over the previous years. The Department completed an assessment of undeveloped U.S. hydropower resources, the technologies needed to develop the resources, and the feasibility of developing the resources, and determined that the Department had contributed the necessary tools to industry to pursue development of these hydropower resources.

*Q5. Preliminary assessments indicated that the ocean off U.S. coastlines represents a vast potential source of clean, renewable energy.*

*Q5a. Historically, what R&D activities, if any, has DOE conducted in the area of ocean power (including wave, tidal, current, and ocean thermal technologies)?*

*A5a.* The Department had a program that ended in 1994, that evaluated Ocean Thermal Energy which did not indicate commercial viability. DOE is currently supporting a small project on wave energy technology R&D with one company and has previously supported projects for ocean current and tidal technologies via the Small Business Innovation Research Program.

*Q5b. Given the early developmental stage of many of the technologies to tap the ocean as an energy resource, why has DOE declined to request RD&D funding to advance these technologies?*

*A5b.* The Department is monitoring domestic and worldwide progress in ocean energy technologies in collaboration with the Electric Power Research Institute and the International Energy Agency. Some countries with higher resource potential than the United States, relative to their overall energy needs, are active in ocean energy R&D. Ocean wave and current technologies are still in their infancy stage, with a small number of demonstration systems operating worldwide. The Department will continue to consider emerging technologies like ocean energy in evaluating its R&D programs based on assessment of national potential of these energy resources, results of R&D, expected technology progress, and the potential benefit from competing investments.

**Questions submitted by Chairman Bart Gordon**

*Q1. There is enormous potential in deploying energy efficient technologies throughout industry, low-income households and the Federal Government itself. Yet programs designed to do exactly that (i.e., Federal Energy Management Program, Weatherization programs, Industrial Technologies) are being cut back.*

*Why is there an apparent lack of recognition by DOE of the need for greater emphasis on improving energy efficiency?*

*A1.* The Department considers energy efficiency as a critical component of our balanced portfolio. The Office of Energy Efficiency and Renewable Energy (EERE) programs related to energy efficiency comprise approximately 46 percent of the total EERE proposed FY 2008 budget (including program direction and support funds).

The Department is pursuing multiple programs to improve energy efficiency. Our Federal Energy Management Program is actively promoting the use of Energy Savings Performance Contracting (ESPC) across all federal agencies—awards have increased from $36 million in 2004, to $124 million in 2005, to a record $321 million in 2006. The Department provides education and outreach on nation-wide utility incentive policies; best practices on demand-side management programs; and is integrating energy efficiency into utility, State, and regional resource planning activities. To assist market adoption of efficiency measures, our Industrial program is pursuing a number of voluntary energy savings programs. Our "Save Energy Now" program sends energy experts to the nation's most energy-intensive manufacturing facilities to conduct assessments on how these businesses can save energy.

The Department is providing funding, tools, and technical assistance to support voluntary energy savings programs on the local level through efforts such as Rebuild America and the State Energy Program. Through these programs, many states retrofit and update existing local government buildings, offices, and schools and also inform the public about the importance of energy conservation. In addition, our Building Technologies Program is implementing an integrated and aggressive plan to achieve cost-neutral Zero Energy Homes by 2020, and commercial buildings by 2025. In addition, the Department helps accelerate the adoption of efficient building technologies and products in the market through the EnergyStar® rating system.

*Q2. The Department's abysmal record on promulgating appliance efficiency standards is now well known by Congress, consumers, industry, and even appliance manufacturers. It has come to the Committee's attention that even those standards that DOE has promulgated thus far are considered even by some industry representatives to be ineffective in saving energy and reducing consumer's electricity costs. Though the exact reasons for the delays and the promulgation of weak standards are not at all clear, the Committee appreciates that some attention is now being paid toward rectifying the situation at the Department.*

*Q2a. Please list all appliances for which DOE is required to promulgate standards.*

*A2a.* Statutory requirements to promulgate standards cover the following categories of appliances. Note that some of the appliance rule-makings may be bundled together for efficiency, so the number of final rule-makings may be lower. The Department is on schedule to complete 23 of the standards by June 2011 and one additional by 2015 (automatic ice makers).

| Appliance |
|---|
| Automatic Ice Makers (Commercial) |
| Central Air Conditioners and Heat Pumps (Residential) |
| Clothes Dryers (Residential) |
| Clothes Washers (Commercial) |
| Dehumidifiers |
| Direct Heating Equipment |
| Dishwashers (Residential) |
| Distribution Transformers (Medium Voltage Dry and Liquid-Immersed) |
| Electric Motors, 1-200 HP |
| Electric Motors, Small |
| Fluorescent Lamps |
| Fluorescent Lamp Ballasts |
| Furnaces and Boilers (Residential) |
| Mobile Home Furnaces |
| Small Furnaces |
| Ice Cream Freezers; Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without Doors (Supermarket Refrigerator Systems); and Remote-Condensing Commercial Refrigerators, Freezers, and Refrigerator-Freezers |
| Incandescent General Service Lamps |
| Incandescent Reflector Lamps |
| Packaged Terminal Air Conditioners and Heat Pumps (Commercial) |
| Pool Heaters (Gas) |
| Ranges and Ovens and Microwave Ovens (Electric and Gas) |
| Refrigerated Bottle or Canned Beverage Vending Machines (Beverage Vending Machines), and Self-Contained Commercial Refrigerators with Doors for Pull-Down Temperature Applications (Beverage Merchandisers) |
| Room Air Conditioners |
| Water Heaters (Residential) |

Determinations are underway in the following categories:

- Battery Chargers and External Power Supplies (Determination Analysis)
- High Intensity Discharge Lamps (Determination Analysis)

*Q2b. To date, how many standards have been promulgated since the Administration took office in January 2001?*

*A2b.* No efficiency standards final rules have been promulgated since 2001. In the 18 years prior to the January 31, 2006 report to Congress, the Department issued 12 standards for products other than those directed in statute. Congress has set standards in legislation as recently as the EPACT05 standards for 15 additional products.

*Q2c. Of those standards that have been set or proposed by DOE, please specify when the standards take effect, how the new standards improve on existing standards, and the projections for energy and cost savings.*

*A2c.* The proposed rule for Distribution Transformers was issued on August 4, 2006. The proposed standards would take effect in 2010, approximately three years after the planned issuance of the final rule. The Department's proposed level for liquid-immersed and medium dry voltage distribution transformers would save 2.4 Quads of cumulative energy over 29 years (2010–2038). In addition, the cumulative national net present value of total consumer costs and savings from 2010–2038 ranges from $2.52 billion to $9.43 billion, depending on discount rates. The proposed rule would improve on existing standards for transformers.

The proposed rule for Residential Furnaces and Boilers was issued on October 6, 2006 with a standard effective date of 2015.

The Department's proposed standard level for residential furnaces and boilers would save 0.41 Quads of cumulative energy over 24 years (2015–2038). In addition, the cumulative national net present value of total consumer costs and savings from 2015–2038 ranges from $650 million to $2.48 billion. The proposed rule also pro-

vided an initial roadmap for states to petition the Department for exemption from preemption of the federal standards. The Department recognizes the potential for additional energy savings that may be achieved under appropriately exempted state standards.

*Q2d. Please provide the same data for alternate proposals that were rejected by DOE.*

*A2d.* First to be clear, the Department has not yet issued a final rule for furnaces and boilers or distribution transformers. We are still in the process of analyzing the proposed rules in light of comments received. In the notices of proposed rule-making, the Department considered several factors for economic justification, including safety and regional financial impacts. The highest standard level for Distribution Transformers evaluated is estimated to save 9.8 quads of energy but is estimated to impose a net cost on consumers of $9.4 billion to $14.1 billion (2004$) in present value terms at three percent and seven percent discount rates, respectively. The lowest standard level considered is estimated to save 1.8 quads and would save consumers between $2.2 billion and $7.4 billion (2004$) in present value terms at three percent and seven percent discount rates, respectively.

*Q2e. Please provide details on the perceived limit in statutory authority to develop stricter standards that would ultimately save consumers billions?*

*A2e.* The Energy Policy and Conservation Act directs the Department to establish and amend energy conservation standards such that they achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. Generally, to determine whether a standard is economically justified, Congress directs that the Department determine that the benefits of any proposed standard exceed its burdens to the greatest extent practicable. Under the statute, the Department cannot propose stricter standards if in so doing burdens exceed consumer benefits.

*Q2f. What is the process for setting these standards, which federal agencies or entities are involved in this process, and who makes the final decision on setting a standard?*

*A2f.* As prescribed by the *Energy Policy Conservation Act* (EPCA), energy efficiency standards generally are established by a three-phase public process: advance notice of proposed rule-making (ANOPR), notice of proposed rule-making (NOPR), and final rule. DOE seeks public comment during both the ANOPR and NOPR phases of the rule-making process. The last step in the rule-making process is the publication of a final rule in the *Federal Register*. The final rule promulgates standard levels based on all of the analyses and explains the basis for the selection of those standards. It is accompanied by the final Technical Support Document.

In each rule-making, DOE must comply with all applicable laws, regulations, and executive orders. In addition to the statutory criteria that must be considered in these rule-makings, the Department also analyzes and responds to public comment. Additionally, the Department conducts reviews for the following 13 requirements:

1. Executive Order (E.O.) 12866, "Regulatory Planning and Review"
2. Regulatory Flexibility Act
3. Paperwork Reduction Act of 1995
4. National Environmental Policy Act of 1969
5. E.O. 13132, "Federalism"
6. E.O. 12988, "Civil Justice Reform"
7. Unfunded Mandates Reform Act of 1995
8. Treasury and General Government Appropriations Act of 1999
9. E.O. 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights"
10. Treasury and General Government Appropriations Act, 2001
11. E.O. 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use"
12. Section 32 of the Federal Energy Administration Act of 1974
13. Congressional Notification

The Secretary of Energy makes the final decisions regarding all the Department's rule-makings.

**Questions submitted by Representative Ralph M. Hall**

*Q1. You talk about the technical feasibility for wind energy to generate 20 percent of our nation's electricity and to produce more than 300 gigawatts of production capacity to our urban load centers.*

*Q1a. What is the time-frame for this goal?*

*A1a.* The time-frame for achievement of twenty percent production by wind will be determined by the private sector in response to market signals.

*Q1b. I have noticed that the President's budget did not include an extension of the production tax credit. Do you see this as an impediment to reaching 20 percent and 300 gigawatts?*

*A1b.* Reaching the technical feasibility point of twenty percent generation by wind will ultimately be determined by the private sector in response to market forces. The Department works collaboratively with the Department of Treasury (which has jurisdiction on these issues) on tax policy issues.

*Q2. In the FreedomCAR and Fuel Partnership, you say the technologies that result from it could lead to substantial oil savings if adopted by industry participants. Is there a plan in place to encourage adoption?*

*A2.* The Partnership focuses on the high-risk research needed to develop the necessary technologies, which helps reduce costs and address barriers. However, commercialization is ultimately industry's decision. In addition, the program's university-oriented activities create graduate education opportunities working with new technologies and encourage undergraduate engineering students to gain experience with hybrid systems technology and advanced combustion engines. This training and experience can help ensure the work force has the necessary expertise to help industry such technologies to industry.

*Q3. You mention in your testimony that R&D on combustion engine efficiency will allow "a car that previously got the CAFE average of 27 miles per gallon on gasoline could potentially get 37 miles per gallon with an advanced, clean diesel."*

*Q3a. Please explain what you mean by this.*

*A3a.* Advanced diesel engines can provide a 25–40 percent improvement in fuel economy relative to the average conventional gasoline engine of today, based on the vehicle type and application. As part of a DOE diesel engine development project for a light truck/SUV application, a fuel economy improvement of over 45 percent was demonstrated. Hybridization of gasoline passenger vehicles potentially show similar range increases in efficiency improvements. The mile per gallon figure stated above is an estimate and will vary depending on vehicle type and duty cycle.

*Q3b. Is R&D being conducted on gasoline engines?*

*A3b.* Yes, R&D is being conducted on gasoline engines with the goal of improving their efficiency by 10 to 20 percent. Such R&D focuses on improving the combustion process for higher efficiency, developing catalysts to reduce emissions from lean-burn gasoline engines for passenger vehicle application, and enabling more efficient use of ethanol.

*Q4a. What biomass conversion technologies are available today for the production of cellulosic ethanol?*

*A4a.* The conversion technologies that are available today can be categorized into two major types of processes, which each involve several types of feedstocks:

1. Biochemical conversion processes combine chemical pretreatments, enzymatic hydrolysis and fermentation to convert sugar from cellulosic feedstocks into ethanol.
2. Thermochemical conversion processes aim to first convert the cellulosic feedstocks into synthesis gas or oil, and then convert these intermediate products into ethanol either through fermentation or a catalytic reaction.

*Q4b. How long will it take for these conversion technologies to become cost effective for mass production?*

*A4b.* The Department's research and development aims to make both biochemical and thermochemical technologies cost competitive by 2012.

*Q4c. How are we going to move from 10-percent scale demonstrations to full-scale deployment by 2012?*

*A4c.* The Program's RD&D reduces the overall cost and risk to the biomass industry, and improves the likelihood of obtaining financing for full-scale commercial facilities. Overall knowledge gained from the 10 percent scale solicitation and the commercial scale Section 932 projects, enzyme and ethanologen development R&D, and the program's other RD&D is aimed at accelerating the ability of the biomass industry to design cost-competitive cellulosic ethanol plants to meet the President's AEI 2012 goal.

*Q4d. How will this be achieved while fulfilling the goal of making these cellulosic based biofuels widely available to the public at reasonable cost to all Americans?*

*A4d.* We believe that the combination of the accelerated DOE Biofuels RD&D programs, the President's legislative proposals to implement the proposed Alternative Fuel Standard (AFS) and the increasing cooperation with USDA, DOT and other key federal agencies to facilitate ethanol deployment—are part of a coherent approach needed to bring the costs in line with competing fuels. Then the market will bring the benefits of cellulosic ethanol based fuels to the public on a large scale within the next decade.

*Q5. We've heard the President speak of switchgrass, corn stover, and wheat straw as feedstocks for cellulosic ethanol. Is enzyme research the Department is undertaking going to be applicable across the spectrum of feedstocks?*

*A5.* Yes. The enzyme research supported by EERE's Biomass Program and the Department's Office of Science target a diverse range of feedstocks including switchgrass, corn stover, wheat straw, as well as wood chips. In recent years, the Biomass Program's research focused on using a combination of pretreatment and enzymes with corn stover as a model agricultural residue. This work is now beginning to focus on switchgrass as a model energy crop. One of the Program's main R&D objectives is to develop more efficient enzymes for lignocellulosic feedstocks (e.g., woodchips) and make them a part of an integrated process that minimizes ethanol costs. To this end, some of the *Energy Policy Act*, Section 932 selectees will work with leading enzyme companies to create tailored enzyme preparations for their feedstocks of interest. Additionally, a new solicitation with the objective of increasing enzyme efficiency is in the planning stages at DOE. It is envisioned that the projects awarded from this solicitation will result in enzyme systems that are cost effective for a variety of feedstocks.

**Questions submitted by Representative Daniel Lipinski**

*Q1. The FY08 budget request calls for an increase of 38.8 percent over FY06 levels for hydrogen technology R&D. How does the Department intend to spend these funds?*

*A1.* The Department's budget request of $307 million reflects the President's Hydrogen Fuel Initiative commitment of $1.2 billion over five years (FY04 to FY08) to accelerate R&D in hydrogen and fuel cell technologies. The increased funds in the FY08 request compared to the FY06 appropriations will be spent on basic science research through the Office of Science (an 83.1 percent increase) and on focused applied R&D through the Office of Energy Efficiency and Renewable Energy (an increase of 38.8 percent).

*Q2a. I am disappointed that the FY08 request has zeroed out funding for geothermal. Recently there has been a great deal of interest in deep drilling for geothermal energy.*

*I am curious to know whether, in making the decision to zero out geothermal funding, there were any discussions about deep drilling potential?*

*A2a.* Our geothermal program has achieved its key research objectives and has provided substantial incentives that support the near-term development of the technology and deployment of the large geothermal resource base. The FY 2007 operating plan for the Department included $5 million to support geothermal power coproduced with oil and gas demonstration efforts, for an evaluation of enhanced geothermal systems to help industry prioritize its technology needs, and to bring to completion selected projects on exploration, drilling, and/or conversion technologies.

*Q2b. Has there been consideration for a demonstration-scale project of an underground repository that you would mine for power generation on the surface?*

*A2b.* Yes, with support from the Department, the world's first heat mining (also called enhanced geothermal systems (EGS) project, where technology is used to cre-

ate a geothermal reservoir, was undertaken at Fenton Hill, New Mexico, in 1976. The initial work demonstrated the feasibility of extracting energy through heat mining.

**Questions submitted by Representative Mark Udall**

*Q1a. Given the challenging national goals being set by Congress and the President for increasing the role of renewable energy in our energy mix, what are the* long-term *science and technology needs for solar, wind and biofuels?*

*A1a.* The Department has undertaken a thorough review of these needs in the series of workshops around the topic of "Basic Research Needs to Assure a Secure Energy Future." The entire series of reports includes work on hydrogen, biofuels, solar, nanotechnology, etc. and is available at this website: *http://www.sc.doe.gov/bes/*. These workshops contributed to the budget and policy formation processes that resulted in the Advanced Energy Initiative and the American Competitiveness Initiative.

Activities noted in the Advanced Energy Initiative (AEI) include lowering the cost of producing cellulosic ethanol, improving the performance of lithium-ion batteries and improving the cost and performance of wind and solar technologies. The introduction of these advanced technologies in the marketplace will lower the costs of producing electricity from these renewable energies and will facilitate the growth of a productive manufacturing base and an active marketplace for renewable energy technologies.

As identified in the AEI, long-term science and technology needs for solar center around increasing conversion efficiency and lowering costs, including the development of novel compound semiconductors, polymers, and nanostructured devices. Work is also needed in photoelectrochemical materials and devices. Solar thermal electric systems need further work in materials, especially thermal storage materials and high temperature working fluids. Thermochemical cycles are also of interest for producing fuels such as hydrogen. Improved polymers are needed for low temperature solar thermal applications.

Key activities for wind technologies will focus on research, development and testing for improving the performance, cost effectiveness and reliability of large and distributed wind energy systems. For wind turbines, further long-term work is needed for meso-scale atmospheric modeling to improve forecasting; for the aerodynamics of wind turbine blades such as turbulence, separation, stall, as well as improved materials and designs for turbine blades, gear-boxes and hubs; and for power electronics for converting power to 60 cycle line voltage.

For biofuels, further work is needed on both biochemical approaches for producing biofuels, i.e., from cellulosic biomass—such as enzymatic hydrolysis, particularly for systems that can ultimately enable pretreatment, hydrolysis, and fermentation in a single tank, and on thermochemical approaches for producing biodiesel, jet fuel, ethanol, and other fuels.

*Q1b. Does the President's budget for EERE strike the proper balance between investment in short-term R&D (e.g., improving and deploying today's technology, processes, etc.) and investment in long-term R&D on "game-changing" technologies (e.g., new biomaterials, PV nanostructures, etc.)?*

*A1b.* Yes. The President's budget request for EERE strikes the proper balance of short-term RD&D investments and longer-term inquiries. In addition, the work of EERE is complemented and coordinated with that in the Office of Science to maximize the benefit of the taxpayer's investments.

*Q1c. Please describe the process of collaboration between EERE and the Office of Science, if any.*

*A1c.* In addition to the activities mentioned above, EERE and the Office of Science (SC) collaborate in a variety of ways, including technical workshops, roadmaps, structured activities between SC and EERE, use by EERE-supported researchers of SC facilities, and joint solicitations. On July 31, 2006, the Department transmitted to Congress, pursuant to Section 994 of the *Energy Policy Act of 2005,* a coordination plan detailing a variety of these joint activities, including a number of workshops conducted on basic science needs for EERE-related applied research.

*Q1d. Is there an established process whereby basic research conducted under OS programs feeds seamlessly into applied research under the auspices of EERE?*

*A1d.* Yes. As discussed in the Section 994 report presented to Congress, the Department periodically reviews science and technology activities, and provides an updated

coordination plan every four years. EERE also plans with SC, and manages a number of Small Business Innovation Research and Small Business Technology Transfer program (SBIR/STTR) activities for SC. Currently, EERE is managing six topics for SC, with an annual value of approximately $15 million.

*Q1e. Is the "balance" referenced above appropriate to strike within EERE? Or should such a balance between short- and long-term research be struck between EERE and OS?*

*A1e.* Both. As part of its balanced portfolio, EERE pursues near-, mid-, and long-term investment strategies for its applied research. The Office of Science is focused on basic research, but new technical platforms discovered through basic research can have a significant impact on EERE technologies in both the near-term and long-term. We have strived to achieve a balance between the EERE and SC investments to ensure technologies are proceeding steadily from the lab to applied R&D and to the marketplace.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Kevin M. Kolevar, Director, Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy*

**Questions submitted by Chairman Nick Lampson**

*Q1. I applaud your efforts to develop a comprehensive electric grid visualization capability to allow improved federal response during emergencies such as hurricanes and to identify regional and local impacts of energy disruptions. I understand that the new transmission grid monitoring system that is now operational at DOE enables situational awareness in the Southeastern United States.*

- *What is your plan to extend this visualization capability across the United States?*
- *Could additional funding and other resources, if they were brought to bear, help accelerate this process?*

*A1.* I appreciate your interest in this important effort. Wide-area situational understanding is a key factor in managing the preparedness for and response to destructive events. The Department is partnering with the Department of Homeland Security, national laboratories, and industry to develop this strategic tool to enable real-time status of the electric grid and to help identify the interdependencies with other critical energy sectors. Although the visualization tool is now operational only for the Southeastern United States, we are working with other major utilities in multiple regions of the country to expand real-time status information on a national level. Additional funding would accelerate the process.

*Q2. In order for intermittent energy sources such as wind and solar to play a significant role in our electricity supply system, we must develop technologies to store the electricity when it is produced, then draw on it when we need it. As I understand it, storage is one of the major obstacles to more widespread adoption of renewables. There is a significant increase in R&D funds for Energy Storage, but a commensurate decrease in funding for Renewable and Distributed Systems Integration.*

- *Can you talk about the difference between the Energy Storage and the Renewable and Distributed Systems Integration programs and why one is being increased and the other cut?*
- *Can you comment on how energy storage can improve the value of renewable generation to the electric system?*
- *Why is funding for renewables integration falling even as the Administration is requesting huge funding increases for technologies like solar photovoltaics?*

*A2.* In FY 2006 and FY 2007, the energy storage program has focused on demonstrating and monitoring the performance of current state-of-the-art energy storage technologies in partnership with the California Energy Commission (CEC) and the New York Energy Research and Development Agency (NYSERDA). In FY 2008, the Office proposes to research and develop the next generation storage concepts to lower cost and improve energy density. Under the Renewable and Distributed Systems Integration activity the Office proposes to coordinate and oversee a variety of demonstration projects that integrate renewables, distributed generation, storage, and advanced controls. This is in response to the recognition of the critical link between energy storage and renewables.

The decrease in funding for the Renewable and Distributed System Integration program reflects the completion of turbine and engine research, which will now transition to systems integration.

Energy storage can significantly increase the integration of renewable sources of energy into the electric system. Storage increases the reliability of intermittent resources like wind and photovoltaics, allowing these sources to become relatively constant sources of power. Renewable power produced in off-peak periods can be stored and used during periods of greater demand, thus making renewables dispatchable. Likewise, energy storage can bridge the gap during decreased periods of renewable production and, when combined with appropriate electronics, it can also eliminate short-term flutters that decrease power quality and impact digital equipment on the grid.

The Department has not had a dedicated integration program that brings together renewables, distributed energy, and storage with advanced communications. In FY 2008 the Office transitioned the focus of the Distributed Energy Research activities to Renewable and Distributed Systems Integration. The decrease reflects the com-

pletion of distributed generation (microturbines, reciprocating engines) activities to reflect the desire of the Department to have a stronger role in renewable integration. In FY 2007, a solicitation was initiated that requested projects focusing on renewable systems integration such as photovoltaics.

*Q3. One way to meet increased electricity demand is for utilities to build more wires and add more generation, but there is also enormous potential that we have barely begun to tap to increase the efficiency options for the grid itself, including high temperature superconductors, demand-side management technologies, distributed generation and others.*

- *Why is overall R&D funding in these areas being cut?*
- *Could you discuss how your office is pursuing options that will better utilize the existing infrastructure?*
- *Which national labs are involved in these efforts?*

*A3.* We agree that there is enormous potential to increase the efficiency of the grid itself through high temperature superconductors, demand-side management technologies, and distributed energy technologies. The overall cut in the Office's R&D funding occurred in two areas, High Temperature Superconductivity and Renewable and Distributed Systems Integration. The cut in High Temperature Superconductivity funding reflects the phasing out of motor research and completing flywheel cooperative agreements. The decrease in funding for the Renewable and Distributed System Integration program reflects the completion of turbine and engine research, which will now transition to systems integration.

The Office is pursuing three other paths in addition to High Temperature Superconductivity to improve/optimize the existing infrastructure. These include real-time monitoring and control of the grid, advanced energy storage, and systems integration research and demonstrations. Real-time monitoring and controls allow for faster operations, which increases reliability, and reduced reserve margins. Energy storage is critical overall to advancing renewables and improving grid operations. Renewable and Distributed Systems integration research is also demonstrating how to best optimize grid asset utilization.

Many of the national laboratories support our research activities. The principle laboratories include: Oak Ridge National Laboratory, Sandia National Laboratory, Idaho National Laboratory, Pacific Northwest National Laboratories, Lawrence Berkley National Laboratory, and Los Alamos National Laboratory. The National Energy Technology Laboratory, a federal procurement office, provides project management activities for the Office.

**Questions submitted by Representative Ralph M. Hall**

*Q1. In your testimony, you say that, "Superconductivity holds the promise of addressing capacity concerns by maximizing use of available 'footprint' and limited space, while moving power efficiently and reliably." You also state that it, ". . .supports advanced substation and interconnection designs. . .using less space and improving the security and reliability of the electric system."*

- *Given the importance of High Temperature Superconductivity, can you please explain the reasoning behind the requested 35 percent decrease in funding from the FY06 level?*

*A1.* The cut in High Temperature Superconductivity reflects the phasing out of motor research and completing flywheel cooperative agreements. Approximately one-third of the $45 million requested for the High Temperature Superconductivity (HTS) subprogram in FY 2007 will be spent on research of wire technologies: 2G wire development, dielectrics, cryogenics, and cable systems. This represents a decrease from FY 2006, when approximately half of the HTS subprogram's funding was spent on these technologies, because these projects have successfully met milestones, proven out their technological capabilities, and now move to the demonstration phase of development. In contrast, the Office expects to spend approximately two-thirds of the HTS subprogram's funding on HTS applications in FY 2007, which is an increase from FY 2006 when just half of the funding was spent in this area. Since these applications, which include motors, have not performed as well, we will now focus more research dollars on achieving similar successes as have been seen with the wire technologies. Thus, the Department is focusing on a near-term critical need within the electric system to not only increase current carrying capacity, especially in urban areas, but also to relieve overburdened cables elsewhere in local grids.

*Q2. In regards to the Infrastructure Security and Energy Restoration activity, FY08 recommends a decrease from FY07. Given the importance of this activity in protecting the Nation's critical energy infrastructure and assisting State and local governments with energy disruption preparation and response, please explain the reasoning behind the reduced funding request.*

*A2.* Although there is a slight decrease of $219,000 in the FY 2008 budget request from the FY 2007 request, the Department still considers its obligations to protect the Nation's critical energy infrastructure under the Homeland Security Presidential Directives 7 and 8 to be extremely important. The Department's involvement with current critical energy infrastructure programs and its commitment to assisting State and local governments with disruption preparation and response is and will continue to be a priority. There is presently less of a need for as much outside support. Therefore, this decrease reflects the reduction of laboratory staff by one in order to accommodate program priorities.

*Q3. I understand that Transmission Reliability R&D, Energy Storage R&D, Gridwise, Gridworks and most projects in Electricity Distribution Transformation R&D programs are transferred to the Visualization and Controls sub-account as of FY07. The FY08 request for this sub-account is $25.3 million, but the budget for these five activities in FY06 was $83.9 million. Please explain this.*

*A3.* The Visualization and Controls sub-account included the transfer of high-priority projects from the Transmission R&D, Gridwise, and Gridworks programs. In FY 2006, the budget for these three (3) activities was $22.6 million. The FY08 request for the Visualization and Controls sub-account has been increased to $25.3 million, which includes additional funding for cyber security research. Most of the projects in the Electricity Distribution Transformation R&D program have been transferred to the Distributed Systems Integration sub-account.

**Questions submitted by Representative Daniel Lipinski**

*Q1. The FY08 request for High Temperature Superconductivity R&D is significantly reduced from the FY06 and FY07 requests. At one time this issue was viewed as a great investment for potentially large energy efficiency gains.*

- *What is Department's plan to continue research in this field?*
- *Does the Dept. no longer see the promise in the technology that it had previously, or are the major research questions essentially resolved?*

*A1.* High Temperature Superconductivity (HTS) holds tremendous promise for maximizing delivery capacity in existing rights-of-way while minimizing energy losses. Over the past 20 years, the Department has stewarded federal resources to carry this technology from inception to commercialization. In the last year, we began to witness the returns on this investment with the demonstration of short-length HTS cables at multiple sites in New York and Ohio. These projects reaffirmed the potential benefits of this revolutionary technology. In FY08, the Department plans to use available funds to continue support for core research in second-generation wire development, as well as to sponsor projects that enable installation of longer-length HTS cables and other applications that address many of the research questions that remain unresolved. The cut in High Temperature Superconductivity funding reflects the phasing out of motor research and completing flywheel cooperative agreements.

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Thomas D. Shope, Principal Deputy Assistant Secretary for Fossil Energy, U.S. Department of Energy*

**Questions submitted by Chairman Nick Lampson**

*Q1. The* Energy Policy Act of 2005 *established a research program for Ultra-deepwater and Unconventional Natural Gas and petroleum exploration. This is a program that Congress clearly cares about, and the President apparently approved of by signing it into law. However, the Department sent a letter to Congress asking to rescind this section of law, and failed to include funding in the FY 2007 Operating Plan, effectively killing this program. Furthermore, you are proposing to cancel out oil and gas research altogether, apparently with the reasoning that this R&D can be done by industry alone. This is surprisingly shortsighted on the part of the Administration given the enormous hydrocarbon resources in these fields, and the fact that, because of cost and technical complexity of extracting these resources, only the biggest of oil companies can afford to do the research and deploy the technologies. These large companies simply have priorities elsewhere.*

*Q1a. What reasons does the Department have for eliminating the Ultra-deep program, especially in light of its elimination of oil and gas research?*

*A1a.* The Administration's request to repeal this program is based on the fact that oil and gas are mature industries that have every incentive, particularly at today's prices, to enhance production and continue research and development of technologies on their own. There is no need for taxpayers to subsidize oil companies in these efforts. The Administration's Research and Development Investment Criteria direct programs to avoid duplicating research in areas that are receiving funding from the private sector. We believe that independent producers, as well as the majors, will continue to purchase innovative technologies developed by service companies.

*Q1b. If Congress does not rescind this section of law will the Department carry out this very vital research program as it is instructed to do by law?*

*A1b.* Yes, the Department is currently implementing the program according to the requirements of the law and will continue to do so unless the law is repealed.

*Q1c. Why have no funds been apportioned to the National Energy Technology Laboratory for carrying out the activities assigned to it in Subtitle J of EPAct 2005?*

*A1c.* The $50 million available under Subtitle J in FY 2007 has been apportioned to NETL. NETL has begun work to produce the first annual research and development plan, which is required under the subtitle before research solicitations can be issued. Development and review of this plan, including review by two Federal Advisory Committees, is proceeding.

*Q1d. How could smaller firms leverage federal resources for oil and gas research?*

*A1d.* Small firms will be eligible for research awards under the Subtitle J program. They may submit research proposals themselves or team with other organizations such as research laboratories or universities to apply for federal funds. Small firms may want to pay special attention to the portion of the solicitation for proposals that will deal with the technology challenges of small producers, one of the research areas specified by the law.

**Questions submitted by Representative Ralph M. Hall**

*Q1. In the President's 2007 State of the Union speech he stated that "It's in our vital interest to diversify America's energy supply—the way forward is through technology," that we must increase the supply of alternative fuels," and that we should "dramatically reduce our dependence on foreign oil." One of the most promising ways to achieve these goals is through development of coal-to-liquids facilities.*

- *Why is there so little funding recommended in the FY 2008 budget for coal-to-liquids programs?*
- *How does DOE justify this lack of funding of such a critical technology?*

*A1.* Although past Department efforts and some congressionally directed funding has focused on production of liquid fuels from coal, the FY 2008 Budget does not support these activities. Coal to liquids is a mature technology with evolutionary advances and incremental improvements possible, and therefore is not consistent with the Research and Development Investment Criteria. Past government funded programs have resulted in improved processes, catalysts and reactors, but there were no realized economic benefits because the technology was still not economic given other business risks and considerations, indicating that the obstacle was more due to market factors than technical issues. These coal-to-liquid processes can produce clean, zero-sulfur liquid fuels that are cleaner than required under the Tier II fuel regulations. The fuels are compatible with petroleum fuels and can utilize the same distribution infrastructure.

The Office of Fossil Energy in DOE carries out an extensive research and technology development in coal gasification and hydrogen from coal. The targets of these programs are improved technology for clean coal-based power generation systems (for example, integrated coal gasification combined-cycle) and hydrogen production from coal, including DOE's FutureGen project. Because of technology overlaps between CTL fuel systems and coal gasification-based power and hydrogen production systems, nearly all of the President's FY 2008 budget for the DOE programs in coal gasification and coal fuels ($65 million) and a significant portion of the $27 million for advanced research support research and technology development that is relevant to the production of CTL fuels.

A major concern regarding deployment of CTL technology is the potential impact on greenhouse gas emissions. The FY 2008 Budget provides $86 million for research directed at carbon capture and sequestration. This work is relevant to addressing the uncertainties regarding the viability of CTL fuels production if carbon dioxide emissions need to be controlled. The Sequestration Program is focused on applications for coal gasification power generation and hydrogen production.

*Q2. OMB and the Natural Research Council of the National noted that substantial benefits accrue from the DOE coal R&D program and from the continued use of coal in the energy mix. However, OMB and NRC have repeatedly criticized DOE for failing to establish a consistent measurement system for the future benefits of its coal research program, the distribution of these benefits between the public and private sectors, and the methodology and assumptions used in estimating program costs and benefits.*

- *Why has DOE been lax in developing these measures and what steps will be taken to remedy this deficiency in FY 2008?*
- *Does DOE's continuing failure to adequately estimate the benefits of its coal programs jeopardize future funding for these programs?*

*A2.* DOE has made significant efforts in recent years to develop a methodology for estimating the benefits of its research and development (R&D) activities that can be implemented on a consistent basis across all programs. Results from these efforts are included in the FY 2008 budget submission to Congress. The Department is working to improve consistency across programs in the methodology and assumptions used in estimating program costs and benefits. The assumptions and methods underlying the modeling efforts have significant impacts on the estimated benefits. Results could vary significantly if external factors differ from the baseline case or alternative scenarios assumed for this analysis.

At the heart of the methodology is the National Energy Modeling System (HEMS), which DOE/EIA uses for its Annual Energy Outlook. The DOE offices of Nuclear Energy, Fossil Energy, Energy Efficiency and Renewable Energy, and Electricity Supply and Energy Reliability use a consistent NEMS framework in conducting benefits analysis. Thus consistent policy assumptions are applied to all programs. Each of these DOE programs are evaluated against a consistent set of "success" and "no success" assumptions, and all benefits reporting for DOE programs are based on a consistent set of metrics for economic, environmental, and energy security impacts. In December 2006, a group of external peer reviewers assessed the consistent policy scenarios applied to all of these DOE programs. In addition to addressing comments from the reviewers, DOE is also working to develop consistent methodologies for gathering cost and performance data for energy systems and for projecting this data into the future.

There are two major challenges that DOE is continuing to deal with in its efforts to improve its benefits estimates:

1. Making benefits estimates intuitive and understandable to its stakeholders, in spite of the large number of major assumptions needed to predict how an

advanced energy technology might perform and compete over the next 50 years.

2. Dealing with the inherent risk associated with R&D. One simply cannot state with certainty how likely high-risk R&D, especially for major programs, such as the near-zero atmospheric emissions coal plant (including $CO_2$ capture and storage), is to meet its time and performance goals. A further complication is that in order to estimate the benefits of an advanced energy system, it must be competed against other advanced systems that also have significant risk associated with meeting cost and performance goals.

The first item is largely a communication challenge, and we are working on new ways to display and explain our results. The second is an extreme methodological challenge.

The Department is currently pilot testing several risk methodologies and will be evaluating the results throughout FY 2007.

We do not believe that the methodological challenges to improve R&D benefits estimates should jeopardize programmatic funding. In some cases a "rough" estimate of benefits can be made that is sufficient to justify that support for certain R&D should be a priority. For example, relatively simple analysis that considers the degree to which greenhouse gases will need to be reduced over time, and the limited number of options for effecting major greenhouse gas reductions, strongly suggests that a variety of options will be necessary to tackle this problem, and that reducing the cost of these options will have huge societal benefits. R&D to reduce the cost of coal-fueled electricity generation that includes carbon capture and storage is clearly one of the more promising options.

*Q3. FutureGen is one of the projects at the forefront of the new technology effort. Central to the success of FutureGen is the ability to sequester $CO_2$ emissions. Has the department explored possible storage sites for this sequestered $CO_2$?*

*A3.* Yes, as part of the FutureGen site selection, possible storage sites for the sequestered $CO_2$ from FutureGen is being explored via a competitive site selection process through a solicitation that was issued on March 7, 2006, by the FutureGen Alliance, our industry partner. Twelve sites in seven states submitted proposals to host the FutureGen site. These sites had to pass qualification criteria to be given further consideration against a set of rigorous site evaluation criteria. The FutureGen Alliance selected four finalist sites from that group: Mattoon, IL; Tuscola, IL; Heart of Brazos near Jewett, TX; and Odessa, TX. A final site selection by the Alliance is expected to be made later this year after the completion of the environmental review process under the *National Environmental Policy Act.*

*Q4. Assuming it will be possible to inject the $CO_2$ into the ground, what type of legal and regulatory framework needs to be in place in order to ensure that these types of plants will be built, and provide for safe long-term storage of large scale, long lived sequestered $CO_2$?*

*A4.* It will be necessary to have legal and regulatory frameworks developed specifically for carbon capture and storage projects. Frameworks can either be adopted or adapted from existing regulatory frameworks. The Department of Energy has been working with the U.S. Environmental Protection Agency (EPA) and the Interstate Oil and Gas Compact Commission (IOGCC) in the review and development of regulatory frameworks for Carbon Capture and Storage (CCS).

CCS can be divided into four areas: capture, transportation, injection, and long-term storage of $CO_2$. It has been suggested that the existing regulations under the *Clean Air Act* could be adopted to permit modifications necessary to capture $CO_2$ from power plants. Transportation of $CO_2$ via pipelines, rail and trucks is currently regulated under federal and State statutes through their respective transportation agencies and, therefore, no new regulations for the transport of $CO_2$ are necessary. Frameworks for the injection and long-term storage of $CO_2$ in geologic formations could be developed from existing analogous regulations such as the *Safe Drinking Water Act* (SDWA) Underground Injection Control (UIC) Program, which are currently implemented by federal or State environmental and/or oil and gas divisions. $CO_2$ injections for enhanced oil and gas recovery are currently permitted as UIC Class II operations. The EPA has recently issued guidance to the EPA regions and states that would allow the deep saline tests under the Regional Carbon Sequestration Partnerships to be permitted as Class V, experimental projects. The lessons learned from these research projects will provide the technical data to permit future full scale $CO_2$ injection projects either under the existing UIC framework or as a new well classification. Regulations for the long-term storage and liability could be

modeled after the UIC program but will need to be developed before sequestration can be adopted as a commercial opportunity to mitigate Greenhouse Gases.

*Q5. The Administration has indicated its strong interest in the development of new and alternative sources of energy. One of the goals of this new technology would be to reduce carbon emissions.*

- *In looking at the situation today, what would you estimate the cost to be for a power plant to install current $CO_2$ capture and sequester technology?*
- *What is the availability of such technology? Is it easily obtained?*

*A5.* The capture costs will vary depending on the type of power plant and if the plant is existing or a new build. The costs to install the technology include capital costs for equipment and operational costs and can be displayed as increased in the cost-of—electricity, incremental plant capital cost, and cost of $CO_2$ avoided and captured. The following table gives estimated current costs. Actual costs could vary significantly based on the specific plant configuration.

| | Type Plant | COE, existing Cents/kWh | COE, w/CCS Cents/kWh | % increase COE | Capital Cost increment $/kW | CO2 Avoided $/Ton | CO2 Captured $/Ton |
|---|---|---|---|---|---|---|---|
| Post-Combustion New Plant | Super-critical pulverized coal (PC) | 6.4 | 11.1 | 70+ | 1,294 | 63 | 41 |
| Pre-Combustion New Plant | integrated gasification combined cycle (IGCC) | 7.5 | 10.0 | 30 | 625 | 33 | 26 |
| | | | | | | | |

The increased costs of electricity for capturing and storing $CO_2$ are significant and the Fuels and Power Systems Program is undertaking extensive R&D to reduce these costs. The current costs of these particular scenarios are explained in more detail in the paragraphs below.

*Post-combustion $CO_2$ Capture:*

Installing $CO_2$ capture on a *new* super-critical pulverized coal power plant using current state-of-the art amine scrubbing technology (capable of capturing 90+ percent of $CO_2$ emissions) results in an incremental total plant capital cost (TPC) equal to $1,294/kW. This corresponds to an incremental increase in cost of electricity (COE) of 4.7cents/kWh (from 6.4 cents/kWh to 11.1 cents/kWh) equivalent to $63/ton $CO_2$ avoided and $41/ton $CO_2$ captured [1]. The current state-of-the-art amine scrubbing is based of the Econamine FG+ carbon dioxide capture process being developed by Fluor Corporation. Significant technical and economical improvements in amine scrubbing have been made in the past 10 years with the leading technology developers being Fluor Corporation and Mitsubishi.

*Pre-combustion $CO_2$ Capture:*

Installing $CO_2$ capture on a *new* integrated gasification combined cycle power plant using current state-of-the-art Selexol scrubbing technology (capable of capturing 90+ percent of $CO_2$ emissions) results in an incremental total plant capital cost (TPC) equal to -$625/kW. This corresponds to an incremental increase in cost of electricity (COE) of 2.5 cents/kWh (from 7.5 cents/kWh to 10.0 cents/kWh) equivalent to $33/ton $CO_2$ avoided and $26/ton $CO_2$ captured.

As of 2004, there are more than 30 small amine scrubbing plants currently capturing $CO_2$ from flue gas sources (post NGCC and PC) to be used as feed sources for enhanced oil recovery, the chemical industry and the food/beverage industry. The size of the current installations range between 100 and 1,000 ton $CO_2$ captured per day-significantly smaller than that required for a full-size PC power plant removing 17,000 ton $CO_2$/day. Although Fluor Corporation is offering the Econamine FG+ at this full-scale, it is clear that some commercial development is still required to extend the envelope of commercial availability into the region required by large scale power plants.

The current state-of-the-art for Selexol Scrubbing is based of the designs developed by UOP. There are 55+ worldwide Selexol Scrubbing processes removing $CO_2$ from natural gas—the process is considered to be commercially available at the size required for a full-scale Integrated Gasification Combined Cycle power plant.

*Q6. Section 1407 of EPACT authorized $100 million a year for three years for high temperature Oxyfuel technology. It was to go to two small and two large Oxyfuel coal plants, both new and retrofits. The DOE has never funded that section nor is there any money in the budget for Oxyfuel technology.*

- *Why has section 1407 not been funded and why is there no focus on retrofits?*

*A6.* The Clean Coal Power Initiative (CCPI) is the primary vehicle used by the Department of Energy to fund demonstration scale advanced coal technology projects such as the high temperature Oxyfuel technology demonstrations authorized under section 1407 of EPACT 2005. In FY 2008, the Department expects to complete the CCPI Round 3 solicitation and proposal evaluations. Both new projects and retrofits are eligible to apply for funding as part of this vehicle. The solicitation will be followed by project selections to assemble the initial portfolio of advanced technology systems with carbon capture for sequestration and beneficial reuse. In addition, the FY 2008 coal budget request includes $5 Million for Oxyfuel/Oxycombustion R&D to continue the work begun in FY 2007 and earlier.

**Questions submitted by Representative Jerry F. Costello**

*Q1. Can you please give an update of the status of the FutureGen project?*

*A1.* The project is moving forward on schedule. We have completed the first phase of the project, which included completion of the initial conceptual design and the initiation of the environmental review process as required under the *National Environmental Policy Act* (NEPA). In addition, under the first phase, a competitive site selection solicitation was issued on March 7, 2006, by the FutureGen Alliance, our industry partner. Twelve sites in seven states submitted proposals to host the FutureGen site. The FutureGen Alliance selected four finalist sites from that group: Mattoon, IL; Tuscola, IL; Heart of Brazos near Jewett, TX; and Odessa, TX. We are aiming to complete the NEPA process this year to be followed by a final site selection by the Alliance. We expect to continue preliminary design of the facility as well as further site characterization on the specific site when it is selected. The project is on target for a 2012 start date for operations.

*Q2. In FY 2007 the Administration requested $54 million for the FutureGen project. Since the FY 2006 enacted level for the project was $18 million, does the Department intend to make up the $36 million shortfall needed to keep the project on schedule?*

*A2.* The Administration has requested and Congress has appropriated funds needed to keep the project on schedule, consist with the project funding plan described in the 2004 FutureGen report to Congress. This funding stream includes $18 million in FY 2006 and $54 million in FY 2007.

*Q3. As you know, the President's budget proposal for FY08 seeks to eliminate funds needed for FutureGen in the out years. How can it keep its construction deadline?*

*A3.* The President's FY 2008 budget for FutureGen is $108 million, consistent with the project funding plan. We are moving forward with the project activities with construction to begin in FY 2009 and start-up of operations in 2012. We intend to request the necessary funds in the out years consistent with this project schedule.

*Q4. Please explain why DOE reduced the number of carbon sequestration projects around the country and how DOE will decide which projects to cut. How does the FY07 Operating Plan change this?*

*A4.* The Office of Fossil Energy has been focusing its efforts on implementation of twenty-five field validation tests through the Regional Carbon Sequestration Partnerships (RCSP) Phase II initiative. These tests are designed to validate promising geologic formations in their regions to store $CO_2$. The tests are testing the injectivity, modeling the fate, and measuring the response of the $CO_2$ in the formations. In addition, these tests are developing the protocols for site characterization, monitoring, infrastructure development, operations, and closure that will be used to develop future large scale field tests. The information collected in these tests will support the development of Phase III, Large-Volume Testing, and provide informa-

tion that can be used to inform future commercial Carbon Capture and Storage sites.

In FY 2008, the Regional Carbon Sequestration Partnerships (CSRP) Field Validation Testing activities (Phase II) will complete and publish results for several of the 25 geologic sequestration tests involving $CO_2$ injection and monitoring, mitigation, and verification (MMV) operations in saline formations, depleted oil and gas fields, and unmineable coal seams. The Department will prioritize among its Phase II tests, beginning with those that offer the greatest potential benefits. The initial focus will be weighted toward saline formations, since they are expected to offer the greatest capacity for geologic carbon sequestration. The Department will also initiate an expedited schedule for the multi-year Phase III of the Regional Partnership Program. In FY 2008, Phase III work will include the conduct of four large scale field tests, including completion of the NEPA Process for selected sites, and other work. In coordination with the current partnerships, the program will determine the "highest potential" opportunities for the initial expedited round of large scale sequestration tests in saline, coal, and/or oil and gas bearing formations. Due to the increased funding level in FY 2007, the Department of Energy (DOE) was able to initiate Phase III in FY 2007, further expediting the schedule for these highest priority tests. The Department will continue to apply a prioritization process to expedite the most important Phase II and Phase III tests. Several of the Phase 11 tests are being strategically conducted to support Phase III activities. In addition to the knowledge gained by the Phase II tests, the initial work on well construction and characterization may support the Deployment Phase should one of the sites used for Phase II testing provide the necessary environment for Large-Volume Deployment Testing.

The DOE will continue these field validation (Phase II) tests through FY 2008. Starting at the end of FY 2007 and through 2008 the DOE will complete *National Environmental Policy Act* (NEPA) activities and initiate four large volume sequestration tests through the Regional Carbon Sequestration Partnerships. This will include the site characterization and infrastructure development for storage projects that will inject up to one million tons of $CO_2$ per year for several years. It is possible that injection could occur in FY 2008. We are also working closely with the EPA to assess requirements and procedures for permitting future commercial geologic sequestration deployments.

*Q5. Since last July, all the DOE Carbon Sequestration Partnerships have been contributing to a thoroughly vetted capacity methodology that will result in a DOE-produced atlas identifying areas in the U.S. which have sequestration capacity. This atlas is scheduled to be published in May of this year.*

- *Are you aware of any shortcomings with the DOE Partnerships to identify and collect data on geographic areas?*
- *Second, do you believe additional funding is needed to identify more sequestration sites in the United States?*

*A5.* The Atlas represents Phase I (2003–2006) of the Regional Carbon Sequestration Partnerships assessment of geological storage capacity. The Department of Energy (DOE) is using existing funding to work on both historical and field data collection. During Phase II, which will last until 2009, the Partnerships are gathering additional information on geologic formations throughout the United States. This includes open source data gathered from Federal and State Geologic Surveys and proprietary data from industry partners. The information collected during Phase II will be used to update the capacity estimates throughout the United States and revise and issue an updated version of the Atlas in 2009. DOE expects to continue the effort to characterize additional geologic formations after 2009 during Phase III of the program. In addition, the data collected during the Phase II field validation tests and Phase III large volume sequestration test will be used to validate the capacity estimates presented in the Atlas. DOE will continue to use its resources to develop technologies and evaluate whether projects will be able to inject and store the necessary volumes to make this a commercial technology to mitigate future greenhouse gas emissions.

DOE has shown that adequate capacity exists through the United States to store hundreds of years of future emissions and additional geographic regions will be incorporated into the DOE assessment by the end of Phase III of the Regional Carbon Sequestration Partnerships Program.

**Questions submitted by Representative Daniel Lipinski**

*Q1. Is the $79 million request for carbon sequestration enough to ensure that the proposed FutureGen plant can be constructed with this necessary technology? Do you believe DOE is allocating enough resources and moving quickly enough to develop this crucial technology that will lead to reducing our emissions of $CO_2$?*

*A1.* The FutureGen Project, as part of its site selection, has conducted initial site characterization of the geologic formations that will store the $CO_2$ generated during its operation. The plant is schedule to be operational in 2012. The $86 million in the 2008 Budget (including $7 million of R&D by federal employees under the Program Direction line item), plus the $105 million in the 2007 Operations Plan under the Continuing Resolution (including $5 million of R&D by federal employees under the Program Direction line item) is sufficient funding to complete NEPA activities for four Large Volume Deployment Tests by FY 2008 and also for its Core Program to continue with development of Monitoring, Mitigation, and Verification (MMV) and other relevant technologies. With these activities, the sequestration technology should be advance enough to be part of FutureGen and also utilize FutureGen for technology verification.

DOE has accelerated four Large-Volume Deployment Tests in coordination with the Regional Carbon Sequestration Partnerships. Funding from FY 2007 will be utilized to initiate these tests so that starting at the end of FY 2007 and through 2008 the DOE will complete *National Environmental Policy Act* (NEPA) activities and initiate four large volume sequestration tests. This will include the site characterization and infrastructure development for storage projects that will inject up to one million tons for $CO_2$ per year for several years.