

Senate Boosts DOE Science and Energy R&D

AAAS R&D Funding Update on DOE R&D in FY 2009 Senate Appropriations

Highlights

- **The Department of Energy's (DOE) Office of Science would be a clear winner in the 2009 budget among R&D agencies because of its key role in the President's American Competitiveness Initiative (ACI), and now the Senate Appropriations Committee has endorsed this proposal. R&D in DOE Science would climb 15 percent from a recently augmented 2008 appropriation to \$4.2 billion, slightly off the request (see Table).** Most Science programs would receive substantial increases to hit historic highs.

- The Senate would dramatically boost funding for DOE's energy R&D programs by 22 percent to \$2.9 billion in 2009 after enormous increases in 2007 and 2008, in contrast to a flat request. Funding for most renewable energy R&D portfolios, energy conservation technologies, and coal research would climb dramatically in the Senate plan. In fossil fuels, coal R&D would soar 31 percent to \$644 million despite the elimination of FutureGen funding, including a 25 percent boost to \$149 million for carbon sequestration research. In renewables, funding for biomass, solar energy, wind energy, geothermal, and hydropower R&D would climb dramatically.

- The total DOE R&D portfolio would soar 12.7 percent or \$1.2 billion to \$11.0 billion in the Senate appropriation (see Table).

- DOE's defense R&D portfolio would increase 4.2 percent to \$3.9 billion, including a large gain for nonproliferation R&D. The Senate would zero out funding for the Reliable Replacement Warhead.

DOE R&D in FY 2009 Senate Appropriations

On July 10, the Senate Appropriations Committee approved its version of the FY 2009 Energy-Water appropriations bill (S 3258) providing funding for the Department of Energy (DOE), the Corps of Engineers, and other agencies, for possible consideration by the full Senate in July. The Senate would spend \$2 billion more on the bill's programs in 2009 than the President's request for a total of \$33 billion in discretionary funding.

President Bush's American Competitiveness Initiative (ACI) and Advanced Energy Initiative (AEI), both set for their third years in 2009, have made the Department of Energy's (DOE) R&D programs a high priority within a tight domestic budget. DOE's Office of Science is the largest federal sponsor of physical sciences research and is thus one of three federal agencies (the other two are the National Science Foundation and the National Institute of Standards and Technology laboratories) that would receive substantial increases to fulfill the ACI's goal of increasing federal investments in basic physical sciences research. DOE's energy R&D portfolio is a key Administration and congressional priority that received enormous increases in 2007 and 2008.

The Senate would use a large portion of its extra domestic spending allocation to boost the total DOE budget by \$1 billion over the request, for a total of \$27.0 billion (up 11.5 percent or \$2.8 billion; see Table). (The 2008 figures include \$125 million in supplemental appropriations DOE received on June 30 as part of the 2008 supplemental bill, \$62.5 million each for the Office of Science and Defense Environmental Cleanup.) The DOE R&D portfolio would climb \$1.2 billion or 12.7 percent to \$11.0

billion in the 2009 Senate appropriation (see Table). (2008 DOE R&D figures include \$62.5 million in Office of Science funding enacted in the 2008 supplemental.)

R&D in the DOE Office of Science

DOE's Office of Science has long been the dominant federal sponsor of physical sciences research, especially in physics and related fields. It is also an important supporter of computer sciences, mathematics, environmental sciences, materials research, nanotechnology, and engineering; the Bush Administration's push to boost physical sciences broadly defined through large increases in the Science budget would pay off for all research areas. The ACI envisions the Science budget doubling between 2006 and 2016, but so far Science appropriations have fallen short of that trajectory. In 2007, DOE requested a 14 percent increase for Science funding, and ended up with 5 percent; in 2008, the request was for a 16 percent increase, but again the increase was 5 percent; the 2008 supplemental added an extra 2 percent a few weeks ago. To catch up with the ACI's ten-year funding trajectory, the Senate would nearly match DOE's request with a \$4.6 billion Science budget, \$560 million or 13.7 percent over the new 2008 total and \$82 million less than the request. More than 90 percent of the Science budget goes to R&D activities; Science R&D would gain 15.2 percent in the FY 2009 Senate appropriation to \$4.2 billion, making DOE Science the big winner among R&D funding agencies in Senate appropriations so far (see Table). The large increase would mark a departure from the flat or declining funding trends of recent years (see Figure 1), and in real terms would match the peak budgets of the early 1990s before the Superconducting Super Collider was canceled.

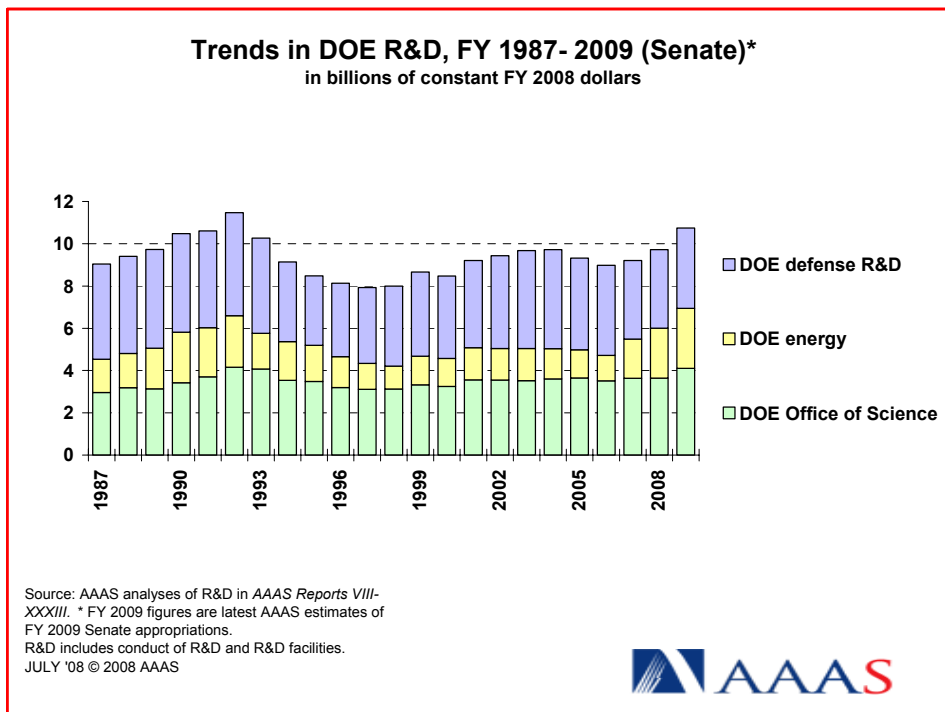


Figure 1. (click on the image for PDF)

Funding for every Science program would increase substantially, with the largest boosts for programs that faced the most disappointing outcomes in 2008 appropriations, including a 63 percent increase for fusion research, an 18 percent boost for nuclear physics, and a 12 percent increase for high-energy physics.

The Office of Science supports cutting-edge research through a mix of laboratory research at DOE's national laboratories, university-based research, and the construction and operation of large scientific user facilities that can be used by external researchers for their experiments. Roughly half of Science R&D

funding goes to operate and construct facilities, while the other half supports research, mostly at DOE laboratories but a large portion at universities. The laboratory research and large facilities are housed primarily at ten Science laboratories that are federally owned and contractor operated, such as the Oak Ridge National Laboratory in Tennessee, Brookhaven National Laboratory in New York, and Argonne National Laboratory in Illinois.

After a significant hit in 2008 that nearly ended the U.S. contribution to the International Thermonuclear Experimental Reactor (ITER) project, fusion research would total \$493 million as requested in the Senate appropriation, up \$191 million or 63 percent. Nearly the entire increase would go to a \$215 million ITER contribution in 2009 on the project now underway in France, after appropriators almost zeroed out U.S. participation in ITER in 2008 to preserve funding for domestic fusion programs; \$15.5 million of the recent \$62.5 million supplemental went to ITER to bring the 2008 U.S. ITER program to \$26 million. Domestic fusion projects in New Jersey, California, and Massachusetts would mostly stay even in 2009 after an increase in 2008.

The High-Energy Physics (HEP) program also took a significant hit in 2008 appropriations, but would rebound in the 2009 Senate appropriation with \$805 million, the same as the request and up \$84 million or 11.6 percent from a recently augmented 2008 appropriation. The program does most of its work at three facilities located at two DOE labs (Fermilab in Illinois and the Stanford Linear Accelerator Center (SLAC) in California) and also cooperates in the international Large Hadron Collider (LHC) in Switzerland, for which the U.S. recently completed its contribution. In wrapping up 2008 appropriations, Congress slashed funding for HEP compared to the request, which resulted in layoff notices and furloughs at the Fermilab in Illinois. The 2008 supplemental added \$32 million to HEP a few weeks ago, which enabled Fermilab to halt the announced layoffs, to end the furloughs, and to resume development of a future neutrino research program. The supplemental also included funds to allow SLAC to recover slightly from staff reductions necessitated by the 2008 appropriation.

The Nuclear Physics program would also receive a strong 18 percent boost to \$510 million in the 2009 request and Senate appropriation, allowing for a full schedule of operations at the Relativistic Heavy Ion Collider (RHIC) in New York. RHIC recently received \$1.5 million in the 2008 supplemental to sustain operations for the rest of this fiscal year.

Basic Energy Sciences (BES) has fared the best among Science program areas in recent years, although the 2008 appropriation resulted in the cancellation of several grants competitions. The program would continue to do well in 2009 with a 10.3 percent increase to \$1.4 billion in 2009. BES is the only Science program where the Senate appropriation would fall short of the request (by \$153 million), but \$59 million of the shortfall would be from the Senate's transfer of solar-related research to the Solar Energy portfolio in energy programs. BES would initiate new Energy Frontier Research Centers, a \$100 million competitively awarded research program on basic research for energy technologies. Construction funding for the National Synchrotron Light Source II, follow-on construction for the Advanced Light Source, and the final phases of the Linac Coherent Light Source would keep the program busy with a full plate of future facilities, even as the Spallation Neutron Source (SNS) and two other neutron sources, four light sources and five nanoscale research centers would keep current operations at a high level. BES recently received \$13.5 million in the 2008 supplemental for its synchrotron light sources and the SNS.

High-performance computing research in the Advanced Scientific Computing Research (ASCR) program would be in for a 5 percent boost to \$369 million in the Senate plan and request to expand the availability of high-performance computing capacity that researchers can use for their experiments, primarily at Oak Ridge and Argonne laboratories. Biological and Environmental Research (BER) could increase 10 percent in 2009 to \$599 million in the Senate appropriation, \$30 million more than the request, to lead DOE's charge into bioenergy, genomics, and climate change modeling, including funding for three bioenergy research centers in Tennessee, Wisconsin, and California to work on cellulosic ethanol and other biofuels. The Senate would add \$10 million to the request for nuclear medicine, and \$20 million for climate change research.

After more than a decade of cuts and stagnant budgets, the DOE Office of Science would climb back to Cold War-era funding levels to an all-time high if the 2009 Senate appropriation prevails (see Figure 1). Most individual Science programs would reach new highs in the 2009 Senate appropriation.

DOE Energy R&D Programs

In the last few years, DOE's applied investments in energy R&D have expanded dramatically from roughly \$1.5 billion a year to well over \$2 billion (see Figure 1). In 2009, DOE would sustain enormous 2007 and 2008 increases in energy R&D with a \$2.4 billion request, up \$11 million or 0.5 percent, but the Senate would appropriate another enormous increase of 22.1 percent to bring the energy R&D portfolio to \$2.9 billion (see Table), nearly doubling in just three years.

The Senate would boost R&D in the Energy Efficiency and Renewable Energy portfolio by 15.3 percent to \$1.4 billion instead of a requested cut. Although hydrogen technology R&D would fall 17 percent to \$175 million, mostly because of the transfer of some hydrogen vehicle funding to the vehicle technology program, R&D on every other technology area would increase dramatically. Biomass R&D would continue its spectacular recent growth with a 19 percent boost to \$235 million, up from \$90 million as recently as 2006, while solar energy R&D spending would be \$229 million, nearly triple the \$82 million as recently as 2006. Nearly all of the Senate's solar increase would come from the transfer of \$59 million in solar-related funding from Basic Energy Sciences in Science. The geothermal R&D program would get a boost in 2009 to \$30 million, up 51 percent, while wind energy funding would increase by 26 percent. The Senate would reverse a proposed cut in the hydropower program and instead triple funding to \$30 million. Among the energy conservation programs, building technologies would receive the largest increase with a 62 percent boost to \$176 million, while vehicle technology would increase 38 percent to \$293 million, in part from the transfer of some programs from Hydrogen.

Also in line for a big increase is nuclear energy R&D, a renewable energy technology funded in a separate account, up 28 percent to \$566 million in the 2009 Senate plan, a reduction from an even larger request. Part of the large increase is from the transfer in of programs from other DOE accounts and partially from a dramatic proposed increase in advanced fuel cycle R&D because of its key role in the Administration's signature Global Nuclear Energy Partnership (GNEP) to promote spent nuclear fuel recycling. The Senate would reduce GNEP-inspired requested increases, but advanced fuel cycle R&D would still show an increase compared to 2008. The Senate would also authorize a new Integrated University Program and give it \$45 million in start-up funding for 2009, composed of \$15 million each from the Nuclear Energy portfolio, the Nonproliferation and Verification R&D portfolio from DOE's defense side, and the independent Nuclear Regulatory Commission (NRC). The new program would support university-based nuclear engineering programs throughout the nation with research grants to universities.

Fossil energy R&D would climb 34.5 percent in 2009 to \$775 million in the Senate plan, with an emphasis on coal research. As in past years, the Senate would fight off DOE's proposals to put all its eggs into the coal basket by saving R&D on other fossil fuels from proposed elimination. Still, coal R&D would gain a whopping 31 percent to \$644 million. The Senate would zero out funding for the recently restructured FutureGen program to express its opposition to DOE's changes to this project to develop a near-emission-free, coal-fired electricity and hydrogen production plant from a single R&D facility to multiple commercial-scale demonstrations. Instead, the Senate would shift FutureGen money to the Clean Coal Power Initiative program to develop and demonstrate cleaner coal-based power plants, resulting in a tripling of its budget from \$69 million to \$232 million. And carbon sequestration research, funded in the coal program because the primary goal is to sequester carbon from coal-fired power plants in geologic formations, would climb 25 percent to \$149 million after similar increases the past two years; additional carbon capture and storage R&D would be funded in the Clean Coal Power Initiative portfolio. The Senate would also provide \$60 million for Fuel Cells Research within the Coal portfolio to complement efforts in the Hydrogen and Basic Energy Sciences portfolios. And although the budget would eliminate the oil R&D and gas R&D programs, the Senate would restore funding. And the Senate would also prevent DOE from blocking \$50 million in mandatory funding for an ultra-deepwater and unconventional natural gas and other petroleum research fund that was created in the Energy Policy Act of 2005 for a 2007 start.

DOE Defense R&D

DOE and its predecessors have long had responsibility for managing the nation's nuclear weapons stockpile, supplying nuclear reactors to the Navy, and dealing with the environmental consequences of nuclear weapons work. DOE's defense R&D to address these responsibilities would gain 4.2 percent or \$157 million to \$3.9 billion in the 2009 Senate appropriation (see Table). The core Weapons Activities program would receive \$6.5 billion in 2009. A little less than half of this spending goes to R&D activities, for a total of \$2.8 billion (up 1.9 percent). To keep pace with an increasing reliance on complex high-end computing simulations of nuclear explosions, the Advanced Simulation and Computing program would receive \$574 million (down 0.1 percent). The program, the defense counterpart to the nondefense ASCR program, mostly takes place in DOE's three weapons laboratories (Los Alamos and Sandia in New Mexico, Lawrence Livermore in California). The Inertial Confinement Fusion program, aimed at simulating nuclear weapons fusion under controlled laboratory conditions, would receive \$453 million, down 3.6 percent primarily because construction costs would wind down on the National Ignition Facility in California, the program's new flagship science facility.

The DOE proposal to initiate research on a new generation of nuclear weapons has been opposed by Congress so far, and once again the Senate would try to halt DOE's efforts to press on with the Reliable Replacement Warhead (RRW) project to explore new warhead designs for use with existing nuclear weapons. DOE recently selected Lawrence Livermore to design the RRW, but the project still faces continuing skepticism in Congress over whether the U.S. needs new warheads, even for existing weapons. Congress zeroed out RRW development funding in 2008, DOE requested \$10 million in 2009, and now the Senate would zero out 2009 funding, although funding for RRW could remain in other programs.

The big winner in Senate plans for DOE's defense R&D is the Nonproliferation and Verification R&D portfolio, increasing 27 percent or \$57 million to \$265 million. Part of the increase is \$15 million in new money for DOE defense's contribution to the Integrated University Program, but most of the increase would aim to improve U.S. capabilities in proliferation and detection through an expanded R&D effort involving detection research, improved computer modeling capabilities and nuclear forensics research.

Outlook and Next Steps

The full Senate could debate and approve the Energy-Water bill in July, but may not debate the bill at all before the November elections. There is almost no chance that Congress will send a final version of the bill to President Bush before the October 1 start of FY 2009. The President has threatened to veto any 2009 appropriations bill that exceeds his request; since Senate version of the bill does so and since Congress is not inclined to do the heavy lifting of negotiating a House-Senate compromise bill only to see it vetoed, the bill may have a long way to go before its funding levels become final. The promised Senate increase for DOE in 2009, if it happens at all, could be delayed until next January.

(This analysis is one of a series of AAAS R&D Funding Updates on FY 2009 congressional appropriations. The complete series of AAAS R&D Funding Updates, including continually updated analyses of R&D in FY 2009 appropriations, is available on the AAAS R&D Web Site (<http://www.aaas.org/spp/rd>) in the "FY 2009 R&D" or the "What's New" sections.)

- July 16, 2008
AAAS R&D Budget and Policy Program
1200 New York Avenue, NW
Washington, DC 20005
(202) 326-6607
AAAS R&D Web site: <http://www.aaas.org/spp/rd>



Table. DOE R&D in FY 2009 Senate Appropriations

**Table. Department of Energy
Senate Appropriations Committee Action on R&D in the FY 2009 Budget
(budget authority in millions of dollars)**

	FY 2008 Estimate	FY 2009 Request	Action by Senate				
			FY 2009 Senate	Chg. from Request Amount	Chg. from Request Percent	Chg. from FY 2008 Amount	Chg. from FY 2008 Percent
DOE Appropriations Containing R&D:							
1. Energy Efficiency & Renewables	1,238	1,025	1,428	403	39.3%	190	15.3%
2. Electricity Delivery & Reliability	111	100	120	20	20.0%	9	8.1%
3. Nuclear Energy	441	630	566	-64	-10.1%	125	28.4%
4. Science 1/	3,637	4,314	4,191	-123	-2.8%	554	15.2%
5. Fossil Energy	576	625	775	150	24.0%	199	34.5%
6. Atomic Energy Defense	3,718	3,825	3,875	50	1.3%	157	4.2%
7. Nuclear Waste Disposal	3	0	3	3	--	0	0.0%
Total DOE R&D	9,724	10,519	10,958	439	4.2%	1,234	12.7%
Detail of selected appropriations:							
1. Energy Efficiency & Renewable Energy (does not include non-R&D components)							
Hydrogen Technology	211	146	175	29	19.7%	-36	-17.1%
Biomass and Biorefinery Sys.	198	225	235	10	4.4%	37	18.6%
Solar Energy 4/	168	156	229	73	46.7%	61	35.9%
Wind Energy	50	53	63	10	19.0%	13	26.1%
Geothermal Tech.	20	30	30	0	0.0%	10	51.4%
Hydropower	10	3	30	27	900.0%	20	202.8%
Vehicle Tech.	213	221	293	72	32.5%	80	37.5%
Building Tech.	109	124	176	53	42.6%	67	61.9%
Industrial Tech.	64	62	65	3	4.8%	1	1.1%
Congressional projects	187	0	124	124	--	-63	-33.5%
BA adjustment	8	5	7	2	43.8%	0	-5.6%
TOTAL Energy Effic. & Renewables	1,238	1,025	1,428	403	39.3%	190	15.3%
4. Science 1/							
High Energy Physics 1/	721	805	805	0	0.0%	84	11.6%
Nuclear Physics 1/	434	510	510	0	0.0%	76	17.5%
Fusion Energy Sciences 1/	302	493	493	0	0.0%	191	63.2%
' - ITER 1/ 5/	26	215	215	0	0.0%	188	721.0%
Basic Energy Sciences 1/ 4/	1,283	1,568	1,415	-153	-9.7%	132	10.3%
Adv. Scientific Computing Res.	351	369	369	0	0.0%	18	5.0%
Biological and Environmental Res.	544	569	599	30	5.3%	54	9.9%
TOTAL Science R&D	3,637	4,314	4,191	-123	-2.8%	554	15.2%
<i>Science Non-R&D Items</i>	<i>399</i>	<i>408</i>	<i>450</i>	<i>41</i>	<i>10.1%</i>	<i>51</i>	<i>12.7%</i>
Total Science Budget (incl nonR&D)	4,036	4,722	4,640	-82	-1.7%	605	15.0%
5. Fossil Energy R&D 2/ (does not include non-R&D components)							
Coal Research	493	624	644	21	3.3%	151	30.6%
- Clean Coal Power Init.	69	85	232	147	173.3%	163	234.9%
- FutureGen	74	156	0	-156	-100.0%	-74	-100.0%
- Carbon sequestration	119	149	149	0	0.0%	30	25.4%
- Other Fuels and Power Sys.	231	234	263	29	12.6%	32	14.0%
Oil Technology	5	0	5	5	--	0	0.9%
Natural Gas Technology	20	0	20	20	--	0	0.9%
Cooperative R&D	5	0	5	5	--	0	0.9%
UltraDeepwater Unconven. Gas 2/	50	0	50	50	--	0	0.0%
Clean Coal Tech. 3/	-58	0	0	0	--	58	-100.0%
Congressional Projects	48	0	33	33	--	-15	-32.0%
Plant & Cap. Equip. and adjs.	13	1	18	16	1299.7%	5	38.9%
Total Fossil Energy R&D 2/	576	625	775	150	24.0%	199	34.5%

(continued)

Table. DOE R&D in FY 2009 Senate Appropriations

6. Atomic Energy Defense Activities

National Nuclear Security Administration (NNSA)

Naval Reactors	743	794	794	0	0.0%	51	6.9%
Weapons Activities	2,742	2,787	2,794	7	0.3%	52	1.9%
(Science Campaigns)	288	323	331	8	2.5%	43	15.1%
(Adv. Simulation and Computing)	575	562	574	12	2.1%	-1	-0.1%
(Inertial Confinement Fusion)	470	421	453	32	7.6%	-17	-3.6%
(All Other Weapons Acts. R&D)	1,410	1,481	1,436	-45	-3.0%	27	1.9%
Nonproliferation & Verification R&D	208	208	265	57	27.3%	57	27.3%
Total NNSA R&D	3,693	3,789	3,853	64	1.7%	160	4.3%
Environmental Management	22	33	22	-11	-32.6%	0	1.1%
Other AEDA R&D	3	3	0	-3	-100.0%	-3	-100.0%
TOTAL Atomic Defense R&D	3,718	3,825	3,875	50	1.3%	157	4.2%

DOE R&D by Budget Function:

Defense	3,718	3,825	3,875	50	1.3%	157	4.2%
General Science	3,637	4,314	4,191	-123	-2.8%	554	15.2%
Energy	2,369	2,380	2,892	512	21.5%	523	22.1%

AAAS estimates based on FY 2009 appropriations bills. Includes conduct of R&D and R&D facilities.

FY 2008 and FY 2009 request figures based on OMB R&D data and supplemental agency budget data.

Some data adjusted by AAAS from DOE budget documents.

Figures are rounded to the nearest million. Changes calculated from unrounded figures.

1/ Includes recently enacted 2008 supplementals (Public Law 110-252).

2/ There is \$50 million in mandatory funding for ultra-deepwater and unconventional natural gas R&D in FY 2008 and FY 2009, but the FY 2009 request defers these funds.

3/ Rescissions and deferrals of previously appropriated funds.

4/ FY 2009 Senate transfers \$59 million in Basic Energy Sciences funding to Solar Energy.

5/ International Thermonuclear Experimental Reactor.

July 16, 2008 - AAAS estimates of Senate Appropriations Committee-approved appropriations.

These figures may be amended or rejected by the full Senate.

Department of Energy Budget (budget authority in millions of dollars)

	FY 2008 Estimate	FY 2009 Request	FY 2009 Senate	Action by Senate			
				Chg. from Request Amount	Chg. from Request Percent	Chg. from FY 2008 Amount	Chg. from FY 2008 Percent
Weapons Activities (NNSA)	6,297	6,618	6,525	-94	-1.4%	227	3.6%
Other NNSA Activities	2,513	2,966	3,141	175	5.9%	628	25.0%
Total NNSA	8,810	9,584	9,666	82	0.9%	855	9.7%
Defense Environmental Cleanup	5,404	5,297	5,772	474	9.0%	367	6.8%
Nuclear Waste and Other Defense	954	1,074	1,021	-53	-5.0%	67	7.0%
Total DOE defense	15,168	15,955	16,458	502	3.1%	1,290	8.5%
Science	4,080	4,722	4,640	-82	-1.7%	560	13.7%
Energy Efficiency and Renewables	1,722	1,255	1,928	673	53.6%	206	12.0%
Nuclear Energy	683	854	803	-51	-5.9%	120	17.6%
Fossil Energy	743	754	877	123	16.3%	134	18.0%
Other Energy Programs	1,287	1,725	1,602	-123	-7.1%	315	24.5%
Nondefense Environmental Mngmt.	101	213	269	56	26.2%	168	166.0%
Power Marketing Administrations	268	232	257	25	10.8%	-11	-4.0%
Departmental Administration & IG	194	207	207	0	0.0%	12	6.3%
Total DOE Budget	24,247	25,918	27,042	1,124	4.3%	2,794	11.5%

Source: Department of Energy budget justification and FY 2009 appropriations bills.

DOE appropriations only (does not include offsets and other mandatory).

Includes R&D and non-R&D components. Figures are rounded to the nearest million.

FY 2008 figures include recently enacted supplementals in Public Law 110-252.

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