

War, Terrorism, and Growing Deficits Limit Bush FY 2006 R&D Budget; Civilian Science Funding Flat

For the third consecutive year, Bush administration officials are opening their discussions about the federal government's proposed science and research budget by first talking about topics that have nothing to do with science: the need to support the ongoing war on terror and the mounting pressure caused by the growing deficit. This "context setting" is a sure sign that the budget numbers for civilian science

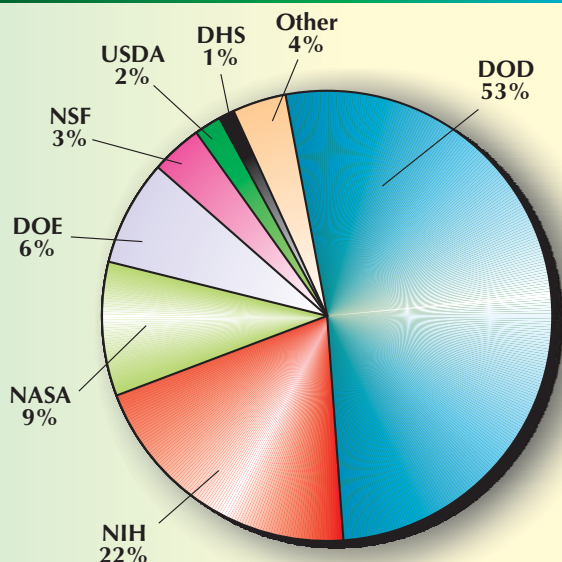
With the administration attempting to hold non-security domestic spending flat across the board, R&D increases are limited primarily to homeland security and the president's Moon/Mars initiative.

and technology will not be good, and for fiscal year 2006, they aren't.

Even John Marburger, director of the Office of Science and Technology Policy, who has managed to find silver linings in the past two years of flat or declining funding, recently described the president's budget proposal as "the tightest in

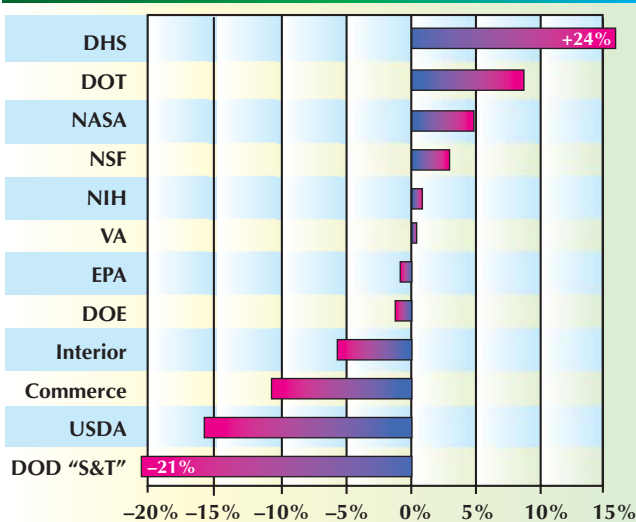
nearly two decades." Despite that, at a Senate hearing in February, Marburger managed to be upbeat about the science budget, noting that R&D money makes up 13.6% of total discretionary spending, "the highest level in 37 years." The federal R&D budget request of \$132.3 billion is an increase of \$733 mil-

Total R&D by Agency: FY 2006 Proposed



Where Bush's R&D money would go. The Department of Defense is once again the largest recipient of federal R&D money in the administration's FY 2006 budget proposal. The DOD's science and technology budget, would drop 19.5%. DOD weapons development would receive only modest increases, with the missile defense program being cut by \$1 billion to \$8.8 billion. The National Institutes of Health would receive \$28.7 billion, an increase of 0.5%. NIH research would rise by the same percentage to \$27.9 billion. NASA, which revamped its budget procedures yet again this year, does relatively well, but that is tied in part to the president's Moon/Mars vision. At NSF most of the 2.8% R&D increase would go to facilities funding, with most research directorates receiving increases of about 1%. One result will be an attempt by NSF officials to revamp their grant process to make it more targeted. The decline in DOE's R&D budget, especially the 4.5% cut to the Office of Science, would cause a significant reduction in operating times at many of the DOE research facilities. Proposed increases in hydrogen, nuclear energy, fuel cells, and coal R&D are the winners in the budget, with energy-related R&D up 8.4% to \$1.2 billion. The Department of Homeland Security, while still a small slice of the budget pie, continues to grow with a \$246 million focus on radiological and nuclear countermeasures.

FY 2006 R&D Request: Percent Change from FY 2005



DHS, Department of Homeland Security. DOD, Department of Defense. DOE, Department of Energy. DOT, Department of Transportation. EPA, Environmental Protection Agency. NIH, National Institutes of Health. USDA, Department of Agriculture. VA, Veterans Administration.

Winners and losers in Bush's science funding. When presidential science adviser John Marburger appeared before the House Committee on Science earlier this year, he said, "This administration understands that science and technology are major drivers of economic growth and important for . . . winning the war on terrorism." The understanding may be there, but the administration's FY 2006 budget is heavy on homeland security and defense, and with the notable exception of NASA, weak on civilian-oriented research. The House science committee termed the proposals for funding basic research "insufficient." Under the Bush proposal, nondefense R&D would increase just 0.3% to \$57 billion. NASA R&D would increase 4.6% to \$11.5 billion primarily because of money freed up by the planned return of the space shuttle to flight later this year. The *International Space Station* receives additional money, as does the president's Moon/Mars program. The Department of Energy would see its R&D funding decline by 1.9%, with the Office of Science decreasing 4.5% to \$3.2 billion. Department of Homeland Security R&D funding would slow compared to recent years, but would still increase 3.6% to \$1.3 billion. Department of Defense R&D would grow 0.1%, but basic research would fall 12.9%, and applied research would be down 14.7%. NSF would increase 2.4%, but much of that increase involves a transfer of icebreaking ships and \$48 million from the Coast Guard.

National Science Foundation R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
	(millions of dollars)*			
NSF total	5611	5473	5605	2.4
NSF R&D†	4123	4057	4170	2.8
Research and related activities (R&RA)				
Mathematical and physical sciences (MPS)				
Mathematical sciences	200	200	200	0.0
Astronomical sciences	197	195	199	1.8
Physics	228	225	230	2.3
Chemistry	185	179	181	1.1
Materials research	251	241	246	2.2
Multidisciplinary activities	31	29	30	1.7
Total MPS	1092	1070	1086	1.5
Geosciences (GEO)				
Atmospheric sciences	238	233	240	2.7
Earth sciences	152	149	154	3.4
Ocean sciences	323	312	315	1.1
Total GEO	713	694	709	2.2
Engineering	566	561	581	3.5
Biological sciences	587	577	582	0.9
Computer and information science and engineering (CISE)				
Computer and network systems	115	132	143	8.0
Computing and communications research	80	91	103	12.2
Information and intelligent systems	80	93	105	13.1
Information technology research	218	174	145	–16.3
Shared cyberinfrastructure	112	124	125	1.1
Total CISE	605	614	621	1.1
US polar programs				
Polar research programs‡	274	277	319	15.4
Antarctic logistical support	68	68	68	0.0
Total polar programs	342	344	387	12.4
Social, behavioral, and economic sciences	184	197	199	1.0
Office of International Science and Engineering	41	34	35	2.3
Integrative activities	164	130	135	3.8
Budget authority adjustment	–17	0	0	—
Total R&RA	4277	4221	4333	2.7
Major research equipment and facilities§	156	174	250	44.0
Education and human resources	945	841	737	–12.4
Salaries and expenses	220	223	269	20.5
National Science Board	4	4	4	0.8
Inspector General	10	10	12	14.7

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

†Adjusted downward for salaries, expenses, and other non-R&D activities.

‡Includes \$48 million in proposed transfer from the US Coast Guard for icebreakers.

§The \$76 million increase would fund continued work on the Atacama Large Millimeter Array radio telescope, EarthScope, IceCube Neutrino Observatory, the Rare Symmetry Violating Processes, and the Scientific Ocean Drilling Vessel.

lion over FY 2005 and sets another funding record, he said.

But he also noted that the administration's budget "maintains a strong focus on winning the war against terrorism while moderating the growth in overall spending, and this focus is reflected in the proposed R&D budget." What isn't mentioned in any of the administration's FY 2006 budget discussions is the tens of billions of dollars that will go to the war in Iraq this year. That money will loom in the background of all of the budget hearings on Capitol Hill, but no one knows exactly what impact it will have on the rest of the budget.

With the context set, the details of the administration's FY 2006 proposal reveal a budget that continues to squeeze civilian science. According to the R&D budget analysis by the American Association for the Advancement of Science, the high levels of federal R&D investment cited by Marburger are due mainly to increases in the FY 2005 budget for defense and homeland security funding. "In completing

the FY 2005 appropriations last December," the AAAS analysis says, "Congress went along with the president's proposals to freeze most domestic discretionary spending at FY 2004 levels. As a result, the nondefense, non-homeland security R&D portfolio stagnates this year, with modest increases in some areas offset by cuts in others." Even though overall defense spending is up significantly, defense R&D, particularly basic research, is flat or down. Homeland security, as expected, does very well under the budget proposal. And the overall NASA budget, reflecting the president's Moon/Mars initiative, also receives a significant boost.

But if Congress passes the president's budget proposal as is, "growth in the federal R&D portfolio would fail to keep pace with inflation for the first time in a decade, and most R&D programs would suffer cuts in real terms," according to the AAAS. An overview of the numbers from the AAAS provides a general sketch of what the administration is proposing:

► The proposed FY 2006 R&D portfolio boost of \$132.3 billion, although it's a record setter as Marburger noted, is just 0.1% above FY 2005 and short of the 2% increase needed to keep pace with inflation. So in real terms, the R&D portfolio would decline for the first time since 1996, with total federal support for basic and applied research dropping 1.4% to \$55.2 billion.

► Nondefense R&D investments would increase just 0.3% to \$57 billion. NASA would receive additional money for the *International Space Station* and the Moon/Mars program, but almost all other nondefense R&D agencies would see their funding decrease. ► NSF would see an increase of 2.8% in its R&D budget, which would offset last year's cut, but much of the 2.8% is directed at facilities and includes money transferred from the US Coast Guard as part of a transfer to NSF of icebreaking ships in Antarctica. The average NSF research grant support level would decrease for the second year in a row. The foundation's much-touted Math and Science Partnership education program would take a big hit as much of its support is moved to the Department of Education.

► R&D funding at the Department of Energy's (DOE's) Office of Science would decline 4.5% to \$3.2 billion. That cut would reduce the Office of Science budget to where it was five years ago.

► Defense R&D would fall by \$16 million to \$75.4 billion. This would come after multibillion-dollar increases over the past five years. Basic research at the Department of Defense would be cut sharply. Overall science and technology funding would drop 21% and weapons-related R&D would fall 2.6%, including cuts to inertial confinement fusion and advanced computing research. The missile defense program would see a \$1 billion cut.

► Department of Homeland Security R&D funding, which has increased by more than \$200 million in each year since the department began operations in 2003, would rise only \$44 million, or 3.6%, to \$1.3 billion. All of the DHS R&D would be consolidated into the directorate of science and technology.

The administration's budget proposal must work its way through 10 appropriations subcommittees in the House and another 12 subcommittees in the Senate. What comes out of the process will, as always, look significantly different from what the president is proposing. Each year, the majority members on the House Committee on Science—in recent years Republicans—issue a "views and estimates" report, which is a reliable indicator of what Congress thinks of the

president's science funding proposals. Typically the Republican document is reasonably favorable, and the Democratic members issue their own more critical report. This year the Republican report highlights so many concerns that the Democrats simply endorsed it instead of writing their own.

Ranking committee Democrat Bart Gordon, of Tennessee, said the report was so on point that the Democrats supported it "to send a stronger message to the administration, budget committee, and appropriators that the science and technology budget the president submitted is not the best we can do even under the current fiscal circumstances. We have to do better."

The report, released by committee chairman Sherwood Boehlert (R-NY), says that the committee's "top objective will be to pass authorization legislation for NASA. This legislation is needed to provide congressional direction in the wake of the president's space exploration vision." The committee also intends to pass the Organic Act for the National Oceanic and Atmospheric Administration, an act recommended by the US Commission on Ocean Policy that would give NOAA more authority and make it a more science-based agency.

While NASA and NOAA are listed as the top priorities, the report says the committee will also work to strengthen funding and activities at NSF, the Office of Science at DOE, and NIST. The report points specifically to proposed cuts in NSF's math and science education program and indicates that those cuts will have a difficult time making it through Congress.

The administration's proposal contains cuts for all three multiagency R&D initiatives, and the committee report says increases, not cuts, are needed. Funding for the National Nanotechnology Initiative would fall 2.5% to \$1.1 billion, well below the level authorized in 2003 by the Nanotechnology R&D Act. The networking and information technology R&D initiative would drop by 6.8% to \$2.1 billion, and the Climate Change Science Program would decrease 1.4% to \$1.9 billion. The cut in the climate change program, according to the AAAS analysis, comes primarily from steep cuts in NASA's contribution through space-based observations of the environment.

The committee also noted that under the budget proposal, funding would remain flat for cybersecurity R&D programs at NSF, NIST, and the DHS. That funding is well below levels authorized by Congress, the report says, and an increase in funding is needed.

With the deficit growing and both

NASA R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
	(millions of dollars)*			
NASA total	15 378	16 197	16 456	1.6
NASA R&D	10 574	10 990	11 527	4.6
R&D programs				
Science, aeronautics, and exploration (SAE)	9461	9335	9661	3.5
Science, total	5600	5527	5477	−0.9
Solar system exploration				
Discovery	272	181	169	−6.6
New Frontiers	148	211	159	−24.8
Technology	193	131	96	−26.8
Deep space mission systems	265	258	257	−0.1
Solar system research	418	345	363	5.0
Mars exploration	596	681	723	6.2
Robotic lunar exploration	17	52	135	158.8
Solar system exploration total	1909	1858	1901	2.3
The universe				
Navigator	165	234	199	−14.7
<i>James Webb Space Telescope</i>	243	312	372	19.2
<i>Hubble Space Telescope</i>	243	216	191	−11.6
<i>Stratospheric Obs. for Infrared Astronomy</i>	67	51	48	−5.1
Gamma-Ray Large Area Space Telescope	103	107	99	−7.1
Discovery	51	126	118	−6.1
Explorer	58	82	101	22.9
Universe research	363	332	316	−4.8
International space science	32	13	13	−2.3
Beyond Einstein	27	42	56	32.8
The universe, total	1352	1513	1512	−0.1
The Earth–Sun system				
Earth systematic missions	208	301	182	−39.5
Living with a star	126	203	234	15.6
Solar terrestrial probes	158	100	79	−21.4
Explorer program	129	104	117	13.0
Earth system science pathfinder	114	108	136	25.6
Multimission operations	415	334	268	−19.7
Earth–Sun research	927	819	845	3.2
Applied sciences	30	44	52	20.0
Education and outreach	24	23	23	1.7
Earth–Sun technology	207	122	127	4.6
The Earth–Sun system, total	2339	2156	2064	−4.3
Exploration systems				
Constellation systems	912	527	1120	112.7
Exploration systems	677	696	919	32.1
Prometheus nuclear systems	0	432	320	−26.0
Human systems research and technology	986	1031	807	−21.8
Exploration systems total	2574	2685	3165	17.9
Aeronautics research	1057	906	852	−5.9
Education programs	230	217	167	−23.0
Exploration capabilities				
International Space Station	1364	1676	1857	10.8
Space shuttle	4061	4669	4531	−3.0
Space and flight support	466	485	376	−22.6
Exploration capabilities total	5890	6830	6763	−1.0

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

the war in Iraq and the war on terrorism continuing, the squeeze on science funding is tighter than in the past two decades. Yet Boehlert and other political leaders are echoing statements from the science and technology communities that scientific research is critical to both sustaining the US economy and increasing security. The Republican report points to a statement by DHS Under-secretary Charles McQueary, who said at a science committee hearing, "The nation's advantage in science and technology is key to securing the homeland." How the science and technology budget plays out

won't be evident until late in the year, but the following agency highlights help define the playing field and indicate some areas of contention.

National Science Foundation. NSF is the only federal agency with responsibility for research in all major scientific and engineering fields, and in most of those fields the foundation is the largest, or second largest, source of federal funds. NSF is the second largest federal supporter of academic R&D, behind the National Institutes of Health, and sends 81% of its R&D support to colleges and universities.

Proposed cuts in NSF funding typ-

Department of Energy R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
		(millions of dollars)*		
DOE total	23 351	23 918	23 443	–2.0
DOE R&D	8763	8614	8452	–1.9
Science R&D programs				
High-energy physics (HEP) total	716	736	714	–3.1
Proton accelerator-based physics	383	401	387	–3.5
Research	76	76	75	–0.3
University research†	46	44	44	0.0
National laboratory research‡	29	30	30	–1.1
University service accounts	1	1	1	7.6
Facilities	306	325	312	–4.2
Tevatron operations and improvements	233	246	231	–6.2
Large Hadron Collider projects & support§	65	62	63	–2.9
AGS operations	1	1	1	–2.0
Other facilities	9	16	20	20.4
Electron accelerator-based physics	145	144	133	–7.7
Research	27	25	25	–2.3
University research	16	16	16	0.0
National laboratory research	11	10	9	–6.6
Facilities (B-factory operations and improvements)	118	118	108	–8.9
Nonaccelerator physics	47	47	39	–17.8
University research	14	13	13	0.0
National laboratory research	19	17	17	0.0
Projects	14	14	4	–70.5
Other	1	3	5	39.7
Theoretical physics	49	49	49	0.2
Advanced technology R&D (accelerators and detectors)	79	95	106	12.3
Construction#	12	7	0	–100.0
Nuclear physics total	380	405	371	–8.4
Medium-energy nuclear physics	119	125	112	–10.6
Research	31	36	35	–4.4
University research (includes 35 universities)	16	16	15	–0.9
National laboratory research (includes TJNAF, ANL, BNL, and LANL)	15	15	15	–2.6
Other research	3	5	5	–7.7
Operations**	88	88	77	–13.1
Heavy-ion nuclear physics	161	175	162	–7.3
Research	30	33	33	–0.1
University research (includes 26 universities)	12	13	12	–4.8
National laboratory research (includes BNL, LBNL, LANL, LLNL, and ORNL)	18	17	18	5.2
Other research	0	4	4	–7.9
Operations (primarily RHIC)	131	141	127	–8.9
Low-energy nuclear physics	71	76	69	–9.8
Research	47	52	46	–10.9
University research (includes 25 universities)	18	19	17	–8.9
National laboratory research (includes ANL, BNL, LBNL, LANL, LLNL and ORNL)	22	25	23	–4.5
Other research	7	9	6	–34.0
Operations (ATLAS and HRIBF facilities)	24	24	22	–7.3
Nuclear theory	28	29	27	–9.3
Fusion energy sciences total	256	274	291	6.1
Science	143	155	143	–7.9
Tokamak experimental research	45	45	44	–3.1
Alternative concept experimental research	57	61	50	–18.0
SciDAC (advanced computing)	3	4	4	0.0
Theory	25	25	25	–3.2
General plasma science	12	12	14	12.6
Small business research	0	7	6	–10.3
Facility operations††	86	90	128	41.8
Enabling R&D	27	29	20	–29.9
Basic energy sciences (BES) total	991	1105	1146	3.7
Materials sciences	559	635	746	17.5
Chemical sciences, geosciences, and energy biosciences (CGEB)	214	239	222	–7.4
National user facilities operations (funding is contained within the materials sciences and CGEB budgets)				
Advanced Light Source, LBNL	44	46	42	–7.1
Advanced Photon Source, ANL	96	100	98	–2.0
National Synchrotron Light Source, BNL	37	37	37	0.0
Stanford Synchrotron Radiation Laboratory	30	31	28	–7.7
High Flux Isotope Reactor, ORNL	40	47	40	–14.7
Radiochemical Engineering Development Ctr, ORNL	6	5	0	–100.0
Intense Pulsed Neutron Source, ANL	17	17	17	0.0
Manuel Lujan Jr Neutron Scattering Ctr, LANL	10	10	10	2.5
Spallation Neutron Source, ORNL‡‡	18	33	107	222.9
Center for Nanoscale Materials, ANL	0	0	4	—
Molecular Foundry, LBNL	0	0	9	—
Center for Nanophase Materials Sciences, ORNL	0	0	18	—
Center for Integrated Nanotechnologies, SNL/LANL	0	0	13	—
Linac Coherent Light Source, SLAC	0	0	4	—

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ically attract a great deal of attention on Capitol Hill, and this year promises to be no exception. Here are the numbers congressional leaders will be considering: The FY 2006 budget request for NSF is \$5.6 billion, an increase of 2.4%, or \$132 million over FY 2005. Because NSF received a 3.1% cut in FY 2005, the overall request for this year is actually 1% below the FY 2004 level.

The views and estimates report notes that the proposed 2.4% increase “includes money provided to foot the bill for icebreaking expenses currently paid by the US Coast Guard, so the increase for NSF in reality comes to about 1.5%.” Those numbers look even worse when compared to funding levels authorized by Congress in the National Science Foundation Authorization Act of 2002, which called for doubling NSF’s budget by 2007. Had the authorization levels been met, NSF would be looking at an \$8.5 billion budget in FY 2006 instead of the proposed \$5.6 billion figure.

NSF’s research and related activities (R&RA) account, which funds most science research, would receive \$4.3 billion—\$113 million, or 2.7%, more than FY 2005. It is in this account that the icebreaker money skews the real funding outlook. Much of the 2.7% increase is due to the proposed transfer of \$48 million from the Coast Guard icebreaker program to NSF’s Office of Polar Programs. The icebreakers, two large ships and a smaller one, are aging, and their operating costs are estimated by some on the hill to be closer to \$70 million, which would cut further into the R&RA account. But if the \$48 million icebreaker money is left out of the R&RA equation, then most of the research directorates would receive increases of about 1%. Only the engineering directorate, with a 3.5% increase, would receive a raise above the rate of inflation.

NSF’s integrative activities account within R&RA would increase by \$5 million to \$135 million, and within that account, funding for the Major Research Instrumentation Program would remain at the FY 2005 level of \$90 million. The program, which awards grants to universities and colleges to purchase laboratory equipment, was cut last year from the FY 2004 funding level of \$110 million.

Funding for the foundation’s participation in the multiagency Nanoscale Science and Engineering Initiative would increase 1.8% to \$344 million, with major funding split between the engineering and the mathematics and physical sciences directorates. NSF’s participation in other multiagency ini-

tatives would increase by only 1%.

One of the biggest fights on Capitol Hill, as reflected in the House science committee report, is likely to be over the administration's efforts to transfer the Math and Science Partnership (MSP) program to the Department of Education. The committee report details the problem this way:

The committee is especially disturbed by the proposed cuts in NSF's education and human resources directorate. Since 1950, NSF has been tasked with strengthening math and science education programs at all levels. Yet, under the budget proposal, the overall investment in education at NSF would drop from \$841.4 million in FY 2005 to \$737 million in FY 2006 (down 12%). NSF's education programs are unique in their capacity to develop new and improved materials . . . create better teacher training . . . and move promising ideas from research to practice. The committee fears that disinvestments in this area will deprive states, school districts and schools of the tools and ideas they need to achieve the goals of the No Child Left Behind Act.

The administration is proposing to cut \$19 million from NSF's contribution to the MSP program, which NSF runs jointly with the Department of Education. While NSF's participation in MSP drops under the president's proposal, the Department of Education would see its MSP budget increase from \$179 million in FY 2005 to \$269 million in FY 2006.

One area that does get a big boost is NSF's support of R&D facilities, which would increase 18.5% to \$429 million. As part of that support, the major research equipment and facilities construction account would receive \$240 million, a 44% increase from the \$174 million in FY 2005. While there are no new starts in the facilities program, there are increases for two projects started in FY 2005. The Scientific Ocean Drilling Vessel project would receive \$58 million, up from \$15 million, and the Rare Symmetry Violating Processes project would increase from \$15 million in FY 2005 to \$42 million.

The Atacama Large Millimeter Array, EarthScope, and the IceCube Neutrino Observatory would be funded at FY 2005 levels. Several other projects that were being considered for FY 2006 startup have been pushed back at least a year.

Department of Energy R&D Programs (continued)

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
	(millions of dollars)*			
Linac for LCLS	0	0	30	—
Construction	219	230	178	−22.6
Advanced scientific computing research	197	232	207	−10.9
Biological and environmental research	624	582	456	−21.7
Fossil energy R&D	547	448	382	−14.7
Energy conservation	379	367	356	−3.0
Atomic defense activities R&D total	4198	4138	4031	−2.6
National Nuclear Security Administration (NNSA) total	4147	4080	3968	−2.8
Weapons activities R&D, total	3186	3084	2940	−4.7
Science campaigns	259	276	262	−5.1
Advanced simulation and computing	715	697	661	−5.2
Inertial confinement fusion	512	536	460	−14.1
All other weapons R&D	1700	1575	1557	−1.2
Nonproliferation and verification	226	224	272	21.4
Naval reactors	735	772	756	−2.1
Other atomic energy defense activities R&D	8	2	2	0.0
Environmental management	43	56	61	8.9
Radioactive waste management	75	63	44	−30.2

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

†Consists of groups from more than 60 universities doing experiments at proton accelerator facilities. Most experiments are conducted at Fermilab's Tevatron; development of the physics program for the LHC; and the MINOS and MINIBOONE neutrino experiments at Fermilab and the Soudan Mine in Minnesota.

‡The national lab research program is "slightly reduced" to provide more support for high-priority Tevatron operations.

§Fermilab research (\$13 million) includes data taking and analysis of the CDF, D-Zero, and MiniBooNE experiments, and commissioning of the MINOS detector. LBNL (\$5.2 million) and BNL (\$7.3 million) research focuses on the CDF and D-Zero data analysis and on the ATLAS research and computing program. ANL (\$4 million) will work on the CDF data, ATLAS, and the MINOS detector.

§Reflects the 95% completion of the US LHC detector projects (ATLAS and CMS) in fiscal year 2005 and slippage in the overall schedule because of difficulties at CERN.

||Focused mainly on R&D for the SNAP mission concept, and fabrication of VERITAS. With the completion of DOE's contribution to GLAST/LAT fabrication in FY 2005, this funding category is "significantly reduced."

#Decrease to zero reflects the completion of the NuMI project in FY 2005.

**Primarily TJNAF and MIT/BATES laboratories.

††Includes DIII-D, Alcator C-Mod, NSTX, NCSX, ITER preparations, and other, smaller operations.

‡‡The SNS receives another \$41.7 million in final-phase construction costs.

AGS, Alternating Gradient Synchrotron. ANL, Argonne National Laboratory. ATLAS, a Toroidal LHC Apparatus. BNL, Brookhaven National Laboratory. HRIBF, Hollifield Radioactive Ion Beam Facility. LANL, Los Alamos National Laboratory. LBNL, Lawrence Berkeley National Laboratory. MSFC, NASA's Marshall Space Flight Center. ORNL, Oak Ridge National Laboratory. RHIC, Relativistic Heavy Ion Collider. SNL, Sandia National Laboratories. TJNAF, Thomas Jefferson National Accelerator Facility.

Department of Energy. Overall, DOE would see its R&D funding drop by 1.9% to \$8.5 billion, a decrease of \$161 million. The proposed cuts to the Office of Science of 4.5%, to \$3.2 billion, would be spread across many programs, including physics, biology, and energy sciences. Only two accounts, basic energy sciences and fusion energy sciences, would receive increases, but the money would be focused on two specific projects. In basic energy sciences, money for the Spallation Neutron Source would jump from \$33 million to \$149 million as the facility moves from construction to operations. The AAAS analysis notes that the SNS increase would leave other basic energy programs flat funded in FY 2006. The science committee report supports the SNS funding but is concerned that it will "come at the expense of research grant funding, which is down by about 10% in this request."

In fusion science, ITER, an international prototype fusion energy project, gets the big boost, with its budget increasing from \$5 million in FY 2005 to \$56 million in FY 2006. Some on Capitol Hill have questioned why so much money is going to an international project that is stalled because of disputes over where the reactor should be located. With ITER receiving a large increase, the rest of the fu-

sion programs would see cuts.

Another serious concern with the cuts to the Office of Science is the effect they will have on operations at DOE facilities around the country. The facilities are routinely used by outside researchers, and tight budgets in recent years have reduced the operating time at many facilities. The science committee report complains that "under the budget proposal, existing user facilities would be shut down for more weeks of the year because of lack of funds. These facilities are used by industrial and academic researchers as well as by researchers at the national laboratories themselves." The facilities are expensive and, the report says, "it is wasteful to allow them to sit idle for much of the year."

The austere budget proposal is also creating problems for the Office of Science's much-vaunted facilities plan, released in 2003, which prioritized the 20 research facilities it hopes to open during the next 20 years. One project included in that plan, the BTeV at Fermilab, is to be canceled later this year at the end of the engineering design phase. Another project, the Rare Isotope Accelerator, would be deferred under the FY 2006 proposal.

The increases in DOE R&D funding would go primarily to the hydrogen fuel initiative, increased 15%

Department of Defense R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
	(millions of dollars)*			
DOD total R&D	65 948	70 929	71 009	0.1
Research, development, test and evaluation (RDT&E)				
Total basic research (6.1)	1358	1513	1319	−12.9
US Army				
In-house independent research	23	23	21	−11.0
Defense research sciences	151	163	138	−15.6
University research initiatives	82	84	67	−20.0
University and industry research centers	97	100	82	−18.1
Force health protection	16	22	0	−100.0
Total US Army	369	393	308	−21.7
US Navy				
University research initiatives	89	91	76	−16.9
In-house independent research	15	19	16	−20.0
Defense research sciences	364	380	357	−6.2
Total US Navy	468	491	448	−8.7
US Air Force				
Defense research sciences	210	252	224	−11.2
University research initiatives	104	119	105	−11.7
High-energy laser research	12	12	12	−2.7
Total US Air Force	326	383	341	−11.1
Defense agencies				
Defense research sciences	130	170	130	−23.3
National defense education program	0	3	10	311.3
Government–industry cosponsorship of university research	7	7	0	−100.0
DEPSCoR	11	13	9	−30.2
Chemical and biological defense research	47	54	73	34.2
Total defense agencies	195	246	222	−9.8
Applied research (6.2)	4347	4850	4139	−14.7
Advanced technology development (6.3)	6185	6708	5064	−24.5
Total science and technology	11 890	13 071	10 522	−19.5
Other RDT&E†	52 752	55 726	58 834	5.6
Total RDT&E	64 643	68 797	69 356	0.8
Medical research	486	507	169	−66.6
Other appropriations	819	1625	1484	−8.7

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

†Includes RDT&E categories 6.4 through 6.7.

from \$224 million to \$257 million. This is part of an evolving initiative that would tie together DOE efforts in everything from developing hydrogen fuel cells to obtaining hydrogen from coal. Money would come from several existing DOE programs, and from the Office of Science. Nuclear energy R&D would receive an increase of 12%, to \$95 million, but half of that money would go to a nuclear hydrogen production program.

NASA. Although NASA employees initially rejoiced at the news that their agency had received a proposed 1.6% budget increase in FY 2006 to implement the president's Moon/Mars vision, that increase is half a billion dollars less than the agency previously said it would need to implement the program. Former NASA administrator Sean O'Keefe, before leaving NASA in mid-February, said that the agency's proposed \$16.5 billion budget remained healthy in "these challenging times" because of the "specific policy direction set by the president."

Under the administration's proposal, NASA's R&D budget would increase 4.6%, or \$507 million, over FY 2005. But as Congress takes a closer look at the budget, NASA is bracing for challenges to the choices the administration made for the agency. These include a proposed 6%

aeronautics research cut that could cause the loss of thousands of jobs at NASA and threaten some research centers with closure. In addition, the Earth sciences program would drop 4%, while biological and physical research would fall 22%.

The FY 2006 budget also would mean the cancellation of a rescue mission to the *Hubble Space Telescope* and the delay of the *Jupiter Icy Moon Orbiter*. A significant delay in *JIMO* would likely lead to cancellation of the project. Although the *HST* seems doomed, the budget proposal reaffirms NASA's commitment to the *International Space Station* and the space shuttle program. Indeed, the shuttle and space station programs account for about 40% of the agency's entire budget. But even here there is controversy because the costs of returning the space shuttle to flight continue to increase, while the FY 2006 budget assumes they will drop.

More controversy involving the shuttle occurred when O'Keefe admitted in February that a proper risk analysis of a shuttle mission to service the *HST* had not been done, despite NASA's claims to the contrary last year. The budget proposal includes \$75 million for a de-orbit module for *HST*, and there is also \$18 million for extending the telescope's life without fix-

ing it, said NASA's Science Associate Administrator Alphonso V. Diaz. American Astronomical Society President Robert Kirshner said in a recent statement that he was "very disappointed with NASA's current plan not to service *HST*. We know that NASA is committed to doing the world's best astronomy, and servicing *Hubble* with the shuttle is part of the best program."

Nearly \$753 million of the budget would go toward development of a crew exploration vehicle that is intended to replace the shuttle in 2014, four years after the last shuttle flight.

The Prometheus nuclear power propulsion program did not get as much money as expected after NASA officials realized how costly *JIMO* would be. The craft is the flagship demonstration vehicle for the nuclear power propulsion program, but because of its spiraling costs, NASA may soon announce a less ambitious replacement vehicle. The loss of *JIMO* may strengthen the case for developing *Juno*, a spacecraft that would go into polar orbit around Jupiter to investigate the existence of an ice-rock core. *Juno* is currently competing for approval against *Moonrise*, a lunar sample return mission (see PHYSICS TODAY, February 2005, page 26) and a final decision on which mission will get the go-ahead will be made later this year. Both *Juno* and *Moonrise* are part of NASA's New Frontiers Program, which would be cut by 24% under the FY 2006 budget proposal.

Perhaps the most significant change at NASA may be organizational. Last month, Ames Research Center at Moffett Field, California, offered buyouts (capped at \$25 000) to all but 70 of its 1400 federal employees. Other centers will soon follow. More than 350 employees left NASA last year due to buyouts and the agency expects more than 1000 employees to leave each year over the next five years under the program. NASA is currently evaluating whether to close some of its 10 research centers or to sell them to a third party and run them under contracts similar to that at the Jet Propulsion Laboratory in Pasadena, California.

Department of Defense. Because the billions of dollars going to the war in Iraq are not included in the administration's DOD budget proposal but are added later in separate "supplemental" budget requests, the FY 2006 request is misleading. In FY 2005 the DOD controls a record-breaking \$476 billion budget, which includes a recently proposed multibillion-dollar supplemental request for Iraq. For FY 2006 the DOD budget request is for \$419 billion, a dramatic decrease. But

because FY 2006 supplemental war-related requests are expected to be in the range of \$75 billion or more, the decrease isn't real.

Of most interest to the scientific community is the DOD's basic (6.1) and applied (6.2) research funding, which account for about 13% of all such federal research support. Basic research would fall 12.9% to \$1.3 billion in the FY 2006 budget, and would include decreases in all of the military services. Much of the decrease would come through the elimination of FY 2005 congressional earmarks—money put in the budget by Congress for specific programs not in the DOD's original budget request. But beyond the earmarks, according to the AAAS budget analysis, several core research programs would also be cut. The university research initiatives program, for example, would be cut 15.7% to \$248 million. The program awards basic research grants to universities.

Applied research would drop 14.7%, or \$711 million, to \$4.1 billion in FY 2006. Applied research programs for the US Army, Navy, and Air Force would all undergo sharp cuts—40% in the army's case. The Defense Advanced Research Projects Agency (DARPA) would receive a 3.6% increase to \$3.1 billion, the third increase in as many years.

Department of Homeland Security. The rapid growth that has marked DHS since the department was founded by the Homeland Security Act of 2002 shows signs of slowing in FY 2006, although DHS still does well compared with most other federal agencies. R&D at DHS would increase 3.6%, or \$44 million, to \$1.3 billion. That is respectable, but significantly less than the \$200 million increases in the previous three budgets. The FY 2006 budget also would complete the centralization of all DHS R&D under the Directorate of Science and Technology.

The FY 2006 proposal sets radiological and nuclear countermeasures as a top priority with a request of \$246 million. Of that amount, \$227 million would go to establish a new domestic nuclear detection office that would have the task of developing a system for detecting and reporting on terrorist attempts to transport or use radiological or nuclear materials.

Biological countermeasures would remain as the largest part of the DHS R&D budget, receiving \$362 million in FY 2006. Much of that money would continue R&D activities in detection technologies and the creation of a national detection network.

NIST and NOAA. The good news in the proposed NIST budget is a 12.7% increase for research at the institute's laboratories.

Department of Commerce (NOAA and NIST) R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
(millions of dollars)*				
National Oceanic and Atmospheric Administration R&D				
Total	640	636	565	–11.2
NIST R&D				
Total	457	461	416	–9.7
Scientific and Technical Research Services (STRS)†	279	317	357	12.7
Advanced Technology Program	134	114	0	–100.0
Construction of research facilities	43	30	59	99.0

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

†STRS includes NIST's laboratories. Physics would receive a 9.5% increase from \$41.3 million in fiscal year 2005 to \$45.3 million in the FY 2006 proposal.

Department of Homeland Security R&D Programs

	FY 2004 actual	FY 2005 estimate	FY 2006 request	FY 2005–06 percent change
(millions of dollars)*				
DHS total†	35 604	38 511	41 067	
Total DHS R&D	1028	1243	1287	3.6
Border and transportation security‡	145	178	0	–100.0
Science and technology	869	1047	1287	22.9
Biological countermeasures	455	363	362	–0.1
NBACC construction§	4	35	0	–100.0
Chemical countermeasures	23	53	102	92.5
Explosives countermeasures	7	20	15	–25.4
Radiological and nuclear countermeasures	106	123	246	101.0
Threat and vulnerability assessment	59	66	47	–28.6
Standards	32	40	36	–10.6
Components	21	55	94	71.4
University programs	22	70	64	–9.1
Emerging threats	11	11	11	–2.3
Rapid prototyping	68	76	21	–72.5
Counter MANPADS#	17	61	110	80.3
SAFETY Act	0	10	6	–44.0
Interoperable communications	0	21	21	–2.4
Critical infrastructure	12	27	21	–23.0
Cybersecurity	10	18	17	–7.2
R&D consolidation	0	0	117	—
Budget authority adjustment	22	0	0	—
Coast Guard	15	18	0	–100.0

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

†For comparison purposes, money appropriated for Project BioShield in fiscal years 2004 and 2005 has been excluded.

‡Those amounts were \$884 749 in FY 2004, and \$2 507 776 in FY 2005. The FY 2005 appropriations fund the BioShield program through 2008, so no request was made for the program in FY 2006.

§R&D programs that transferred into DHS with the Transportation and Security Administration and the Coast Guard in 2003 would be moved out of those units and into the Science and Technology Directorate in FY 2006.

||Includes \$227 million for a new domestic nuclear detection office.

#Counter MANPADS are funds to develop a system to defend commercial airliners against attacks from small anti-aircraft missiles.

The bad news is that the money would come from the elimination of NIST's Advanced Technology Program (ATP), something the Senate may not allow to happen. For the past three budgets, the administration and House Republicans have tried to get rid of ATP on the grounds that it is a government subsidy of private industry. The program provides funds to small companies to help develop new technologies that are deemed too risky for full private-industry investment. Program advocates claim it is very successful, but efforts to kill the program continue.

The FY 2006 budget would zero out ATP, not even providing enough funds to close out existing grants. In addition, a similar program, the Manufacturing Extension Partnership would be cut 57% to \$47 million. If that cut is enacted, many of the MEP centers will likely close.

The tradeoff, according to the AAAS analysis, is that the savings from the ATP and MEP programs

would fund the boost in the NIST laboratories. Two years ago, when the same problem existed, Congress saved ATP by taking money from the laboratories and MEP. This year, if the Senate decides to save ATP again and bolster MEP, the money could once again come from the laboratories.

NOAA's R&D budget would drop by 11.2% to \$565 million, but from the administration's point of view, the funding would remain about the same as it requested last year; the drop comes almost entirely from the elimination of congressional earmarks. NOAA's climate research program would stay at \$178 million but would involve taking \$18 million from congressionally earmarked programs and moving it to core research programs. Weather and air quality research would decrease from \$51 million to \$38 million, again because of the elimination of earmarks. The National Sea Grant College Program would stay at \$61 million. ■

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