

Energy Gains, Science Falters in 2008 DOE Budget

AAAS R&D Funding Update on DOE R&D in FY 2008 Final Appropriations

Highlights

- The Department of Energy's (DOE) R&D portfolio in fiscal year (FY) 2008 would do relatively well with a \$644 million or 7.4 percent increase to \$9.4 billion (see Table), but the omnibus appropriations bill brings several disappointments in DOE's Science portfolio.

- Although large increases for the Office of Science between 15 and 18 percent made it through the request, House and Senate appropriations, and an authorization bill as a cornerstone of federal efforts to boost basic physical sciences research, most of the increases vanished in the omnibus appropriations bill. **DOE Science's final 2008 budget of \$4.0 billion would be a 4.6 percent increase, but a loss of nearly \$500 million from earlier congressional appropriations.**

- DOE's energy-related R&D would enjoy another large increase in 2008, up 23.0 percent to \$1.9 billion after a similar increase in 2007, in sharp contrast to a requested cut. Congress went along with proposed increases for R&D investments in renewable energy technologies such as hydrogen, biomass, and solar energy, but also revived geothermal and hydropower R&D programs proposed for elimination. In fossil fuels, Congress added to a large request for coal R&D, including a 19 percent boost for carbon sequestration R&D, but also saved gas and oil technology R&D programs from elimination and added congressionally designated projects after a one-year moratorium. Congress also boosted energy conservation programs proposed for cuts.

- Congress eliminated requested funding for the Reliable Replacement Warhead (RRW). In addition to flat funding for nuclear weapons R&D, Congress appropriated large increases for nonproliferation R&D, resulting in a total DOE defense R&D investment of \$3.8 billion, up 2.9 percent.

- The America COMPETES Act of August 2007 created a new semi-independent Advanced Research Projects for Agency (ARPA-E) to fund breakthrough alternative energy R&D technologies, but ARPA-E did not receive any appropriations in the omnibus bill.

DOE R&D in FY 2008 Final Appropriations

On December 26, President Bush signed into law the FY 2008 omnibus appropriations bill (HR 2764) that had cleared Congress a week earlier, bringing the 2008 appropriations process to a close. The omnibus bill included a final version of the FY 2008 Energy-Water appropriations bill that was billions of dollars less than earlier House or Senate versions of the bill providing funding for Department of Energy (DOE) programs. The omnibus bill provides DOE with a total budget of \$24.4 billion in 2008, \$136 million or 0.6 percent more than 2007 but well below the President's request (see Table).

DOE was in line for a large R&D funding increase in DOE's request, and even larger increases in earlier House and Senate appropriations bills, but these increases for science and defense programs evaporated in the December omnibus bill, leaving only the large increases for energy R&D. **DOE R&D totals \$9.4 billion in the 2008 omnibus bill, 7.4 percent more than last year**, but well short of the request, the House appropriation, and especially a Senate appropriation that topped \$10 billion. While earlier congressional appropriations had large increases for all three of DOE's R&D missions areas in defense, science, and energy, only energy R&D ends up with large increases in the final bill.

President Bush's American Competitiveness Initiative (ACI) and Advanced Energy Initiative (AEI), both set for their second years in 2008, made the Department of Energy's (DOE) R&D programs a high priority within an increasingly 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 were in line to receive substantial increases to fulfill the ACI's goal of increasing federal investments in basic physical sciences research. DOE's energy R&D portfolio funds R&D on a variety of topics, including renewable energy R&D on the Administration priorities of hydrogen, solar power, and biomass, all of which received substantial increases in 2007. The Democratic majority in the 110th Congress had signaled its support for these two Administration priorities, both rhetorically (under different labels) and financially in wrapping up 2007 appropriations earlier this year with increases for these programs.

But in late negotiations over the omnibus appropriations bill, Congress gave up \$22 billion in domestic appropriations that had been added to House and Senate appropriations bills in the face of presidential veto threats; the ACI proposed increases took a big hit in all three ACI agencies. Earlier in 2007, the House fully funded a requested 15 percent increase for the Office of Science while adding even more money for biological and environmental programs for a 16.8 percent increase; the Senate followed with an 18 percent increase. But the final Science increase of 5.3 percent increase falls far short of these earlier plans, and becomes only a 1.4 percent increase after factoring out congressional earmarks.

R&D in the DOE Office of Science

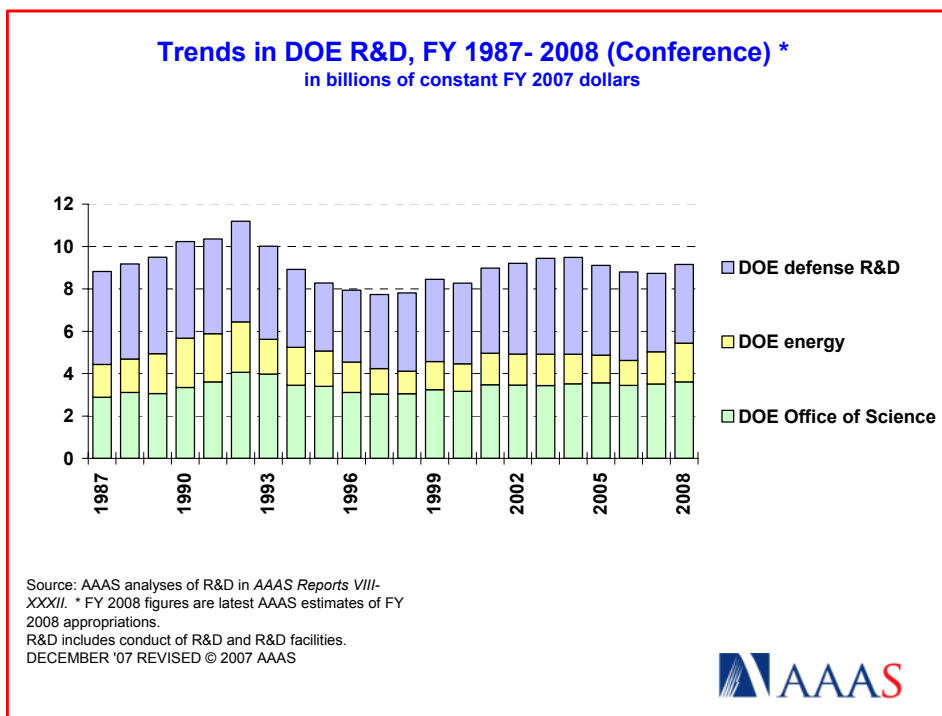


Figure 1. (click on the image for PDF)

DOE's Office of Science, in its various incarnations over the decades, has long been the dominant federal sponsor of physical sciences research, and is also an important supporter of computer sciences, mathematics, environmental sciences, materials research, nanotechnology, and engineering. Last year, DOE requested a 14 percent increase for Science funding, and ended up with 5 percent in February's final 2007 appropriations. To catch up with the ACI's funding trajectory, the 2008 request for the total Office of Science budget would have been a 16 percent boost to \$4.4 billion, consistent with a plan to double the budget between 2006 and 2016. But just like last year, the final Science increase in 2008 is far less. The total Science budget would increase 5.3 percent to \$3.7 billion, after several rescissions and across-the-

board cuts in the omnibus bill. More than 90 percent of the Science budget goes to R&D activities; Science R&D would gain 5.3 percent increase to \$3.7 billion (see Table). The 2008 increase following 2007's increase would mark a departure from the flat or declining funding trends of earlier years but just barely (see Figure 1), and would keep Science funding generally flat for this entire decade.

Funding for several Science programs would decline in 2008, and leave funding well below recent levels (see Figure 2). The high-energy physics, nuclear physics, fusion sciences, and basic energy sciences programs would get dramatically less than the request, with wrenching dislocations in store for the programs and laboratories executing these programs. 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.

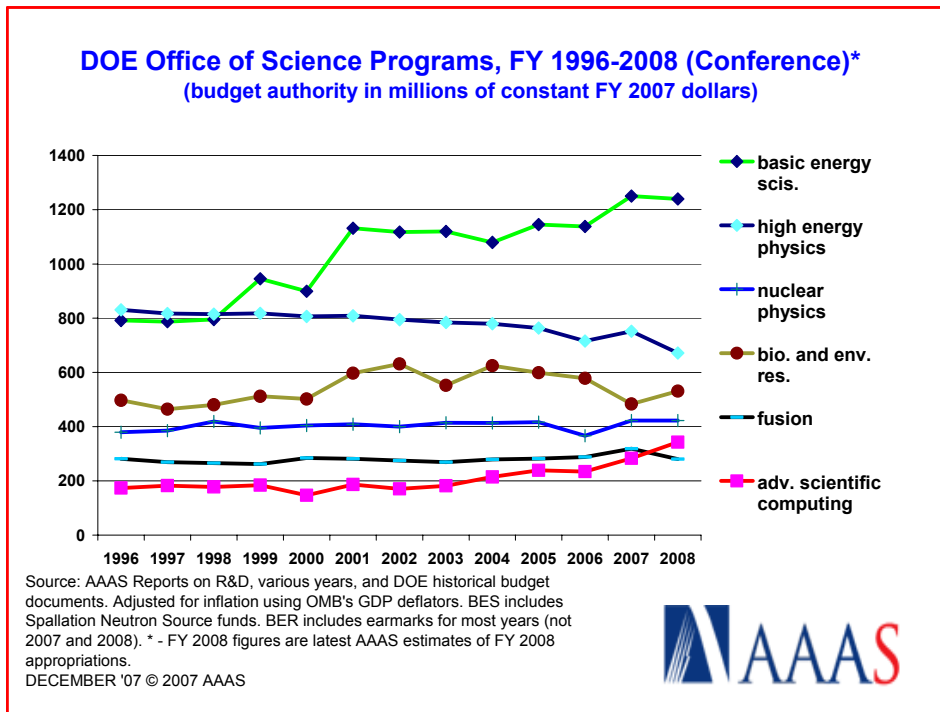


Figure 2. (click on the image for PDF)

Some Science programs would do well, including Biological and Environmental Research (BER) with a 13 percent boost to \$544 million, particularly for climate change research. Computing research would increase 24 percent to \$351 million to reach an all-time high (see Figure 2). And there would be \$124 million in R&D earmarks, congressionally designated performer-specific projects making a reappearance in 2008 appropriations after a one-year moratorium on domestic earmarks in 2007.

But steep cuts are in store for other Science programs. Congress would zero out **the U.S. contribution to the multinational International Thermonuclear Experimental Reactor (ITER)** in the Fusion Energy Sciences program. ITER funding climbed from \$19 million in 2006 to \$60 million last year, but the omnibus bill provides nothing for the program instead of the \$160 million request. As a result, Fusion funding would fall 10 percent to \$287 million, leaving just enough funding for a slight increase for domestic fusion activities in New Jersey, California, and Massachusetts. And the High Energy Physics (HEP) program, which funds basic research on the nature of matter and energy, would see its funding fall 8

percent down to \$688 million (see Table). The program does most of its work at three facilities located at two DOE labs (Fermilab in Illinois and the Stanford Linear Accelerator Center in California) and also cooperates in the international Large Hadron Collider (LHC) in Switzerland, which transitions from fabrication toward operation later this year. Instead of the \$60 million request, there would be only \$15 million for the International Linear Collider, the next big international high-energy physics project after the LHC; most of the 2008 work would have been performed at Fermilab. Fermilab would face additional hits, including the elimination of its NOvA neutrino experiment; the lab has already announced layoffs that could exceed 10 percent of its staff. The High-Energy Physics program has fared the worst among the Science program lines this decade (see Figure 2). The Nuclear Physics (NP) program would do only slightly better with a 2.4 percent increase to \$433 million, far less than the request to leave funding flat for the entire decade (see Figure 2). NP seeks to understand the structure and interactions of subatomic particles, and supports four user facilities. And Basic Energy Sciences (BES) would receive less than \$1.3 billion in 2008, barely an increase and far short of the \$1.5 billion request, with as-yet unknown impacts on its array of scientific user facilities and laboratory research.

DOE Energy R&D Programs

The dollars that would have gone to Science programs instead flowed to the Energy side of DOE in final 2008 appropriations, turning requested cuts into large increases for the second year in a row. In 2006, President Bush proposed dramatic funding boosts for selected alternative energy R&D programs as part of his Advanced Energy Initiative (ACI) to reduce U.S. dependence on Middle East oil; Congress unexpectedly added even more money to bring DOE energy R&D to \$1.5 billion in 2007, a surprising 32 percent boost over the year before. The 2008 request retreated from the 2007 highs in most areas down to \$1.4 billion, but Congress brings total DOE energy R&D in 2008 to \$1.9 billion, up another 23 percent. Both the House and Senate made a point in 2007 of decrying a decades-long decline in federal energy R&D investments down to one-fifth to one-third of peak 1980 funding levels, and pointed to the 2007 and 2008 increases as the first steps toward restoring federal investments in energy R&D. DOE energy R&D investments climb 62 percent in just two years.

While the Administration's energy R&D increases in some areas would have been offset by steep cuts or program eliminations in other energy areas, Congress provided increases across the board for renewables, energy conservation, and fossil fuels R&D programs.

In renewable energy, Congress added to the request for nearly every program, with the only exception hydrogen R&D, which would still increase 9.0 percent over last year to \$211 million, up dramatically from \$153 million in 2006 (see Table and Figure 3). Biomass R&D would decline slightly from 2007 to \$198 million in 2008, but would still be nearly triple the 2006 funding level, while solar energy R&D would total \$168 million, up 5.7 percent from 2007 and more than double the \$82 million in 2006. Congress turned a requested cut in wind energy R&D into a slight increase to \$50 million, and would save geothermal R&D from proposed elimination with a \$20 million appropriation. Congress also restored funding to the now-dormant hydropower program with \$10 million. Also in for a big increase is nuclear energy R&D, a renewable energy technology funded in a separate account, up 47 percent to \$162 million in 2008. These programs were heavily earmarked in the recent past to 2006, and after a one-year moratorium earmarks reappear in 2008, though they are now in a separate account and would not impact the above totals. Of the earmarks for renewable energy and energy conservation in the omnibus bill, \$127 million would go to R&D projects (see Table).

Congress once again reverses proposed cuts in many energy conservation and fossil energy R&D programs, as in 2007. Congress allocates \$557 million for fossil energy R&D, up a dramatic 13 percent instead of down 27 percent as requested. Coal R&D funding would surge 16 percent to \$493 million, including \$74 million for the FutureGen program to develop a carbon-neutral, coal-fired electricity and hydrogen production plant. Congress added \$40 million to the request for carbon sequestration R&D to bring the 2008 total to \$119 million, up 19 percent over 2007 and nearly double the funding the program had in 2006. At the same time, Congress once again reverses the proposed eliminations of the oil R&D and gas R&D programs. For good measure, Congress also nixes DOE's request to block \$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. Congress declined to block 2007 funding, so DOE initiated the program in 2007, paid for out of oil and gas royalty fees. The House blocked 2008 funding in order to shift money to other programs, but the Senate and now the omnibus bill leave the program untouched, thus adding \$50 million to 2008 Fossil Energy spending.

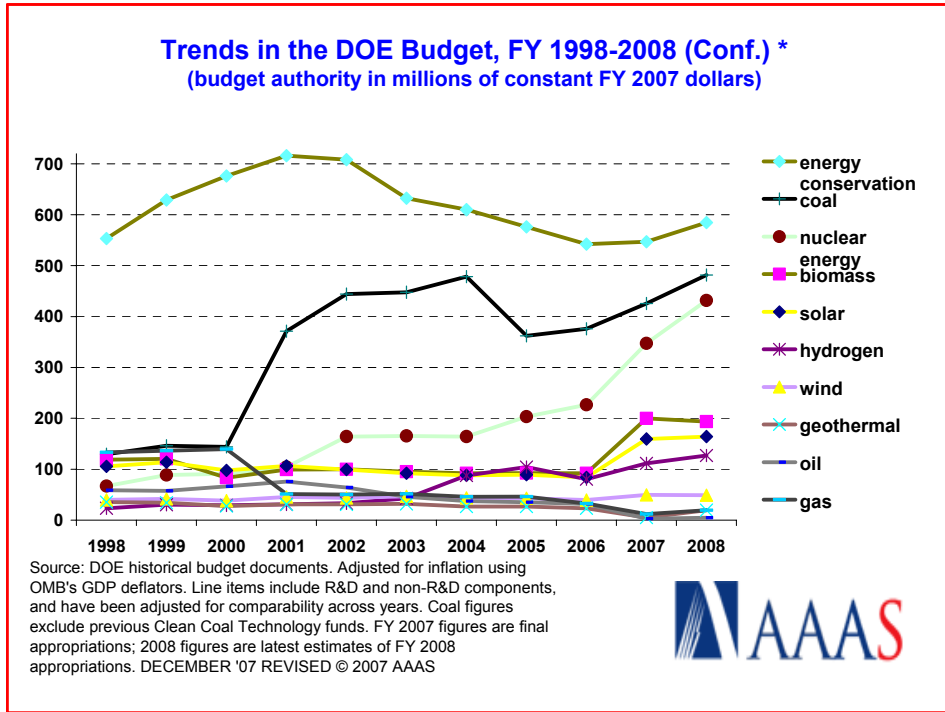


Figure 3. (click on the image for PDF)

The Energy Conservation portfolio is now part of the Energy Supply and Conservation program, and Congress would provide increases instead of proposed cuts for its component Vehicle Technologies, Building Technologies and Industrial Technologies parts.

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 gains 2.9 percent or \$107 million to \$3.8 billion in 2008** (see Table). The core Weapons Activities program, which funds science-based alternatives to nuclear testing in order to maintain the U.S. nuclear weapons stockpile, would remain flat at \$2.7 billion for R&D in 2008 (down 0.1 percent).

The DOE proposal to initiate research on a new generation of nuclear weapons has been opposed by Congress so far, and the **2008 omnibus bill makes that opposition emphatic by zeroing out funding for 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. Funding would be stagnant for some other key defense R&D areas, including inertial confinement fusion (\$470 million, down 4.0 percent) and advanced simulation and computing (\$574 million, down 6.1 percent), the defense counterparts to the Office of Science's fusion and computing portfolios, respectively. The one big growth area would be in nonproliferation R&D. The nonproliferation and verification R&D program would receive \$387 million in 2008 (see Table), up a surprising 43 percent from last year.

Outlook and Next Steps

Now that the 2008 omnibus bill is law, the impacts of DOE's final 2008 budget are rippling across the nation. The sharp reversal of fortunes in the Office of Science's plans for big increases are already being felt at FermiLab in Illinois, which bears the brunt of the High-Energy Physics portfolio cuts, and will soon be felt in Europe when the U.S. goes empty-handed to its ITER partners. Other Science facilities are still working out how to reduce operating times, staff, and research grants to deal with the shortfalls to their requested funding levels. On the energy side, however, DOE faces the opposite challenge of spending the enormous increases the energy R&D programs have won over the last two years and ramping up R&D efforts that had long been accustomed to flat or declining budgets. Meanwhile, the 2009 budget request is due in early February, setting into motion what is sure to be another budget roller-coaster ride of give-and-take between the Bush Administration and the Congress.

(This analysis is one of a series of AAAS R&D Funding Updates on FY 2008 congressional appropriations. The complete series of AAAS R&D Funding Updates, including continually updated analyses of R&D in FY 2008 appropriations, is available on the AAAS R&D Web Site (<http://www.aaas.org/spp/rd>) in the "FY 2008 R&D" or the "What's New" sections.)

- January 2, 2008

AAAS R&D Budget and Policy Program

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Table. DOE R&D in FY 2008 House-Senate Conference

**Table. Department of Energy
House-Senate Conference on R&D in the FY 2008 Budget
(budget authority in millions of dollars)**

	FY 2007 Estimate	FY 2008 Request	House-Senate Conference				
			FY 2008 CONF.	Chg. from Request Amount	Chg. from Request Percent	Chg. from FY 2007 Amount	Chg. from FY 2007 Percent
DOE Appropriations Containing R&D:							
1. Energy Supply & Conservation 1/	969	974	1,262	288	29.6%	293	30.3%
2. Science	3,511	4,052	3,697	-355	-8.8%	186	5.3%
3. Fossil Energy R&D	493	359	558	199	55.4%	65	13.1%
4. Atomic Energy Defense Activities	3,699	3,796	3,806	10	0.3%	107	2.9%
5. Radioactive Waste Management	60	53	53	0	-0.9%	-7	-12.5%
Total DOE R&D	8,732	9,234	9,376	142	1.5%	644	7.4%
1. Energy Supply and Conservation 1/							
Efficiency and Renewables 1/	760	761	988	227	29.8%	228	30.0%
- Hydrogen Technology	194	213	211	-2	-0.9%	18	9.0%
- Biomass and Biorefinery Sys.	200	179	198	19	10.6%	-2	-0.8%
- Solar Energy	159	148	168	20	13.6%	9	5.7%
- Wind Energy	49	40	50	9	23.6%	0	0.5%
- Geothermal Tech.	5	0	20	20	--	15	296.4%
- Hydropower	0	0	10	10	--	10	--
- Vehicle Tech.	188	176	213	37	21.0%	25	13.3%
- Building Tech.	104	86	109	23	26.1%	5	4.5%
- Industrial Tech.	57	46	64	18	40.0%	8	13.9%
- Congressional projects 3/	0	0	127	127	--	127	--
- minus demos & other non-R&D	-196	-128	-182	-54	42.0%	14	-7.0%
Electricity Delivery & Reliability	99	88	112	24	27.5%	13	13.4%
Nuclear Energy	110	125	162	37	29.7%	52	47.4%
TOTAL Energy Supply 1/	969	974	1,262	288	29.6%	293	30.3%
2. Science							
High Energy Physics	752	782	688	-94	-12.0%	-63	-8.4%
Nuclear Physics	423	471	433	-39	-8.2%	10	2.4%
Fusion Energy Sciences	319	428	287	-141	-33.0%	-32	-10.2%
Basic Energy Sciences	1,250	1,498	1,270	-229	-15.3%	20	1.6%
Adv. Scientific Computing Res.	283	340	351	11	3.2%	68	23.9%
Biological and Environmental Res.	483	532	544	13	2.4%	61	12.6%
Congressional Projects 2/	0	0	124	124	--	124	--
TOTAL Science R&D	3,511	4,052	3,697	-355	-8.8%	186	5.3%
Science Non-R&D Items	287	346	276	-69	-20.1%	-10	-3.6%
Total Science Budget (incl nonR&D)	3,797	4,398	3,973	-425	-9.7%	176	4.6%
3. Fossil Energy R&D 3/ (does not include non-R&D components)							
Coal Research	426	427	493	67	15.7%	68	15.9%
- Clean Coal Power Init.	60	73	69	-4	-5.0%	9	14.8%
- FutureGen	54	108	74	-34	-31.2%	20	37.6%
- Carbon sequestration	100	79	119	40	50.4%	19	18.9%
- Other Fuels and Power Sys.	211	167	231	64	38.6%	19	9.2%
Oil Technology	3	0	5	5	--	2	83.5%
Natural Gas Technology	12	0	20	20	--	8	65.2%
UltraDeepwater Unconven. Gas 3/	50	0	50	50	--	0	0.0%
Clean Coal Tech. 4/	0	-58	-58	0	0.0%	-58	--
Congressional Projects 2/	0	0	44	44	--	44	--
Plant & Cap. Equip. and adjs.	3	-10	3	13	-134.2%	1	28.5%
Total Fossil Energy R&D 3/	493	359	557	198	55.3%	64	13.1%

(continued)

Table. DOE R&D in FY 2008 House-Senate Conference

4. Atomic Energy Defense Activities

National Nuclear Security Administration (NNSA)

Naval Reactors	750	776	743	-33	-4.3%	-7	-1.0%
Weapons Activities	2,655	2,730	2,652	-78	-2.8%	-3	-0.1%
<i>(Reliable Replacement Warhead)</i>	36	89	0	-89	-100.0%	-36	-100.0%
<i>(Science Campaigns)</i>	270	273	288	15	5.3%	17	6.3%
<i>(Adv. Simulation and Computing)</i>	612	586	574	-11	-1.9%	-38	-6.1%
<i>(Inertial Confinement Fusion)</i>	490	412	470	58	14.0%	-20	-4.0%
<i>(All Other Weapons Acts. R&D)</i>	1,247	1,370	1,320	-50	-3.6%	73	5.9%
Nonproliferation & Verification R&D	270	266	387	121	45.6%	117	43.2%
Total NNSA R&D	3,675	3,772	3,782	10	0.3%	107	2.9%
Environmental Management	21	21	21	0	0.9%	0	0.9%
Other AEDA R&D	3	3	3	0	0.0%	0	0.0%
TOTAL Atomic Defense R&D	3,699	3,796	3,806	10	0.3%	107	2.9%

DOE R&D by Budget Function:

Defense	3,699	3,796	3,806	10	0.3%	107	2.9%
General Science	3,511	4,052	3,697	-355	-8.8%	186	5.3%
Energy	1,522	1,386	1,873	487	35.1%	351	23.0%

AAAS estimates based on FY 2008 appropriations bills. Includes conduct of R&D and R&D facilities.

FY 2007 and FY 2008 request figures based on OMB R&D data and supplemental agency budget data.

Some data adjusted by AAAS from DOE budget documents.

FY 2007 figures include 2007 supplemental appropriations enacted in Public Law 110-28.

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

1/ Combined from the former Energy Supply and Energy Conservation accounts.

2/ Congressionally designated projects (earmarks) are appropriated under a separate line in the 2008 omnibus bill.

3/ There is \$50 million in mandatory funding for ultra-deepwater and unconventional natural gas R&D in FY 2007 and FY 2008, but the FY 2008 request defers these funds.

4/ Rescissions and deferrals of previously appropriated funds.

FY 2008 Conference figures adjusted to reflect across-the-board reductions in the 2008 omnibus appropriations bill.

December 17, 2007 - AAAS estimates of House-Senate Conference appropriations.

These appropriations may be rejected by the House or Senate, and may be vetoed by the President.

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

	FY 2007 Estimate	FY 2008 Request	House-Senate Conference				
			FY 2008 CONF.	Chg. from Request Amount	Chg. from Request Percent	Chg. from FY 2007 Amount	Chg. from FY 2007 Percent
Weapons Activities (NNSA)	6,276	6,511	6,297	-214	-3.3%	22	0.3%
Other NNSA Activities	2,940	2,876	2,514	-362	-12.6%	-427	-14.5%
Total NNSA	9,216	9,387	8,811	-576	-6.1%	-405	-4.4%
Defense Environmental Cleanup	5,732	5,364	5,349	-15	-0.3%	-382	-6.7%
Nuclear Waste and Other Defense	983	1,056	954	-102	-9.7%	-29	-3.0%
Total DOE defense	15,931	15,807	15,114	-693	-4.4%	-816	-5.1%
Science	3,797	4,398	3,973	-425	-9.7%	176	4.6%
Energy Supply and Conservation 1/	2,155	2,188	2,823	635	29.0%	668	31.0%
Fossil Energy	593	567	743	176	31.1%	150	25.3%
Other Energy Programs	937	1,186	1,071	-115	-9.7%	133	14.2%
Nondefense Environmental Mngmt.	350	181	182	1	0.7%	-167	-47.9%
Power Marketing Administrations	271	240	268	28	11.4%	-3	-1.0%
Departmental Administration & IG	196	196	194	-2	-0.9%	-1	-0.6%
Total DOE Budget	24,228	24,763	24,368	-395	-1.6%	140	0.6%

Source: Department of Energy budget justification and FY 2008 appropriations bills.

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

FY 2008 Conference figures adjusted to reflect across-the-board reductions in the 2008 omnibus appropriations bill.

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

1/ Combined from the former Energy Supply and Energy Conservation accounts.

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