

Mechanical Engineering in the FY 2015 Budget

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INTRODUCTION

Mechanical engineering research and development spans a very wide range of problems and applications. It is present in virtually everything involving the design, manufacture, operation, or decommissioning of objects. As such, mechanical engineering has a presence from the nano- to galactic scales since humanity is actively engaged in design and exploration across this entire spectrum. The purpose of this chapter is to provide the reader with information about the major activity areas where mechanical engineering R&D may be found and funding trends. The funding requests discussed in this chapter represent potential – not dedicated – sources of funding for mechanical engineers. Recent trends in federally-supported mechanical engineering-related R&D include:

- Emphasis on advanced manufacturing and energy;
- Enhanced investments in space technology development; and
- Increased focus on industrial partnerships and technology commercialization.

DEPARTMENT OF DEFENSE (DOD)

Mechanical engineering is prevalent in the Research, Development, Test, and Evaluation (RDT&E) account, which is budgeted for \$63.5 billion for RDT&E in FY 2015, a 0.86 percent increase from the final FY 2014 omnibus of \$62.9 billion. This is the first time in six years that the Administration has requested an increase in funding for DOD RDT&E.

DOD's core science and technology (S&T) development accounts are divided into basic research ("6.1"), applied research ("6.2"), and

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advanced technology development (“6.3”). Under the President’s budget, basic research would see a 6.9 percent decrease from the FY 2014 appropriated amount, decreasing to \$2.02 billion. Applied research and advanced technology development would fall to \$4.46 billion (-4.0 percent) and \$5.04 billion (-6.2 percent) respectively from the final FY 2014 amounts. The Administration’s overall proposal would bring S&T funds to \$11.5 billion, down 5.5 percent from FY 2014.

S&T funding for Defense-wide account activities would decrease by 2.4 percent to \$5.18 billion. Each of the individual service branches would see reductions under the President’s request, with the deepest cuts scheduled for Army accounts with a 10.2 percent reduction to \$2.2 billion; Air Force S&T funds would decline 7.8 percent to \$2.1 billion, followed by the Navy with a 5.3 percent reduction to \$1.9 billion. These decreases are across-the-board with significant 13 percent reductions in the Army’s 6.3 account and in the Air Force’s 6.1 account.

The Administration has requested an increase of \$137 million for the Defense Advanced Research Projects Agency (DARPA), all of which would go toward the 6.3 account. Within DARPA, basic research accounts would decrease by 0.8 percent to \$362 million; applied research would decrease by 3.2 percent to \$1.14 billion. The advanced technology development efforts would increase 15.1 percent to \$1.3 billion. DOD is requesting \$362 million, a one percent decrease over FY 2014, for DARPA’s Defense Research Sciences account, listed under basic research. This would end what had been significant increases for this program over the past four budget cycles.

DOD is requesting \$45 million for the National Defense Education Program, a 41.6 percent decrease from the FY 2014 level of \$77 million. This decrease would have a significant impact on the funding available to meet the future STEM needs of DOD. University Research Initiatives accounts from across the services would decline by a combined 8 percent, from \$398 million in FY 2014 to \$366.0 million in FY 2015.

DEPARTMENT OF ENERGY (DOE)

The Department’s budget for FY 2015 reflects a strong priority of an “all-of-the-above” approach to energy innovation. There is also significant focus on advanced manufacturing and clean energy R&D.

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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, and Office of Fossil Energy. The requests for each of these offices are \$5.1 billion, \$2.3 billion, \$0.8 billion, and \$0.5 billion, respectively. Relative to FY 2014, these requests reflect increases of just under one percent for the Office of Science and 22 percent for EERE, a 2.8 percent decrease for the Office of Nuclear Energy, and a 15.4 percent decrease for the Office of Fossil Energy. A significant portion of the increase for EERE comes through the Advanced Manufacturing program to support a new Clean Energy Manufacturing Innovation Institute.

Within the Office of Science, there are three programs in which mechanical engineering related R&D typically occurs. These are Basic Energy Sciences (BES), \$1.8 billion; Advanced Scientific Computing Research (ASCR), \$541 million; and Fusion Energy Sciences (FES), \$416 million. BES would increase by \$94 million or 5.5 percent from the FY 2014 appropriation of \$1.7 billion. ASCR would increase by \$63 million or 13.2 percent from \$478 million in FY 2014. Fusion Energy Sciences would decrease \$88 million or 17.6 percent from an FY 2014 appropriation of \$504 million.

Programs within EERE involving mechanical engineering R&D include wind and solar energy, \$115 million and \$282.3 million respectively. This would represent a 30.5 percent increase for wind and 9.8 percent increase for solar. Biomass and Bio-refinery Systems Research, Demonstration & Development (RD&D) has again been zeroed out in the FY 2015 request as it was in the FY2014 request, and replaced with the Bioenergy Technologies Program. Vehicle and Building Technologies funding would increase to \$359 million and \$211.7 million for FY 2015, and the Advanced Manufacturing program (formerly called the Industrial Technologies Program) would also grow by \$124 million for FY 2015 to a total of \$305 million. Geothermal technology would increase by \$15.7 million to \$61.5 million for FY 2015.

The Office of Nuclear Energy would decrease by 2.8 percent, or \$25 million, falling to \$836.3 million. Fuel Cycle R&D would increase by 1.6 percent to \$189 million. Reactor Concepts RD&D would decline by 11 percent, or \$12.2 million, to \$100.5 million. Nuclear Energy Enabling Technologies would increase 10 percent to \$78.2 million.

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DEPARTMENT OF HOMELAND SECURITY (DHS)

R&D for DHS is divided between the Science and Technology Directorate (S&T) and the Domestic Nuclear Detection Office (DNDO). The budget proposes funding DNDO's only R&D account, R&D and Operations, at \$199 million in FY 2015, a 2.9 percent decrease. The total request for the DHS S&T Directorate is \$1.07 billion, a 12.1 percent decrease from the FY 2014 funding level of 1.2 billion. S&T's Research, Development, and Innovation budget would decrease 6 percent from \$462 million in FY 2014 to \$434 million in FY 2015. Laboratory Facilities would decrease 20.6 percent from \$548 million in FY 2014 to \$435 million in FY 2015. University Programs would decrease by 22.5 percent from \$40 million in FY 2014 to \$31 million in FY 2015.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The FY 2015 budget request for EPA is \$7.9 billion, a \$310 million or 3.8 percent decrease from the FY 2014 enacted amount of \$8.2 billion. The EPA's Science and Technology account would increase by \$4.6 million to \$763.7 million in FY 2015.

The Clean Air and Climate S&T accounts would rise by \$1.9 million to \$118.4 million in FY 2015. The Air, Climate, and Energy Research account for FY 2015 would increase to \$102 million from the FY 2014 enacted level of \$94.9 million. Safe and Sustainable Water Resources would rise \$3.1 million to \$114 million for FY 2015.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's budget request for FY 2015 is \$17.4 billion, \$200 million less than FY 2014. Significant changes continue to occur for NASA's programming in FY 2015 including a "new Strategic Plan to drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality and stewardship of Earth¹." These new efforts represent a significant expansion in NASA's R&D portfolio, including several new programs directed towards partnerships with the commercial sector.

The Aeronautics Research program funds mechanical engineering-related research to produce cleaner, safer, and more efficient aircraft.

¹ NASA Strategic Plan 2014,
http://www.nasa.gov/sites/default/files/files/FY2014_NASA_SP_508c.pdf

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NASA has recently realigned this program to focus on newly defined strategic areas. The new programs include Airspace Operations and Safety Program (\$131 million), Advanced Air Vehicles Program (\$213.6 million), Integrated Aviation Systems Program (\$127 million), and the Transformative Aeronautics Concepts Program (\$79.5 million).

NASA's Exploration budget would decrease to \$3.9 billion, down 3.4 percent from the \$4.1 billion for FY 2014. Despite this overall decrease, there are significant increases to Commercial Spaceflight programs, which increase 21.8 percent to \$848 million, up from \$696 million in FY 2014. Exploration would receive \$1.1 billion for the Orion Multi-Purpose Crew Vehicle (MPCV), a cut of 12 percent from FY 2014 funding, and \$1.4 billion for Space Launch Systems, a 13.7 percent decrease. The Exploration R&D program account would also increase by 13.6 percent to 343 million in FY 2015.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The Department of Commerce's National Institute of Standards and Technology (NIST) would receive \$900 million in the FY 2015 budget request, 5.9 percent increase over the FY 2014 enacted amount.

The total NIST request is divided into three separate appropriations. Under the request, Scientific and Technical Research and Services (STRS) would receive \$680 million, a 4.5 percent increase over the FY 2014 enacted amount. Industrial Technology Services (ITS) would receive \$161 million, a 12.6 percent increase over the FY 2014 enacted amount. This category consists of \$141 million (a \$13 million increase) for the Hollings Manufacturing Extension Partnership (MEP) and \$15 million to continue the Advanced Manufacturing Technology Consortia (AMTech), a program to "promote industry consortia to tackle common technological barriers" related to nanotechnology products.² Finally, Construction of Research Facilities (CRF) would receive \$59 million, a 5 percent increase from the FY 2014 enacted amount of \$56 million.

NATIONAL INSTITUTES OF HEALTH (NIH)

While mechanical engineers are increasingly partnering with physicians and researchers across all NIH institutes, mechanical engineering-related R&D is most predominant within the National Institute of Biomedical

²AMTech website, <http://www.nist.gov/ampo/>

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Imaging and Bioengineering (NIBIB). NIBIB requests \$329.2 million for FY 2015, relatively flat funding from the \$329 million FY 2014 enacted level. The budget for NIBIB Research Grants would increase by 3.1 percent to \$222.5 million. Funding for intramural research would remain flat at \$11.4 million. NIBIB's Research Management and Support request receives a 1 percent increase at \$19.6 million.

NIBIB funds the Applied Science and Technology (AST) program which supports the development and application of innovative technologies, methods, products, and devices for research and clinical application that transform the practice of medicine. The FY 2015 request for AST is \$155.8 million, a 1.4 percent increase from FY 2014. Additionally, NIBIB funds the Discovery Science and Technology (DST) program, which focuses on the discovery of innovative biomedical engineering and imaging principles for the benefit of public health. The FY 2015 request for DST is \$88.8 million, a 0.1 percent increase from FY 2014. The Technological Competitiveness – Bridging the Sciences program, which funds interdisciplinary approaches to research, would receive \$20.8 million in FY 2015, a 1 percent increase from the FY 2014 level.

One area of note is a 20 percent decrease in funding for R&D Contracts.

NATIONAL SCIENCE FOUNDATION (NSF)

NSF's annual budget represents 24 percent of the total federal budget for basic research conducted at U.S. colleges and universities. The FY 2015 budget offers relatively flat funding compared to FY 2014 enacted levels.

Within the Research and Related Activities (R&RA) account is the NSF Engineering Directorate (ENG), which would receive \$858 billion in FY 2015, up 0.8 percent from FY 2014. The budget for ENG includes \$165 million, an increase of 3.8 percent from FY 2014, mandated for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, which ENG administers for all of NSF. The request for ENG, less the SBIR/STTR program, is \$693 million, a 0.1 percent increase over FY 2014.

ENG investments will support major priorities such as the Strategy for American Innovation, the Advanced Manufacturing Partnership (AMP), clean energy technology, the National Nanotechnology Initiative (NNI), the National Robotics Initiative (NRI), and the new Brain Research

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through Advancing Innovative Neurotechnologies (BRAIN) Initiative. Targeted ENG investments are intended to address national challenges.

The Chemical, Bioengineering, Environmental and Transport (CBET) Systems division of ENG would receive \$175 million, a 1.2 percent increase. The Civil, Mechanical, and Manufacturing Innovation (CMMI) division would receive \$210 million, a 0.5 percent increase. The Electrical, Communications, and Cyber Systems (ECCS) division would receive \$110 million, flat funding. Engineering Education and Centers (EEC) would decrease by 4.1 percent to \$117 million. Emerging Frontiers in Research and Innovation (EFRI) would receive \$31 million, a 2.3 percent increase. While mechanical engineering continues to participate in programs across all divisions, as well as agency-wide, traditional mechanical engineering research is most pervasive in CBET and CMMI.