DIRECTORATE FOR ENGINEERING (ENG) $911,120,000
+$84,950,000 / 10.3%

ENG Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Chemical, Bioengineering, Environmental, and Transport Systems (CBET)	$171.51	$171.45	$185.30	$13.85	8.1%
Civil, Mechanical, and Manufacturing Innovation (CMMI)	203.59	203.58	224.02	20.44	10.0%
Electrical, Communications, and Cyber Systems (ECCS)	106.74	106.73	117.90	11.17	10.5%
Engineering Education and Centers (EEC)	123.93	120.00	126.25	6.25	5.2%
Industrial Innovation and Partnerships (IIP)	187.79	193.41	225.45	32.04	16.6%
SBIR/STTR	*146.86*	*152.76*	*177.15*	*24.39*	*16.0%*
Emerging Frontiers in Research and Innovation (EFRI)	30.99	31.00	32.20	1.20	3.9%
Total, ENG	**$824.55**	**$826.17**	**$911.12**	**$84.95**	**10.3%**

Totals may not add due to rounding.

About ENG

ENG is a global leader in identifying and catalyzing fundamental engineering research, innovation, and education. To achieve this vision, the directorate leads in frontier engineering research, cultivates an innovation ecosystem, develops the next-generation engineer, and demonstrates organizational excellence.

Since its inception, ENG has provided substantial support for frontier research and education across all fields of engineering. ENG-funded basic and use-inspired research, combined with the creativity of well-educated engineers and the resources of state-of-the-art facilities, have fueled many important innovations that in turn have stimulated economic growth and improved the health and quality of life for all Americans.

Many ENG programs and activities support national priorities and contribute to solutions to grand challenges. ENG is central to several cross-Foundation investments designed to create the knowledge and innovations required for these areas. These investments include Cyber-Enabled Materials, Manufacturing, and Smart-Systems (CEMMSS); Innovation Corps (I-Corps); Science, Engineering, and Education for Sustainability (SEES); and the Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21).

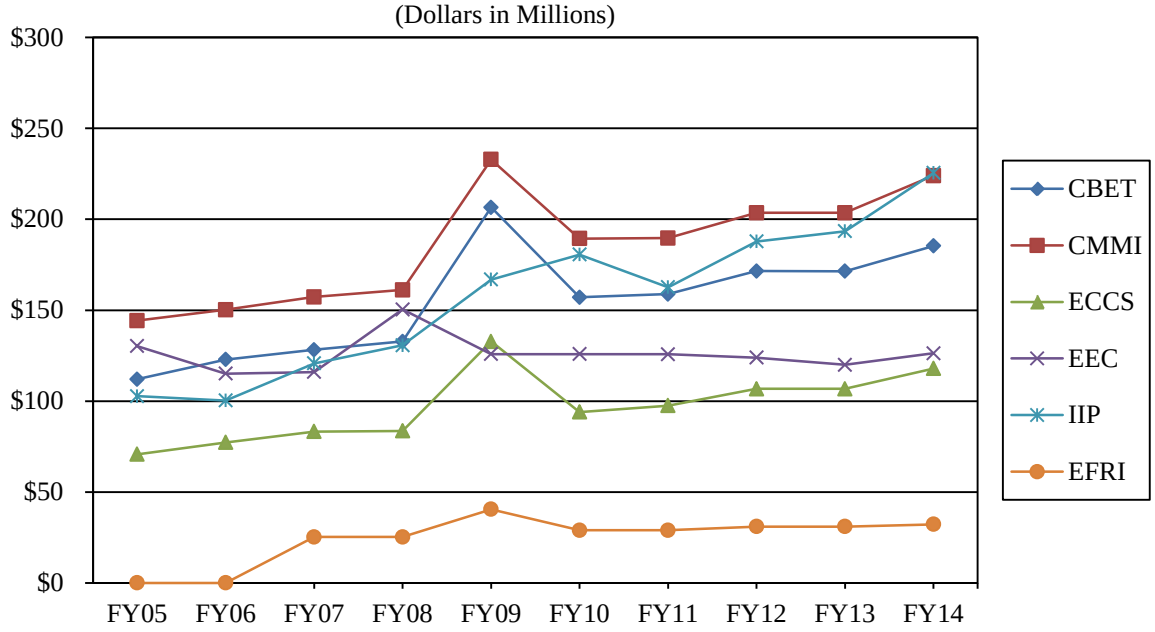
- ENG will be a major contributor in the CEMMSS investment through interdisciplinary research in breakthrough materials and materials design, advanced manufacturing techniques and processes, and smart systems research, including robotics.
- The ENG role in SEES will continue with significant emphasis on Sustainable Research Networks and Sustainable Energy Pathways, in addition to engineering research related to sustainable synthesis, use, and reuse of chemicals and materials as part of the Sustainable Chemistry, Engineering, and

Materials (SusChEM) component. ENG investment in Hazards SEES will help catalyze well-integrated interdisciplinary research efforts in hazards-related engineering in order to improve the understanding of natural hazards and technological hazards linked to natural phenomena, mitigate their effects, and to better prepare for, respond to, and recover from disasters.

- ENG will build on its significant contributions to innovation programs in growing the evolving I-Corps program to the next phase of establishing a platform for innovation, thus joining other established innovation programs such as Partnerships for Innovation (PFI), Engineering Research Centers (ERC), Industry/University Cooperative Research Centers (I/UCRC), and others that are managed by ENG.
- ENG leads the Foundation in strategic research investments focusing on research and education in manufacturing in all its dimensions (advanced manufacturing, nanomanufacturing, and transformative technologies for traditional manufacturing).
- The ENG investment in CIF21 will build upon the directorate's support of groundbreaking work in cyber–physical systems, engineering modeling and simulation, smart networks, and sensors.

ENG provides about 32 percent of the federal funding for basic research in engineering at academic institutions.

ENG Subactivity Funding
(Dollars in Millions)



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 2014 Summary by Division

- The FY 2014 Request for CBET will promote research and education for sustainability in the areas of water, climate, clean energy, and sustainable chemistry by contributing to the NSF-wide SEES investment. CBET's request will bolster 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.

- The FY 2014 Request for the CMMI 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. 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.

- The FY 2014 Request for ECCS 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 the areas of 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 also enhance support for early-career researchers and support an STC.

- The FY 2014 Request for EEC will provide funding for a combination of three new ERCs or Nanosystems Engineering Research Centers (NERCs) and provide planned growth supplements to the first class of NERCs established in FY 2012. EEC will work closely with the Directorate for Education and Human Resources (EHR) in integrating the ENG-led engineering education research into the comprehensive agency-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE) – that consolidates the Foundation's investments in undergraduate education. EEC will enhance support for early-career researchers and for activities that facilitate alternative pathways to engineering careers, especially for non-traditional engineering students such as veterans. Support for the Research Experiences for Undergraduates (REU) program will be increased, with a particular focus on first and second year students.

- The FY 2014 Request for IIP 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, PFI, I/UCRC, and other activities, the division will enable academic researchers to begin translation of fundamental research discoveries, encourage academia and industry to collaborate (especially regionally), and prepare students to be entrepreneurial leaders in innovation.

- The FY 2014 Request for EFRI 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 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Advanced Manufacturing	$55.44	$48.42	$77.50	$29.08	60.1%
BioMaPS	3.31	3.31	7.00	3.69	111.5%
CAREER	50.89	50.34	54.58	4.24	8.4%
CEMMSS	56.00	56.00	126.42	70.42	125.8%
CIF21	3.70	5.00	12.00	7.00	140.0%
Clean Energy Technology	122.00	121.80	130.00	8.20	6.7%
EARS	4.00	4.00	14.00	10.00	250.0%
I-Corps	2.72	2.50	8.00	5.50	220.0%
INSPIRE	2.99	-	6.00	6.00	N/A
NNI	183.22	166.37	174.75	8.38	5.0%
NRI	8.33	8.33	10.00	1.67	20.0%
SEES	19.77	19.25	26.76	7.51	39.0%
SaTC	5.00	3.25	4.25	1.00	30.8%

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

- ENG will strategically invest additional funds across the directorate 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 2014 Request for Advanced Manufacturing is $77.50 million.

- ENG will invest $7.0 million in Research at the Interface of the Biological, Mathematical, Physical Sciences, and Engineering (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, CMMI, and ECCS divisions.

- ENG's CAREER funding of $54.58 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.

- ENG support of $126.42 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.

- ENG funding of $12.0 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 $130.0 million for clean energy-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 investment will be strategically divided among all divisions.

- EARS support of $14.0 million represents an increase of $10.0 million over the FY 2012 Enacted level. The National Science and Technology Council (NSTC) report, *Enhanced Access to the Radio Spectrum: A Path Forward*, outlines the need for research on new and innovative ways to use the spectrum more efficiently. In partnership with the Directorates for Computer and Information Science and Engineering (CISE) and Mathematical and Physical Sciences (MPS), ENG's ECCS division will initiate support for the basic research that underpins this effort.

- ENG investment in the NSF I-Corps program of $8.0 million 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 2013 NSF initiated two additional I-Corps competitions – 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. These investments will continue in FY 2014. 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 participation in Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) will continue to strengthen ENG's long-standing support for interdisciplinary, potentially transformative research by complementing existing efforts, such as EFRI, with a suite of highly creative Foundation-wide activities and funding opportunities. ENG's FY 2014 Request for INSPIRE is $6.0 million.

- The directorate will continue supporting the National Nanotechnology Initiative (NNI), with additional funding directed towards the NNI Signature Initiatives: Nanoelectronics for 2020 and Beyond; Sustainable Nanomanufacturing — Creating the Industries of the Future; Nanotechnology for Solar Energy Collection and Conversion; Nanotechnology for Sensors and Sensors for Nanotechnology; and Nanotechnology Knowledge Infrastructure. ENG's FY 2014 Request for NNI is $174.75 million.

- ENG support for the National Robotics Initiative (NRI) will fund research on assistive mechanisms for those with physical disabilities and cognitive impairment as well as the elderly; on systems integration that enables ubiquitous, advanced robotics to be realized; and on next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and transportation. This $10.0 million investment will be directed to CBET, CMMI, and ECCS. NRI is a cross-agency initiative involving NSF's CISE and ENG directorates along with external partners, including the National Aeronautics and Space Administration (NASA), the National Institutes of

Health (NIH), and the U.S. Department of Agriculture (USDA).

- ENG will support the NSF-wide SEES investment by funding activities across the directorate that will lay the foundation for technologies 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 2014 Request for SEES is $26.76 million.

- ENG support of $4.25 million for the Secure and Trustworthy Cyberspace (SaTC) activity will focus on the engineering aspects of the Administration's *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program* (released December 2011). The program'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 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2013 Request Amount	Change Over FY 2013 Request Percent
Centers Programs Total	**$99.95**	**$99.82**	**$87.87**	**-$11.95**	**-12.0%**
Engineering Research Centers (EEC)	70.06	70.00	70.50	0.50	0.7%
Nanoscale Science & Engineering Centers (Multiple)	17.87	17.62	5.75	-11.87	-67.4%
Science & Technology Centers (Multiple)	10.12	10.00	10.00	-	-
Science of Learning Centers (EEC)	1.90	2.20	1.62	-0.58	-26.4%

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 will increase by $500,000 to a total of $70.50 million. Building on the long-standing ERC program model, ENG will provide funding for a combination of three new ERC or NERCs and provide planned growth supplements to the first class of NERCs established in FY 2012.

- NSEC support will be reduced by $11.87 million, to a total of $5.75 million as two centers receive final funding in FY 2013. 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 2014. 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 $580,000, to a total of $1.62 million in FY 2014, as the center continues a planned ramp down.

ENG Funding for Facilities

(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Facilities (Total)	**$31.37**	**$31.33**	**$32.83**	**$1.50**	**4.8%**
NEES (CMMI)	20.39	20.50	22.00	1.50	7.3%
NNIN (Multiple)	10.98	10.83	10.83	-	-

Totals may not add due to rounding.

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

ENG will increase operations and maintenance budgets for facilities by $1.50 million at the FY 2014 Request level. Notable items include:

- Support for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2014 increases by $1.50 million to a total of $22.0 million, in line with the terms of the cooperative agreement. ENG will 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 2012 Enacted level of $10.83 million. FY 2014 represents year one 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.

In FY 2014 the number of research grant proposals is expected to be 9,200. ENG expects to award approximately 1,600 research grants in FY 2014. Average annualized award size and duration are estimated to be $128,000 and three years, respectively, in FY 2014.

In FY 2014, funding for centers accounts for nearly 12 percent of ENG's non-SBIR/STTR Request.

Funding for facilities accounts for less than 5 percent of ENG's non-SBIR/STTR FY 2014 Request.

ENG Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate[1]	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	11,340	12,850	12,300
Number of New Awards	2,067	2,220	2,260
Funding Rate	18%	17%	18%
Statistics for Research Grants:			
Number of Research Grant Proposals	8,684	9,600	9,200
Number of Research Grants	1,440	1,450	1,600
Funding Rate	17%	15%	17%
Median Annualized Award Size	$106,764	$102,000	$107,000
Average Annualized Award Size	$125,891	$122,000	$128,000
Average Award Duration, in years	2.9	3.0	3.0

[1] Award estimates for FY 2013, such as numbers of awards and size/duration, are based upon the FY 2012 enacted level.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2011–2012, ENG funded Manhattan Strategies, Inc. to evaluate the Nanotechnology Undergraduate Education (NUE) program. The final report was received September 30, 2012. This external evaluation of the 155 projects funded to date is being conducted to determine the outputs and outcomes resulting from NUE funding, the collaborating departments and colleges, the impact of the program on engineering education as reported by the funded projects, whether program outcomes have been disseminated throughout the academic community, and the level of K-12 outreach. Major recommendations included:
  - Development and integration of a theory of action or logic model into the FY 2013 solicitation and beyond, to define and direct Principal Investigator (PI) efforts toward the achievement of articulated program goals and objectives.
  - Implementation of a structured reporting process to improve data collection from PIs allowing portfolio-wide reporting capabilities to describe the outputs and impacts associated with NUE funding.
  - Articulation of clear expectations for dissemination of NUE program outputs and outcomes, particularly those that leverage existing funded and successful tools such as NanoHUB. The FY 2013 NUE solicitation requires that NUE awardees publish all educational content, assessment instruments, and learning results of their programs on nanoHUB.org. In addition, NUE awardees are required to host their entire NUE program web page on nanoHUB.
  - Consideration of PI lessons learned, best practices, recommendations, and articulated needs detailed within completed NUE annual reports.

  ENG will take these recommendations into account as it develops its contributions to the CAUSE program.

- In late FY 2013, EEC will initiate a survey of university faculty and administrators who have participated in or "housed" ERCs to ascertain the impact of an ERC on the broader culture of its lead and partner institutions, in terms of: spreading a culture of interdisciplinary collaboration, partnerships in innovation with industry, expanding the role of universities in innovation, the integration of research and education, and promoting the involvement of faculty and students in bringing engineering concepts to pre-college classrooms. The results of this survey are expected in FY 2014 and will inform the direction of future ERC solicitations.

Science and Technology Policy Institute (STPI) Reports:

- The CMMI division is currently using STPI for a retrospective assessment of solid freeform fabrication/additive manufacturing (SFF). This project will research and identify how SFF-related fundamental research sponsored by the agency originated and evolved since its initiation. Analytical input will be 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.
- In FY 2010–2011, ENG utilized STPI to perform a formative assessment and evaluation of the processes by which topic areas and potentially transformative projects are selected by EFRI, and to design a protocol for future outcome evaluation of EFRI research projects. In response to this report and 2011 Committee of Visitors (COV) recommendations, the directorate substantially revised the research topic selection process and instituted several internal process innovations in FY 2011–2012. The topic selection process frequency has been modified to every other year and external experts are being engaged in evaluating candidate topics. In order to enhance participation of underrepresented groups, the office launched a new opportunity to provide support to active EFRI projects for establishing summer institutes for mentored research experiences with groups including undergraduates, community college students, high school students, teachers, professors at minority serving institutions, and veterans.
- In FY 2011–2012, the directorate supported two studies to assess future earthquake engineering research and research infrastructure needs. A National Research Council (NRC) committee prepared a workshop report on research grand challenges for networked earthquake engineering experimental facilities and cyberinfrastructure. To build on this work, STPI developed potential scenarios for the future of NSF-supported earthquake engineering facilities. The Foundation used the results and recommendations of these studies to craft the research solicitations and facility operations competition for the next generation NEES facility.

Workshops and Reports:

- Nanotechnology Infrastructure Workshop – April 3-4, 2012. Arlington, VA. The intent of this workshop was to develop a vision of the needs and appropriate future investments for a national infrastructure for nanotechnology. NSF is currently soliciting proposals for NG NNIN. www.acpt.nsf.gov/eng/eccs/nanotechnology_infrastructure_workshop_report.pdf
- NSF/Air Force Office of Scientific Research (AFOSR) Workshop – 2D Materials and Devices Beyond Graphene – May 30-31, 2012. Owing to the results of graphene research, the question of whether 2D atomic layers from other materials can be isolated and exploited for fundamental study and applications has become very relevant. The workshop on 2D layered materials and devices beyond graphene sought to define an emerging field that has sprouted at the heels of the large body of graphene work. The high level of interest shown by the large spectrum of scientists points to the acceptance of this theme as the next big thing in materials after graphene. Connections to the Administration's Materials Genome Initiative and the NNI Signature Initiative *Nanotechnology*

Knowledge Infrastructure (NKI): Enabling National Leadership in Sustainable Design were identified. http://nsf2dworkshop.rice.edu/final-report/

Committees of Visitors:

- In 2012, COVs reviewed CBET and CMMI. The COVs presented their reports to the ENG Advisory Committee, which convened in April and October of 2012.
  - Main findings from the CBET COV were: The percent success rate in proposal funding has fallen to historically low levels; the number of submissions has grown disproportionately large; and "Awards have become, too frequently, inadequate to cover the minimum costs of a project." According to the COV, CBET is a remarkable program due to both the excellence of the program topics, the quality of the staff, and the success of the program despite having one of the largest numbers of proposals relative to available funds and staff. However, these challenges related to the large number of proposal submissions could in the future create both staffing problems and affect the quality of submitted proposals. The COV conveyed concern that researchers with exceptional ideas may not pursue their research through NSF due to the low probability of success.
  - Main findings from the CMMI report were: CMMI is doing a great job under difficult and challenging circumstances – particularly under the budget constraints and restrictions on travel. Due to the importance of face-to-face panels (can be blended with some virtual participation, but face to face should be the core of the review process), travel is necessary for program management, enhancing collaboration, project oversight, and global STEM cooperation and participation.
- In 2013, COVs will review EEC and IIP. In 2014, COVs will review ECCS and EFRI.

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 hired a program director for evaluation and assessment who is leading a group charged with developing 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 2012 Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	11,050	10,800	12,000
Other Professionals	1,732	1,800	1,900
Postdoctorates	468	500	500
Graduate Students	6,895	7,300	7,400
Undergraduate Students	3,808	3,500	4,100
Total Number of People	**23,953**	**23,900**	**25,900**

DIVISION OF CHEMICAL, BIOENGINEERING, ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET)

$185,300,000
+$13,850,000 / 8.1%

CBET Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CBET	**$171.51**	**$171.45**	**$185.30**	**$13.85**	**8.1%**
Research	**164.13**	**165.16**	**178.26**	**13.10**	**7.9%**
CAREER	21.90	21.55	23.29	1.74	8.1%
Centers Funding (total)	11.21	11.08	6.88	-4.20	-37.9%
NSEC	6.15	6.08	1.88	-4.20	-69.1%
STC for Emergent Behavior	5.06	5.00	5.00	-	-
Education	**3.65**	**2.60**	**3.35**	**0.75**	**28.8%**
Infrastructure	**3.73**	**3.69**	**3.69**	**-**	**-**
NNIN	3.73	3.69	3.69	-	-

CBET supports research to enhance and protect U.S. national health, energy, 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 bioengineering, advanced materials, environmental engineering, 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 research in biotechnology and 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, 67 percent of the CBET portfolio is available for new research grants and 33 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $1.74 million to a total of $23.29 million in FY 2014. This increase is consistent with CBET's emphasis on supporting early-career researchers.
- CBET investment in SEES increases $1.50 million to a total of $12.25 million in FY 2014 and will support the areas of water sustainability and climate change mitigation and adaptation research with an emphasis in the energy area, to be supplemented by core investments in the areas of sustainable chemistry, water, energy, and the environment.

- Investments for CIF21 increase by $1.0 million, to a total of $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.
- CBET funding of the National Robotics Initiative (NRI), part of the ENG CEMMSS portfolio, increases $1.0 million to a total of $2.0 million and will include research on assistive mechanisms for those with physical disabilities and cognitive impairment, as well as the aging population, especially through the Biosensing program and the General and Age-Related Disabilities Engineering (GARDE) program.
- The division will also provide $3.0 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 $4.0 million in FY 2014 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 2014 request, CBET will invest $750,000 in collaborative research in support of the proposed cross-foundation activity in Cognitive Science and Neuroscience.
- STC funding remains at $5.0 million, equivalent with the FY 2012 Enacted level, 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 will be reduced by $4.20 million, to a total of $1.88 million, as two centers supported by the division will receive final funding in FY 2013.

Education

- CBET contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity. Total CBET funding for these activities in the FY 2014 Request is $3.35 million.

Infrastructure

- ENG continues support for infrastructure through investment in the NG NNIN of user facilities at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF CIVIL, MECHANICAL, AND MANUFACTURING INNOVATION (CMMI) $224,020,000 +$20,440,000 / 10.0%

CMMI Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, CMMI	**$203.59**	**$203.58**	**$224.02**	**$20.44**	**10.0%**
Research	**177.66**	**177.63**	**196.07**	**18.44**	**10.4%**
CAREER	17.45	16.76	18.28	1.52	9.1%
Centers Funding (total)	5.49	5.48	1.61	-3.87	-70.6%
NSEC	5.49	5.48	1.61	-3.87	-70.6%
Education	**3.62**	**3.55**	**4.05**	**0.50**	**14.1%**
Infrastructure	**22.31**	**22.40**	**23.90**	**1.50**	**6.7%**
NNIN	1.92	1.90	1.90	-	-
NEES	20.39	20.50	22.00	1.50	7.3%

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, 76 percent of the CMMI portfolio is available for new research grants and 24 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $1.52 million, to a total of $18.28 million, in FY 2014. This increase is consistent with CMMI's emphasis on supporting early-career researchers.
- Fundamental core research in support of advanced manufacturing will be $57.0 million in FY 2014 as part of the NSF-wide CEMMSS activity. Areas of continued emphasis include nanomanufacturing, manufacturing enterprise systems and operations research, smart manufacturing, and design and manufacturing of complex engineered systems.
- Research to support the NRI will be funded at $5.0 million with advances helping to ensure continued U.S. leadership in the robotics field.

- The division will also provide $12.0 million in support of the national MGI through the DMREF effort under the NSF-wide CEMMSS investment area.
- Investments in SEES, requested at $6.0 million in FY 2014, 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 $7.0 million in FY 2014. 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 will be reduced by $3.87 million, to a total of $1.61 million, as two centers supported by the division will receive final funding in FY 2013.

Education

- CMMI contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity in FY 2014. Total CMMI funding for these activities in the FY 2014 Request is $4.05 million.

Infrastructure

- Support for NEES operations in FY 2014 will increase $1.50 million to a total of $22.0 million. ENG will 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 NG NNIN facility at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF ELECTRICAL, COMMUNICATIONS, AND CYBER SYSTEMS (ECCS) **$117,900,000**
+$11,170,000 / 10.5%

ECCS Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, ECCS	**$106.74**	**$106.73**	**$117.90**	**$11.17**	**10.5%**
Research	**99.53**	**99.63**	**110.21**	**10.58**	**10.6%**
CAREER	11.53	12.03	13.01	0.98	8.1%
Centers Funding (total)	8.59	8.54	5.96	-2.58	-30.2%
NSEC	3.53	3.54	0.96	-2.58	-72.9%
STC for Efficient Electronics	5.06	5.00	5.00	-	-
Education	**1.88**	**1.86**	**2.45**	**0.59**	**31.7%**
Infrastructure	**5.33**	**5.24**	**5.24**	**-**	**-**
NNIN	5.33	5.24	5.24	-	-

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 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER funding increases by $980,000, to a total of $13.01 million in FY 2014. 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 $3.0 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 ($3.0 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.
- In an ongoing collaboration with CISE, the division will increase support for research on cyber–physical systems (CPS) by $4.0 million, to a total of $8.0 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 will increase by $10.0 million, to a total of $14.0 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 2014 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 will be reduced by $2.58 million, to a total of $960,000, as two centers supported by the division receive final funding in FY 2013.

Education

- ECCS contributes to a number of education and diversity activities, including ADVANCE, REU, and NSF's Career Life Balance activity in FY 2014. Total ECCS funding for these activities in the FY 2014 Request is $2.45 million.

Infrastructure

- ENG continues support for infrastructure through investment in the NG NNIN user facility at the FY 2012 Enacted level. FY 2014 represents year one of this planned ten-year investment.

DIVISION OF ENGINEERING EDUCATION AND CENTERS (EEC) **$126,250,000**
+$6,250,000 / 5.2%

EEC Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EEC	**$123.93**	**$120.00**	**$126.25**	**$6.25**	**5.2%**
Research	**86.27**	**87.15**	**94.16**	**7.01**	**8.0%**
Centers Funding (total)	74.66	74.72	73.42	-1.30	-1.7%
ERC	70.06	70.00	70.50	0.50	0.7%
NSEC	2.70	2.52	1.30	-1.22	-48.4%
SLC	1.90	2.20	1.62	-0.58	-26.4%
Education	**37.66**	**32.85**	**32.09**	**-0.76**	**-2.3%**

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, cyber security, 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 NSF's comprehensive agency-wide framework – Catalyzing Advances in Undergraduate STEM Education (CAUSE), which consolidates the Foundation's investments in undergraduate education. The Engineering Career Development category includes programs such as Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET).

In general, 15 percent of the EEC portfolio is available for new research grants. The remaining 85 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 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Support for the ERC program increases by $500,000, to a total of $70.50 million. Building on the long-standing ERC program model, ENG will provide funding for a combination of three new ERC or NERCs and provide planned growth supplements to the first class of (NERCs) established in FY 2012.
- Funding of $1.62 million will provide continued support for an SLC — the Center of Excellence for Learning in Education, Science, and Technology (CELEST) led by Boston University. FY 2014 is the final year of funding for this SLC based on its scheduled ramp-down of support.

Education

- In FY 2014, NSF is adopting a comprehensive agency-wide framework –CAUSE – that consolidates the Foundation's investments in undergraduate education. While the majority of funding for CAUSE 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 2014, ENG's total funding of $12.60 million (formerly for the Engineering Education Research and NUE programs) will be integrated into to the CAUSE activity.
- Funding for the REU Sites program is increased $1.75 million over the FY 2012 Enacted level to $11.0 million. The additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, "Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics."
- Funding for the 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 also provide $1.0 million to support the SEES Fellows program.

DIVISION OF INDUSTRIAL INNOVATION AND PARTNERSHIPS (IIP) **$225,450,000 +$32,040,000 / 16.6%**

IIP Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, IIP	**$187.79**	**$193.41**	**$225.45**	**$32.04**	**16.6%**
Research	**187.79**	**193.41**	**225.45**	**32.04**	**16.6%**
SBIR/STTR	146.86	152.76	177.15	24.39	16.0%

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 entrepreneurs and future 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 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 transfer and 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 healthcare information and telecommunications technologies.

The division also manages the grant-making process, and is a strong intellectual contributor to the I-Corps investment. 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, 92 percent of the IIP portfolio is available for new research grants. The remaining 8 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 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Funding for SBIR/STTR increases by $24.39 million, to a total of $177.15 million, which is consistent with the levels specified in the SBIR/STTR Reauthorization Act of 2011 (P.L 112-81), which stipulates 2.8 percent and 0.4 percent of NSF's FY 2014 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 $22.45 million. The PFI program is an umbrella for two complementary components. The Accelerating Innovation Research (AIR) component is designed to strengthen the U.S. innovation ecosystem. AIR will support projects that accelerate the translation of technologically-promising research discoveries toward a path of commercialization, and foster synergistic collaborations between an existing NSF-funded innovation research alliance and other public and private entities. The Building Innovation Capacity (BIC) component will fund projects to stimulate partnerships and research collaborations between academic researchers and small business practitioners to further basic research toward market-accepted innovations.
- Funding for I-Corps increases by $5.50 million, to a total of $8.0 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 $11.20 million. The increased support will emphasize topics related to advanced manufacturing, clean energy, and cyberinfrastructure in line with NSF investments in CEMMSS and CIF21. The increased funding will also support Research Experiences for Undergraduates (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 $6.65 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 2014 Request for GOALI is $17.0 million.

OFFICE OF EMERGING FRONTIERS IN RESEARCH AND INNOVATION (EFRI) **$32,200,000**
+$1,200,000 / 3.9%

EFRI Funding
(Dollars in Millions)

	FY 2012 Actual	FY 2012 Enacted/ Annualized FY 2013 CR	FY 2014 Request	Change Over FY 2012 Enacted Amount	Change Over FY 2012 Enacted Percent
Total, EFRI	**$30.99**	**$31.00**	**$32.20**	**$1.20**	**3.9%**
Research	**30.99**	**31.00**	**32.20**	**1.20**	**3.9%**

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: sustainable energy sources; integrated systems designed to make U.S. infrastructures more resilient to disasters; advances in robotics; manufacturing healthcare; and regeneration of some of the body's most complex tissues. In FY 2011, EFRI invested in two topic areas to use insights from the biological world to inspire new engineering capabilities. These two topical areas were Engineering New Technologies Based on Multicellular and Inter-kingdom Signaling (MIKS), and Mind, Machines, and Motor Control (M3C) and were developed in close collaboration with the Directorate for Biological Sciences, CISE, and SBE. The results from these investigations will enable new biological energy sources and better protection for the environment, and human health, including new bionic prosthetics for amputees. In FY 2012 and FY 2013, EFRI is investing in three topic areas: Flexible Bioelectronics Systems (BioFlex); Origami Design for the Integration of Self-assembling Systems for Engineering Innovation (ODISSEI); and Photosynthesis Biorefineries (PSBR).

The Department of Energy (DOE) and the Environmental Protection Agency (EPA) have co-funded some of the current EFRI projects in sustainable energy and environmental design. AFOSR entered into a five-year Memorandum of Understanding (MOU) with NSF in FY 2012 to help support projects of mutual interest related to FY 2014, as well as future EFRI topics.

In general, 92 percent of the EFRI portfolio is available for new research grants and 8 percent supports continuing increments for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted Level.

Research

- FY 2014 funding will provide support for up to 15 interdisciplinary team projects aimed at addressing national challenges such as renewable energy or advanced manufacturing.