

DIRECTORATE FOR ENGINEERING (ENG)**\$858,170,000**
+\$7,100,000 / 0.8%**ENG Funding**
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Chemical, Bioengineering, Environmental, and Transport Systems (CBET)	\$167.01	\$173.00	\$174.99	\$1.99	1.2%
Civil, Mechanical, and Manufacturing Innovation (CMMI)	200.81	209.20	210.40	1.20	0.6%
Electrical, Communications, and Cyber Systems (ECCS)	104.58	110.06	110.41	0.35	0.3%
Engineering Education and Centers (EEC)	115.21	122.24	117.38	-4.86	-4.0%
Industrial Innovation and Partnerships (IIP)	202.41	205.97	213.69	7.72	3.8%
<i>SBIR/STTR</i>	<i>161.34</i>	<i>159.39</i>	<i>164.99</i>	<i>5.61</i>	<i>3.5%</i>
Emerging Frontiers in Research and Innovation (EFRI)	30.16	30.60	31.30	0.70	2.3%
Total, ENG	\$820.18	\$851.07	\$858.17	\$7.10	0.8%

Totals may not add due to rounding.

About ENG

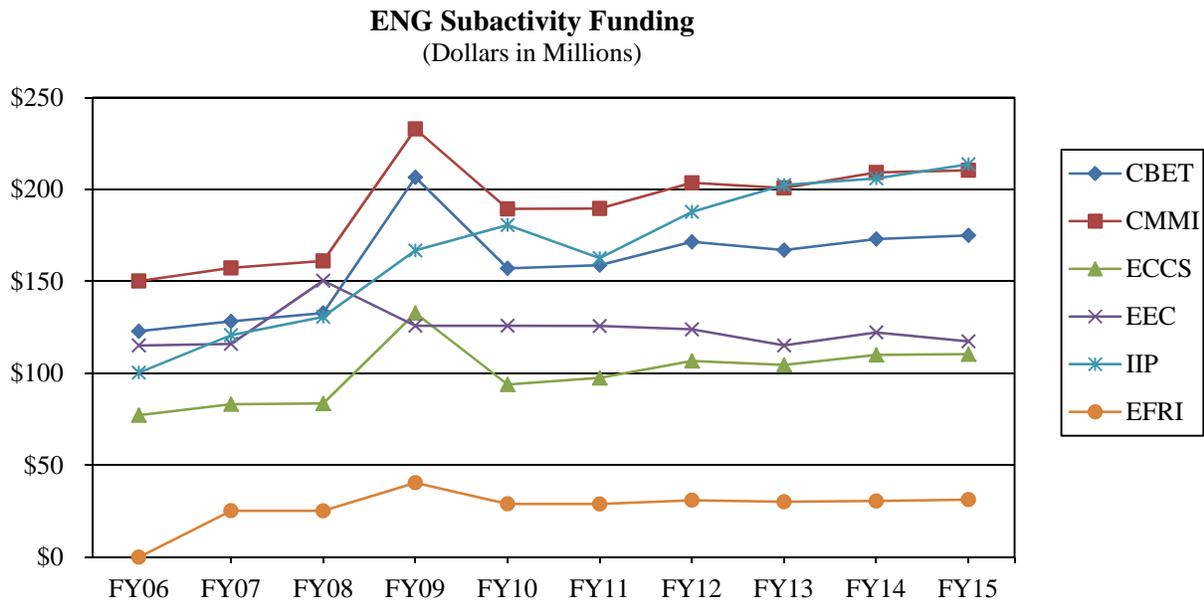
Fundamental research supported by the Directorate for Engineering (ENG), combined with the creativity of well-educated engineers and the resources of state-of-the-art facilities, has resulted in many important discoveries. These discoveries have fueled exciting technological innovations, including artificial retinas, green gasoline, and advanced lithography techniques, which in turn have stimulated economic growth and are improving the quality of life for all Americans.

ENG's FY 2015 Budget Request aims to bring about new breakthroughs for national priorities and grand challenges by (1) implementing key NSF-wide major investments, and (2) supporting core programs in frontier engineering research.

ENG investments will support major priorities and investments 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 through Advancing Innovative Neurotechnologies (BRAIN) Initiative. Targeted ENG investments will make unique and essential contributions to these far-reaching national challenges.

The directorate will continue to invest throughout its core programs in emerging and frontier basic research areas, such as flexible bioelectronics, complex systems, and nanotechnology safety. Through support of small businesses and academic partnerships with industry, ENG will help launch exciting technological innovations. ENG also will continue to prepare the future engineering workforce through leadership in engineering education research and through opportunities for hands-on research.

ENG provides about 37 percent of the federal funding for basic research in engineering at academic institutions.



FY 2015 Summary by Division

- CBET's FY 2015 Request will promote research and education for sustainability in the areas of the water/energy/food nexus by contributing to the NSF-wide Science, Engineering, and Education for Sustainability (SEES) investment. CBET will continue to support transformative work in collaboration with life/physical sciences through the Research at the Interface of the Biological, Mathematical and Physical Sciences (BioMaPS) program and the Cognitive Science and Neuroscience activity, including the BRAIN Initiative. CBET's request will bolster Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) support through investment in robotics research to assist those with physical disabilities or cognitive impairment. CBET will also enhance support for early-career researchers and support a Science and Technology Center (STC) from the Class of 2010.
- CMMI's FY 2015 Request will enable contributions to the CEMMSS investment through research and education in advanced manufacturing, interdisciplinary research in advanced materials and manufacturing processes, as well as materials design, robotics, and cyber-physical system approaches to capitalize on interdisciplinary research opportunities arising in cyber-enabled smart manufacturing systems. Cyberinfrastructure Framework for 21st Century Science and Engineering (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 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 2015 Request will enable contributions to the CIF21 investment through support for research and education in advanced devices and systems directed towards computing, data storage, networking, and data management. The ECCS investment in the Enhanced Access to the Radio Spectrum (EARS) activity will 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 increase its support to critical areas of national importance such as understanding the brain, advanced electronic materials, and low-power computing. ECCS will also enhance support for early-career researchers and support an STC.

- EEC's FY 2015 Request will provide funding for a combination of Engineering Research Centers (ERC) and Nanosystems Engineering Research Centers (NERCs), including planned growth supplements to the first class of NERCs established in FY 2012 and two to three new centers awarded as part of the Class of 2014. In FY 2015 EEC will participate in the NSF-wide activity, Improving Undergraduate STEM Education (IUSE), which covers the agency's investments in undergraduate education. Engineering Education and Nanotechnology Undergraduate Education (NUE) undergraduate programs are 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 2015 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 begin translation of fundamental research discoveries, encourage academia and industry to collaborate and prepare students to be innovators and entrepreneurs.
- EFRI's FY 2015 Request will provide support for 15 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 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Advanced Manufacturing	\$68.50	\$77.50	\$73.15	-\$4.35	-5.6%
BioMaPS	\$3.64	\$4.31	\$3.00	-\$1.31	-30.4%
CAREER	47.91	42.42	42.91	0.49	1.2%
CEMMSS	75.00	95.00	90.00	-5.00	-5.3%
CIF21	7.00	12.00	10.00	-2.00	-16.7%
Clean Energy	126.00	128.00	134.41	6.41	5.0%
Cognitive Science and Neuroscience	-	0.75	4.95	4.20	560.0%
I-Corps	4.57	8.00	10.62	2.62	32.8%
Improving Undergraduate Stem Education (IUSE) ¹	-	6.00	6.00	-	-
Engineering Education ²	4.50	-	-	-	N/A
NUE ²	1.50	-	-	-	N/A
NRT ³	6.63	5.38	4.38	-1.00	-18.6%
SEES	18.15	15.00	12.00	-3.00	-20.0%
SaTC	3.25	3.75	3.25	-0.50	-13.3%

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

¹ Engineering Education and Nanotechnology Undergraduate Education (NUE) were consolidated into IUSE in FY 2014.

² Engineering Education totals \$10.99 million in FY 2013 for all levels of education. The \$4.50 million shown is for undergraduate education only. NUE totals \$1.68 million in FY 2013; \$1.50 million is for undergraduate education.

³ The FY 2013 Actual represents Integrative Graduate Education and Research Traineeship (IGERT) program funding. Outyear commitments for IGERT are included in the NRT line and are \$4.44 million in FY 2014 and \$3.60 million in FY 2015.

- ENG will strategically invest in advanced manufacturing to support innovations in multi-scale modeling for simulation-based design and manufacturing across the supply chain, nanomanufacturing, innovative materials and manufacturing processes, energy systems manufacturing, and complex engineering systems design and manufacturing. In addition to working across all directorates, 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. ENG's FY 2015 Request for Advanced Manufacturing is \$73.15 million.
- ENG will invest \$3.0 million in BioMaPS through the clean energy and advanced manufacturing activities as well as ENG core programs. Funding for this activity will be directed to the CBET and CMMI divisions.
- ENG's CAREER funding of \$42.91 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.
- ENG support of \$90.0 million for CEMMSS will build upon existing frontier research and advance connections between robotics and manufacturing; materials and manufacturing; cyber-physical

systems and robotics; robotics and the biological aspects of engineering. CEMMSS also includes multi-directorate investments in the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) focus area.

- ENG funding of \$10.0 million in the CIF21 investment will focus on computational and data-enabled science and engineering research, infrastructure and community building, and access and connections to cyberinfrastructure facilities. Funding will be directed to CBET, CMMI, and ECCS.
- ENG support of \$134.41 million for 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 divided among all divisions.
- ENG will invest \$4.95 million in Cognitive Science and Neuroscience research critical to success of the BRAIN initiative and integral to activities associated with the interdisciplinary work within this multi-directorate 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.
- ENG investment of \$10.62 million in the NSF I-Corps program will seek to identify NSF-funded researchers who will receive additional support – in the forms of mentoring and funding – to accelerate innovation that can attract subsequent third-party investment. In FY 2015 NSF will continue to support I-Corps 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. I-Corps Sites are funded at academic institutions, having already existing innovation or entrepreneurial units, to enable them to nurture and support multiple, local teams to transition their ideas, devices, processes, or other intellectual activities into the marketplace. The I-Corps Nodes subcomponent's goal is to establish regional nodes to provide training to I-Corps Teams; develop tools and resources that will impact and expand the benefits of the entire I-Corps program within a two to three year timeframe; and identify and pursue longer-term (five+ year) research projects based on the knowledge gained in the growth of the program.
- ENG will participate in the NSF-wide activity, Improving Undergraduate STEM Education (IUSE), which covers the agency's investments in undergraduate education. Through the undergraduate components of the Engineering Education program and the Nanotechnology Undergraduate Education (NUE) program, which are consolidated into IUSE in FY 2014, ENG 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. Funding is \$6.0 million total.
- In FY 2015, ENG will participate in the NSF-wide activity, NSF Research Traineeship (NRT) program, which is a modernization of the Integrative Education and Research Traineeship (IGERT) program. For more information regarding NRT, see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative in the NSF-Wide Investments chapter.
- ENG will support the NSF-wide SEES investment by funding activities across the directorate that will lay the foundation for technologies that aim to mitigate, and adapt to, environmental change that threatens sustainability. The greatest share of funding will be directed to CBET, CMMI, and ECCS,

for investments in Sustainability Research Networks and Sustainable Chemistry research. ENG's FY 2015 Request for SEES is \$12.0 million.

- ENG support of \$3.25 million for the Secure and Trustworthy Cyberspace (SaTC) activity 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 (released December 2011). NITRD's research thrusts cover a set of interrelated priorities for U.S. government agencies that conduct or sponsor research and development in cybersecurity.

ENG Funding for Centers Programs and Facilities

ENG Funding for Centers Programs

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, Centers Programs	\$86.10	\$85.87	\$78.75	-\$7.12	-8.3%
Engineering Research Centers (EEC)	62.24	68.50	64.00	-4.50	-6.6%
Nanoscale Science & Engineering Centers (Multiple)	11.98	5.75	4.75	-1.00	-17.4%
Science & Technology Centers (Multiple)	10.11	10.00	10.00	-	-
Science of Learning Centers (EEC)	1.77	1.62	-	-1.62	-100.0%

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 \$4.50 million to a total of \$64.0 million. Two to three new centers are expected to be awarded as part of the Class of 2014. Five centers from the Class of 2006 receive reduced final year funding as part of the normal ERC funding cycle, as these centers prepare for self-sufficiency after the completion of NSF support.
- NSEC support will be reduced by \$1.0 million, to a total of \$4.75 million, as the program continues to sunset as planned. It is anticipated core programs in ENG will increase support to nano science and engineering, offsetting the reduction.
- ENG will continue to fund two STCs in FY 2015. CBET will support the Center on Emergent Behaviors of Integrated Cellular Systems, and ECCS will support the Center for Energy Efficient Electronics Science.
- ENG decreases investments in the directorate-supported SLC by \$1.62 million, as the center receives final year funding in FY 2014 as planned.

ENG Funding for Facilities

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, Facilities	\$33.17	\$35.83	\$27.83	-\$8.00	-22.3%
CHES (Multiple)	-	5.00	5.00	-	-
NEES (CMMI)	21.82	20.00	12.00	-8.00	-40.0%
NNIN (Multiple)	11.35	10.83	10.83	-	-

Totals may not add due to rounding.

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

ENG will decrease operations and maintenance budgets for facilities by \$8.0 million at the FY 2015 Request level. Notable items include:

- Beginning in FY 2014, ENG will provide partial support for the operations and maintenance cost for CHES. The funding level of \$5.0 million is unchanged in FY 2015.
- Support for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2015 decreases by \$8.0 million to a total of \$12.0 million. The reduction 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 will also leverage investment in CIF21 to support NEES connections and foster data-enabled research within the earthquake engineering community.
- ENG continues support for infrastructure through investment in the Next Generation National Nanotechnology Infrastructure Network (NG NNIN) of user facilities at the FY 2014 Estimate level of \$10.83 million. FY 2015 represents year two of this planned ten-year investment.

Summary and Funding Profile

ENG supports investments in core research and education as well as research infrastructure such as facilities.

ENG Funding Profile			
	FY 2013		
	Actual	FY 2014	FY 2015
	Estimate	Estimate	Estimate
Statistics for Competitive Awards:			
Number of Proposals	10,742	11,000	11,300
Number of New Awards	2,217	2,300	2,330
Funding Rate	21%	21%	21%
Statistics for Research Grants:			
Number of Research Grant Proposals	8,374	8,550	8,700
Number of Research Grants	1,508	1,570	1,590
Funding Rate	18%	18%	18%
Median Annualized Award Size	\$102,600	\$103,000	\$103,000
Average Annualized Award Size	\$122,600	\$123,000	\$123,000
Average Award Duration, in years	2.9	3.0	3.0

In FY 2015 the number of research grant proposals is expected to be 11,300. ENG expects to award approximately 1,590 research grants in FY 2015. Average annualized award size and duration are estimated to be \$123,000 and three years, respectively, in FY 2015.

In FY 2015, funding for centers accounts for just over 11 percent of ENG's non-SBIR/STTR Request.

Funding for facilities accounts for just over 4 percent of ENG's non-SBIR/STTR FY 2014 Request.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2013-FY 2014, Manhattan Strategies Inc. is performing a feasibility study for the evaluation of the I-Corps Teams program. As part of the roadmap, the I-Corps program established the need for an external and rigorous impact evaluation. The objectives of this study are to establish the feasibility of performing rigorous impact evaluation and the methodological approaches that could be used for that purpose. In particular, NSF is interested on the impact that the program has on the teams that go through the program and who are the ultimate subject of the intervention receiving the benefit of training.
- In FY 2013 ENG developed a Logic Model for the General and Age Related Disability Engineering (GARDE) program in CBET, to articulate and develop indicators for the following programmatic objectives: 1) fundamental research and R&D of novel and transformative assistive and rehabilitation engineering, 2) more suited to the needs of end users, 3) Greater inclusion of persons with disabilities (PwDs) in the research and development (R&D) process, 4) increased collaboration of engineers with and without disabilities, 5) increased representation of PwDs in engineering careers, 6) support of tech transfer for PwDs by PwDs (small business), 6) enhanced profile of engineering for disabilities within the engineering research community, and 7) long-term: Improved attainment of career goals for PwDs and engineers working on questions related to disabilities; improved accessibility of

transformative technology engineered for PwDs and the medical community. In addition to developing indicators and metrics to be included in ENG's generic clearance request for monitoring systems across the directorate, the Program Evaluation & Assessment office also developed a questionnaire to interview students that participated in GARDE-funded research projects, in order to gather data for assessment and evaluation of objectives 2 and 5, specifically about whether PwDs are being included in the R&D process, and whether students trained on GARDE awards are inclined to continue in this field.

In FY 2014 data will be collected to inform the outcomes of the program at that level. Data from the first round of collections (students on current GARDE awards) are expected by the end of the 2013-2014 academic year.

- In FY2013 ENG IIP funded the migration of SBIR/STTR data to NSF's data warehouse and its integration with NSF's administrative data. This served as NSF's pilot for data integration, and the use of analytics with monitoring and decision support purposes. Dashboards are being produced in FY2014 to provide data for more informed decision making. The funding lineage of an award, the principal investigator's history, as well as a clear depiction of each program director's portfolio (technologies, companies, outcomes) are some of the dashboards made possible by data integration that will be deployed in FY 2014.
- In FY 2013, ENG developed an evaluation strategy for Engineering Education research programs in the Engineering Education and Centers Division. The strategy encompasses CAREER awards, the Research Initiation Grants in Engineering education (RIGEE) program, the Research in Engineering Education (REE) program, and workshops funded on related topics. The goal of this evaluation is to develop a comprehensive view of ENG's investments and impacts in the field of engineering education research. Due to the diversity of programs in this portfolio, this evaluation includes a number of different methodologies adapted to the needs of each type of award or investment.

Science and Technology Policy Institute (STPI) Reports:

- The CMMI division recently used STPI for a retrospective assessment of solid freeform fabrication/additive manufacturing (SFF). 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 initiatives similar to NSF's Strategic Manufacturing (STRATMAN) initiative that, in part, helped launch and mature SFF technologies, and to inform NSF's participation in the Additive Manufacturing Innovation Institute. (www.ida.org/upload/stpi/pdfs/p5091final.pdf)

Workshops and Reports:

- Energy-Water Nexus Workshop, Arlington, VA, June 10-11, 2013. This workshop facilitated networking and coordination among professional organizations (particularly engineering societies), federal agencies (NSF, DOE, etc.), industry (e.g., ExxonMobil, etc.), and academic researchers to address energy-water nexus concerns and issues. The workshop generated a detailed report including a potential research agenda for basic research on addressing and mitigating emerging energy-water nexus problems. (www.crwr.utexas.edu/reports/pdf/2013/rpt13-07.pdf)
- Workshop on Mapping and Engineering the Brain, August 13-14, 2013, Washington DC. The Workshop identified and discussed grand challenges facing the scientific community in the multi-scale mapping and engineering of the brain. The workshop focused on identifying major challenges and opportunities in mapping, modeling, interfacing and ultimately understanding the brain over the next 10 years and beyond, through advanced neurotechnology. (www.prweb.com/pdfdownload/11185332.pdf)

Directorate for Engineering

Committees of Visitors (COV):

- In 2013, COVs reviewed EEC and IIP. The COVs are scheduled to present their reports to the ENG Advisory Committee in April 2014.
- In 2014, COVs will review ECCS and EFRI.
- In 2015, COVs will review CBET and CMMI.

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

In addition to continuous ongoing evaluation within the ERC and I/UCRC programs, the directorate has additional evaluations in development. ENG has a dedicated program director for evaluation and assessment who is leading a group charged with implementing an overarching strategy for the directorate, which includes developing and ratifying logic models for the different engineering programs. The program director is working on a pilot evaluation with selected fundamental engineering research and engineering education programs. Using a “Logic Model” approach, the engineering evaluation and assessment plan will focus on immediate-, intermediate-, and long-term impact of engineering investments on society. In addition, ENG is working with the Science of Science and Innovation Policy (SciSIP) program within the Social, Behavioral and Economic Sciences Directorate (SBE) on a National Academies study to evaluate the quality of research output and impact on society.

Number of People Involved in ENG Activities

	FY 2013		
	Actual Estimate	FY 2014 Estimate	FY 2015 Estimate
Senior Researchers	8,606	8,800	8,850
Other Professionals	1,774	1,800	1,810
Postdoctorates	469	480	480
Graduate Students	7,089	7,230	7,270
Undergraduate Students	3,859	3,930	3,950
Total Number of People	21,797	22,240	22,360

**DIVISION OF CHEMICAL, BIOENGINEERING,
ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET)** **\$174,990,000**
+\$1,990,000 / 1.2%

CBET Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, CBET	\$167.01	\$173.00	\$174.99	\$1.99	1.2%
Research	160.39	165.23	167.59	2.36	1.4%
CAREER	19.37	18.10	18.41	0.31	1.7%
Centers Funding (total)	8.94	6.88	6.57	-0.31	-4.5%
Nanoscale Science & Engineering	3.88	1.88	1.57	-0.31	-16.5%
STC for Emergent Behavior	5.06	5.00	5.00	-	-
Education	2.90	2.77	2.40	-0.37	-13.4%
Infrastructure	3.73	5.00	5.00	-	-
CHESS	-	1.31	1.31	-	-
NNIN	3.73	3.69	3.69	-	-

Totals may not add due to rounding.

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, sustainable energy, and 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, forest products, metals, 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 has been organized into four thematic clusters: Chemical, Biochemical, and Biotechnology Systems; Biomedical Engineering and Engineering Healthcare; Environmental Engineering and Sustainability; and Transport and Thermal Fluids Phenomena.

In general, 74 percent of the CBET portfolio is available for new research grants and 26 percent supports continuing increments for grants made in previous years.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- CAREER funding increases by \$310,000 to a total of \$18.41 million in FY 2015. This increase is consistent with CBET's emphasis on supporting early-career researchers.
- CBET investment in SEES totals \$7.25 million in FY 2015 and will support the areas of sustainability. Emphasis on areas within the water/energy/food nexus will be a focus.

Directorate for Engineering

- Investments for CIF21 total \$2.0 million, and will contribute to developing 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 MPS in Designing Materials to Revolutionize and Engineer our Future (DMREF) under the NSF-wide CEMMSS investment area.
- Support for BioMaPS is requested at \$2.50 million in FY 2015 and will include research on nanoscale biosensing, neuro-engineering, and cellular biomechanics, as well as metabolic engineering and engineering aspects of synthetic biology.
- In the FY 2015 request, CBET will invest \$3.0 million in collaborative research in support of the cross-foundation activity in Cognitive Science and Neuroscience. This initiative holds promise for addressing fundamental questions about healthy brain functions and laying the groundwork for advancing treatments for brain disorders or traumatic brain injury.
- STC funding remains at \$5.0 million, equivalent with the FY 2014 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 \$1.57 million, as the program continues to sunset as planned.

Education

- CBET contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF’s Career Life Balance (CLB) activity. Total CBET funding for these activities in the FY 2015 Request is \$2.40 million. CLB funding decreases to more accurately reflect demand. Funding also decreases for REU supplements to allow maintained support for other NSF and ENG priority programs.

Infrastructure

- ENG continues support for infrastructure through investments in the NG NNIN and CHES facilities at the FY 2014 Estimate level.

DIVISION OF CIVIL, MECHANICAL, AND MANUFACTURING INNOVATION (CMMI) **\$210,400,000**
+\$1,200,000 / 0.6%

CMMI Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, CMMI	\$200.81	\$209.20	\$210.40	\$1.20	0.6%
Research	173.59	182.33	192.00	9.67	5.3%
CAREER	17.25	14.20	14.30	0.10	0.7%
Centers Funding (total)	3.27	1.61	1.35	-0.26	-16.1%
Nanoscale Science & Engineering Centers	3.27	1.61	1.35	-0.26	-16.1%
Education	3.07	3.47	3.00	-0.47	-13.5%
Infrastructure	24.14	23.40	15.40	-8.00	-34.2%
CHES	-	1.50	1.50	-	-
NNIN	2.33	1.90	1.90	-	-
NEES	21.82	20.00	12.00	-8.00	-40.0%

Totals may not add due to rounding.

CMMI funds fundamental research in support of the Foundation’s strategic goals directed at advances in the disciplines of civil, mechanical, industrial, systems, manufacturing engineering, and materials design. In addition, the division has a focus on the reduction of risks and damage resulting from earthquakes and other hazards and disasters. 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 advance transformative research results that promote innovative manufacturing technology; enable the design and analysis of complex engineering systems; enhance the sustainability and resiliency of U.S. infrastructure (for example, buildings, transportation, and communication networks); help protect the Nation from extreme events; and apply engineering principles to improve the Nation’s service enterprise systems, such as healthcare.

In general, 77 percent of the CMMI portfolio is available for new research grants and 23 percent supports continuing increments for grants made in previous years.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- CAREER funding increases by \$100,000, to a total of \$14.30 million, in FY 2015. This increase is consistent with CMMI’s emphasis on supporting early-career researchers.
- Fundamental core research in support of advanced manufacturing will be \$45.50 million in FY 2015 as part of the NSF-wide CEMMSS activity. Areas of continued emphasis include nanomanufacturing, materials engineering and processing, manufacturing enterprise systems and operations research, smart manufacturing, and design and manufacturing of complex engineered systems.

Directorate for Engineering

- Research to support the NRI will be funded at \$5.0 million and contributes to ensuring continued U.S. leadership in the robotics field.
- The division will also provide \$7.0 million in support of the national MGI through the DMREF effort under the NSF-wide CEMMSS investment area.
- Investments in SEES, requested at \$2.25 million in FY 2015, will continue to support research for resilient and sustainable infrastructure, disaster-resilient systems, energy manufacturing, and energy-efficient materials and processes.
- Support for CIF21 totals \$5.50 million in FY 2015. CMMI will contribute to this NSF-wide investment by supporting research on computational-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 \$1.35 million as the program continues to sunset as planned.

Education

- CMMI contributes to a number of education and diversity activities, including ADVANCE, REU, and CLB in FY 2015. Total CMMI funding for these activities in the FY 2015 Request is \$3.0 million. CLB funding decreases to more accurately reflect demand. Funding also decreases for REU supplements to allow maintained support for other NSF and ENG priority programs.

Infrastructure

- Support for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2015 decreases by \$8.0 million to a total of \$12.0 million. The reduction 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 NG NNIN and CHES facilities at the FY 2014 Estimate level.

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

**\$110,410,000
+\$350,000 / 0.3%**

ECCS Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, ECCS	\$104.58	\$110.06	\$110.41	\$0.35	0.3%
Research	97.42	102.11	102.76	0.65	0.6%
CAREER	11.23	10.12	10.20	0.08	0.8%
Centers Funding (total)	7.16	5.96	5.79	-0.17	-2.9%
Nanoscale Science & Engineering Centers	2.10	0.96	0.79	-0.17	-17.7%
STC for Efficient Electronics	5.06	5.00	5.00	-	-
Education	1.87	1.91	1.61	-0.30	-15.7%
Infrastructure	5.30	6.04	6.04	-	-
CHESS	-	0.80	0.80	-	-
NNIN	5.30	5.24	5.24	-	-

Totals may not add due to rounding.

ECCS addresses fundamental research issues underlying electronic and photonic devices and component technologies, radio frequency through terahertz (THz) 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, 67 percent of the ECCS portfolio is available for new research grants and 33 percent supports continuing increments for grants made in previous years.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- CAREER funding increases by \$80,000, to a total of \$10.20 million in FY 2015. This increase is consistent with ECCS’s emphasis on supporting early-career researchers.
- ECCS will increase support for the NSF-wide CIF21 activity at a level of \$1.50 million through support 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) 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.

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- In an ongoing collaboration with CISE, the division will support research on cyber-physical systems (CPS) totaling \$4.50 million. 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.
- The ECCS investment in EARS totals \$4.0 million 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. Research on novel integrated antenna technologies and investigations of electromagnetic propagation in lossy media will be increased.
- ECCS funding of \$5.0 million in FY 2015 supports 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 \$790,000 as the program continues to sunset as planned.

Education

- ECCS contributes to a number of education and diversity activities, including ADVANCE, REU, and CLB in FY 2015. Total ECCS funding for these activities in the FY 2015 Request is \$1.61 million. CLB funding decreases to more accurately reflect demand. Funding also decreases for REU supplements to allow maintained support for other NSF and ENG priority programs.

Infrastructure

- ENG continues support for infrastructure through investments in the NG NNIN and CHES facilities at the FY 2014 Estimate level.

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

\$117,380,000
-\$4,860,000 / 4.0%

EEC Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, EEC	\$115.21	\$122.24	\$117.38	-\$4.86	-4.0%
Research	79.60	95.71	91.86	-3.85	-4.0%
CAREER	0.05	-	-	-	N/A
Centers Funding (total)	66.74	71.42	65.04	-6.38	-8.9%
Engineering Research Centers	62.24	68.50	64.00	-4.50	-6.6%
Nanoscale Science & Engineering Centers	2.73	1.30	1.04	-0.26	-20.0%
Science of Learning Centers	1.77	1.62	-	-1.62	-100.0%
Education	35.61	25.67	24.66	-1.01	-3.9%
Infrastructure	-	0.86	0.86	-	-
CHES	-	0.86	0.86	-	-

Totals may not add due to rounding.

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 a Science of Learning Center (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. The Engineering Education Research category also includes EEC’s participation in the NSF-wide activity, IUSE, which covers the agency’s investments in undergraduate education. Through the undergraduate portions of their ENG Education and NUE programs (\$4.50 million and \$1.50 million, respectively), EEC will continue to support research and development leading to and propagating interventions that improve both the quality and quantity of

Directorate for Engineering

STEM graduates. 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 the center funding vehicle, which includes awards made as five-year cooperative agreements.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- Support for the ERC program decreases by \$4.50 million to a total of \$64.0 million. The decrease is due to reduced needs as two to three new centers are expected to be awarded as part of the Class of 2014 and five centers from the Class of 2006 receive reduced final year funding as part of the normal ERC funding cycle as these centers prepare for self-sufficiency at the completion of NSF support.
- ENG decreases investments in the directorate-supported SLC—the Center of Excellence for Learning in Education, Science, and Technology (CELEST) led by Boston University by \$1.62 million, as the center receives final year funding in FY 2014 as planned.

Education

- In FY 2014, NSF is adopting a comprehensive agency-wide framework –IUSE – that consolidates the Foundation’s investments in undergraduate education. While the majority of funding for IUSE is provided through EHR, other NSF directorates contribute directly to this effort, ensuring an enduring connection to established discipline-based activities and expertise. In FY 2015, ENG’s total funding of \$6.0 million will support the IUSE activity, as it reflects the consolidation of the Engineering Education Research and Nanotechnology Undergraduate Education programs into IUSE.
- Funding for the REU Sites program remains at \$10.25 million in FY 2015, equivalent to the FY 2014 Estimate. -
- Funding for RET totals \$4.0 million. Over the past 10 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, thus impacting the current anemic engineering pipeline. The increase will support these participants in areas of national need such as sustainability, energy, manufacturing, robotics, and others.
- EEC will provide \$4.38 million to support the NSF Research Traineeship (NRT) and Integrative Graduate Education and Research Traineeships (IGERT) programs.

Infrastructure

- EEC continues support for infrastructure through investments in the CHES facility at the FY 2014 Estimate level.

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

\$213,690,000
+\$7,730,000 / 3.8%

IIP Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, IIP	\$202.41	\$205.97	\$213.69	\$7.73	3.8%
Research	202.41	205.64	213.36	7.73	3.8%
SBIR/STTR	161.34	159.39	164.99	5.61	3.5%
Infrastructure	-	0.33	0.33	-	-
CHESS	-	0.33	0.33	-	-

Totals may not add due to rounding.

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 I/UCRC program, the 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' purpose is to identify NSF-funded researchers who will receive additional support – in the forms of mentoring and funding – to accelerate the translation of knowledge derived from fundamental research into emerging products and services that can attract subsequent third-party funding.

In general, 89 percent of the IIP portfolio is available for new research grants. The remaining 11 percent funds continuing grants made in previous years, primarily due to the long-duration of I/UCRC awards. All other IIP programs are managed with standard grants.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- Funding for SBIR/STTR increases by \$5.61 million, to a total of \$164.99 million, which is consistent with the levels specified in the SBIR/STTR Reauthorization Act of 2011 (P.L 112-81), which stipulates 2.9 percent and 0.4 percent of NSF's FY 2015 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 totals \$21.0 million. The PFI program is an umbrella for two complementary components. The Building Innovation Capacity (BIC) component supports academe-industry partnerships, which are led by an interdisciplinary academic research team with a least one industry partner, to collaborate in building technological and human innovation capacity and to further basic research toward market-accepted innovations. 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 alliance the opportunity to develop academic-based innovation ecosystems.
- Funding for I-Corps increases by \$2.62 million, to a total of \$10.62 million, to provide more resources that will help determine the readiness to commercialize technologies built on previously or currently NSF-funded basic research projects.
- The I/UCRC program totals \$10.50 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 educational impact of I/UCRC program and prepare students for innovation leadership in a globally competitive marketplace through opportunities to work closely with industry.
- IIP's support for the GOALI program totals \$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. ENG's total FY 2015 Request for GOALI is \$16.0 million.

Infrastructure

- IIP continues support for infrastructure through investments in the CHESS facility at the FY 2014 Estimate level.

**OFFICE OF EMERGING FRONTIERS IN RESEARCH
AND INNOVATION (EFRI)**

\$31,300,000
+\$700,000 /2.3%

EFRI Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, EFRI	\$30.16	\$30.60	\$31.30	\$0.70	2.3%
Research	30.14	30.30	31.00	0.70	2.3%
Education	0.01	0.10	0.10	-	-
Infrastructure	-	0.20	0.20	-	-
CHES	-	0.20	0.20	-	-

Totals may not add due to rounding.

EFRI strategically pursues and funds projects in important emerging areas in a timely manner. 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 will provide 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; 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 Mathematical and Physical Sciences (MPS). The results from these investigations will 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 2014, EFRI is investing in an important new topic area 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

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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 as well as 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 and provided co-funding for ODISSEI research projects and is collaborating on and 2-DARE Topic, the competition for which is 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 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- FY 2015 funding will provide support for up to 15 interdisciplinary team projects aimed at addressing national challenges such as renewable energy or advanced manufacturing.

Infrastructure

- EFRI continues support for infrastructure through investments in the CHESS facility at the FY 2014 Estimate level.