

DIRECTORATE FOR ENGINEERING (ENG)

\$949,220,000
+\$56,910,000 / 6.4%

ENG Funding (Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Chemical, Bioengineering, Environmental, and Transport Systems (CBET)	\$167.76	\$177.82	\$192.26	\$14.44	8.1%
Civil, Mechanical, and Manufacturing Innovation (CMMI)	195.23	209.52	222.73	13.21	6.3%
Electrical, Communications, and Cyber Systems (ECCS)	100.37	110.43	119.24	8.81	8.0%
Engineering Education and Centers (EEC)	119.50	117.49	110.39	-7.10	-6.0%
Industrial Innovation and Partnerships (IIP)	205.99	226.98	248.11	21.13	9.3%
Emerging Frontiers and Multidisciplinary Activities (EFMA)	44.27	50.07	56.49	6.42	12.8%
Total, ENG	\$833.12	\$892.31	\$949.22	\$56.91	6.4%

Totals may not add due to rounding.

¹ The Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) is the reorganized form of Emerging Frontiers in Research and Innovation (EFRI), beginning in FY 2015. FY 2014 Actual obligations for all divisions have been restated for comparability.

About ENG

Fundamental research supported by the Directorate for Engineering (ENG), combined with the creativity of well-educated engineers and the resources of state-of-the-art facilities, has resulted in many important discoveries and inventions. These advances have fueled exciting technological innovations, including, for example, nanotechnology-enabled consumer, industrial, and health care products and manufacturing; novel laser-based tools for brain research and neurological diseases; wireless devices and communications and computing systems; and internet-enabled smart advanced manufacturing systems and supply chains, that in turn have strengthened our Nation's innovation ecosystem, stimulated economic growth, enhanced national security, and improved the quality of life for all Americans.

ENG aims to bring about new technological breakthroughs to address national priorities and grand challenges by (1) investing in key Administration and NSF-wide priorities, and (2) supporting frontier engineering research, education, and innovation through core programs.

ENG investments will support Administration priorities such as the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, the Advanced Manufacturing Partnership (AMP), clean energy technology, the National Nanotechnology Initiative (NNI), and the National Robotics Initiative (NRI).

ENG will lead or contribute directly to NSF-wide strategic investments in programs such as Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS), Risk and Resilience (via the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program), Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS), the NSF Innovation Corps (I-Corps™),

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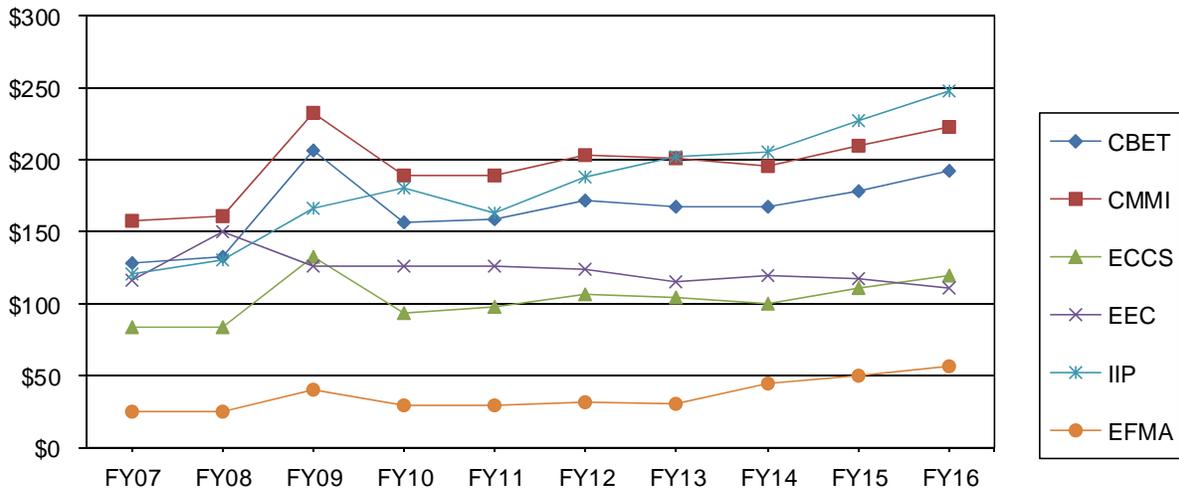
Understanding the Brain (UtB), Optics and Photonics, Improving Undergraduate STEM Education (IUSE) via the Professional Formation of Engineers: Revolutionizing Engineering Departments (PFE:RED) program, and Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (NSF INCLUDES).

The directorate will continue to invest throughout its core programs in emerging and frontier basic research areas, including, for example, systems science and engineering, next generation electronic and computing devices, circuits, and systems, and the engineering of biology. Through support of small businesses and academic partnerships with industry, ENG will help bring high-impact technological innovations into the market and support the national innovation ecosystem.

ENG will continue to develop the next-generation engineering workforce through offering hands-on research opportunities to students and through supporting engineering education research. Engineering education is undergoing major changes with significant increases in student enrollments across the nation. At the same time, it is essential to better prepare engineering students to be the future leaders and innovators in engineering research and in industry, and to work in a constantly changing global economy. Additionally, the engineering education ecosystem continues to face major challenges in attracting women and underrepresented minorities. ENG will continue to identify and support systemic innovations to meet these critical and compelling challenges. Programs such as IUSE (via PFE:RED) and NSF INCLUDES are designed to meet these challenges.

ENG provides about 33 percent of the federal funding for basic research at academic institutions in the engineering sciences.

ENG Subactivity Funding
(Dollars in Millions)



The Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) is the reorganized form of Emerging Frontiers in Research and Innovation (EFRI), beginning in FY 2015. FY 2014 Actual obligations for all divisions have been restated for comparability.

FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2016 Summary by Division

- CBET's FY 2016 Request will support research and education in the areas of the food, energy, and water nexus by contributing to the NSF-wide INFEWS investment. CBET will continue to support transformative work in collaboration with life/physical sciences through UtB and the Research at the Interface of the Biological, Mathematical and Physical Sciences (BioMaPS) programs. CBET will bolster CEMMSS support through investments in advanced biomanufacturing that focuses on studying theories and technologies of design, engineering, and manufacturing bio-related (natural or synthetic) products; and robotics research to assist those with physical disabilities or cognitive impairment. CBET will enhance support of research in Synthetic Biology focusing on metabolic engineering and the engineering aspects of Synthetic Biology. CBET will continue to invest in novel ideas for clean energy technologies. CBET will also enhance support for early-career researchers and continue to support a Science and Technology Center (STC) from the Class of 2010.
- CMMI's FY 2016 Request will enable contributions to the CEMMSS investment through research and education in advanced manufacturing; interdisciplinary research in advanced materials and manufacturing processes; materials design, robotics, and cyber-manufacturing to enable research on the networked integration of manufacturing machines, equipment, and systems into an increasingly accessible manufacturing service infrastructure. CMMI's request will contribute to the NSF-wide priority Risk and Resilience through the CRISP program to deepen fundamental knowledge and stimulate innovations to improve resilience, interoperations, performance, and readiness in interdependent critical infrastructure systems. Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21) support will focus on research and education on computational-based approaches for engineering design, analysis, and predictive modeling, particularly under high degrees of uncertainty. CMMI's contribution to Science, Engineering, and Education for Sustainability (SEES) will include research for resilient and sustainable buildings and infrastructure, disaster-resilient systems, energy systems manufacturing, and energy-efficient materials and processes.
- ECCS's FY 2016 Request will invest in the Enhanced Access to the Radio Spectrum (EARS) activity to support research on more efficient radio spectrum use and greatly improved low-power energy-conserving device technologies. The division will also provide support for CEMMSS-related work in robotics, smart health research, and cyber-physical systems in the area of integration of intelligent decision-making algorithms and hardware into physical systems. ECCS will support the CIF21 program through research and education in advanced devices and systems directed towards computing, data storage, networking, and data management. ECCS's Request will also enable research in Urban Science to increase our understanding of how to intelligently and effectively design, adapt, and manage cities to maximize their positive potential while minimizing negative unintended consequences. ECCS will increase its support to critical areas of national importance such as UtB, advanced electronic materials, and low-power computing. ECCS will also enhance support for early-career researchers and support an STC.
- EEC's FY 2016 Request will provide funding for a combination of Engineering Research Centers (ERC) and Nanosystems Engineering Research Centers (NERCs), including planned growth supplements for three new centers awarded as part of the Class of 2015. In FY 2016, EEC will support PFE:RED to enable engineering departments to achieve significant sustainable changes necessary to overcome long-standing issues in their undergraduate programs and educate inclusive communities of engineering students prepared to solve 21st century challenges. PFE:RED will be under the framework of the NSF-wide IUSE activity, which integrates the agency's investments in undergraduate education. Engineering Education and Nanotechnology Undergraduate Education

(NUE) undergraduate programs were consolidated into IUSE in FY 2014. EEC will continue to support research and development leading to and propagating interventions that improve both the quality and quantity of STEM graduates. For more information regarding IUSE and NSF’s undergraduate framework, see the IUSE narrative in the NSF-Wide Investments chapter. Support for the Research Experiences for Undergraduates (REU) program will be maintained, with a particular focus on providing early opportunities to conduct research.

- IIP’s FY 2016 Request reflects its commitment to enhancing the Nation’s innovation ecosystem. Through programs for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR), IIP will continue to support technological breakthroughs that benefit society. Through I-Corps™, Partnerships for Innovation (PFI), Industry/University Cooperative Research Centers Program (I/UCRC), and other activities, the division will enable academic researchers to translate fundamental research discoveries into market realities, and encourage academia and industry to collaborate and prepare students to be innovators and entrepreneurs.
- EFMA’s FY 2016 Request will provide support for 16 Emerging Frontiers in Research and Innovation (EFRI) interdisciplinary teams to pursue cutting-edge research with the potential for transformative impacts on national needs and grand challenges.

Major Investments

ENG Major Investments (Dollars in Millions)

Area of Investment	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	Change Over	
				FY 2015 Estimate Amount	Percent
BioMaPS	\$4.31	\$3.00	\$3.00	-	-
CAREER	59.60	50.91	51.58	0.67	1.3%
CEMMSS	97.79	96.81	107.52	10.71	11.1%
<i>Advanced Manufacturing</i>	<i>80.91</i>	<i>79.96</i>	<i>80.15</i>	<i>0.19</i>	<i>0.2%</i>
Clean Energy	128.00	137.56	140.87	3.31	2.4%
CIF21	12.00	10.00	10.00	-	-
I-Corps™	8.17	11.00	13.00	2.00	18.2%
NSF INCLUDES	-	-	1.40	1.40	N/A
INFEWS	-	-	13.00	13.00	N/A
IUSE	5.45	6.00	6.00	-	-
NRT ¹	4.72	2.85	2.59	-0.26	-9.1%
Optics and Photonics	110.00	112.00	114.00	2.00	1.8%
Risk and Resilience	11.00	12.00	17.00	5.00	41.7%
SEES	13.20	12.00	3.00	-9.00	-75.0%
SaTC	3.75	3.25	3.25	-	-
Understanding the Brain	8.63	10.99	16.75	5.76	52.4%
Urban Science	-	-	2.00	2.00	N/A

Major investments may have funding overlap and thus should not be summed.

¹ Outyear commitments for Integrative Graduate Education and Research Traineeship (IGERT) are included in the NRT line and are \$4.72 million in FY 2014, \$1.13 million in FY 2015, and \$1.81 million in FY 2016.

- BioMaPS (\$3.0 million, equal to the FY 2015 Estimate): ENG support seeks to contribute to the understanding of biology using engineering tools to exploit unique aspects of biological systems in applications that are useful in industrial, environmental, and health care arenas. Funding for this activity is in the CBET and CMMI divisions.
- Faculty Early Career Development (CAREER) (+\$670,000, to a total of \$51.58 million): Supports young investigators who exemplify the role of teacher–scholar through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations.
- CEMMSS (+\$10.71 million, to a total of \$107.52 million): Support will build upon existing frontier engineering research and advance connections among breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems leading to enhanced disciplinary and interdisciplinary research.
- Advanced Manufacturing (+\$190,000, to a total of \$80.15 million): Provides support for research in nanosystems design and scalable nano-manufacturing; additional emphasis on the “Factory of the Future”: Cyber-enabled, adaptive, agile distributed manufacturing; and increased focus on advanced biomanufacturing. ENG will maintain close connections with efforts by other agencies to raise U.S. manufacturing capacity by ensuring an appropriate link with the NSF investments in fundamental research and education in manufacturing.
- Clean Energy Technology (+\$3.31 million, to a total of \$140.87 million): ENG support of clean energy technology-related activities will enhance research and innovations in smart grid technologies, solar energy technologies, biofuels and bioenergy, wind energy generation, and renewable energy storage. The ENG clean energy technology investment will be strategically coordinated across all divisions.
- CIF21 (\$10.0 million, equal to the FY 2015 Estimate): ENG support will focus on computational and data-enabled science and engineering research, infrastructure, and community building, and access and connections to cyberinfrastructure facilities. Funding is in CBET, CMMI, and ECCS.
- I-Corps™ (+\$2.0 million, to a total of \$13.0 million): ENG will continue to lead the NSF-wide I-Corps™ program. In FY 2016, ENG will support I-Corps™ Teams, Sites, and Nodes to further build, utilize, and sustain a national innovation ecosystem that continues to augment the development of technologies, products, and processes that benefit the Nation. Funding is through IIP.
- NSF INCLUDES (+\$1.40 million, to a total of \$1.40 million): ENG will align its investments in this NSF-wide effort to increase participation of underrepresented groups in STEM fields.
- INFEWS (+\$13.0 million, to a total of \$13.0 million): FY 2016 funding represents the initial investment in this NSF-wide activity. ENG will support fundamental engineering research required to understand, model, and design food-energy-water systems. INFEWS will leverage existing ENG programs in energy, water, and biotechnology, which support projects such as ones to reduce water consumption in power plants.
- IUSE (\$6.0 million, equal to the FY 2015 Estimate): ENG will participate in the NSF-wide IUSE activity, which integrates the agency’s investments in undergraduate education. In FY 2016, ENG will continue to support PFE:RED under the IUSE framework to enable research and development

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leading to and propagating interventions that improve both the quality and quantity of engineering graduates.

- NSF Research Traineeship (NRT) (-\$260,000, to a total of \$2.59 million): ENG will continue to participate in the NRT program, which is the successor to the Integrative Graduate Education and Research Traineeship (IGERT). The FY 2016 decrease reflects a continuing reduction in the remaining commitments to the IGERT program as it is sunseting.
- Optics and Photonics (+\$2.0 million, to a total of \$114.0 million): ENG supports research and engineering efforts leading to significant advances in novel optical sources and photodetectors, optical communication devices, photonic integrated circuits, single-photon quantum devices, and nanophotonics. ENG will increase support of multidisciplinary research in the optics and photonics area with emphasis on nanoscale devices and systems. Applications in high-speed optical communications for environmental and biomedical research will be encouraged.
- Risk and Resilience (+\$5.0 million, to a total of \$17.0 million): ENG will co-lead this priority area with the Directorate for Geosciences to advance knowledge of risk assessment and predictability, and to support the creation of tools and technologies for increased resilience. In FY 2016, ENG will continue to support the CRISP program by catalyzing collaborations among researchers across the domains of engineering; computer and computational science; and social, behavioral, and economic sciences to deepen fundamental knowledge and stimulate innovations to improve resilience, interoperations, performance, and readiness of our critical infrastructure.
- SEES (-\$9.0 million, to a total of \$3.0 million): Investment is decreased as program activities sunset. Funds will be re-invested in INFEWS, Risk and Resilience, and other priorities within the ENG portfolio. ENG will continue to support Sustainable Chemistry research.
- Secure and Trustworthy Cyberspace (SaTC) (\$3.25 million, equal to the FY 2015 Estimate): ENG support for SaTC will focus on the engineering aspects of the Networking and Information Technology Research and Development (NITRD) Strategic Plan for the Federal Cybersecurity Research and Development Program. NITRD's research thrusts cover a set of interrelated priorities for U.S. government agencies that conduct or sponsor research and development in cybersecurity.
- UtB (+\$5.76 million, to a total of \$16.75 million): ENG will invest in UtB and neuroscience research critical to success of the BRAIN Initiative and integral to activities associated with the multidisciplinary nature of this investment. Research will drive integration across scales and across disciplines, and accelerate the development of new experimental and analytical approaches, including computational and data-enabled modeling, and new neural engineering and technology research and development.
- Urban Science: ENG will make an initial investment of \$2.0 million in the urban science activity. In partnership with the Directorates for Computer and Information Science and Engineering (CISE) and Social, Behavioral, and Economic Sciences (SBE), ENG will support research to increase our understanding of how to intelligently and effectively design, adapt, and manage cities to maximize their positive potential while minimizing negative unintended consequences.

ENG Funding for Centers Programs and Facilities

ENG Funding for Centers Programs

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	Change Over	
				FY 2015 Estimate Amount	Percent
Total, Centers Programs	\$86.78	\$79.25	\$67.25	-\$12.00	-15.1%
Engineering Research Centers (EEC)	70.06	64.50	56.50	-8.00	-12.4%
Nanoscale Science & Engineering Centers (multiple)	4.98	4.75	0.75	-4.00	-84.2%
Science and Technology Centers (multiple)	10.08	10.00	10.00	-	-
Science of Learning Centers (EEC)	1.66	-	-	-	N/A

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Support for the ERC program decreases by \$8.0 million, to a total of \$56.50 million. Decreased support will result in a reduction in the number of centers from 19 to 15, as the program is between competition years in FY 2016. The next class of ERCs will be funded in FY 2017. Funding and numbers of centers include three Nanosystems ERCs that were first supported in FY 2012.
- NSEC support will be reduced by \$4.0 million, to a total of \$750,000, as the program continues to sunset as planned. It is anticipated core programs in ENG will increase support to nanoscale science and engineering, offsetting the reduction.
- ENG will continue to fund two STCs in FY 2016. CBET will support the Center on Emergent Behaviors of Integrated Cellular Systems, and ECCS will support the Center for Energy Efficient Electronics Science.
- ENG funding of a directorate-supported Science of Learning Center (SLC) ended as the center received its final year funding in FY 2014 as planned.

ENG Funding for Facilities

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	Change Over	
				FY 2015 Estimate Amount	Percent
Total, Facilities	\$33.85	\$27.83	\$28.33	\$0.50	1.8%
Cornell High Energy Synchrotron Source (CHESS)	5.04	5.00	5.00	-	-
Natural Hazards Engineering Research Infrastructure (NHERI)	-	12.00	12.50	0.50	4.2%
National Nanotechnology Coordinated Infrastructure (NNCI)	-	10.83	10.83	-	-
National Nanotechnology Infrastructure Network (NNIN)	10.67	-	-	-	N/A
Network for Earthquake Engineering and Simulation (NEES)	18.14	-	-	-	N/A

Totals may not add due to rounding.

For detailed information on individual facilities, please see the Facilities chapter.

- Support for CHESS operations and maintenance costs are maintained at \$5.0 million, equal to the FY 2015 Estimate.
- Support for the Natural Hazards Engineering Research Infrastructure (+\$500,000, to a total of \$12.50 million) is consistent with the cooperative agreement for this earthquake engineering facility, which replaced the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2015.
- ENG continues support for nanotechnology research infrastructure through investment in the National Nanotechnology Coordinated Infrastructure (NNCI) (\$10.83 million, equal to the FY 2015 Estimate). This network of user facilities replaced the National Nanotechnology Infrastructure Network (NNIN) in FY 2015.

Summary and Funding Profile

ENG supports investment in core research, innovation, and education as well as research infrastructure such as facilities.

In FY 2016, the number of research grant proposals is expected to be about 9,800. ENG expects to award approximately 1,600 research grants in FY 2016. Average annualized award size and duration are estimated to be \$133,000 and three years, respectively, in FY 2016.

In FY 2016, funding for centers accounts for slightly less than nine percent of ENG’s non-SBIR/STTR Request.

Funding for facilities is slightly less than four percent of ENG’s non-SBIR/STTR FY 2016 Request.

ENG Funding Profile			
	FY 2014	FY 2015	FY 2016
	Actual	Estimate	Estimate
	Estimate	Estimate	Estimate
Statistics for Competitive Awards:			
Number of Proposals	11,885	12,240	12,600
Number of New Awards	2,152	2,260	2,330
Funding Rate	18%	18%	18%
Statistics for Research Grants:			
Number of Research Grant Proposals	9,259	9,550	9,840
Number of Research Grants	1,502	1,570	1,620
Funding Rate	16%	16%	16%
Median Annualized Award Size	\$111,547	\$112,000	\$112,500
Average Annualized Award Size	\$130,993	\$132,000	\$133,000
Average Award Duration, in years	3.0	3.0	3.0

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2014, NSF’s Evaluation and Assessment Capability office commissioned a study of the feasibility of conducting rigorous impact evaluation of I-Corps™ Teams. The study, which concluded in October 2014, was aimed at exploring methodological options for rigorous impact

evaluation of the program. NSF is currently evaluating the recommendations and determining the next steps for evaluation of the I-Corps™ Teams program.

- A pilot test of the question items and logic model developed for the EFRI program will be finalized in the second quarter of FY 2015. The study encompasses a complete data collection effort for the first two cohorts and an evaluation of the burden on principal investigators and availability of data. This pilot will inform the FY 2016 development of a permanent longitudinal outcome monitoring system for the EFRI program that will inform program management decision-making and will enable access to outcome data for rigorous evaluation.
- In FY 2014, the IIP division completed logic models and associated indicators for all programs. In FY 2015 and FY 2016, the directorate will continue the efforts by following NSF-wide approaches and frameworks to evaluate and assess fundamental and translational research.
- In FY 2016, the directorate will utilize the developing NSF Business Intelligence platform and the output data available from the Research Performance Progress Report (RPPR) and open access to create dashboards and automated reports aimed at visualizing the output of programs, clusters, divisions, and the directorate, and their relationships with other factors and variables.

Science and Technology Policy Institute (STPI) Reports:

- CMMI supported STPI for a retrospective assessment of solid freeform fabrication/additive manufacturing (SFF) that concluded in November 2013. The project researched and identified how SFF-related fundamental research sponsored by the agency originated and evolved since its initiation. Analytical input was provided regarding major research directions, the outcomes from NSF support (major discoveries, new technologies and affected industries, and development of a SFF community), factors affecting innovation, and lessons learned that can be used to help design future activities similar to NSF's Strategic Manufacturing (STRATMAN) program that, in part, helped launch and mature SFF technologies, and to inform NSF's participation in the Additive Manufacturing Innovation Institute.¹

Workshops and Reports:

- A three-day Advanced Biomanufacturing Workshop was conducted in July 2014, in Talloires, France. The workshop was a follow up on the NSF-sponsored workshop on Advanced Biomanufacturing held July 25-26, 2013, in Arlington, Virginia. The 2014 workshop provided a comprehensive overview of Advanced Biomanufacturing, including molecular approaches and building blocks, cellular approaches, assemblies and polymers, tissue and organ approaches, and systems integration. The workshop permitted more focused discussions among a smaller group of participants, including investigators from European institutions, which was not the case in the initial workshop that included only U.S. investigators.
- A workshop on Assessment of International R&D on Biological Engineering & Manufacturing (BE&M) was convened on November 5, 2014, in Arlington, VA. This workshop reviewed the results from a study assessing international research and development activities in advanced biological engineering and manufacturing. The objectives of the study were to assess worldwide biomanufacturing capabilities, to identify technological and scientific gaps and opportunities for international collaboration, and to pinpoint areas where funding should be directed to enable advances in technologies supporting the new generation of medical therapies based on living cells, tissue engineering, and regenerative medicine approaches.²
- A three-day workshop on Noninvasive Imaging of Brain Function was conducted in July 2014, in Arlington, VA. The workshop focused on identifying current limitations in imaging brain function *in vivo* and on discussing emerging technologies that could expand the reach of noninvasive human functional brain imaging. Recognized national experts were invited to discuss the three main aspects

¹ www.ida.org/upload/stpi/pdfs/p5091final.pdf

² www.wtec.org/bem/#intro

of noninvasive imaging of brain function: imaging modalities, sensors and nanoreceptors, and algorithms and computational approaches.³

- A workshop on Frontiers of Additive Manufacturing Research and Education was held on July 11-12, 2013, in Gainesville, FL. The workshop provided a forum for sharing ideas and disseminating information about the frontiers of additive manufacturing research, education, and technology transfer. The workshop covered the following four themes: 1) technology and applications; 2) processes, machines, materials, and design; 3) university-industry collaboration and technology transfer; and 4) education and training.⁴

Committees of Visitors (COV):

- In September 2014, COVs reviewed ECCS and EFRI. The COVs will present their reports to the ENG Advisory Committee that will be convened in April 2015.
- In 2015, COVs will review CBET and CMMI.
- In 2016, COVs will review EEC and IIP.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Number of People Involved in ENG Activities			
	FY 2014	FY 2015	FY 2016
	Actual	Estimate	Estimate
	Estimate	Estimate	Estimate
Senior Researchers	8,356	8,700	9,100
Other Professionals	1,695	1,800	1,900
Postdoctorates	382	400	400
Graduate Students	7,327	7,700	8,100
Undergraduate Students	4,183	4,400	4,600
Total Number of People	21,943	23,000	24,100

³ http://people.bu.edu/bifano/NSF_NIBF_Workshop_Report_Final.pdf

⁴ <http://search.ufl.edu/web/#gsc.tab=0&gsc.q=nsf%20report>

**DIVISION OF CHEMICAL, BIOENGINEERING,
ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET) \$192,260,000
+\$14,440,000 / 8.1%**

CBET Funding
(Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
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Total, CBET	\$167.76	\$177.82	\$192.26	\$14.44	8.1%
Research	162.50	173.03	187.42	14.39	8.3%
CAREER	25.83	21.84	22.13	0.29	1.3%
Centers Funding (total)	6.64	6.57	5.33	-1.24	-18.9%
Nanoscale Science & Engineering Centers	1.60	1.57	0.33	-1.24	-79.0%
STC for Emergent Behavior	5.04	5.00	5.00	-	-
Education	1.56	1.10	1.15	0.05	4.5%
Infrastructure	3.71	3.69	3.69	-	-
National Nanotechnology Coordinated Infrastructure (NNCI)	-	3.69	3.69	-	-
National Nanotechnology Infrastructure Network (NNIN)	3.71	-	-	-	N/A

Totals may not add due to rounding.

¹ FY 2014 Actual obligations have been restated for the FY 2015 reorganization of the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) from Emerging Frontiers in Research and Innovation (EFRI) for comparability.

CBET supports research to enhance and protect U.S. national health, energy, food, water, environment, process manufacturing, and security. Through CBET, the physical, chemical, life, and social sciences are integrated in engineering research and education, resulting in advances in the rapidly evolving fields of biotechnology, bioengineering, advanced materials, environmental engineering, and sustainable energy. CBET also invests in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET investments contribute significantly to the knowledge base and to the development of the workforce for major components of the U.S. economy, including chemicals, pharmaceuticals, medical devices, specialty chemicals, and materials for advanced manufacturing, natural gas and petroleum production, food, textiles, utilities, and microelectronics.

CBET supports the chemical, environmental, biomedical, mechanical, civil, and aerospace engineering disciplines. To serve these communities and achieve its goals, CBET is organized into four thematic clusters: Chemical and Biochemical Systems; Biomedical Engineering and Engineering Healthcare; Environmental Engineering and Sustainability; and Transport, Thermal, and Fluid Phenomena.

In general, 75 percent of the CBET portfolio is available for new research grants and 25 percent is available for continuing grants.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- CAREER funding increases by \$290,000 to a total of \$22.13 million in FY 2016. This increase is consistent with CBET's emphasis on supporting early-career researchers.

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- CBET's investment in SEES decreases by \$5.0 million, to a total of \$2.25 million, as involvement in this program's activities sunset. Funds will be re-invested in INFEWS, Risk and Resilience through the CRISP activity, and other priorities within the portfolio.
- An initial investment of \$5.0 million is made in the NSF-wide INFEWS emphasis. CBET programs support fundamental engineering research in energy, water, and biotechnology, and in research projects focusing on sustainable water and energy use. Support will also be provided for projects to advance the understanding of the complex food-energy-water system and water-energy, food-energy, and food-water subsystems, as well as their interdependencies. In addition, support will be provided that explores potential technological innovations that incorporate sustainability, safety/security/protection, efficiency, and affordability.
- Support is increased by \$3.50 million, to a total of \$9.0 million, for research in the UtB investment area. This activity holds promise for revealing fundamental principles underlying brain structure and function and for enhancing understanding of the brain through the development of new technologies and theories. Support will also focus on proposals from interdisciplinary teams of researchers poised to promptly address targeted issues in innovative experimentation; neurotechnology development; modeling and simulation; and quantitative theory development. One major objective of these investments is to establish truly transdisciplinary team-based brain research that rises above the work of existing disciplines.
- Increased support of \$5.0 million over the FY 2015 Estimate is requested in the area of Synthetic Biology research. Synthetic Biology – design, construction, and analysis of existing and/or novel biological parts, devices, and systems using principles from biology and engineering – has been identified as one of the most promising research directions in recent years. This encompasses very fundamental research as well as the creation of new technologies that have enormous potential to revolutionize biomanufacturing, create new materials, and develop innovative tools that will allow us to unravel the mysteries of complex biological systems.
- CBET plans to enhance support for research in advanced biomanufacturing that focuses on studying theories and technologies of design, engineering, and manufacturing bio-related (natural or synthetic) products, such as cells and cell-based therapeutic products (i.e. individualized tissues and organoids), or devices with biomaterials and/or cells as components. This program will leverage the Biomedical Engineering and Biotechnology and Biochemical Engineering programs in CBET.
- Investments for CIF21 total \$2.0 million, and will contribute to develop a cyberinfrastructure of sustainable computation that allows the use of expert algorithms by multiple groups (including undergraduates and industrial practitioners) less experienced than experts to perform calculations after minimal instruction. Existing resources (envelopes, clouds, open source modules, etc.) will be used to create this environment of learning and discovery.
- The division will also provide \$2.0 million in support of the national Materials Genome Initiative (MGI), through a collaborative effort with the Directorate for Mathematical and Physical Sciences (MPS) in Designing Materials to Revolutionize and Engineer our Future (DMREF) under the NSF-wide CEMMSS investment area.
- STC funding remains \$5.0 million, equivalent with the FY 2015 Estimate, to continue support for the STC on Emergent Behavior of Integrated Cellular Systems, led by the Massachusetts Institute of Technology.
- CBET support for the NSEC program totals \$330,000, as the program continues to sunset as planned.

Education

- CBET contributes to a number of education and diversity activities, including REU and NSF's Career Life Balance (CLB) activity. Total CBET funding for these activities in the FY 2016 Request is \$1.15 million. CLB funding is maintained at the FY 2015 Estimate and funding for REU supplements increases by \$50,000.

Infrastructure

- CBET continues support for infrastructure in FY 2016 through investments in the NNCI at the FY 2015 Estimate level.

**DIVISION OF CIVIL, MECHANICAL, AND
MANUFACTURING INNOVATION (CMMI)**

**\$222,730,000
+\$13,210,000 / 6.3%**

CMMI Funding
(Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Total, CMMI	\$195.23	\$209.52	\$222.73	\$13.21	6.3%
Research	173.83	193.92	206.58	12.66	6.5%
CAREER	19.95	16.97	17.19	0.22	1.3%
Centers Funding (total)	1.24	1.35	0.31	-1.04	-77.0%
Nanoscale Science & Engineering Centers	1.24	1.35	0.31	-1.04	-77.0%
Education	1.35	1.70	1.75	0.05	2.9%
Infrastructure	20.06	13.90	14.40	0.50	3.6%
Natural Hazards Engineering Research Infrastructure (NHERI)	-	12.00	12.50	0.50	4.2%
National Nanotechnology Coordinated Infrastructure (NNCI)	-	1.90	1.90	-	-
National Nanotechnology Infrastructure Network (NNIN)	1.92	-	-	-	N/A
Network for Earthquake Engineering and Simulation (NEES)	18.14	-	-	-	N/A

Totals may not add due to rounding.

¹ FY 2014 Actual obligations have been restated for the FY 2015 reorganization of the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) from Emerging Frontiers in Research and Innovation (EFRI) for comparability.

CMMI funds fundamental research in support of the Foundation’s strategic goals directed at advances in the disciplines of civil, mechanical, industrial, systems, manufacturing, and materials engineering. In addition, the division has a focus on the reduction of risks and damage resulting from earthquakes, wind and other hazards. CMMI encourages discovery enabled by the use of cross-cutting technologies such as adaptive systems, nanotechnology, and high-performance computational modeling and simulation. The division promotes cross-disciplinary research partnerships at the intersections of traditional research disciplines to achieve transformative research results that promote innovative manufacturing technology; enable the design and analysis of complex engineering systems; enhance the sustainability and resilience of U.S. infrastructure (for example, buildings, transportation, and communication networks); help protect the Nation from extreme natural events; and apply engineering principles to improve the Nation’s service and manufacturing enterprise systems, including healthcare.

In general, 81 percent of the CMMI portfolio is available for new research grants and 19 percent is available for continuing grants.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- CAREER funding increases by \$220,000, to a total of \$17.19 million, in FY 2016. This increase is consistent with CMMI’s emphasis on supporting early-career researchers.

- Fundamental core research in support of advanced manufacturing will increase by \$190,000, to a total of \$51.02 million, as part of the NSF-wide CEMMSS activity. Areas of continued emphasis include nanomanufacturing, materials engineering and processing, service and manufacturing enterprise systems and operations research, smart manufacturing, and design and manufacturing of complex engineered systems.
- Research to support NRI will be maintained at \$5.0 million, equal to the FY 2015 Estimate, to contribute to ensuring continued U.S. leadership in the robotics field.
- The division will also maintain funding of \$7.0 million, equal to the FY 2015 Estimate, in support of the national MGI through the DMREF effort under the NSF-wide CEMMSS investment area.
- Increased support of \$2.0 million, to a total of \$7.0 million, is made in the agency's Risk and Resilience focus through the CRISP program. Support will be provided to promote interdisciplinary research needed to produce the new knowledge required for transforming our infrastructure, as well as for CRISP interdisciplinary research (engineering, computer science, social/behavioral/economic sciences) focused on the understanding, design, and management of critical interdependent infrastructures systems and processes. These systems and processes are required to provide essential goods and services despite hazards stemming from causes natural, technological, or malicious.
- Support for CIF21 remains \$5.50 million in FY 2016. CMMI will contribute to this NSF-wide investment by supporting research on computationally-based approaches for engineering design, analysis, and predictive modeling, particularly under high degrees of uncertainty. Efforts will support research in the areas of data-enabled science and engineering, with emphasis on complex systems design and analysis, and methods to utilize disparate and distributed data sets for CMMI-relevant research. Linkages between these CEMMSS-related research programs and elements of the CIF21 activity will be strengthened, as researchers make greater use of modeling and simulation, and data-enabled capabilities made possible by CIF21 investments.
- CMMI support for the NSEC program totals \$310,000, a reduction of \$1.04 million, as the program continues to sunset as planned.

Education

- CMMI contributes to a number of education and diversity activities, including REU and CLB. Total CMMI funding for these activities in the FY 2016 Request is \$1.75 million. CLB funding is requested at the FY 2015 Estimate and funding for REU supplements increases by \$50,000.

Infrastructure

- Support for the NHERI increases by \$500,000, to a total of \$12.50 million. NHERI is the successor to NEES that received final year funding of \$18.14 million in FY 2014. The reduction in overall operations costs from the previous facility follows recommendations from numerous studies that indicate a need for a leaner and more focused facilities program for earthquake engineering simulation. The reduction in facilities and operational costs enables additional investments to be made in research that addresses engineering strategies to design for and mitigate against multiple hazards including earthquakes, wind, storm surge, and combinations of these and other potential hazards.
- ENG continues support for infrastructure through investments in the NNCI at the FY 2015 Estimate.

**DIVISION OF ELECTRICAL, COMMUNICATIONS,
AND CYBER SYSTEMS (ECCS)**

\$119,240,000
+\$8,810,000 / 8.0%

ECCS Funding
(Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Total, ECCS	\$100.37	\$110.43	\$119.24	\$8.81	8.0%
Research	94.33	104.24	113.00	8.76	8.4%
CAREER	13.72	12.10	12.26	0.16	1.3%
Centers Funding (total)	5.93	5.79	5.11	-0.68	-11.7%
Nanoscale Science & Engineering Centers	0.89	0.79	0.11	-0.68	-86.1%
STC for Efficient Electronics	5.04	5.00	5.00	-	-
Education	0.99	0.95	1.00	0.05	5.3%
Infrastructure	5.05	5.24	5.24	-	-
National Nanotechnology Coordinated Infrastructure (NNCI)	-	5.24	5.24	-	-
National Nanotechnology Infrastructure Network	5.05	-	-	-	N/A

Totals may not add due to rounding.

¹ FY 2014 Actual obligations have been restated for the FY 2015 reorganization of the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) from Emerging Frontiers in Research and Innovation (EFRI) for comparability.

ECCS addresses fundamental research issues underlying electronic and photonic devices and component technologies, radio frequency through terahertz circuit integration, nanoelectronics, bioelectronics, energy (including alternate energy sources), power, smart-grid, controls, computation, networking, communications, control, sensing, robotics, and cyber-physical technologies. The division supports fundamental research of novel electronic and photonic devices, the integration of these devices into circuit and system environments, and the networking of intelligent systems at multiple scales for applications in energy, healthcare, disaster mitigation, telecommunications, environment, manufacturing, and other systems-related areas. ECCS research and education investments emphasize interdisciplinary collaboration and the convergence of technologies to take on major technological challenges for the next generation of innovative devices and systems.

In general, 72 percent of the ECCS portfolio is available for new research grants and 28 percent is available for continuing grants.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- CAREER funding increases by \$160,000, to a total of \$12.26 million, in FY 2016. This increase is consistent with ECCS’s emphasis on supporting early-career researchers.
- Initial support of \$2.0 million will be provided in the area of Urban Science through a smart cities opportunity. In partnership with CISE and SBE, ENG will support activities focused on

multidisciplinary urban science and engineering, enabling effective integration of networked computing systems, physical devices, data sources, and infrastructure underlying smart cities.

- ECCS will continue support for the NSF-wide CIF21 activity, equal to the FY 2015 Estimate of \$1.50 million, for research in advanced devices and systems directed towards computing, data storage, networking, and data management.
- The division's investment in the NRI (\$2.50 million, unchanged from the FY 2015 Estimate) is part of the NSF-wide CEMMSS portfolio and will support the integration of electronic, mechanical, computing, sensing devices and systems, controls, and intelligent systems that enable ubiquitous, advanced robotics to be realized.
- In an ongoing collaboration with CISE, the division will support research on cyber-physical systems (CPS) totaling \$4.50 million, unchanged from the FY 2015 Estimate. The ECCS investment is part of the NSF-wide CEMMSS portfolio and will be directed towards the integration of intelligent decision-making algorithms and hardware into physical systems.
- ECCS will increase support of multidisciplinary research in the optics and photonics area by \$1.50 million, to a total of \$41.50 million, with emphasis on nanoscale devices and systems. Applications in high-speed optical communications and environmental and biomedical research will be encouraged.
- ECCS will increase support for UtB research by \$1.01 million, to a total of \$2.25 million, for projects researching noninvasive brain imaging by sensing emitted electric and magnetic fields. Projects may develop novel high-sensitivity sensors and sensing algorithms to enhance spatial and temporal resolutions.
- The ECCS' investment in EARS remains \$4.0 million, equal to the FY 2015 Estimate, and will support research on more efficient radio spectrum use and greatly improved low power, energy-conserving device technologies. Increased emphasis will be directed towards research of novel high-linearity transistors, devices, and circuits that will permit more efficient spectrum use, as well as research into new modulation techniques, circuits, and communications systems. Extension of the radio spectrum to bandwidth-rich higher frequencies will be enabled with research of new types of transistors, electronic devices, and circuits that can operate at these higher frequencies with enhanced efficiency. ECCS will also increase support on novel integrated antenna technologies and investigations of electromagnetic propagation in media where energy in electromagnetic signal is dissipated.
- ECCS funding of \$5.0 million maintains support for the STC for Energy Efficient Electronics Science, led by the University of California at Berkeley and awarded in FY 2010.
- ECCS support for the NSEC program totals \$110,000, a reduction of \$680,000, as the program continues to sunset as planned.

Education

- ECCS contributes to a number of education and diversity activities, including REU and CLB. Total ECCS funding for these activities in the FY 2016 Request is \$1.0 million. CLB funding is requested at the FY 2015 Estimate and funding for REU supplements increases by \$50,000.

Infrastructure

- ENG maintains support for infrastructure through investments in the NNCI at the FY 2015 Estimate.

**DIVISION OF ENGINEERING EDUCATION
AND CENTERS (EEC)**

\$110,390,000
-\$7,100,000 / -6.0%

EEC Funding
(Dollars in Millions)

	FY 2014 Actual ¹	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Total, EEC	\$119.50	\$117.49	\$110.39	-\$7.10	-6.0%
Research	92.92	93.96	85.37	-8.59	-9.1%
CAREER	0.11	-	-	-	N/A
Centers Funding (total)	72.95	65.54	56.50	-9.04	-13.8%
Engineering Research Centers	70.06	64.50	56.50	-8.00	-12.4%
Nanoscale Science & Engineering Centers	1.25	1.04	-	-1.04	-100.0%
Science of Learning Centers	1.64	-	-	-	N/A
Education	26.58	23.53	25.02	1.49	6.3%

Totals may not add due to rounding.

¹ FY 2014 Actual obligations have been restated for the FY 2015 reorganization of the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) from Emerging Frontiers in Research and Innovation (EFRI) for comparability.

EEC integrates disciplinary basic research and education conducted in other divisions of ENG and across NSF into strategic frameworks critical for addressing societal grand challenges and promoting innovation. Research included in the EEC portfolio spans both the physical and life sciences and engineering, from nanostructured materials to new device concepts, subsystems, and systems. Applications range across a wide spectrum, including energy, medicine, telecommunications, nanoelectronics, manufacturing, civil infrastructure, the environment, computer networks, cybersecurity, and others. Also included are formal scholarly studies in engineering education and on how people learn.

The complex, integrative role of EEC requires a comprehensive infrastructure of people, equipment, and centers. Fresh, creative approaches to developing the engineering workforce are vital, as a lack of properly prepared engineers is a critical barrier to a healthy U.S. economy. EEC invests in faculty, graduate and undergraduate students, post-doctoral scholars, and K-12 teachers. As nontraditional students – e.g. part-time, delayed enrollment, veteran, etc. – comprise more than 70 percent of the general undergraduate population, EEC is defining unique alternative pathways for these students, especially veterans, to successfully earn degrees in engineering.

The programs in EEC are administratively managed within three categories: (1) Major Centers and Facilities; (2) Engineering Education Research; and (3) Engineering Career Development. The Major Centers and Facilities category is comprised of the signature ERC program, NSECs, and an SLC. They provide the framework for interdisciplinary research and education, development, and technology transfer in partnership with academia, industry, and government. The Engineering Education Research category advances new productive engineering pedagogy and learning strategies in traditional and non-traditional environments. This category also includes EEC’s participation in the NSF-wide activity, IUSE, which integrates the agency’s investments in undergraduate education. The Engineering Career Development category includes programs such as REU and Research Experiences for Teachers (RET).

In general, 18 percent of the EEC portfolio is available for new research grants. The remaining 82

percent funds continuing grants and cooperative agreements made in previous years. This high fraction of multi-year commitments is primarily a consequence of centers funding, which includes awards made as five-year cooperative agreements.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- Support for the ERC program decreases by \$8.0 million, to a total of \$56.50 million. Decreased support will result in a reduction in the number of centers from 19 to 15 as the program is between competition years in FY 2016. The next class of ERCs will be funded in FY 2017. Funding and numbers of centers include three Nanosystems ERCs that were first supported in FY 2012.
- EEC funding of the directorate-supported SLC, the Center of Excellence for Learning in Education, Science, and Technology (CELEST), led by Boston University, ended as the center received final year funding in FY 2014 as planned.

Education

- In FY 2014, NSF adopted a comprehensive agency-wide framework – IUSE – that consolidates NSF’s investments in undergraduate education. While the majority of funding for IUSE is provided through the Directorate for Education and Human Resources (EHR), other NSF directorates contribute directly to this effort, ensuring an enduring connection to established discipline-based activities and expertise. In FY 2016, ENG’s consolidation of the Engineering Education Research and Nanotechnology Undergraduate Education programs into IUSE will be funded at \$6.0 million, equal to the FY 2015 Estimate.
- Funding for the REU Sites program increases \$250,000, to a total of \$10.75 million in FY 2016. REU projects offer an opportunity to tap the Nation’s diverse student talent pool and broaden participation in science and engineering. Research experience has been found to be one of the most effective avenues for attracting and retaining students in engineering and for preparing them for careers in this field.
- Funding for RET increases \$100,000, to a total of \$4.25 million. Over the past ten years, the RET in Engineering Sites program has provided K-12 teachers and community college faculty the opportunity to gain research experience in university laboratories. The professional development gained by the participants through this unique experience has enriched their performance in the classroom and their guidance of students toward engineering. The increase will support these participants in areas of national need such as sustainability, energy, manufacturing, robotics, and others.
- EEC will provide \$1.40 million to support the agency’s broadening participation pilot NSF INCLUDES.
- Support of the NRT program decreases by \$260,000, to a total of \$2.59 million. ENG will continue to participate in NRT, a modernization of the IGERT program. The FY 2016 decrease is a continuing reduction in the remaining commitments to IGERT awards.
- EEC support for the NSEC program ends as the final center supported by the division receives its last year funding in FY 2015 as planned.

**DIVISION OF INDUSTRIAL INNOVATION
AND PARTNERSHIPS (IIP)**

\$248,110,000
+\$21,130,000 / 9.3%

IIP Funding
(Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over	
				FY 2015 Estimate Amount	Percent
Total, IIP	\$205.99	\$226.98	\$248.11	\$21.13	9.3%
Research	205.79	226.83	247.96	21.13	9.3%
SBIR/STTR	159.99	177.11	194.36	17.25	9.7%
Education	0.20	0.15	0.15	-	-

Totals may not add due to rounding.

¹ FY 2014 Actual obligations have been restated for the FY 2015 reorganization of the Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) from Emerging Frontiers in Research and Innovation (EFRI) for comparability.

IIP contributes to the NSF innovation ecosystem by: (1) supporting innovation research that builds on fundamental research discoveries that exhibit potential for societal and economic impact; (2) encouraging research partnerships between academia and industry; and (3) offering hands-on experience in the innovation process to current and future entrepreneurs and innovators.

IIP is home to two federal small business research programs, the Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program. These programs support innovation research that leverages academic research findings and builds partnerships among small businesses, academia, large companies, and/or other stakeholders with the goal of achieving technology commercialization and enabling new products, processes, or services. Technology topics draw upon the breadth of NSF scientific and engineering research disciplines and are aligned along national and societal priorities.

IIP supports academic research through three research programs: the Industry/University Cooperative Research Center (I/UCRC) program, the Partnership for Innovation (PFI) program, and the Grant Opportunities for Academic Liaison with Industry (GOALI) program. These programs aim to stimulate academia-industry partnerships, leverage industrial support, accelerate technology commercialization, and empower future generations in science and engineering. University grantees in these programs collaborate with industry to create enabling technologies that meet national needs, such as managing the electrical power system, improving manufacturing and biological processing, and supporting new information and communications technologies.

The division also administers, and is a strong intellectual contributor to, the I-Corps™ program. The NSF I-Corps™ connects NSF-funded science and engineering research with the technological, entrepreneurial, and business communities, and fosters a national innovation ecosystem that links scientific discovery with technology development, societal needs, and economic opportunities.

In general, 93 percent of the IIP portfolio is available for new research grants and seven percent is available for continuing grants.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- Funding for SBIR/STTR increases by \$17.25 million, to a total of \$194.36 million, consistent with the levels specified in the SBIR/STTR Reauthorization Act of 2011 (P.L. 112-81), which stipulates 3.0 percent and 0.45 percent of NSF's FY 2016 extramural research funding be allocated to the SBIR and STTR programs, respectively. Increased support for SBIR/STTR will (1) provide more resources to the small business community to carry on cutting-edge, high-risk, and high-impact research projects; and (2) provide an opportunity for greater collaboration with the disciplinary divisions across NSF in the spirit of catalyzing technology commercialization of discovery research.
- Funding for the PFI program increases \$500,000, to a total of \$22.0 million. The PFI program is an umbrella for two complementary components. The Building Innovation Capacity (BIC) component supports academic-industry partnerships, which are led by an interdisciplinary academic research team with at least one industry partner, to collaborate in building technological, human and service system innovation capacity and to further basic research toward market-accepted innovations. These partnerships focus on the integration of technologies inspired by breakthrough discoveries into a specified human-centered smart service system with the potential to achieve transformational change in an existing service system or to spur an entirely new service system. The Accelerating Innovation Research (AIR) component is designed to enable research discoveries to be translated onto a path toward commercial reality while engaging faculty and students in entrepreneurial and market-oriented thinking, leveraging the prior investments NSF has made, and providing NSF-funded research alliances the opportunity to develop academic-based innovation ecosystems.
- Funding for I-Corps™ increases by \$2.38 million, to a total of \$13.0 million, to provide greater resources that will help determine the readiness to commercialize technologies built on previously or currently NSF-funded basic research projects.
- Funding for I/UCRC increases \$500,000, to a total of \$12.50 million. Support will emphasize topics related to advanced manufacturing, clean energy, and cyberinfrastructure, in line with NSF investments in CEMMSS and CIF21. Funding will also support REU, which will further enhance the educational impact of I/UCRC and prepare students for innovation leadership in a globally competitive marketplace through opportunities to work closely with industry.
- IIP's support for GOALI increases by \$500,000, to a total of \$6.25 million. The program promotes university-industry partnerships by making project funds or fellowships/traineeships available to support an eclectic mix of industry-university linkages across the Foundation.

Education

- Support for the REU program, \$150,000, remains the same as the FY 2015 Estimate.

**OFFICE OF EMERGING FRONTIERS AND
MULTIDISCIPLINARY ACTIVITIES (EFMA)**

**\$56,490,000
+\$6,420,000 / 12.8%**

EFMA Funding
(Dollars in Millions)

	FY 2014 ¹ Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Total, EFMA	\$44.27	\$50.07	\$56.49	\$6.42	12.8%
Research	35.82	41.71	48.13	6.42	15.4%
Education	3.41	3.36	3.36	-	-
Infrastructure	5.04	5.00	5.00	-	-
Cornell High Energy Synchrotron Source (CHESS)	5.04	5.00	5.00	-	-

Totals may not add due to rounding.

¹ The Office of Emerging Frontiers and Multidisciplinary Activities (EFMA) is the reorganized form of Emerging Frontiers in Research and Innovation (EFRI), beginning in FY 2015. FY 2014 Actual obligations have been restated for comparability.

EFMA strategically pursues and funds projects in important emerging areas in a timely manner. The office also provides support to multidisciplinary education programs such as ADVANCE and REU. Additionally, EFMA is the home to ENG’s annual operations support of the Cornell High Energy Synchrotron Source (CHESS) facility. The largest activity in EFMA is the Emerging Frontier in Research and Innovation (EFRI) program.

Each year EFRI recommends, prioritizes, and funds interdisciplinary topics at the frontiers of engineering research and education that have the potential for transformative impacts on national needs and/or grand challenges. Technological innovations have given rise to new industries, expanded access to quality healthcare, and fueled national prosperity even as global competition has grown. To help ensure the nation’s continued success, EFRI provides critical, strategic support of fundamental discovery, particularly in areas that may lead to breakthrough technologies and strengthen the economy’s technical underpinnings. EFRI will have the necessary flexibility to target long-term challenges, while retaining the ability and agility to adapt as new challenges demand.

EFRI encourages the engineering community to come forward with new and paradigm-shifting proposals at the interface of disciplines and fields in important emerging areas. Their ideas and discoveries may potentially lead to new research areas for NSF and other agencies, new industries or capabilities that result in a leadership position for the country, and/or significant progress on a recognized national need or grand challenge.

Recent EFRI topics have included areas such as: integrated processes and systems designed to make U.S. infrastructures more resilient to disasters and unexpected events; sustainable energy sources; advances in robotics; and flexible technologies and regenerative engineering for healthcare. In FY 2012 and FY 2013, EFRI invested in three topic areas: Flexible Bioelectronics Systems (BioFlex); Origami Design for the Integration of Self-assembling Systems for Engineering Innovation (ODISSEI); and Photosynthetic Biorefineries (PSBR). These were developed in close collaboration with the Directorates for Biological Sciences (BIO) and MPS. The results from these investigations hold the potential to enable new biological energy sources and better protection for the environment, and human health, including novel

cancer screening technologies, and innovations in many areas, ranging from surgical instruments to adaptive aircraft structures and reconfigurable robots. In FY 2015, EFRI is investing in an important topic area for the second consecutive year on 2-Dimensional Advance Materials Research and Engineering (2-DARE). This topic is being managed jointly by ENG and MPS. The rapid and recent advances in graphene, a single sheet of carbon atoms arranged in a two-dimensional (2D) honeycomb crystal lattice, have raised questions for other examples of 2D materials that might have distinct and useful properties. The EFRI 2-DARE topic promotes the exploration of the exciting prospects of 2D atomic layers and devices in the wide range of compositions of 2D-layered materials beyond graphene that can stimulate technologically significant applications in the coming years.

EFRI coordinates its interdisciplinary activities both within NSF and with relevant federal agencies. The Department of Energy (DOE) and the Environmental Protection Agency (EPA) have co-funded some of the EFRI projects in sustainable energy and environmental design. The Air Force Office of Scientific Research (AFOSR) entered into a five-year Memorandum of Understanding (MOU) with NSF in FY 2012 to collaborate and help support projects of mutual interest. AFOSR participated in reviews of ODISSEI research projects, and is collaborating on the second year of the FY 2015 2-DARE competition currently underway.

In general, 90 percent of the EFRI portfolio is available for new research grants and 10 percent supports continuing increments for grants made in previous years.

FY 2016 Summary

All funding decreases/increases represent change over the FY 2015 Estimate.

Research

- FY 2016 EFRI support increases by \$1.50 million, to a total of \$32.50 million, and will provide support for up to 16 interdisciplinary team projects aimed at addressing national challenges such as renewable energy, advanced manufacturing, and critical and resilient infrastructure systems and processes.
- An increase of \$4.92 million, to a total of \$15.63 million, is provided to support new and ongoing NSF-wide multidisciplinary investments and other important national priorities.

Education

- EFMA support for the ADVANCE and REU programs are maintained at the FY 2015 Estimate of \$3.26 million and \$100,000 respectively.

Infrastructure

- EFMA continues support for infrastructure through investments in the CHESS facility at the FY 2015 Estimate.

