

DIRECTORATE FOR ENGINEERING (ENG)**\$908,300,000**
+\$164,370,000 / 22.1%**ENG Funding**
(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Percent
Chemical, Bioengineering, Environmental, & Transport Systems (CBET)	\$157.08	-	\$156.82	\$194.03	\$37.21	23.7%
Civil, Mechanical, & Manufacturing Innovation (CMMI)	189.40	-	188.00	226.10	38.10	20.3%
Electrical, Communications, & Cyber Systems (ECCS)	93.97	-	94.00	131.00	37.00	39.4%
Engineering Education & Centers (EEC)	125.86	-	124.11	132.40	8.29	6.7%
Industrial Innovation & Partnerships (IIP)	180.63	-	152.00	191.57	39.57	26.0%
<i>SBIR/STTR</i>	<i>156.84</i>	-	<i>125.77</i>	<i>146.88</i>	<i>21.11</i>	<i>16.8%</i>
Emerging Frontiers in Research & Innovation (EFRI)	28.99	-	29.00	33.20	4.20	14.5%
Total, ENG	\$775.92	-	\$743.93	\$908.30	\$164.37	22.1%

Totals may not add due to rounding.

About ENG

The Directorate for Engineering (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. Directorate-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 quality of life and health for all Americans.

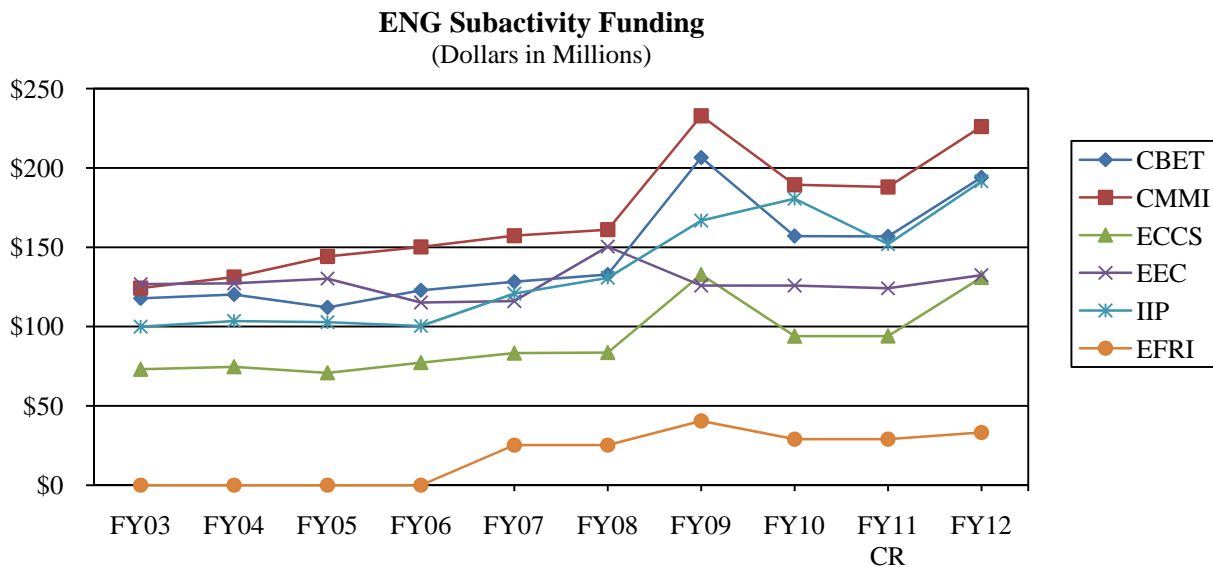
Many ENG programs and activities contribute to solutions for national priorities and grand challenges. ENG is central to major NSF investments in Science, Engineering, and Education for Sustainability (SEES), advanced manufacturing, and the Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21), which are designed to create the knowledge and innovations required for these areas.

- The ENG role in SEES will grow as greater emphasis is put on Sustainable Energy Pathways (SEP). Through coordination with all other NSF directorates, especially the Directorate for Social, Behavioral and Economic Sciences (SBE), ENG will be able to tackle the human dimensions of the sustainability issue in the engineered or “built” environment.

- ENG leads the Foundation in strategic research investments focusing on innovations 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.

In addition, the directorate plans to fund the first class of Nanoscale Engineering Research Centers (nano ERCs) that will transition the nano-devices created at graduating Nanoscale Science and Engineering Centers (NSECs) to the systems level as modeled within the ERC program.

ENG provides about 39 percent of the federal funding for basic engineering research at academic institutions.



FY 2012 Summary by Division

- The FY 2012 Request for the **Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET)** will promote research and education for sustainability in the areas of water, climate, and especially energy, contributing to the NSF-wide SEES investment. CBET’s request will bolster the National Robotics Initiative (NRI) with 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 2012 Request for the **Division of Civil, Mechanical, and Manufacturing Innovation (CMMI)** will enable contributions to the CIF21 investment by supporting research and education on computational-based approaches for engineering design, analysis, and predictive modeling, particularly under high degrees of uncertainty. CMMI’s contribution to the SEES portfolio will include research for resilient and sustainable buildings and infrastructure, disaster-resilient systems, energy manufacturing, and energy-efficient materials and processes. The division’s request will enable more research for advanced manufacturing technologies, and it will enhance support for early-career researchers.

- The FY 2012 Request for the **Division of Electrical, Communications, and Cyber Systems (ECCS)** will enable contributions to the CIF21 portfolio 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 Enhancing Access to the Radio Spectrum (EARS) activity will support research on more efficient radio spectrum use and energy-conserving device technologies. ECCS will also enhance support for early-career researchers and support an STC.
- The FY 2012 Request for the **Division of Engineering Education and Centers (EEC)** will establish the first class of nano Engineering Research Centers (nano ERCs). This investment will transition the nano-devices created at graduating Nanoscale Science and Engineering Centers (NSECs) to the systems level and commercialization. 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.
- The FY 2012 Request for the **Division of Industrial Innovation & Partnerships (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 the Accelerating Innovation Research (AIR) activity and other programs, 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 2012 Request for the **Office of Emerging Frontiers in Research & Innovation (EFRI)** will provide support for 16 interdisciplinary teams to pursue cutting-edge research with the potential for transformative impacts on national needs and/or grand challenges.

Major Investments

ENG Major Investments

(Dollars in Millions)

Area of Investment	FY 2010	FY 2010	FY 2010	FY 2012 Request	Change Over	
	Omnibus Actual	ARRA Actual	Enacted/ Annualized FY 2011 CR		FY 2010 Enacted Amount	Percent
NNI	\$152.50	\$17.72	\$148.00	\$174.37	\$26.37	17.8%
Clean Energy	115.20	-	115.20	172.65	57.45	49.9%
SEES Portfolio	102.00	-	108.20	162.00	53.80	49.7%
Engineering Research Centers	48.60	-	54.91	81.00	26.09	47.5%
Advanced Manufacturing	38.50	-	38.42	65.42	27.00	70.3%
CAREER	60.26	-	46.98	53.38	6.40	13.6%
BioMaPS	-	-	-	18.00	18.00	N/A
National Robotics Initiative	-	-	-	12.50	12.50	N/A
Science and Technology Centers	3.37	-	3.36	10.00	6.64	197.6%
CIF21 Portfolio	-	-	-	9.00	9.00	N/A
EARS	-	-	-	4.00	4.00	N/A

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

- 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; and Nanotechnology for Solar Energy Collection and Conversion.
- ENG support for clean energy 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.
- ENG will support the NSF-wide SEES investment by funding activities across the directorate that will lay the foundation for technologies to mitigate against, and adapt to, environmental change that threatens sustainability. The greatest share of funding will be directed to CBET, CMMI, and ECCS, for investments in Sustainable Energy Pathways.
- The directorate will increase investment in the EEC ERC program in order to fund the first class of nano ERCs. This investment will transition the nano-devices created at graduating NSECs to the systems level and commercialization.
- 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 manufacturing, and complex engineering systems design and manufacturing. The directorate will support industry–university partnerships and anticipates that at least one of the new nano ERCs will be in the area of advanced manufacturing.

- ENG supports the CAREER program, an Administration priority. ENG's CAREER awards support 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 will invest 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 the core programs. Funding for this activity will be directed to CBET, CMMI, and ECCS. Additional information on BioMaPS is available in the Selected Cross-Cutting Programs section of the NSF-wide Investments chapter.
- ENG support of 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 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 NASA, NIH, and USDA.
- The STC for Advanced Materials for Water Purification, supported by CBET, sunsets in 2011. ENG will fund two other STCs in FY 2012: CBET will support the Center on Emergent Behaviors of Integrated Cellular Systems, and ECCS will support the Center for Energy Efficient Electronics Science.
- ENG investment in the new NSF-wide CIF21 investment will focus on three components: Data-Enabled Science, New Computational Infrastructure, and Access and Connections to Cyberinfrastructure Facilities. Funding will be directed to CBET, CMMI, and ECCS.
- ENG support for Enhancing Access to the Radio Spectrum (EARS) begins in FY 2012. The recent NSF workshop report, *Enhancing Access to the Radio Spectrum*, outlines the need for research on new and innovative ways to use the spectrum more efficiently. In partnership with Directorate for Computer and Information Science and Engineering (CISE) and the Directorate for Mathematical and Physical Sciences (MPS), ENG ECCS will initiate support for the basic research that underpins this effort. Additional information on EARS is available in the Selected Cross-Cutting Programs section of the NSF-wide Investments chapter.

Summary and Funding Profile

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

In FY 2012 the number of research grant proposals is expected to increase by nearly 2,000 compared to the FY 2010 Enacted. ENG expects to award approximately 1,800 research grants in FY 2012. Average annualized award size and duration are estimated to be \$123,000 and three years, respectively, in FY 2012.

In FY 2012, funding for centers accounts for nearly 15 percent of ENG's non-SBIR Request. Centers funding is increasing as research in many ENG-supported disciplines has evolved to be more collaborative.

Funding for facilities accounts for 5 percent of ENG's non-SBIR FY 2012 Request. Funding is decreasing as a result of a slight reduction in support to the Network for Earthquake Engineering and Simulation equipment sites.

ENG Funding Profile

	FY 2010 Actual Estimate	FY 2010 Enacted/ Annualized FY 2011 CR Estimate	FY 2012 Estimate
Statistics for Competitive Awards:			
Number of Proposals	13,230	11,674	16,000
Number of New Awards	2,375	2,252	2,970
Regular Appropriation	2,321	2,252	2,970
ARRA	54	-	-
Funding Rate	18%	19%	19%
Statistics for Research Grants:			
Number of Research Grant Proposals	9,746	9,627	11,500
Number of Research Grants	1,423	1,365	1,800
Regular Appropriation	1,423	1,365	1,800
ARRA	-	-	-
Funding Rate	15%	14%	16%
Median Annualized Award Size	\$100,000	\$101,000	101,000
Average Annualized Award Size	\$122,322	\$115,000	123,000
Average Award Duration, in years	2.9	3.0	3.0

ENG Funding for Centers Programs and Facilities

ENG Funding for Centers Programs

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted	
				Amount	Percent
Centers Programs	\$79.78	\$85.22	\$107.95	\$22.73	26.7%
<i>Engineering Research Centers (EEC)</i>	48.60	54.91	81.00	26.09	47.5%
<i>Nano Centers Program (Multiple)</i>	25.59	24.75	14.75	-10.00	-40.4%
<i>Science & Technology Centers (CBET/ECCS)</i>	3.37	3.36	10.00	6.64	197.6%
<i>Science of Learning Centers (EEC)</i>	2.22	2.20	2.20	-	-

Totals may not add due to rounding.

Detailed information on individual centers can be found in the NSF-Wide Investments chapter.

Centers Programs

- Support for the ERC program will increase by \$26.09 million, to a total of \$81.0 million. Building on the long-standing ERC program model, ENG will fund the first class of three nano ERCs. This investment will transition the nano-devices created at graduating NSECs to the systems level and commercialization.
- Support for NSECs will decrease by \$10.00 million, to a total of \$14.75 million, as commensurate ENG funding for the six graduated NSECs is reallocated to the ERC program for new nano ERCs.
- ENG will fund two Class of 2010 STCs for a total of \$10.0 million in FY 2012. FY 2011 is the final year of support for the STC for Advanced Materials for Water Purification from the Class of 2002.

ENG Funding for Facilities

(Dollars in Millions)

	FY 2010	FY 2010	FY 2012	Change Over	
	Omnibus	Enacted/ Annualized		FY 2010 Enacted	Percent
	Actual	FY 2011 CR	Request	Amount	
Facilities	\$34.40	\$32.83	\$31.33	-\$1.50	-4.6%
<i>NEES (CMMI)</i>	23.46	22.00	20.50	-1.50	-6.8%
<i>NNIN (Multiple)</i>	10.94	10.83	10.83	-	-

Totals may not add due to rounding.

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

Facilities

- ENG support for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) operations in FY 2012 will be reduced by \$1.50 million, to a total of \$20.50 million, in line with an overall reduction in core research supported at the network sites. The directorate will leverage investment in CIF21 to support NEES connections and foster data-enabled research within the earthquake engineering community.
- ENG continues support for the National Nanotechnology Infrastructure Network (NNIN) of user facilities at the FY 2010 Enacted level. FY 2012 represents year seven of this planned ten-year investment.

Program Evaluation and Performance Improvement

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

In 2010, COVs reviewed EEC and IIP. The COVs presented their reports to the ENG Advisory Committee, which convened in April and October of 2010. ENG divisions are responding to and implementing recommendations from recent COVs.

In 2011, COVs will review EFRI and ECCS. In 2012, COVs will review CBET and CMMI.

ENG, along with GEO and SBE, provided funding to the National Research Council to review the Science Plan of the WATERS Network, a potential Major Research Equipment and Facilities Construction (MREFC) project. Based on the findings and recommendations in the NRC report,

published in 2010, NSF decided not to proceed on the MREFC path for the WATERS Network at this time and instead embark on the Research and Related Activities (R&RA) path, with the issuing and implementation of the Water, Sustainability, and Climate solicitation in FY 2010.

ENG funded SRI International to evaluate the outcomes of ENG-supported Research Experiences for Undergraduates (REU) awards. In October 2010, ENG received SRI's report on the longer-term impacts of the ENG REU and other undergraduate research experiences, which was based on data collected from ENG REU students from 2006. ENG has disseminated the report and is seeking community input on how to accomplish the report's recommendations.

In FY 2010–2011, the directorate is supporting two studies to assess future earthquake engineering research and research infrastructure needs. An NRC committee is preparing a workshop report on research grand challenges for networked earthquake engineering experimental facilities and cyberinfrastructure. To build on this work, the Science and Technology Policy Institute (STPI) is developing potential scenarios for the future of NSF-supported earthquake engineering facilities.

In FY 2010–2011, ENG is supporting 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.

Number of People Involved in ENG Activities

	FY 2010 Actual Estimate	FY 2010 ARRA Estimate	FY 2010 Enacted/ Annualized FY 2011 CR Estimate	FY 2012 Estimate
Senior Researchers	11,565	393	6,695	14,100
Other Professionals	1,936	20	1,205	2,360
Postdoctorates	532	4	374	650
Graduate Students	7,074	31	6,986	8,630
Undergraduate Students	3,611	17	2,263	4,500
Total Number of People	24,718	465	17,523	30,240

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

\$194,030,000
+\$37,210,000 / 23.7%

CBET Funding

(Dollars in Millions)

	FY 2010	FY 2010	FY 2010	FY 2012 Request	Change Over	
	Omnibus Actual	ARRA Actual	Enacted/ Annualized FY 2011 CR		FY 2010 Enacted Amount	Percent
CBET	\$157.08	-	\$156.82	\$194.03	37.21	23.7%
Research	153.38	-	153.12	190.33	37.21	24.3%
<i>CAREER</i>	27.88	-	26.00	28.50	2.50	9.6%
<i>Centers Funding (total)</i>	9.47	-	9.26	9.86	0.60	6.5%
<i>Nano Centers</i>	6.10	-	5.90	4.86	-1.04	-17.6%
<i>STC for Water Purification</i>	3.37	-	3.36	-	-3.36	-100.0%
<i>STC on Emergent Behavior</i>	-	-	-	5.00	5.00	N/A
Infrastructure	3.70	-	3.70	3.70	-	-
<i>NNIN</i>	3.70	-	3.70	3.70	-	-

Totals may not add due to rounding.

CBET supports research to enhance and protect U.S. national health, energy, environment, and security. Through CBET, the physical, life, and social sciences are merged in engineering research and education, resulting in advances in the rapidly evolving fields of bioengineering and 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, forest products, metals, petroleum, 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, 68 percent of the CBET portfolio is available for new research grants. The remaining 35 percent funds continuing grants made in previous years.

FY 2012 Summary

Research

- CAREER funding increases by \$2.50 million to a total of \$28.50 million in FY 2012. This increase is consistent with CBET’s emphasis on supporting early-career researchers and contributes to the Administration priority of keeping support for CAREER increasing at the same rate as overall NSF funding.
- The Environmental Engineering and Sustainability Cluster investment in SEES will support the areas of water sustainability, climate engineering, and climate change mitigation and adaptation research with an emphasis in the energy area, to be supplemented by core investments in the areas of green chemistry, water, energy and the environment.

- Investments for CIF21 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.
- To bolster the ENG portfolio for Advancing American Innovation, CBET will invest in several focused research areas:
 - Science and Engineering Beyond Moore’s Law (SEBML) investments will support material processing research in reaction and process engineering as well as interfacial thermodynamics and self-assembly.
 - Investments in support of the NRI will fund research on assistive mechanisms for those with physical disabilities and cognitive impairment as well as the aging population through the Bioengineering and Engineering Healthcare cluster, especially through the Biosensing program and the Research to Aid Persons with Disabilities (RAPD) program.
 - Support for BioMaPS – research at the interface/intersection of biology, the physical sciences, and engineering – will be provided primarily through the Bioengineering and Engineering Healthcare cluster, to include research on nanoscale biosensing, neuro-engineering, and cellular biomechanics, as well as metabolic engineering and engineering aspects of synthetic biology.
- CBET reduces support for the existing portfolio of NSECs by \$1.04 million below the FY 2010 Enacted level of \$5.90 million as ENG transitions its investment to nano ERCs.
- STC funding increases by \$1.64 million in FY 2012 to fund the STC on Emergent Behavior of Integrated Cellular Systems, led by the Massachusetts Institute of Technology, and as the Center for Advanced Materials for Water Purification graduates from the program.

Infrastructure

- CBET will continue support of \$3.70 million for NNIN user facilities. FY 2012 represents year seven of this planned ten-year investment.

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

\$226,100,000
+\$38,100,000 / 20.3%

CMMI Funding
(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Percent
CMMI	\$189.40	-	\$188.00	\$226.10	38.10	20.3%
Research	164.02	-	164.10	203.70	39.60	24.1%
<i>CAREER</i>	17.30	-	11.50	13.75	2.25	19.6%
<i>Nano Centers</i>	5.64	-	5.45	4.70	-0.75	-13.8%
Infrastructure	25.38	-	23.90	22.40	-1.50	-6.3%
<i>NEES</i>	23.46	-	22.00	20.50	-1.50	-6.8%
<i>NNIN</i>	1.92	-	1.90	1.90	-	-

CMMI funds fundamental research in support of the Foundation’s strategic goals directed at advances in the disciplines of civil, mechanical, industrial, systems, and 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 the Nation’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.

The integration of research and education is supported across all programs of the division. These investments contribute broadly to the engineering knowledge base and create the human capital needed for major components of U.S. industry to compete in a global economy. To achieve its goals, CMMI has been organized into four thematic clusters: Advanced Manufacturing, Mechanics & Engineering Materials, Resilient & Sustainable Infrastructures, and Systems Engineering & Design.

In general, 72 percent of the CMMI portfolio is available for new research grants. The remaining 22 percent funds continuing grants made in previous years.

FY 2012 Summary

Research

- CAREER funding increases by \$2.25 million, to a total of \$13.75 million, in FY 2012. This increase is consistent with CMMI’s emphasis on supporting early-career researchers and contributes to the Administration priority of keeping support for CAREER increasing at the same rate as overall NSF funding.
- Support for CIF21 is initiated in FY 2012. 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. Further efforts will support

research in the areas of data-enabled science and engineering, with emphasis on complex systems design and analysis.

- Fundamental research in support of advanced manufacturing technology increases in FY 2012. Areas of emphasis include nanomanufacturing (including SEBML), manufacturing enterprise systems, smart manufacturing, design and manufacturing of complex engineered systems, modeling and simulation for manufacturing including integration with CIF21 initiatives, innovative materials and manufacturing processes, and BioMaPS research in such areas as clean energy systems, bio-based materials, bio-imaging, and bio-inspired sensors.
- Investments in SEES increase to support cross-disciplinary research associated with resilient and sustainable buildings and infrastructure, disaster-resilient systems, energy manufacturing, and energy-efficient materials and processes.
- Under the umbrella of Advancing American Innovation, CMMI will contribute to several focused research activities:
 - CMMI-related Smart-Health research increases to support fundamental research efforts in operations research, service enterprise systems, mechanobiology and nano-biomechanics, and design techniques and analysis methods for Smart-Health infrastructure and systems.
 - Research in support of the NRI will increase to ensure U.S. leadership in robotics research. FY 2012 priorities for CMMI include research on advanced sensing; control systems; dynamical systems mechanics; optimization, design, and decision algorithms; novel multifunctional robotic structures and mechanisms. Research may lead to the development of next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and safer driving.

Infrastructure

- FY 2012 support for NEES operations will be reduced by \$1.50 million, to a total of \$20.50 million, in line with an overall reduction in core research supported at the network sites. CIF21 investment will also support NEES connections and foster data-enabled research within the earthquake engineering community.
- Support for NNIN will continue at the FY 2010 Enacted level.

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

\$131,000,000
+\$37,000,000 / 39.4%

ECCS Funding
(Dollars in Millions)

	FY 2010		FY 2010	FY 2012	Change Over	
	Omnibus	ARRA	Enacted/ Annualized FY 2011 CR		FY 2010 Enacted	Percent
	Actual	Actual		Request	Amount	
ECCS	\$93.97	-	\$94.00	\$131.00	37.00	39.4%
Research	88.67	-	88.77	125.77	37.00	41.7%
<i>CAREER</i>	15.05	-	9.08	10.33	1.25	13.8%
<i>Centers Funding (total)</i>	3.61	-	3.40	7.40	4.00	117.6%
<i>Nano Centers</i>	3.61	-	3.40	2.40	-1.00	-29.4%
<i>STC for Efficient Electronics</i>	-	-	-	5.00	5.00	N/A
Infrastructure	5.30	-	5.23	5.23	-	-
<i>NNIN</i>	5.30	-	5.23	5.23	-	-

ECCS addresses fundamental research issues underlying electronic and photonic devices and component technologies, radio frequency circuit integration, nanoelectronics, energy, power, smart-grid, controls, computation, networking, communications, robotics, and cyber-physical technologies. The division supports fundamental research of novel electronic and photonic devices and 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, 69 percent of the ECCS portfolio is available for new research grants. The remaining 27 percent funds continuing grants made in previous years.

FY 2012 Summary

Research

- Because support for early-career researchers is an ECCS priority, the division funds CAREER grants at a higher rate than general unsolicited research grants. This priority is consistent with ENG objectives and contributes to the Administration goal for CAREER grant support. FY 2012 funding of \$10.33 million represents an increase of \$1.25 million over the FY 2010 Enacted level.
- ECCS will contribute to the CIF21 portfolio through support for research in advanced devices and systems directed towards computing, data storage, networking, and data management.
- Under the umbrella of Advancing American Innovation, ECCS will provide research support in several areas:
 - Building on its investment in SEBML, ECCS will increase support for novel electronic and optical devices, particularly nanoelectronics, which will permit improved performance and enable operation beyond current limits.
 - ECCS support for Smart Health research, at the interface of biological and electronic systems, will focus on areas such as distributed and ubiquitous computing and communications technologies to greatly expand the capability of current systems.

- The division's investment in the NRI will support the integration of electronic, mechanical, computing, controls, and intelligent systems that enable ubiquitous, advanced robotics to be realized.
- The ECCS investment in EARS will support research on more efficient radio spectrum use and energy-conserving device technologies.
- In support of BioMaPS, ECCS will invest in bio-electronic devices and systems for sensing, analysis, communications, computing, and the interface of biological and electronic systems. This will result in improved systems that will significantly advance health care, environmental sensing, and climate change monitoring.
- In an ongoing collaboration with CISE, the division will maintain support for research on cyber-physical systems (CPS) at \$4.0 million. The ECCS investment will be directed towards the integration of intelligent decision-making algorithms and hardware into physical systems.
- ECCS reduces support for the existing NSEC portfolio by \$1.0 million below the FY 2010 Enacted level of \$3.4 million as ENG transitions its investment to nano ERCs.
- ECCS funding of \$5.0 million in FY 2012 funds the STC for Energy Efficient Electronics Science led by the University of California at Berkeley and awarded in FY 2010.

Infrastructure

- The division continues support of \$5.23 million for NNIN user facilities. FY 2012 represents year seven of this planned ten-year investment.

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

\$132,400,000
+\$8,290,000 / 6.7%

(Dollars in Millions)

	FY 2010	FY 2010	FY 2010	FY 2012	Change Over	
	Omnibus	ARRA	Enacted/ Annualized		FY 2010 Enacted	Amount
	Actual	Actual	FY 2011 CR	Request		
EEC	\$125.86	-	\$124.11	\$132.40	\$8.29	6.7%
Research	77.12	-	78.60	98.76	20.16	25.6%
<i>CAREER</i>	0.02	-	0.40	0.80	0.40	100.0%
<i>Centers Funding (total)</i>	61.06	-	67.11	85.99	18.88	28.1%
<i>ERC</i>	48.60	-	54.91	81.00	26.09	47.5%
<i>Nano Centers</i>	10.24	-	10.00	2.79	-7.21	-72.1%
<i>SLC</i>	2.22	-	2.20	2.20	-	-
Education	48.74	-	45.51	33.64	-11.87	-26.1%

EEC integrates disciplinary basic research and education, often accomplished in other divisions of ENG and across NSF, into strategic frameworks critical to addressing societal grand challenges and to 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 facilities. 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 comprise more than 70 percent of the general undergraduate population, EEC is defining unique alternative pathways for these students, especially veterans, to earn degrees in engineering successfully.

The programs in EEC are administratively managed within three categories: (1) Major Centers; (2) Engineering Education Research; and (3) Human Resources. The Major Centers category is comprised of the signature ERC program along with NSECs and a Science of Learning Center. 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. The Human Resources category includes programs such as Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET).

In general, 22 percent of the EEC portfolio is available for new research grants. The remaining 78 percent funds continuing grants made in previous years. This high fraction of continuing grant commitments is a consequence primarily of the ERC funding modes which includes awards made as five year cooperative agreements.

FY 2012 Summary

Research

- Support for the ERC program increases by \$26.09 million, to a total of \$81.0 million. Building on the long-standing ERC program model, ENG will fund the first class of three nano ERCs. This investment will transition the nano-devices created at graduating NSECs to the systems level and commercialization. It is expected that at least one of these new nano ERCs will be in the area of advanced manufacturing. Increased support will also allow for the continuation and expansion of opportunities to encourage small business partnerships with ERCs.
- Support for NSECs decreases by \$7.21 million, to a total of \$2.79 million, as commensurate ENG funding for the six graduated NSECs is reallocated to the ERC program in order to fund the new nano ERCs.
- Funding of \$2.20 million will provide continued support for a Science of Learning Center – the Center of Excellence for Learning in Education, Science, and Technology (CELEST) led by Boston University.
- Support for the CAREER program increases by \$400,000 to a total of \$800,000, allowing for the addition of one award.

Education

- Funding for the Engineering Education Program maintains prior year funding level of \$11.85 million. EEC will provide support in the areas of education pedagogy, veterans in engineering programs, virtual learning and others. The division will also continue to support an Education Innovation Center jointly funded with EHR.
- Nanotechnology Undergraduate Education funding remains level at \$1.0 million.
- Funding for the REU sites program is maintained at the FY 2010 Enacted level of \$10.50 million.
- Funding for the RET program decreases by \$2.0 million to a total of \$2.20 million.
- Funding to support all educational elements of ENG's thrust areas in robotics, SEBML, SEES, and CIF21 will be increased by \$1.20 million. Some portion of those funds may be used for REU/RET site programs addressing these specific, targeted thrust areas.
- ENG's FY 2010 Enacted funding of \$7.0 million for the Graduate Research Fellowships (GRF) Program will be eliminated in the FY 2012 Request as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).

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

\$191,570,000
+\$39,570,000 / 26.0%

IIP Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Percent
IIP	\$180.63	-	\$152.00	\$191.57	39.57	26.0%
Research	180.63	-	152.00	191.57	39.57	26.0%
<i>SBIR/STTR</i>	<i>156.84</i>	<i>-</i>	<i>125.77</i>	<i>146.88</i>	<i>21.11</i>	<i>16.8%</i>

IIP contributes to the NSF innovation ecosystem by: (1) supporting innovation research that builds on fundamental research discoveries that exhibit potential for societal 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 between academia, small business, and large industry with the goal of achieving commercialization of 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 also supports academic research by leveraging industrial support through three research programs: the Industry/University Cooperative Research Centers (I/UCRC) program, the Partnerships for Innovation (PFI) program, and the Grant Opportunities for Academic Liaison with Industry (GOALI) program. University grantees in these programs work closely with industry to create enabling technologies for national needs, such as managing the electrical power system, improving manufacturing and biological processing, and supporting new healthcare information and telecommunications technologies. Furthermore, these programs prepare students for innovation leadership in a globally competitive marketplace through opportunities to work closely with industry.

In general, 90 percent of the IIP portfolio is available for new research grants. The remaining 10 percent of funding supports continuing grants made in previous years, primarily to the long-duration I/UCRCs. All other programs are managed with standard grants.

FY 2012 Summary

Research

- The SBIR/STTR program increase of \$21.11 million, to a total of \$146.88 million, is in line with set-asides required by Public Law 112-1.
- Funding for Accelerating Innovation Research (AIR) in FY 2012 will total \$19.50 million, and will include innovation research fellowships in small businesses and industry-defined fundamental research (IDFR). The IDFR component expands on an earlier pilot in partnership with the Industrial Research Institute (IRI). The program will bring together leaders in industrial science to identify pre-competitive fundamental research requirements that will ultimately have a direct effect on the success

of American industry. The program intends to allow participating companies to inform a scientific research agenda, in a pre-competitive space, by defining key questions and then partnering universities and companies to explore them. The increase will also allow support for the continuation and expansion of opportunities to encourage small business partnerships with ERCs.

- Investment in the Industry/University Cooperative Research Centers (I/UCRC) program increases by \$1.80 million, to a total of \$9.65 million. The increased support will focus on topics related to sustainable energy and cyberinfrastructure in line with NSF investments in SEES and CIF21.
- Support for the PFI program will be maintained at \$9.19 million, the same as in the prior fiscal year.
- IIP Support for the GOALI program increases by \$1.35 million to a total of \$6.35 million. Increased support in clean energy will allow for six additional awards. ENG's total FY 2012 Request for GOALI will be \$16.10 million.

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

\$33,200,000
+\$4,200,000 / 14.5%

EFRI Funding
(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted	
					Amount	Percent
EFRI	\$28.99	-	\$29.00	\$33.20	4.20	14.5%
Research	28.99	-	29.00	33.20	4.20	14.5%

EFRI was created in FY 2007 to enable ENG to strategically pursue 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. 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; and regeneration of some of the body’s most complex tissues. In FY 2010, EFRI invested in Sustainable Environmental and Energy Design (SEED) to develop foundational technologies for “green” buildings of the future, and in Renewable Energy Storage (RESTOR) to overcome a major barrier to widespread adoption of renewable energy sources. FY 2010 awards are being coordinated and managed in partnership with other NSF directorates as well as with the Department of Energy and the Environmental Protection Agency. In FY 2011, EFRI will consider proposals for emerging frontier research to investigate the areas of Engineering New Technologies Based on Multicellular and Inter-kingdom Signaling (MIKS), and Mind, Machines, and Motor Control (M3C).

In general, 95 percent of the EFRI portfolio is available for new research grants. The remaining 5 percent funds continuing grants made in previous years.

FY 2012 Summary

Research

- FY 2012 funding will provide support for 2 additional interdisciplinary team projects, for a total of 16 projects, that will address national challenges such as renewable energy or advanced manufacturing.

