

DIRECTORATE FOR ENGINEERING (ENG)

\$825,670,000
+\$81,740,000 / 11.0%

ENG Funding
(Dollars in Millions)

	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus Actual	ARRA Actual			FY 2010 Estimate	FY 2011 Request
Chemical, Bioengineering, and Transport Systems (CBET)	\$146.00	\$60.57	\$156.82	\$169.07	\$12.25	7.8%
Civil, Mechanical, and Manufacturing Innovation (CMMI)	174.93	57.96	188.00	206.50	18.50	9.8%
Electrical, Communications, and Cyber Systems (ECCS)	87.21	45.57	94.00	103.00	9.00	9.6%
Engineering Education and Centers (EEC) ^{1/}	118.23	32.18	124.11	138.40	14.29	11.5%
Industrial Innovation and Partnerships (IIP) ^{2/}	112.12	54.70	152.00	177.70	25.70	16.9%
<i>SBIR/STTR</i>	90.39	49.91	125.77	142.86	17.09	13.6%
Emerging Frontiers in Research and Innovation (EFRI)	26.50	14.00	29.00	31.00	2.00	6.9%
Total, ENG	\$664.99	\$264.99	\$743.93	\$825.67	\$81.74	11.0%
Research	565.42	224.22	634.25	703.36	69.11	10.9%
Education	52.17	30.49	62.71	73.99	11.28	18.0%
Infrastructure	31.89	10.27	32.83	33.33	0.50	1.5%
Stewardship	15.51	-	14.14	14.99	0.85	6.0%

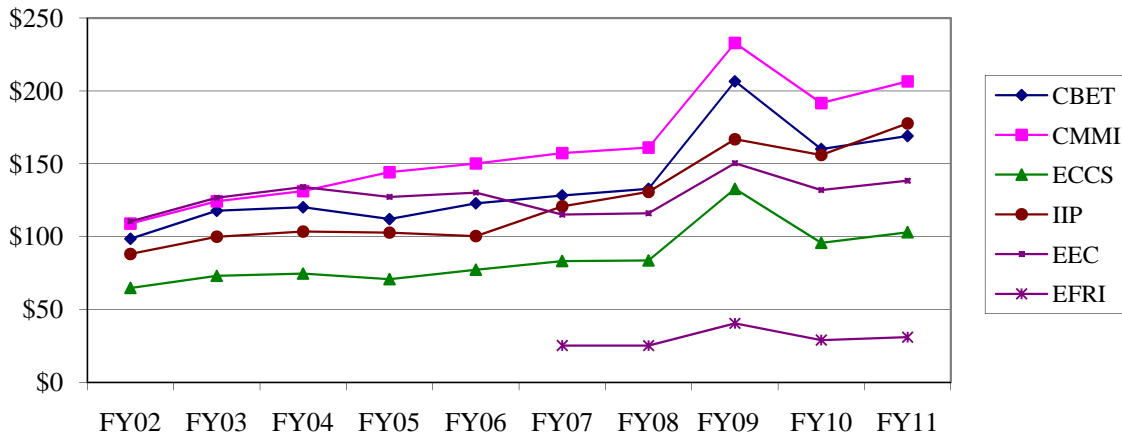
Totals may not add due to rounding.

^{1/} Funding for the Science of Learning Center (SLC) within the Division for Engineering Education and Centers is included for all years for comparability. SLC is cofunded with the Directorate for Social, Behavioral and Economic Sciences beginning in FY 2010.

^{2/} Funding for Partnerships for Innovation (PFI) was transferred in FY 2010 from Integrative Activities (IA) to the Directorate for Engineering, which manages the program. Funding for PFI is shown for all years for comparability.

ENG provides critical support for the Nation’s engineering research activities and is a driving force behind the training and development of the U.S. engineering workforce. ENG supports fundamental research, the creation of cutting-edge facilities and tools, and broad interdisciplinary collaborations. ENG also enhances U.S. innovation through its centers, partnerships, and small business programs.

ENG Subactivity Funding
(Dollars in Millions)



ENG in Context

ENG provides approximately 35 percent of the total federal support for university-based, fundamental engineering research. The directorate's work impacts students and the research community, the business community, and the Nation as a whole. By making education an essential element of its grants and centers, and by supporting research experiences for teachers, undergraduates, graduate students, and new faculty, ENG helps prepare the future engineering workforce to innovate and compete in the global economy. By emphasizing interdisciplinary, high-risk, and potentially transformative engineering research, the directorate encourages the research community to advance the frontiers of knowledge and tackle increasingly complex problems. Through its centers and the Small Business Innovation Research program, the directorate speeds the translation of promising fundamental research into innovations that can be commercialized.

ENG has supported a wide range of critical breakthroughs essential to the Nation's prosperity, security, quality of life, and capacity for innovation. These include creative ways to make the Nation's physical infrastructure more sustainable and resilient; revolutionary advances in sensor technologies; catalytic methods for creating biofuels; new techniques for medical diagnostics and treatments; commercial-scale production of high-quality nanomaterials; novel methods for monitoring and treating drinking water supplies; and a host of others in a portfolio generated by thousands of grantees.

To identify new opportunities and challenges for transformative engineering research, the directorate supports workshops and projects each year. Examples of recent workshops held in 2009 are:

- Frontiers of Engineering Symposium;
- Designing Cyber for Future Energy Systems;
- Enhancing the Post-9/11 Veterans Educational Benefit;
- First International Congress of Sustainability Science and Engineering: Where Science and Engineering Meet the Needs of Society;
- International Assessment of Research and Development in Flexible Hybrid Electronics;
- Life Cycle Aspects of Nanoproducts, Nanostructured Materials, and Nanomanufacturing: Problem Definitions, Data Gaps, and Research Needs (NSF-EPA workshop); and
- Opportunities and Challenges for the Emerging Field of Synthetic Biology.

The FY 2011 Request for ENG includes \$37.0 million to leverage activities across the directorate aimed at increasing support for transformative research. Examples of potential foci for these investments include innovative processes for identifying potentially transformative research, special solicitations and competitions, and increased use of specialized funding mechanisms, notably NSF's EAGER (EARly-concept Grants for Exploratory Research).

Factors Influencing the Allocation Across Divisions and Major Programs

- ENG priorities were influenced by the American Recovery and Reinvestment Act, and the America COMPETES Act, which called for renewed emphasis on: high-risk, high-reward research in areas such as sustainable energy, healthcare technology, and security; support for students and young investigators in engineering; and translation of discoveries from fundamental research into innovative technologies to promote economic growth and job creation.
- ENG also considered several recent reports from the engineering community, including:
 - ARISE: Advancing Research in Science and Engineering (American Academy of Arts and Sciences, 2008);
 - Engineering for a Changing World (Duderstadt/Univ. of Michigan, 2008);
 - Grand Challenges for Engineering (National Academy of Engineering, 2008); and

- Rising Above the Gathering Storm (National Academies, 2007).
- ENG will strengthen programs supporting early-career researchers and engineering innovation. Increased support for engineering students and early-career faculty will help ensure the Nation's future supply of university educators and investigators and of industry innovators. ENG programs will place a stronger emphasis on preparing engineers who understand the connections between fundamental research and national and industry needs and who are adept at transforming discoveries into innovative technologies.
- ENG will increase support for interdisciplinary teams of investigators, particularly to address high-risk, high-reward challenges in energy and sustainability, healthcare, infrastructure resiliency, and other areas of national and community importance.
- The directorate will maintain funding levels for ENG facilities in accordance with their cooperative agreements, enabling these valuable resources to continue serving the research community and to advance collaboration in vital areas.
- ENG will eliminate funding for the planned Water and Environmental Research Systems (WATERS) Network project. An independent scientific assessment of this joint ENG/GEO/SBE venture was supportive of the project's research goals, but found that the case for a large dedicated facility was lacking. ENG intends to continue to allocate funding towards important related research efforts but does not intend to pursue design or construction funding for the WATERS Network as a major facility project.

ENG Funding for Centers and Facilities

ENG Funding for Centers and Facilities

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
Centers	\$93.39	-	\$85.22	\$96.47	\$11.25	13.2%
<i>Eng. Res. Centers (EEC)</i>	61.42	-	54.91	67.50	12.59	22.9%
<i>Nanoscale Sci. and Eng. Centers (Multiple)</i>	25.26	-	24.75	24.75	-	-
<i>STC: Advanced Materials for Water Purification (CBET)</i>	6.71	-	3.36	2.02	-1.34	-39.9%
<i>SLC: Excellence for Learning in Education, Science, and Technology (CELEST)</i>	-	-	2.20	2.20	-	-
Facilities	\$31.89	\$10.27	\$32.83	\$33.33	\$0.50	1.5%
<i>NEES (CMMI)</i>	20.97	-	22.00	22.50	0.50	2.3%
<i>NNIN (Multiple)</i>	10.92	10.27	10.83	10.83	-	-

Detailed information on individual Centers can be found in the NSF-Wide Investments chapter. For further detail about individual Facilities, please see the Facilities chapter.

Centers

- Funding for the Engineering Research Centers (ERC) program will increase by \$12.59 million in FY 2011, to a total of \$67.50 million. Increased funding will support five new Generation-3 Centers and the planned growth of the FY 2008 class of ERCs. The original schedule called for three new ERC awards at the end of FY 2010 and two additional centers in early FY 2011, bringing the total portfolio to 18 centers. However, due to a delay in the current ERC competition, the three awards planned for FY 2010 will be made in FY 2011. Consequently, the portfolio of 13 ERCs in the FY 2010 Estimate will require funding at a level that is \$8.29 million lower than the amount in the FY 2010 Request. Those funds have been reallocated to other critical ENG needs in the FY 2010 Estimate.
- ENG funding for the Science and Technology Center (STC) for Advanced Materials for Water Purification, which was established in 2002, will decrease by \$1.34 million to a total of \$2.02 million in FY 2011, as the planned NSF support for the Center begins to wind down.

Facilities

- In FY 2011, funding for the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) will increase by \$500,000 to \$22.50 million.
- The National Nanotechnology Infrastructure Network (NNIN) will receive steady support from ENG for FY 2011 as planned.

ENG Administration Priority Programs and NSF Investments

ENG Administration Priority Programs and NSF Investments

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus Actual	ARRA Actual			FY 2010 Estimate	FY 2011 Request
Faculty Early Career Development (CAREER)	\$47.61	\$29.28	\$46.98	\$50.30	\$3.32	7.1%
Graduate Research Fellowship (GRF)	6.97	4.08	7.00	8.28	1.28	18.3%
Science, Engineering and Education for Sustainability (SEES)	N/A	N/A	108.20	120.00	11.80	10.9%
Science and Engineering Beyond Moore's Law (SEBML)	3.00	-	10.00	20.00	10.00	100.0%

ENG's FY 2011 budget will make significant contributions to four key NSF activities that support students, early career researchers, and the next generation of scientists and engineers engaged in sustainability research and the creation of revolutionary communications/computing technologies. The budget also encourages potentially transformational research and supports critical priorities in global climate change and information technology innovation. For more information on Administration priority programs and NSF investments, please refer to the Overview section.

Specific ENG investments include:

- Increased support for CAREER awards to a total of \$50.30 million, bolstering ENG's substantial investment with eight additional awards.

- Strengthened support for the Graduate Research Fellowship program to a total of \$8.28 million; additional funding of \$1.28 million will increase the number of engineering fellows by 25.
- In FY 2011, ENG will invest \$120.0 million in the NSF-wide Science, Engineering, and Education for Sustainability (SEES) portfolio to integrate efforts in climate and energy science and engineering. The portfolio will support research and education related to sustainable energy and the environment, and energy manufacturing, including the scale-up of manufacturing technologies that enable the economic conversion of sunlight, air, and water, using a biological intermediary such as algae, into hydrocarbons. Research will focus on civil infrastructure resilience and sustainability to elucidate the complex interdependencies that must be understood to design energy-efficient buildings, infrastructure, and their associated communities. Support will also be provided for micro-grid and smart-grid approaches to next-generation power distribution systems, advances in power system devices, advanced technologies for energy harvesting and for solar, wind, and other alternate energy sources, and new optical device technologies for smart lighting.
- Doubled support for Science and Engineering Beyond Moore's Law (SEBML) to \$20.0 million, in recognition of the opportunity for engineering contributions to overcome the scaling limits of silicon technology while improving energy efficiency and performance capabilities.

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 and directorate Advisory Committees. Please see this chapter for additional information.

ENG convenes Committees of Visitors, composed of qualified external evaluators, to review each division every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments. The Chemical, Bioengineering, Environmental, and Transport Systems (CBET) and Civil, Mechanical, and Manufacturing Innovation (CMMI) divisions were reviewed in FY 2009. The Engineering Education and Centers (EEC) and the Industrial Innovation and Partnerships (IIP) divisions will be reviewed in FY 2010, and the Electrical, Communications, and Cyber Systems (ECCS) division and the Office of Emerging Frontiers in Research and Innovation (EFRI) will be reviewed in FY 2011.

Number of People Involved in ENG Activities

	FY 2009		FY 2010 Estimate	FY 2011 Estimate
	FY 2009 Estimate	ARRA Estimate		
Senior Researchers	6,376	2,289	6,695	7,096
Other Professionals	1,148	466	1,205	1,278
Postdoctorates	356	141	374	396
Graduate Students	6,653	2,404	6,986	7,405
Undergraduate Students	2,155	668	2,263	2,399
Total Number of People	16,688	5,968	17,523	18,574

ENG Funding Profile

	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Statistics for Competitive Awards:			
Number of Proposals	10,613	11,674	12,258
Number of New Awards	2,691	2,252	2,594
Regular Appropriation	1,774	2,252	2,594
ARRA	917	-	-
Funding Rate	25.4%	19.3%	21.2%
Statistics for Research Grants:			
Number of Research Grant Proposals	8,752	9,627	10,108
Number of Research Grants	1,804	1,365	1,585
Regular Appropriation	1,198	1,365	1,585
ARRA	606	-	-
Funding Rate	20.6%	14.2%	15.7%
Median Annualized Award Size	100,001	101,000	101,500
Average Annualized Award Size	120,510	115,000	115,500
Average Award Duration, in years	3.0	3.0	3.0

**DIVISION OF CHEMICAL, BIOENGINEERING,
ENVIRONMENTAL, AND TRANSPORT SYSTEMS (CBET) \$169,070,000
+ \$12,250,000 / 7.8%**

CBET Funding								
(Dollars in Millions)								
	FY 2009	FY 2009	FY 2010	FY 2011	Change Over			
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request	FY 2010 Estimate	
	Actual	Actual			Estimate	Request	Amount	Percent
CBET	\$146.00	\$60.57	\$156.82	\$169.07	\$12.25	7.8%		
Research	142.30	57.17	153.12	165.37	12.25	8.0%		
<i>Nanoscale Sci. and Eng. Centers (NSEC)</i>	5.85	-	5.90	5.90	-	-		
<i>STC: for Advanced Materials for Water Purification</i>	6.71	-	3.36	2.02	-1.34	-39.9%		
Infrastructure	3.70	3.40	3.70	3.70	-	-		
<i>NNIN</i>	3.70	3.40	3.70	3.70	-	-		

CBET investments in fundamental research and education contribute significantly to the knowledge base and workforce development for major components of the U.S. economy—including food, natural resources, utilities, microelectronics, medical devices, pharmaceuticals, and chemicals—impacting important national priorities such as environmental sustainability, security, healthcare, and energy.

CBET supports a diverse range of disciplinary research involving the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET also fosters research and education in the highly interdisciplinary areas of bioengineering/healthcare and the energy/water/environment nexus.

In general, 65 percent of the CBET portfolio is available for new research grants. The remaining 35 percent funds continuing grants made in previous years.

Factors Influencing the Allocation Across CBET Programs

- Maintaining healthy core disciplinary programs is CBET’s highest priority.
- CBET will increase support for interdisciplinary teams of investigators, particularly to address high-risk, high-reward challenges in energy, sustainability, and healthcare, as well as other areas of national and community importance. These include:
 - Continued support of fundamental research for sustainable energy, including a funding partnership with DOE focusing on thermoelectric energy conversion for waste heat recovery in vehicles.
 - Fundamental research on sustainably producing chemicals and energy from biological materials and organisms—the essential feature of a bio-economy. The division plans to continue a national leadership role in potential transformative research to advance biomass conversion into green gasoline.
 - Strengthening its program on environmental, health, and safety issues, particularly as they relate to nanotechnologies.
 - Growth in the area of environmental sustainability, particularly to support emerging research related to water sustainability as part of the SEES investment.

- Support for nano-bioengineering research to advance environmental and healthcare technologies, as part of its contribution to Science and Engineering Beyond Moore's Law (SEBML).
- Potentially transformative research and strengthening support for engineering innovation.
- Increased support for engineering students and early-career faculty to help ensure the Nation's future capacity for university educators and investigators and for industry innovators.
- As part of its commitment to broadening participation in engineering, CBET will strengthen its program for research to aid persons with disabilities in several ways, including supporting more researchers with disabilities as grantees to enrich contributions to the program.
- CBET support for the STC for Advanced Materials for Water Purification will decrease by \$1.34 million as the center begins a planned phase-down as it approaches the final year of NSF support.

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

**\$206,500,000
+\$18,500,000 / 9.8%**

CMMI Funding

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over		
	Omnibus	ARRA			FY 2010	FY 2011	FY 2010 Estimate
	Actual	Actual			Estimate	Request	Amount
CMMI	\$174.93	\$57.96	\$188.00	\$206.50	\$18.50	9.8%	
Research	152.06	56.20	164.10	182.10	18.00	11.0%	
<i>Nanoscale Sci. and Eng. Centers (NSEC)</i>	6.01	-	5.45	5.45	-	-	
Facilities	22.87	1.76	23.90	24.40	0.50	2.1%	
<i>NEES</i>	20.97	-	22.00	22.50	0.50	2.3%	
<i>NNIN</i>	1.90	1.76	1.90	1.90	-	-	

CMMI supports fundamental research and education to bring about advances that promote manufacturing innovation; enhance the sustainability and resiliency of the Nation’s civil infrastructure, including buildings, transportation, and communications networks; help protect the Nation from natural and extreme events; and apply engineering principles to improve the Nation’s service enterprise systems, such as healthcare. These investments contribute broadly to the engineering knowledge base and build the human capital capacity needed for major components of U.S. industry to compete in a global economy.

CMMI programs are organized into four clusters: Advanced Manufacturing, Mechanics and Engineering Materials, Resilient and Sustainable Infrastructures, and Systems Engineering and Design. CMMI supports disciplinary and interdisciplinary research conducted by the mechanical, industrial, civil, materials, systems, structural, electrical, manufacturing, and bioengineering communities.

Approximately 69 percent of the funding allocated to the division is available to initiate new projects, with the remaining 31 percent applied primarily to fund continuing awards made in previous years.

Factors Influencing the Allocation Across CMMI Programs

- CMMI will allocate funds to high-quality proposals across its programs to enable the division to raise its success rate. Investment in thematic areas across CMMI will include those addressing national needs and priorities. These include:
 - Research to support transformative manufacturing technologies consistent with the Administration’s R&D priorities for revitalizing U.S. manufacturing, including nanomanufacturing and the application of nanotechnology to existing manufacturing industries; fundamental research associated with SEBML manufacturing challenges and opportunities; and basic research efforts on manufacturing enterprise systems and complex systems design and manufacturing.
 - Support of the Science, Engineering, and Education for Sustainability (SEES) initiative including research efforts in energy manufacturing and energy efficient materials engineering;

- Research on civil infrastructure resilience and sustainability to provide fundamentals necessary to design energy-efficient buildings, infrastructure, and associated communities;
 - Participation in the RE-ENERGYSE initiative via graduate student support in areas such as energy manufacturing, energy efficient materials processing, and energy supply chain and logistics;
 - Research to enable the vision of SEBML through the nanoscale engineering of non-silicon semiconductor materials, the creation of manufacturing equipment and processes for them, and the design of efficient and economical facilities;
 - Investigations into complexity that focus on the quantification of uncertainty in modeling and simulation and on decision-making in difficult environments with less-than-perfect information, which can impact health-care delivery, design and manufacturing, and a wide range of other areas; and
 - Simulation-based engineering and science to capitalize on advances in high-performance computational tools and physics-based models for design, materials processes, manufacturing, and mechanics as advocated in recent reports from the National Research Council and the World Technology Evaluation Center.
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- CMMI will focus on building capacity within the research community and on developing early-career faculty by active mentoring (for example via proposal writing workshops) and by continuing to emphasize CAREER awards.
 - The division will continue support of interdisciplinary research by funding high-quality research that lies at the interface of traditional engineering disciplines and is best pursued through collaboration by multiple investigators.
 - CMMI will increase its investment in the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) by \$500,000 to a total of \$22.50 million to provide the community with state-of-the-art facilities to conduct earthquake engineering research and improve the safety of buildings and infrastructure.

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

\$103,000,000
+\$9,000,000 / 9.6%

ECCS Funding

(Dollars in Millions)

	FY 2009		FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	
	Actual	Actual			Amount	Percent
ECCS	\$87.21	\$45.57	\$94.00	\$103.00	\$9.00	9.6%
Research	81.98	40.46	88.77	97.77	9.00	10.1%
<i>Nanoscale Sci. and Eng. Centers (NSEC)</i>	3.40	-	3.40	3.40	-	-
Infrastructure	5.23	5.11	5.23	5.23	-	-
<i>NNIN</i>	5.23	5.11	5.23	5.23	-	-

ECCS addresses fundamental research issues underlying electronic and photonic devices and component technologies, nano-electronics, energy, power, smart-grid, controls, computation, networking, communications, and cyber technologies. The division supports the integration and networking of intelligent systems principles 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.

The ECCS Division is organized around three programs that focus on research and educational issues of device and component technologies, network and computational technologies, and systems engineering:

- Electronics, Photonics and Device Technologies (EPDT),
- Power, Controls and Adaptive Networks (PCAN), and
- Integrative, Hybrid and Complex Systems (IHCS).

In general, 88 percent of the ECCS portfolio is available for new research grants. The remaining 12 percent funds continuing grants made in previous years.

Factors Influencing the Allocation Across ECCS Programs

- Maintaining healthy disciplinary programs is ECCS’s top priority.
- Fostering a technically competent workforce remains a priority and is reflected in the division’s strong support for CAREER awards.
- ECCS will invest in interdisciplinary awards in the areas of Cyber-Physical Systems (CPS), alternative energy and smart grid technologies, and bioelectronics, and Science and Engineering Beyond Moore’s Law (SEBML). To overcome charge leakage effects and related thermal limitations of additional scaling, the ECCS investment in SEBML will address novel device design concepts, multi-scale modeling and simulation, and quantum information science and engineering (QISE).
- ECCS will support projects for broadening participation with enhanced funding for Graduate Research Supplements.

- Recognizing a shortage of certain laboratory equipment important for research progress, particularly in the areas of device and circuit characterization and fabrication, ECCS provides equipment funding to principal investigators who require such tools to conduct their research.
- ECCS encourages industry collaborations through the Grant Opportunities for Academic Liaison (GOALI) program.

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

**\$138,400,000
+\$14,290,000 /11.5%**

EEC Funding

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010	FY 2010
	Actual	Actual	Estimate	Request	Amount	
EEC	\$118.23	\$32.18	\$124.11	\$138.40	\$14.29	11.5%
Research	82.78	1.73	78.60	91.61	13.01	16.6%
<i>Eng. Res. Centers (ERC)</i>	<i>61.42</i>	-	<i>54.91</i>	<i>67.50</i>	<i>12.59</i>	<i>22.9%</i>
<i>Nanoscale Sci. and Eng. Centers (NSEC)</i>	<i>10.00</i>	-	<i>10.00</i>	<i>10.00</i>	-	-
<i>SLC: Excellence for Learning in Education, Science, and Technology (CELEST)</i>	-	-	<i>2.20</i>	<i>2.20</i>	-	-
Education	35.45	30.45	45.51	46.79	1.28	2.8%

EEC promotes and facilitates university interdisciplinary research and curricula by supporting innovative programs that integrate research and education, improve the quality of the engineering workforce, cut across disciplines, develop partnerships with industry, and enable a breadth of investigation that spans the inception of an idea to proof of concept.

The division’s programs are divided into three major categories: (1) Major Centers (Engineering Research Centers (ERC), Nanoscale Science and Engineering Centers (NSEC), and a Science of Learning Center (SLC)), for the support of interdisciplinary research that fosters partnerships among academe, government, and industry; (2) Engineering Education Research, for advancing the quality and productivity of both undergraduate and graduate engineering pedagogy; and (3) Human Resources, for the development of a diverse and capable engineering workforce. EEC programs address issues that are critical to all fields of engineering and complement the research and education portfolios of the other divisions of the Directorate for Engineering.

In years with no new ERC awards, 15 percent of the EEC budget is typically available for new grants, while 85 percent is used primarily to fund grants made in previous years for centers, graduate fellowships, and undergraduate programs. In FY 2011, with new ERC awards expected, the investment in new awards will approximately double to 30 percent.

Factors Influencing the Allocation Across EEC Programs

- EEC will support the growth of Engineering’s flagship Engineering Research Centers (ERC) program by \$12.59 million, to a total of \$67.50 million. In FY 2011, EEC anticipates investing in 18 ERCs, including five new ones. Generation-3 ERCs place increased emphasis on innovation and entrepreneurship, partnerships with small research firms, and international collaboration and cultural exchange. These added dimensions speed the translation of fundamental research to innovations in U.S. industry and prepare engineering graduates to succeed in a global economy. Centers proposed for funding in FY 2011 have a specific focus on energy and infrastructure research—two national needs—and broaden a portfolio of ERCs investigating topics that include biomaterials for implants, power electronics, detection and warning systems for severe storms, and systems for delivery and management of renewable electric energy.

- The FY 2011 ERC increase will also provide for the planned phased growth of recently awarded centers. The increase will enhance economic competitiveness and stimulate job creation in two ways: by initiating collaborative research partnerships to translate ERC research advances into innovative new products; and by increasing the involvement of pre-college teachers to bring engineering to pre-college classrooms and stimulate student interest in engineering careers.
- Support to research programs for engineering education (\$12.85 million) as a platform for transforming engineering education, to encourage engineering schools to recruit and serve veterans, and to address the barrier between research in engineering education and its successful implementation in the classroom. With the Directorate for Education and Human Resources (EHR), EEC will invest in a new program to establish Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) Centers that focus on research in energy education and translational educational research.
- Continued investment in developing the engineering workforce through important human resources programs: Research Experiences for Undergraduates (REU) Sites (\$10.50 million), Research Experiences for Teachers (RET) (\$4.20 million), and increased investment in the Graduate Research Fellowship program (GRF) (+\$1.28 million, to a total of \$8.28 million) including the Innovation Fellows program which seeks to encourage more domestic students to enter engineering Ph.D. programs.
- Maintaining support for the ongoing NSECs (\$10.0 million), where research advances the ultra-small technologies that will transform electronics, materials, medicine, and many other fields. The NSECs will also engage key partners from industry, national laboratories, and other sectors; furthermore, NSECs will continue to support education programs from the graduate to the pre-college levels designed to develop a highly skilled workforce. Funds are also provided to smaller interdisciplinary teams and to the Network for Computational Nanotechnology (www.nanoHub.org), a web-accessible repository of simulations of nanoscale phenomena for research and education.

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

**\$177,700,000
+\$25,700,000 / 16.9%**

IIP Funding
(Dollars in Millions)

	FY 2009 Omnibus Actual	FY 2009 ARRA Actual	FY 2010 Estimate	FY 2011 Request	Change Over FY 2010 Estimate Amount	Percent
IIP	\$112.12	\$54.70	\$152.00	\$177.70	\$25.70	16.9%
Research	112.12	54.70	152.00	177.00	25.70	16.9%
<i>Small Business Innovation Research (SBIR)</i>	86.80	44.85	112.47	127.76	15.29	13.6%
<i>Small Business Technology Transfer (STTR)</i>	3.59	5.05	13.30	15.10	1.80	13.5%
<i>Industry/University Coop. Res. Centers (IUCRC)</i>	8.43	3.24	7.85	7.85	-	-

IIP supports the NSF innovation environment by 1) spurring translation of fundamental research, 2) encouraging collaboration between academia and industry, and 3) educating to innovate.

IIP is home to two NSF small business research programs, the Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program. These small business-centered programs support innovation research and build partnerships between the academic and industry sectors. These programs support the innovation economy by funding translational research at U.S. small businesses on topics that span the breadth of NSF scientific and engineering research and that reflect national and societal priorities.

In addition, IIP leverages industrial support through three research programs, the Industry/University Cooperative Research Centers (IUCRC) program, the Grant Opportunities for Academic Liaison with Industry (GOALI) program, and the Partnerships for Innovation (PFI) program. These university grantees 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 to become globally aware leaders in innovation by working closely with industry.

In general, 95 percent of the IIP portfolio is available for new research grants. The remaining 5 percent of funding supports continuing grants made in previous years, primarily to the long-duration IUCRCs. All other programs are managed with standard grants.

Factors Influencing the Allocation Across IIP Programs

- Increases in the SBIR, \$15.29 million, to a total of \$127.76 million and STTR, \$1.80 million, to a total of \$15.10 million program investments are in line with federal mandates. IIP will seek to strengthen the connections between these small business research programs and the university-based research programs to foster the translation of important discoveries into commercial products.
- Responding to national need in the area of innovation. IIP will invest \$12.0 million in a new aspect of the PFI program for the “NSF Innovation Ecosystem.” The division will provide research grants to universities in partnership with other institutions to increase the economic and social impacts of university research. The goals of the grants would be to (1) increase the

engagement of faculty and students across all disciplines in the innovation and entrepreneurship process; (2) increase the impact of the most promising university innovations through commercialization, industry alliances, and start-up formulation; and (3) develop a regional community that supports the “innovation ecosystem” around the university.

- Industry-University collaboration and translational research. IIP will maintain I/UCRC funding at the FY 2010 level of \$7.85 million as the program continues to establish new, innovative centers and to extend support for current, successful centers. The division will also create mechanisms to spur collaboration between the centers and the NSF SBIR/STTR grantees. These collaborations are expected to speed the translation of fundamental research discoveries into innovations that benefit challenges of importance to both industry and the Nation.
- Core Reallocation. IIP will reallocate \$3.38 million in core funding from the GOALI (\$1.38 million, to a total of \$7.80 million) and PFI (-\$2.0 million, to a total of \$7.19 million) programs as the focus shifts to activities associated with the “Innovation Ecosystem.”

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

\$31,000,000
+\$2,000,000 / 6.9%

EFRI Funding

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
EFRI	\$26.50	\$14.00	\$29.00	\$31.00	\$2.00	6.9%
Research	26.50	14.00	29.00	31.00	2.00	6.9%

EFRI was created within the Office of the Assistant Director for Engineering 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. Recent EFRI research topics have included renewable energy storage; integrated systems designed to make U.S. infrastructure more resilient to disasters; optimal methods for obtaining hydrocarbons from plants and microorganisms; and regeneration of some of the body’s most complex tissues.

EFRI encourages the engineering community to come forward with new and paradigm-shifting proposals at the interface of disciplines and fields. Their 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.

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.

In general, 95 percent of the EFRI portfolio is available for new research grants while 5 percent is used primarily to fund grants made in previous years.

Factors Influencing the Allocation Across EFRI Programs

- Potentially transformative frontier research and national needs are the principal drivers for funding allocations in EFRI and will likely result in funding of 15 total awards.
- EFRI seeks to invest in engineering research opportunities that would be difficult to fund with other NSF mechanisms. Successful projects usually require small- to medium-sized interdisciplinary teams of researchers and significant funding for several years in order to make substantial progress and to provide evidence for additional follow-on funding through other established mechanisms.
- Topics for EFRI support typically address research areas important to NSF, the research community, and the Nation as a whole. Research may relate to the grand challenges identified by

National Academy of Engineering (www.engineeringchallenges.org), and, beginning in FY 2010, EFRI has provided the opportunity for the research community to directly submit topic ideas through the NSF website.

- EFRI will also consider seed funding for potential areas of interest; for example, with co-funding from the MPS Division of Mathematical Sciences in FY 2009, EFRI invested in a handful of exploratory research projects on complex systems.