

Mechanical Engineering in the FY 2008 Budget

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Table 1: Summary of Mechanical Engineering-Related Programs in the FY 2008 Budget (in millions of dollars)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Request
Department of Defense	13,272	13,329	10,787
Department of Energy	3,202	3,438	4,189
Department of Homeland Security	817	1,005	978
Environmental Protection Agency	240	228	239
National Aeronautics and Space Admin.	1,577	1,370	553
National Institute of Standards and Tech.	751	676	639
National Institutes of Health	907	898	896
National Science Foundation	398	427	461

Table 2: Detail of Mechanical Engineering-Related Programs in the FY 2008 Budget (in millions of dollars)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Request
Department of Defense (DOD)			
<i>Army</i>			
Basic Research (“6.1”)	364	366	306
Applied Research (“6.2”)	1,184	1,204	686
Advanced Technology Development (“6.3”)	1,847	1,267	736
<i>Navy</i>			
Basic Research (“6.1”)	467	492	467
Applied Research (“6.2”)	762	786	678
Advanced Technology Development (“6.3”)	1,012	768	535
<i>Air Force</i>			
Basic Research (“6.1”)	374	409	375
Applied Research (“6.2”)	1,039	1,156	1,011
Advanced Technology Development (“6.3”)	975	1,038	580
<i>Defense Wide</i>			
Basic Research (“6.1”)	252	298	280

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Applied Research (“6.2”)	1,963	2,184	1,982
Advanced Technology Development (“6.3”)	3,033	3,363	3,152
- <i>University Research Initiative (non-add)</i>	272	249	246
Total DOD	13,272	13,329	10,787

Department of Energy (DOE)

Office of Science

Basic Energy Sciences	1,135	1,297	1,377
Advanced Scientific Computing Research	235	265	340
Fusion Energy Sciences	288	319	428
<i>Office of Nuclear Energy, Science, & Tech.</i>			
Nuclear Energy R&D	224	224	568
Univ. Nuclear Reactor Infrastructure & Edu.	27	0	0
<i>Office of Energy Effic. /Renewable Energy</i>			
Hydrogen Technology	156	216	213
Biomass and Biorefinery Systems R&D	91	177	179
Solar and Wind Energy	122	192	208
Geothermal Technology	23	5	0
Hydropower	0.5	1	0
Vehicle, Building & Industrial Technologies	308	349	309
<i>Office of Fossil Energy</i>	592	593	567

Total DOE	3,202	3,438	4,189
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Department of Homeland Security (DHS)

Science and Technology Directorate

Biological and Chemical Countermeasures	376	314	229
Border and Maritime	43	33	26
Command, Control, Interoperability	108	63	64
Explosives	262	105	64
Human Factors	6	7	13
Test, Evaluation and Standards	35	25	25
Infrastructure and Geophysical	86	75	24
Innovation	0	38	60
Laboratory Facilities	83	106	89
Transition	19	24	25
University and Fellowship Programs	62	49	39
<i>Domestic Nuclear Detection Office R&D</i>	209	273	320

Total DHS	817	1,005	978
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Environmental Protection Agency (EPA)

Clean Air Research	-	-	81
Air Toxics Research **	19	12	-

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Climate Change Research	18	18	17
Sustainability Research	27	21	23
Drinking Water and Water Quality Research	100	106	105
Nat'l Ambient Air Quality Stds. (NAAQS)**	65	65	-
Fellowships	16	8	8
Total EPA	<u>245</u>	<u>230</u>	<u>234</u>

National Aeronautics and Space Administration (NASA)

<i>Aeronautics Technology</i>			
Aviation Safety and Security	148	102***	74
Airspace Systems	174	120***	98
Fundamental Aeronautics	562	447***	293
Aeronautics Test Program	-	55***	88
<i>Exploration Systems Research & Technology</i>	693	646	***
Total NASA	<u>1,577</u>	<u>1,370</u>	<u>553</u>

National Institute of Standards and Technology (NIST)

<i>Scientific & Tech. Res. & Services</i>			
NIST Laboratories	394	434	500
<i>Industrial Technology Services (ITS)</i>			
Advanced Technology Program (ATP)	79	79	0
Manufacturing Extension Partnership	104	104	46
Construction of Research Facilities	174	59	93
Total NIST	<u>751</u>	<u>676</u>	<u>639</u>

National Institutes of Health (NIH)

NIH-wide SBIR/STTR (excl. NIBIB)	609	600	596
National Institute of Biomedical Imaging & Bioengineering (NIBIB)	298	298	300
Total NIH	<u>907</u>	<u>898</u>	<u>896</u>

National Science Foundation (NSF)

Chemical, Bioeng., Env., & Transport Sys.	112*	125*	124
Civil, Mechanical, & Manuf. Innovation	141§	149§	152
Engineering Education and Centers	120	124	126
Emerging Frontiers in Res. & Innov.	0	0	25
Total NSF	<u>373</u>	<u>398</u>	<u>427</u>

* Combines former Bioengineering and Chemical & Transport Sys. divisions.

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§ Combines former Civil and Mechanical Systems and Design and Manufacturing Innovation divisions.

** Air Toxics Research and NAAQS programs will be combined into the Clean Air Research program in the FY 2008 request. There would be a net increase of \$4 million from the FY 2007 to the FY 2008 requests.

*** Exploration Systems Research and Technology (ESRT) and Human Systems Research and Technology (HSRT) have been combined into a new theme Advanced Capabilities. This new theme consists of three programs: the Lunar Human Research Program (LHRP), Exploration Technology Development Program (ETDP), and the Human Research Program (HRP).

INTRODUCTION

Mechanical engineering research and development spans a very wide range of problems and applications. Mechanical engineering has a presence virtually in anything involving the design, manufacture, operation or decommissioning of objects or bodies in motion. As such, mechanical engineering has a presence from the nano- to galactic scales. This reflects the fact that mankind is actively engaged in exploration and design across this entire spectrum. The function of this chapter is to provide the reader with a sense of the major activity areas in which mechanical engineering R&D may be found and trends in funding within these areas. In this regard, programs and initiatives may be highlighted that are not specifically mechanical engineering focused. It is important to note therefore that the funding requests discussed in this chapter represent potential sources of funding for mechanical engineers; they do not represent the state of federal funding specifically for mechanical engineering alone. In addition, it is important to keep in mind that only sources of R&D funding have been identified. Funding for application and missions involving mechanical engineering, such as the space shuttle, do not lie within the purview of this analysis. Where possible, these distinctions have been highlighted.

DEPARTMENT OF DEFENSE (DOD)

The FY 2008 President's budget request for DOD Science and Technology (S&T) accounts is \$10.8 billion, which is a \$2.5 billion or 19.1 percent reduction from FY 2007. While the reduction reflects removal of congressional earmarks by the Administration in this year's budget request, this does not account for the entirety of the reduction. The total FY 2008 DOD budget request, which does not include the anticipated supplemental appropriations for war fighting in Iraq and

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Afghanistan, is \$481.4 billion. The S&T portion, then, represents 2.2 percent of DOD's total budget request. S&T in FY 2008 would be 0.3 percent less than the entire DOD request in comparison to its relative amount in FY 2007.

S&T funds support Basic Research ("6.1"), Applied Research ("6.2"), and Advanced Technology Development ("6.3") at DOD and all three accounts are expected to decrease under the FY 2008 President's budget request. Basic Research would see a reduction of \$136 million or 8.7 percent to \$1.4 billion. Applied Research would be reduced by \$973 million or 18 percent to \$4.4 billion. Advanced Technology Development is slated to receive the largest dollar amount decrease, \$1.4 billion or 22.3 percent; the FY 2008 request is \$5.0 billion.

The Defense Advanced Research Projects Agency (DARPA) would decrease by 1 percent to \$3.1 billion for FY 2008. The budgets for the University Research Initiative (URI) programs that support graduate education in Mathematics, Science, and Engineering would see a 14 percent reduction to \$246 million.

DEPARTMENT OF ENERGY (DOE)

The Department's budget for FY 2008 reflects priorities to funding basic scientific research, achieving breakthroughs in advanced energy technologies, and maintaining commitments to a robust nuclear security program. In particular, increases in DOE research programs reflect an interest in spurring technological innovation through the American Competitiveness Initiative (ACI) and commercializing new, cleaner energy technologies through the Advanced Energy Initiative (AEI).

Mechanical engineering related R&D lies primarily in four offices: Office of Science, Office of Energy Efficiency and Renewable Energy (EERE), Office of Nuclear Energy, Science and Technology (NE) and Office of Fossil Energy.

Within the Office of Science, there are three programs in which mechanical engineering related R&D typically occurs. These are Basic Energy Sciences (BES; \$1.5 billion), Advanced Scientific Computing and Research (ASCR; \$0.3 billion), and Fusion Energy Sciences (FES; \$0.4 billion). All three of these programs would experience increases under the FY 2008 budget request.

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Programs within EERE involving mechanical engineering R&D include Biomass and Bio-refinery Systems R&D (\$179.3 million), Wind and Solar Energy (\$40.1 million and \$148.3 million respectively), Hydrogen Technology (\$213 million), and Vehicle, Industrial and Building Technologies (\$176 million, \$46 million and \$86 million respectively). The FY 2008 request again calls for phasing out hydropower and geothermal technology. Congress had appropriated \$5 million and \$1 million in FY 2006 and 2007, respectively. Most programs in EERE would decrease in FY 2008 with the exception of Biomass and Bio-refinery Systems which would increase by \$2.3 million or 1.3 percent.

DOE also requested significantly greater amounts for nuclear energy. Overall Nuclear Energy R&D, as part of Energy Supply and Conservation, will increase significantly for the second year by 60.6 percent to \$567.7 million above FY 2007. This includes a \$152 million or 83 percent increase to \$395 million in the Advanced Fuel Cycle Initiative. Nuclear Power 2010, Generation IV and Nuclear Hydrogen Initiative would increase above FY 2007 appropriated levels as well, to \$114.0 million, \$36.1 million and \$22.6 million in FY 2008.

Under the FY 2008 budget request, the Office of Fossil Energy would see a 9.2 percent increase over FY 2007 appropriations to \$863 million. Within the Office of Fossil Energy, Fossil Energy R&D programs would decrease by \$25.2 million or 4.3 percent in FY 2008 as a result of eliminating research funding for oil and natural gas research. Funding for research on new coal technologies would see a large increase of \$73.6 million or 17.7 percent above FY 2007 to \$426.6 million.

DEPARTMENT OF HOMELAND SECURITY (DHS)

The total FY 2008 budget request for DHS is \$46.4 billion, an 8 percent increase over the FY 2007 appropriation. The FY 2008 budget is centered around five themes: protecting the nation from dangerous people, protecting the nation against dangerous goods, protecting critical infrastructure, building a nimble emergency response system, and strengthening DHS management and unity.

The DHS R&D portfolio request would be reduced for the second straight year, falling 2.7 percent to \$978 million. R&D is divided between the Domestic Nuclear Detection Office (DNDO, \$320 million) and the Science and Technology Directorate (S&T, \$658 million).

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The overall budget for the Science and Technology Directorate would decline 18 percent from \$973 million to \$799 million. Precise comparisons with last year's budget are difficult, as a number of major program items were re-organized, eliminated, or moved to different directorates. The biological and chemical countermeasures activities would fall 27 percent to \$229 million. Work on explosive countermeasures would fall 39 percent to \$64 million in FY 2008. The University Programs Fellowship Programs request would decline by \$10 million to \$39 million. The only item within the S&T Directorate to receive an increase was the new "Innovation" budget for advanced technologies, which would rise from \$38 million in FY 2007 to \$60 million next year, an increase of 37 percent.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The FY 2008 budget request for EPA is \$7.2 billion, a slight decrease from the FY 2007 request of \$7.3 billion. The Agency's Science and Technology account would fall from \$788 million in last year's request to \$754.5 million in FY 2008, a reduction of \$33.8 million.

Areas involving mechanical engineering related R&D are highlighted in Table 2. Overall ME-related R&D would increase slightly from \$230 million to \$234 million, a 1.7 percent increase. This would be primarily because of a \$3.5 million increase in funds for clean air research, a program which will consolidate the former Air Toxics Research and National Ambient Air Quality Standards programs. Sustainability Research would also increase from the FY 2007 request by \$1.1 million to \$22.5 million. Fellowships effectively would remain at the same level of \$8.4 million. Climate Change Research at EPA would fall to \$16.9 million, a decrease of \$1.7 million below the FY 2007 request.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's budget request for FY 2008 is \$17.3 billion, an increase of 3.1 percent over the \$16.8 billion request for FY 2007. The Vision for Space Exploration continues to be the leading priority reflected in NASA's request.

Mechanical engineering-related research is primarily conducted in the Aeronautics Research Mission Directorate (ARMD) and in the Exploration Systems Mission Directorate (ESMD). Aeronautics research

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would decrease for the third consecutive year. The FY 2008 request for NASA contains \$554.0 million for aeronautics technology, an increase of \$24.7 million from the FY 2007 request. This would include \$74.1 million, a decrease of \$28.1 million below the FY 2007 budget request, for the Aviation Safety and Security Program; \$98.1 million for the Airspace Systems Program, a reduction of \$21.9 million from the FY 2007 request; \$293.4 million for Fundamental Aeronautics, a decrease of \$153.8 million from the FY 2007 budget request; and the Aeronautics Test Program with a request of \$88 million in FY 2007. By comparison, the FY 2006 appropriated amount for aeronautics technology was \$893 million. It should be noted that the FY 2008 budget reflects new cost simplifications that significantly reduce Center overhead and infrastructure allocated to Aeronautics.

However, reductions in the request for ESMD in FY 2008 to \$3.9 billion are specifically intended to prevent further delays in the Vision for Space Exploration. NASA requested \$646.1 million for the Exploration Systems Research and Technology (ESRT) program in FY 2007, but ESRT was combined with several other programs and renamed Advanced Capabilities. The FY 2008 NASA request proposes \$855.8 million for Advanced Capabilities, which consist of the Lunar Human Research Program (LPRP), Exploration Technology Development Program (ETDP), and Human Research Program (HRP). Prometheus Power and Propulsion, which focuses on the development of nuclear propulsion techniques, would be a project under ETDP.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The President's budget request for NIST in FY 2008 is \$640.7 million. If funded as requested, this would result in a decrease of \$36.3 million, or 5.4 percent, from the FY 2007 joint funding resolution (P.L. 110-5). Mechanical engineering research and development activities within the NIST budget request may be found in two areas: the NIST laboratory portion of the Scientific and Technical Research Services (STRS), and Industrial Technology Services (ITS). STRS provides the measurement and standards infrastructure to support advances in technology and manufacturing. ITS consists of the Advanced Technology Program (ATP) and the Hollings Manufacturing Extension Partnership (HMEP).

The total FY 2008 budget request for STRS is \$508.6 million. This represents a \$66.6 million or 15.0 percent increase from FY 2007.

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Additionally, NIST will fund several new initiatives in the areas of nanotechnology, climate change, quantum science, earthquakes, and resilient structures through STRS to help support the U.S. scientific and industrial communities keep pace with fast-breaking developments.

The ITS FY 2008 budget request contains a 74.7 percent decrease from FY 2007. This is primarily due to the fact that the 2007 resolution provides \$78.9 million for the ATP. Funding for ATP was not included in either of the President's FY 2007 or 3008 budget requests. The FY 2008 budget request for Hollings Manufacturing Extension Partnership (MEP) is \$46.3 million, 55.7 percent less than in FY 2007.

NATIONAL INSTITUTES OF HEALTH (NIH)

The total FY 2008 NIH budget request is \$28.8 billion. This is just \$329 million less than the \$29.1 billion finalized in the FY 2007 joint resolution. The majority of NIH institutes and centers will see flat funding in FY 2008; however the total number of new Research Project Grants (RPGs) is expected to increase.

Because of the highly multidisciplinary nature of health related research including the increasing role of engineers in medical research, mechanical engineering research funding comes from virtually all of the institutes comprising the NIH. The importance of engineering to the health sciences was one of the drivers for creating the NIH Roadmap for Biomedical Research and the Common Fund. In FY 2008, the NIH Roadmap would receive \$486 million, reflecting a 0.7 percent increase over the FY 2007 joint funding resolution.

The NIH Roadmap initiative is inherently coupled with the mission of the National Institute of Biomedical Imaging and Bioengineering (NIBIB). NIBIB's mission is to improve health by leading the development and application of emerging and breakthrough technologies based in the biological, physical, and engineering sciences. The President's FY 2008 budget requests \$300 million for NIBIB, an increase of \$4 million or 1 percent. NIBIB Extramural Research would increase by 0.7 percent to \$271 million while intramural research would decline by 1.0 percent to \$9.1 million. The breakdown for extramural and intramural research within NIBIB is reflective of NIH's push to fund extramural research. NIBIB's Research Management and Support request is \$15.9 million, an increase of 1.2 percent.

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One of the key linkages between the Roadmap and NIBIB is molecular libraries and imaging; a component of the New Pathways to Discovery Initiative. NIBIB funds will support the Applied Science and Technology (AST) program, which support the development and application of innovative technologies, methods, products, and devices for research and clinical application that transform the practice of medicine. Additionally, NIBIB will support the Discover Science and Technology (DST) program, which is focused on the discovery of innovative biomedical engineering and imaging principles for the benefit of public health.

NATIONAL SCIENCE FOUNDATION (NSF)

The total FY 2008 NSF budget request is \$6.4 billion representing a \$513 million or 8.7 percent increase over FY 2007. It is consistent with the goal of doubling the NSF budget by 2016 (*i.e.* over ten years).

Research and Related Activities (RRA) comprises the dominant part of the total NSF request at \$5.1 billion. This is a 7.7 percent increase relative to the FY 2007 joint funding resolution. There are eleven activities under R&RA, including the Engineering Directorate (ENG). The FY 2008 budget request for ENG is \$683 million, an 8.7 percent increase over FY 2007. \$116 million of the ENG budget request would support the NSF SBIR / STTR program. Though not restricted to engineering disciplines, SBIR/STTR is managed by ENG.

ENG has completed its division reorganization that intended to reflect the multidisciplinary nature of engineering and the complex integration of the sub-disciplines comprising ENG. This reorganization reduced the number of divisions from seven to six. The following new divisions receive increases in the FY 2008 request over the FY 2007 estimate: Chemical, Bioengineering, Environmental, and Transport Systems (up 16.5 percent to \$145 million); Civil, Mechanical, and Manufacturing Innovation (up 14.4 percent to \$174 million); Electrical, Communications and Cyber Systems (up 16.1 percent to \$94 million), and Industrial Innovation and Partnerships (up 6.9 percent to \$128 million). The Office of Emerging Frontiers in Research and Innovation funding remains level at \$25 million, while funding for Engineering Education and Centers decreases by 7.2 percent to \$117 million. While mechanical engineering continues to participate in programs across these divisions and, indeed, throughout the Foundation, traditional mechanical engineering research will principally lie in CBET and CMMI.