ENGINEERING $628,550,000

The FY 2007 Budget Request for the Directorate for Engineering (ENG) is $628.55 million, an increase of $47.63 million, or 8.2 percent, over the FY 2006 Current Plan of $580.92 million.

Engineering Funding
(Dollars in Millions)

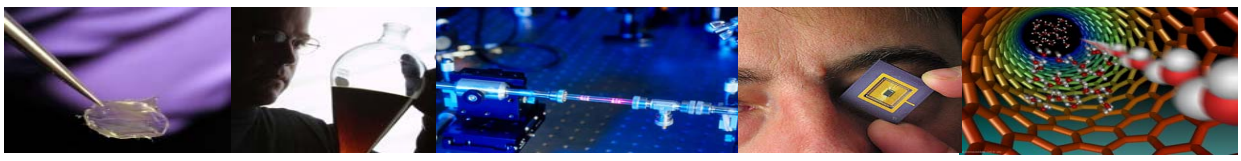
	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Chemical, Bioengineering, Environmental and Transport Systems (CBET)	$112.06	$122.87	$124.44	$1.57	1.3%
Civil, Mechanical and Manufacturing Innovation (CMMI)	141.13	146.79	152.16	5.37	3.7%
Electrical, Communications and Cyber Systems (ECCS)	70.79	77.27	80.90	3.63	4.7%
Industrial Innovation and Partnerships (IIP)	113.10	110.56	120.08	9.52	8.6%
Small Business Innovation Research (SBIR/STTR)	[102.75]	[100.36]	[108.88]	[8.52]	[8.50%]
Engineering Education and Centers (EEC)	120.01	123.43	125.97	2.54	2.1%
Emerging Frontiers in Research and Innovation (EFRI)	-	-	25.00	25.00	N/A
Total, ENG	$557.09	$580.92	$628.55	$47.63	8.2%

Totals may not add due to rounding.

Engineering is the foundation of our Nation's global leadership in technology and innovation. This leadership is the key to our continued economic growth and national security. Engineering also serves as the bridge between science and society, where the fruits of basic research and education are transformed into new technologies and robust systems that make our lives better, safer, and more productive.

The U.S. engineering community continually applies its ingenuity and technical expertise to ensure our Nation is able to rise above today's pressing demands, even as we prepare to meet tomorrow's emerging grand challenges. Many of these frontier challenges are already in the national spotlight, as recent news reports communicate the urgent need for engineering solutions. Protecting our coastlines from potential tsunami and hurricane damage, making meaningful strides toward energy independence, and educating a future workforce that can not only compete, but excel in an era of global competitiveness are just some of the areas where engineers are working toward solutions.

Engineering, therefore, is the catalyst that brings about improvements in personal lives and critical advances in our Nation's strategic interests. It is through investments in fundamental and frontier engineering research that we are able to bring about profound and positive impacts on areas such as environmental protection, improving human health, enabling science to better understand the natural world, and growing our standard of living.



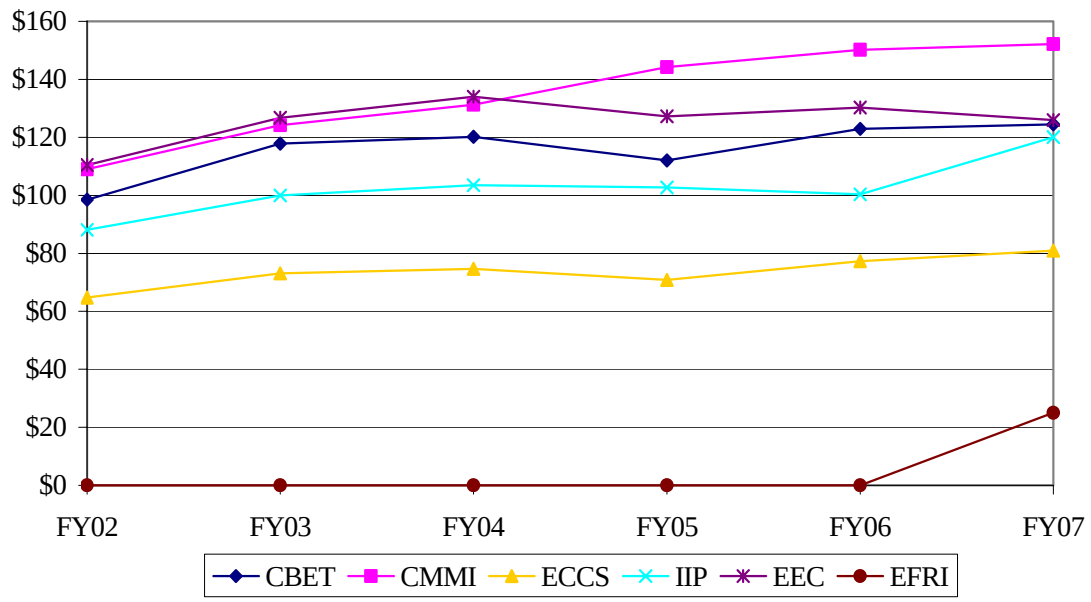
Engineering spans the frontiers from nanotechnology and high-end computing to homeland security and understanding complex engineered and natural systems. Throughout traditional and emerging disciplines, engineering applies fundamental research to service in society.

To ensure that NSF will continue to provide national leadership in engineering research and education, ENG must continually assess its resource allocation and organizational effectiveness. This process, by evaluating the impact of national needs and international competitiveness, led to the decision to restructure the Engineering Directorate in FY 2007. This restructuring will strategically position ENG's investments to help secure the Nation's leadership in innovation, particularly in an increasingly competitive global marketplace for goods and ideas.

A crosswalk to ENG's new framework of the FY 2006 Current Plan is provided at the end of this document.

ENG Subactivity Funding

(Dollars in Millions)

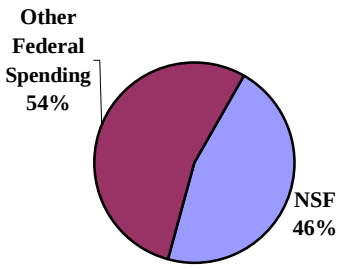


RELEVANCE

The Engineering Directorate is a major source of federal funding for university-based, fundamental engineering research – providing 46 percent of the total federal support in this area.

ENG investments in engineering research and education build and strengthen our Nation's capacity to lead the world in innovation. These investments include such emerging technologies as sensors and sensor systems, molecular electronics, photonics, cyberinfrastructure, metabolic engineering, bioengineering, manufacturing innovation, and nanotechnology.

Federal Support of Basic Research in Engineering at Academic Institutions



ENG also receives feedback and input from the Engineering Advisory Committee and the engineering community to advance the frontiers of discovery, enable technological innovation, and transform education to serve the current and future demands of society. From new fields like nanotechnology to the core disciplines of civil, chemical, electrical, and mechanical engineering – the NSF Engineering Directorate supports the most creative ideas with a proven system of merit review.

Summary of Major Changes by Directorate-wide Investments *(Dollars in Millions)*

ENG FY 2006 Current Plan…..…….. $580.92

Advancing the Frontier

Disciplinary and Interdisciplinary Research +$45.73

Support for core research projects will be increased significantly. ENG will allocate $25.0 million to support research aimed at advancing the frontiers of knowledge and innovation by working across traditional disciplinary boundaries in the ENG priority research areas of Biology in Engineering, New Frontiers in Nanotechnology, Critical Infrastructure Systems, Complexity in Engineered and Natural Systems, and Manufacturing Frontiers. These frontier research areas will guide the decision making process throughout ENG, but specifically within the Office of Emerging Frontiers in Research and Innovation (EFRI). The EFRI Office will reside within the Office of the Assistant Director for Engineering, and will consider areas of emerging frontiers of engineering research, innovation, and education. The Office of Emerging Frontiers in Research and Innovation will serve a critical role in helping the Directorate for Engineering focus on important new areas. Funding for other core research increases slightly to enable funding of higher priority emerging frontier research and innovation.

Sensors and Related Research - In FY 2007, $20.0 million is requested to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the prediction and detection of explosives and related threats. ENG will lead this new NSF-wide effort, in collaboration with other agency efforts, which seeks to advance fundamental knowledge in new technologies for sensors and sensor networks, and in the use of sensor data in control and decision-making across a broad range of applications, particularly those that bear on the prediction and detection of explosive materials and related threats. Additional information is provided in the chapter on NSF-wide Investments.

Priority Areas - Biocomplexity in the Environment (BE) and Mathematical Sciences (MSE) priority areas will continue their phase-downs, transferring into core programs where these emphases will continue within ongoing projects. Human and Social Dynamics (HSD) is sustained at the FY 2006 Current Plan level in FY 2007.

Earthquake Engineering Centers -$6.00

Funding for three earthquake engineering centers will end in FY 2006. These centers, awarded in FY 1997, were a part of the National Earthquake Hazards Reduction Program (NEHRP), and helped to highlight the Nation's need for the Network for Earthquake Engineering Simulation (NEES).

Engineering Research Centers Funding decreases by $630,000, to a total of $62.79 million resulting in a slight decrease of support for outreach supplements.	-$0.63
Small Business Innovation Research Funding increases by $7.63 million, to a total of $97.47 million to meet the mandated agency spending target of 2.5 percent of the agency's extramural research budget.	+$7.63
Small Business Technology Transfer Funding increases by $890,000, to a total of $11.41 million to meet the mandated agency spending target of 0.30 percent of the agency's extramural research budget.	+$0.89
Broadening Participation in the S&E Enterprise	
Research Experience for Undergraduates (REU) Sites Support for the REU Sites program increases by $100,000, to a total of $8.60 million.	+$0.10
Engineering Education Support for unsolicited engineering education projects in core programs decreases. In conjunction with the EHR Directorate, ENG will (1) reallocate existing collaborations funding to provide initial support for the development of minority faculty networks, drawing upon highly successful ENG minority workshops, and (2) undertake a collaborative planning process with tribally-controlled colleges and universities to foster the development of pathways for American Indian students to become engineers.	-$1.93
Bolstering NSF's K-12 Education Portfolio	
Research Experiences for Teachers (RET) Support for the RET Sites program increases by $100,000, to a total of $4.10 million.	+$0.10
GK-12 Support for the GK-12 program increases by $180,000, to a total of $3.37 million.	+$0.18
Facilities and Infrastructure	
Network for Earthquake Engineering Simulation (NEES) Funding for operations and maintenance costs increase $960,000, to a total of $21.27 million.	+$0.96
Organizational Excellence Provides for administrative activities necessary to enable NSF to achieve its mission and goals. These investments include support for Intergovernmental Personnel Act appointments and for contractors performing administrative functions.	+$0.25
Net, all other program changes	+$0.35
Subtotal, Changes	+$47.63
FY 2007 Request, ENG……	**$628.55**

NSF-wide Investments

In FY 2007, the Engineering Directorate will support research and education efforts related to broad, Foundation-wide investments in a number of areas, including NSF's multidisciplinary priority areas and the Administration's interagency R&D priorities.

Engineering NSF-wide Investments

(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Biocomplexity in the Environment	$6.00	$5.94	$4.00	-$1.94	-32.7%
Climate Change Science Program	1.00	1.00	1.00	-	-
Cyberinfrastructure	52.00	52.00	54.00	2.00	3.8%
Human and Social Dynamics	2.00	2.00	2.00	-	-
Mathematical Sciences	2.91	2.88	1.46	-1.42	-49.3%
National Nanotechnology Initiative	123.77	127.77	137.02	9.25	7.2%
Networking and Information Technology R&D	11.20	11.20	11.20	-	-
Sensors/IED Research	-	-	20.00	20.00	-

Biocomplexity in the Environment: A total of $4.0 million will support activities in the Materials Use: Science, Engineering, and Society (MUSES) program.

Climate Change Science Program: A total of $1.0 million to support basic research in the areas of carbon dioxide capture and the reduction of other greenhouse gases.

Cyberinfrastructure (CI): ENG currently funds projects such as NEES – the George E. Brown Jr. Network for Earthquake Engineering Simulation – NSF's first distributed-network cyberinfrastructure research facility, the National Nanotechnology Infrastructure Network (NNIN), and the Nanoscale Computational Network (NCN). In FY 2007, support increases by $2.0 million to a total of $54.0 million and will be used to fund ENG projects at the device, node, network, and system levels that will enable enhanced capabilities for the next generation cyberinfrastructure. Funding will also be used to support projects that use CI to enable frontier research in ENG domain areas.

Human and Social Dynamics: A total of $2.0 million will be invested in Decision Making and Risk and Dynamics of Human Behavior components of this priority area.

Mathematical Sciences: A total of $1.46 million will continue to support synergistic collaborations between mathematicians and engineers to strengthen engineering modeling and experimental work, and enhance undergraduate and graduate engineering education.

National Nanotechnology Initiative: NSF leads the U.S. nanotechnology research effort, and ENG is the focal point within NSF for this critical national research endeavor. The goal is to support fundamental research and catalyze synergistic science and engineering research and education in emerging areas of nanoscale science and technology. This research includes biosystems at the nanoscale; nanoscale structures, novel phenomena, and quantum control; nanoscale devices and system architecture; nanoscale processes in the environment; multi-scale, multi-phenomena theory, modeling and simulation at the

nanoscale; manufacturing processes at the nanoscale; and studies on the societal and educational implications of scientific and technological advances on the nanoscale. Within the total investment for NNI, ENG will fund approximately 30 new awards on Nanoscale Interdisciplinary Research Teams (NIRT) or NIRT-like projects ($65.0 million across NSF). FY 2007 ENG support for NNI increases by $9.25 million to a total of $137.02 million.

Networking and Information Technology R&D: ENG supports a broad array of fundamental computer and network research, including the Control, Networks and Computational Intelligence (CNCI) program, which covers creative research and education underlying the analysis and design of intelligent engineering networks for control, communications, computation and energy. Additionally, FY 2007 support remains constant at $11.20 million.

Sensors/IED Research: NSF is requesting $20.0 million to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the prediction and detection of explosives and related threats. ENG will lead this new NSF-wide effort, in collaboration with other agency efforts, which seeks to advance fundamental knowledge in new technologies for sensors and sensor networks, and in the use of sensor data in control and decision-making across a broad range of applications, particularly those that bear on the prediction and detection of explosive materials and related threats. Additional information is provided in the chapter on NSF-wide Investments.

QUALITY

ENG maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. In FY 2005, 97 percent of research funds were allocated to projects that underwent external merit review.

To ensure the highest quality in processing and recommending proposals for awards, ENG convenes Committees of Visitors, composed of qualified external evaluators, to review each program 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.

ENG also receives advice from the Advisory Committee for Engineering (AC/ENG) on such issues as: the mission, programs, and goals that can best serve the engineering community; how ENG can promote quality graduate and undergraduate education in the engineering sciences; and priority investment areas in engineering research. The AC/ENG meets twice a year. Its members represent a cross section of engineering, with representatives from many different sub-disciplines within the field. Members also come from a variety of institutions, have broad geographic representation, and represent a balance of underrepresented groups.

PERFORMANCE

NSF's FY 2007 budget is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Engineering
By Strategic Outcome Goal and Investment Category
(Dollars in Millions)

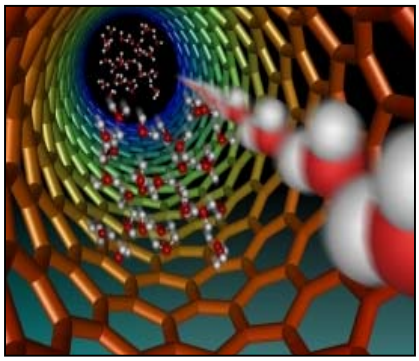
		FY 2006		Change over	
	FY 2005 Actual	Current Plan	FY 2007 Request	FY 2006 Amount	Percent
Ideas					
Fundamental Science and Engineering	$229.25	$245.64	$291.37	$45.73	18.6%
Centers Programs	97.53	99.13	92.58	-6.55	-6.6%
Capability Enhancement	109.18	107.16	115.68	8.52	8.0%
	435.96	451.93	499.63	47.70	10.6%
Tools					
Facilities	27.34	29.61	30.67	1.06	3.6%
Infrastructure and Instrumentation	-	-	-	-	N/A
Polar Tools, Facilities and Logistics	-	-	-	-	N/A
Federally Funded R&D Centers	-	-	-	-	N/A
	27.34	29.61	30.67	1.06	3.6%
People					
Individuals	70.05	71.45	71.97	0.52	0.7%
Institutions	15.48	18.18	16.28	-1.90	-10.5%
Collaborations	1.00	2.00	2.00	-	-
	86.53	91.63	90.25	-1.38	-1.5%
Organizational Excellence	7.26	7.75	8.00	0.25	3.2%
Total, ENG	$557.09	$580.92	$628.55	$47.63	8.2%

Totals may not add due to rounding.

ENG will continue its commitment to education, training, and increasing diversity within all of its Divisions. The FY 2007 budget will maintain award size and continue to focus on multidisciplinary research activities, interagency partnerships, and international activities with special attention given to broadening participation at all levels.

Recent Research Highlights

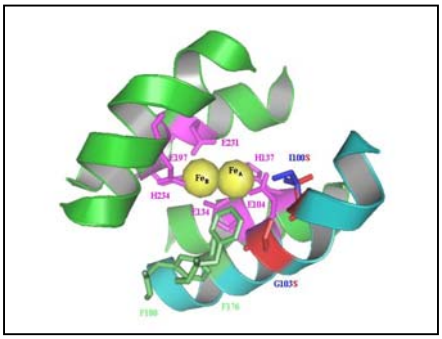
► **Novel Membranes for Manufacturing and Drug Delivery:** Researchers at the University of Kentucky have created membranes made from billions of aligned carbon nanotubes, and verified that some fluids will stream through the almost friction-free nanotube interiors at nearly 100,000 times the rates predicted by standard fluid-flow theory. Although other researchers have speculated that carbon nanotubes would have little friction, the University of Kentucky team, led by an NSF-funded CAREER awardee, was the first to document the high-speed flow.



Water moving through carbon nanotubes.
Credit: M.Denomme, University of Kentucky.

Highly efficient nanotube-based filters may one day contribute to the purification of products ranging from industrial chemicals and pharmaceuticals to dairy production. (CBET)

► **A Better Approach to Producing Drugs for Parkinson's Disease:** Researchers at the University of Connecticut and the University of Maryland have used protein engineering to construct enzymes that are useful in the pharmaceutical industry. These enzymes were used to develop a new class of compounds that show promise for the treatment of Parkinson's disease and other nervous system disorders. These compounds, known as 4-nitrocatechols, could not be produced in the past without also producing substantial impurities that could pose a health risk. By using an engineered enzyme, however, the researchers have now discovered a new biosynthetic pathway to produce the compounds with fewer impurities.



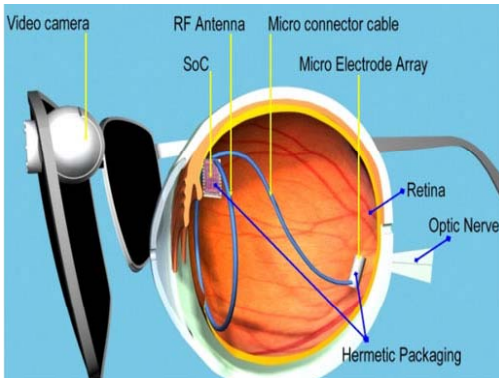
Active site of the Monooxygenase enzyme, which gives better control in the development of drugs for Parkinson's disease. *Credit:: T. Wood, University of Connecticut Bioremediation and Applied Biotechnology Laboratory.*

Enzymes play a key role in the development of many pharmaceuticals by catalyzing the reactions needed to produce drugs. However, it is difficult to obtain the enzymes that are required to form specific drugs. The researchers used directed evolution of enzyme-producing bacteria to rapidly develop the enzymes that they needed. This enzyme gave them better control of drug development, and produced a purer form of 4-nitrocatechol for the treatment of Parkinson's disease. (CBET)

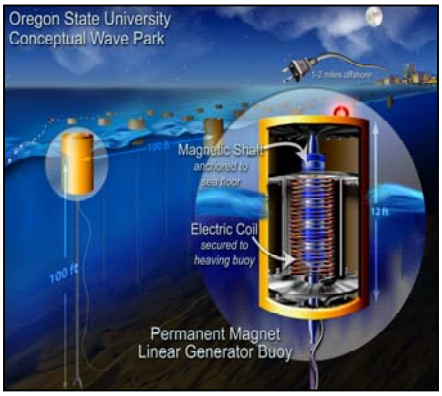
Penelope prepares for her surgical debut. *Credit: Courtesy of New York-Presbyterian Hospital.*

► **Robots in the Operating Room:** A team of engineers and surgeons at Robotic Surgical Tech Inc. have developed a robotic surgical assistant known as "Penelope." Through the use of a robotic arm, voice-recognition technology, and artificial intelligence techniques, Penelope can respond to a surgeon's request for an instrument – often by anticipating the surgeon's needs and having the instruments ready in advance. It can also keep track of what's been used so far, helping to ensure that nothing is accidentally left inside the patient. Penelope made its clinical debut in June 2005 at New York-Presbyterian/The Allen Pavilion, where it participated in a simple excision of a small, benign cyst. (IIP)

► **Retinal Implant Restores Light to the Blind**: Millions of people who have lost their sight due to degenerative eye diseases such as Macular Degeneration may one day see again, thanks to recent progress toward engineering an artificial retina. A research group from the NSF Engineering Research Center for Biomimetic Microelectronic Systems at the University of Southern California has developed a device that enables previously blind individuals to perceive light and patterns. The researchers discovered that, in many cases, the neural pathways of blind people that carry information to the brain were still healthy, even though other parts of the eye were not. The retinal implant takes advantage of this healthy neural tissue by using an external camera and image-processing unit to send signals through the optic nerve to the brain. It is hoped that a clinically approved version will be available for widespread use within five years. (EEC, CBET)



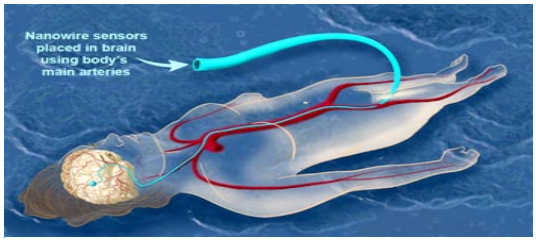
Drawing of an implanted artificial retina. *Credit: University of Southern California Biomimetic MicroElectronic Systems Research.*



Ocean buoy generators promise to convert the movement of waves into energy. *Credit: Nicole Fuller, National Science Foundation.*

► **Power from the Ocean**: Engineers at Oregon State University have developed buoys that can harness the motion of the ocean to produce electricity. The power-generating buoys use the fundamental relationship between electricity and kinetic energy to convert waves in the water into energy we can use. Inside each buoy, a series of electric coils surround a magnetic shaft that is anchored to the seafloor. When waves cause the coil inside the buoy to move up-and-down relative to the fixed magnetic shaft, electricity is generated. Each buoy could potentially produce 250 kilowatts of power, and the technology can be scaled up or down to suit a variety of energy needs. A fleet of about 200 such buoys could power the business district of downtown Portland. (ECCS)

► **Nanowire Probes in the Brain:** Working with platinum nanowires 100 times thinner than a human hair, a team from New York University School of Medicine and Japanese researchers has demonstrated a technique that may one day allow doctors to monitor individual brain cells and perhaps provide new treatments for neurological diseases such as Parkinson's. The researchers explain it is becoming feasible to create nanowires far thinner than even the tiniest capillary vessels. That means nanowires could, in principle, be threaded through the circulatory system to any point in the body without blocking the normal flow of blood or interfering with the exchange of gasses and nutrients through the blood-vessel walls. (CMMI)



Nanowires connected to a catheter tube could be guided hrough the circulatory system to the brain. Each nanowire would record the electrical activity of a single nerve cells, or small groups of nerve cells. *Credit: Zina Deretsky, National Science Foundation.*

Image of the Like90 unmanned helicopter. *Credit: Like90, University of South Florida's Safety Security Rescue Research Center.*

► **Small Unmanned Aircraft Save Lives:** Two small, unmanned aircraft played a key role in saving lives after Hurricane Katrina. NSF-supported researchers brought the vehicles to storm-damaged communities in Mississippi to help responders focus their efforts and avoid hazards. In Pearlington, Mississippi, researchers launched the aircraft from an open patch of road, which was surrounded by downed trees and power lines.

One vehicle, a four-foot long, fixed-wing plane carrying video and thermal cameras, gave a broad view of the disaster area. The other, a miniature helicopter able to operate up to 300 feet in the air, allowed researchers to hover near particular buildings and roofs, assess the damage, and locate survivors who were trapped. (EEC)

Other Performance Indicators

The tables below show the change in the number of people benefiting from ENG funding, and trends in the award size, duration, number of awards, and funding rates.

Number of People Involved in ENG Activities

	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
Senior Researchers	4,700	4,888	5,181
Other Professionals	1,219	1,268	1,344
Postdoctorates	387	402	426
Graduate Students	4,402	4,578	4,853
Undergraduate Students	2,202	2,290	2,427
Total Number of People	12,910	13,426	14,231

ENG Funding Profile

	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
Statistics for Competitive Awards:			
Number	1,493	1,553	1,677
Funding Rate	17%	18%	20%
Statistics for Research Grants:			
Number of Research Grants	840	874	1,020
Funding Rate	13%	14%	15%
Median Annualized Award Size	$97,431	$97,500	$98,000
Average Annualized Award Size	$117,675	$118,000	$119,200
Average Award Duration, in years	2.9	2.9	2.9

New Structure
Engineering Directorate

In FY 2007, the Engineering Directorate will be restructured. This is to ensure that ENG can continue to address the needs of the Nation, while responding to ongoing changes in engineering research and education. As such, ENG has prepared a framework for reorganizing the Activity. A crosswalk of the FY 2006 Current Plan is shown below.

Current Structure	New Structure						Total Current Structure
	CBET	CMMI	ECCS	IIP	EEC	EFRI	
Bioengineering and Environmental Systems (BES)	52.00						$52.00
Chemical and Transport Systems (CTS)	70.87						$70.87
Civil and Mechanical Systems (CMS)		85.35					$85.35
Design and Manufacturing Innovation (DMI)		61.44		3.40			$64.84
Electrical and Communications Systems (ECS)			77.27				$77.27
Engineering Education and Centers (EEC)				6.80	123.43		$130.23
Office of Industrial Innovation (OII)				100.36			$100.36
Total, New Structure	$122.87	$146.79	$77.27	$110.56	$123.43	$0.00	$580.92

The Engineering Directorate is constantly seeking ways to better fulfill its mission of advancing engineering discovery, innovation, and education. For the past 15 years, ENG has been able to fulfill this mission using effectively the same organizational structure.

During that time, however, new research areas have emerged and advanced (e.g., nanotechnology, bioengineering). National priorities have changed (e.g., homeland security and energy independence). And global competition in innovation has increased.

With these changing conditions, and new and emerging demands on the engineering enterprise, ENG must reposition itself to remain at the frontier of discovery, innovation, and education.

To respond proactively to these changes, ENG has unveiled a framework for reorganizing the Activity. This framework will continue to enable ENG to do the following:

- Position ENG at the frontiers of engineering discovery, innovation and education;
- Enhance interdisciplinary research;
- Provide opportunities for exploring new areas not yet recognized in their full potential;
- Enhance flexibility for evolutionary change by combining some units;
- Better integrate across priority areas;
- Enhance the integration of research and education; and,
- Support the continuum from discovery through early engineering innovation.

The new structure reflects a series of overarching goals for the ENG Directorate, and better aligns with national priorities. One of the overarching goals – ***frontier research*** – recommended frontier research areas for FY 2007 emphasis. They are:

- Biology in Engineering
- Complexity in Engineered and Natural Systems
- Critical Infrastructure Systems
- Manufacturing Frontiers
- New Frontiers in Nanotechnology

These frontier research areas will guide the decision-making process throughout ENG, but specifically within the Emerging Frontiers in Research and Innovation (EFRI) budget line. The EFRI Office will reside within the Office of the Assistant Director for Engineering and will consider areas of emerging frontiers of engineering research, innovation, and education. The EFRI Office will identify and prioritize emerging frontier areas of research and education, and provide resources for pursing these priorities. EFRI will serve a critical role in helping the Directorate for Engineering focus on important new areas.

Also, as part of the reorganization, the Industry/University Cooperative Research Centers (I/UCRCs) program will be moved from the Engineering Education and Centers Division to the Industrial Innovation and Partnerships (IIP) Division. The program develops long-term partnerships among industry, academe, and government. The centers are catalyzed by a small investment from the NSF, and are primarily supported by industry center members, with NSF taking a supporting role in their development and evolution. Each center is established to conduct research that is of interest to both the industry and the center. An I/UCRC contributes to the Nation's research infrastructure base and enhances the intellectual capacity of the engineering and science workforce through the integration of research and education.

Finally, the Grant Opportunities for Academic Liaison with Industry (GOALI) program moves from the Civil, Mechanical and Manufacturing Innovation Division to the IIP Division. The program enables partnerships between industry and academe where there is a common intellectual and educational agenda. The program supports (a) faculty, postdoctoral fellows, and students to conduct research and gain experience in an industrial setting; (b) industry scientists and engineers to bring industrial perspective and integrative skills to academe; and (c) interdisciplinary university/industry teams to conduct long-term projects. The program targets high-risk and high-gain research, with focus on fundamental topics that would not otherwise have been undertaken by industry; the development of innovative, collaborative university/industry educational programs; and the direct exchange of new knowledge between academe and industry.

CHEMICAL, BIOENGINEERING, ENVIRONMENTAL AND TRANSPORT SYSTEMS $124,440,000

The FY 2007 Budget Request for the Chemical, Bioengineering, Environmental and Transport Systems Division (CBET) is $124.44 million, an increase of $1.57 million, or 1.3 percent, above the FY 2006 Current Plan of $122.87 million.

Chemical, Bioengineering, Environmental and Transport Systems Funding
(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Chemical, Bioengineering, Environmental, and Transport Systems	**$112.06**	**$122.87**	**$124.44**	**$1.57**	**1.3%**
Major Components:					
Research and Education Grants	100.81	110.45	111.95	1.50	1.4%
Science and Technology Center (STC)	4.00	3.96	4.00	0.04	1.0%
National Nanoscale Infrastructure Network (NNIN)	3.20	3.17	3.20	0.03	0.9%
Nanoscale Science and Engineering Centers (NSEC)	4.05	5.29	5.29	-	-

About CBET:

The Division of Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division supports fundamental research and education in the rapidly evolving, and increasingly interconnected fields of bioengineering, chemical and environmental engineering, and transport systems. This research will have profound effect on the U.S. economy; the health of our land, air, and water environments; our understanding of natural and living systems; and our ability to provide outstanding healthcare. CBET will advance these fields by developing fundamental engineering principles, mathematical models and experimental techniques, and new devices and systems.

In general, 67 percent of the CBET portfolio is available for new awards. The remaining 33 percent funds awards made in previous years.

CBET Priorities for FY 2007:
The division will continue to support existing areas of frontier research within the Engineering Directorate. This includes fundamental studies of catalysis and biocatalysis, bioengineering, chemical and biochemical process design, environmental engineering, advanced materials, fuel cells, combustion, heat transfer, and particle processes. It also will support new areas of research at the nexus of bioengineering, chemical engineering, and environmental transport phenomena. By integrating research from these diverse disciplines, CBET will be able foster new discoveries and new innovations in the areas that most directly affect our quality of life. Within the U.S. and international research communities, CBET support will play a key role in catalyzing and developing highly promising, cutting-edge research fields, such as: tissue engineering, energy, the environment, information technologies, health-related products, and other areas that impact our daily lives.

CBET achieves these objectives across its four program clusters:

- Chemical, Biochemical, and Biotechnology Systems
- Transport and Thermal Fluids Phenomena

- Biomedical and Healthcare Engineering
- Environmental Systems

While sustaining the vitality of these core research areas, CBET actively supports the following key areas:

Energy, Environment, and Sustainability: CBET will continue to support research on environmentally benign processes. Energy conversion areas include cleaner combustion processes, the fabrication of new materials for solar cells, novel electrode materials for fuel cells, microbial fuel cells, liquid biofuels, and biohydrogen. The management of greenhouse gases with their links to climate change will be supported. CBET leads the WATERS Network project, which has as its objective the transformation water resource engineering research at a national scale.

Nanoscale Science and Engineering: CBET will continue its leadership role in designing, synthesizing, and analyzing nanoscale systems. Current emphasis is on active nanoscale systems leading to improved devices and manufacturing techniques. CBET also plays a key role in funding exploratory research on biosystems at the nanoscale. For example, chips and sensors, combined with microfluidics, are integrated intimately with nanobiotechnology. Many of these systems are for medical, environmental, and other sensing applications.

Cyberinfrastructure (CI): Cyberinfrastructure efforts are pervasive throughout the division's programs. Projects involving computational fluid dynamics are funded throughout CBET, and draw increasingly on high-performance computing (HPC) capabilities that are being enhanced by NSF-level CI initiatives. Further, as part of the WATERS network effort, a Project Office has been established and will focus on the collaborative formulation of a comprehensive Cyberinfrastructure Plan for the WATer and Environmental Research Systems (WATER) network.

Multi-Scale Modeling (MSM): Multi-Scale Modeling is growing rapidly in the academic communities funded by NSF and the Engineering Directorate. The Chemical, Bioengineering Environmental and Transport Systems Division hosts the new interagency solicitation on MSM in Biomedical, Biological, and Behavioral (BBB) systems. The first MSM-BBB competition was completed in FY 2005, with four agencies (NSF, NIH, NASA, and DOE) investing nearly $20.0 million to support 24 MSM-BBB projects. A principal investigator meeting is being organized for FY 2006, and the next MSM-BBB competition is in planning for FY 2007.

Biology in Engineering: Biology in Engineering is one of the five priority areas established by the directorate, and is heavily supported by the division. CBET leads both the interagency solicitation on Metabolic Engineering, and the NSF inter-directorate (ENG, BIO, CISE, and MPS) solicitation on Quantitative Systems Biotechnology. CBET will continue to support large-scale activities such as the National Nanotechnology Infrastructure Network, Nanoscale Science and Engineering Centers, and a Science and Technology Center on New Materials for Water Purification.

Changes from FY 2006:

- The major change from FY 2006 is the merging of the BES and the CTS Divisions to form the Chemical, Bioengineering Environmental and Transport Systems Division.
- Combined with a reallocation of core research funds, support for the National Nanotechnology Initiative (NNI) increases by $2.89 million to a total of $42.82 million with an increased focus in the area of Nanoscale Interdisciplinary Research Teams.
- An increase of $5.0 million to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the detection of explosives and related threats.

CIVIL, MECHANICAL AND MANUFACTURING INNOVATION $152,160,000

The FY 2007 Budget Request for the Civil, Mechanical and Manufacturing Innovation Division (CMMI) is $152.16 million, an increase of $5.37 million, or 3.7 percent, above the FY 2006 Current Plan of $146.79 million.

Civil, Mechanical and Manufacturing Innovation Funding
(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Civil, Mechanical and Manufacturing Innovation	**$141.13**	**$146.79**	**$152.16**	**$5.37**	**3.7%**
Major Components:					
Research and Education Grants	117.65	119.92	124.31	4.39	3.7%
Network for Earthquake Enginnering and Simulation (NEES)	17.94	20.31	21.27	0.96	4.7%
National Nanoscale Infrastructure Network (NNIN)	1.65	1.63	1.65	0.02	1.2%
Nanoscale Science and Engineering Centers (NSEC)	3.89	4.93	4.93	-	-

About CMMI:

The Civil, Mechanical and Manufacturing Innovation (CMMI) Division enables a globally competitive and sustainable future for the Nation by supporting fundamental research to advance the frontiers of knowledge. CMMI supports areas related to designing, building, and securing the Nation's critical infrastructure, and manufacturing and service enterprise. CMMI also invests in engineering education to foster a world-class engineering workforce. CMMI programs are organized into three clusters: Engineering Infrastructure Systems, Innovation Science and Decision Engineering, and Materials Transformation and Mechanics. These clusters will provide the knowledge to design and secure the Nation's infrastructure, and to grow our Nation's wealth-producing enterprises.

A major portion of the division's portfolio supports the George E. Brown, Jr. Network for Earthquake Engineering Simulation. NEES is a system of 15 experimental facilities located at universities across the United States, which work together via the NEESgrid cyberinfrastructure. This research facility addresses important challenges in earthquake and tsunami engineering research. Investments in fundamental research in these areas allowed NSF's Engineering Directorate to quickly send research teams to gather ephemeral data following Hurricane Katrina. This fundamental knowledge can now be used to design predictive systems to mitigate damage and loss of life from similar natural hazards.

CMMI's design, manufacture and service portfolio is the largest of the federal agencies that support fundamental research and discovery that is not product or mission driven. This has led to early investments in solid-modeling systems, optimization and network methods, and processes that provide solid representations directly from digital data, and enable engineered processes for growing tissue.

In general, 72 percent of the CMMI portfolio is available for new awards. The remaining 28 percent funds awards made in previous years.

CMMI Priorities for FY 2007:

- Manufacturing Frontiers by supporting research in the enabling processes, systems and enterprises to advance nanomanufacturing and the technology for healthcare delivery.

- Critical Infrastructure Systems by supporting research that leads to technologies for the protection, maintenance, or modification of the Nation's critical civil and cyberinfrastructure.
- Complexity in Engineered and Natural Systems by supporting research that leads to fundamental knowledge of complex systems and their modeling.
- In addition, CMMI will collaborate in advancing ENG's priority areas of: Biology in Engineering and New Frontiers in Nanotechnology.

A major priority is also support for NEES research, operations, and grand challenge research. As of October 2005, 25 research projects have been funded to utilize the NEES facilities. In FY 2007, research will involve experimental and theoretical simulations at the NEES facilities, addressing important challenges in earthquake and tsunami engineering research.

Looking toward the future, CMMI is engaged with its research community to focus its FY 2007 investment priorities. This includes two workshops jointly sponsored with NIH's National Institute for Biomedical Imaging and Bioengineering (NIBIB) on Healthcare Delivery; a workshop on fundamental research needs for the coastal states that potentially suffer from hurricanes, earthquakes and tsunamis; a workshop on research needs in nano-metrology, in collaboration with agencies that are part of the NSTC Interagency Working Group on Manufacturing R&D, to enable nano-enterprises; and, a World Forum to further expand NEES network linkages. In addition, CMMI will actively support an ENG-wide workshop on Complex Systems.

CMMI supports nanoscale science and engineering, with programs in the Materials Transformation and Mechanics' cluster on Nanomanufacturing and Nano/Bio-Mechanics. These programs have a critical role in converting discoveries into innovations, and are a key component of the Engineering Directorate's New Frontiers in Nanotechnology and the grand challenges for the National Nanotechnology Initiative. A range of manufacturing discoveries and innovations are needed to design the systems and processes to deliver products, devices and components that take advantage of the unique properties of the nanoscale. Simultaneously, an entirely new manufacturing workforce needs to be educated and trained in nanotechnology to bring to fruition the many exciting opportunities that nanotechnology has opened up. CMMI's nanomanufacturing program will continue to support research on improving human physical and mental abilities through the integration of nanotechnology, biotechnology, information technology and cognitive science, as well as a new generation of tools and processes to achieve this goal.

Changes from FY 2006:

- The major change from FY 2006 is the merging of the Civil and Mechanical Systems and the Design and Manufacturing Innovation Divisions to form the CMMI Division.
- Combined with a reallocation of core research funds, support for the National Nanotechnology Initiative (NNI) increases by $1.92 million to a total of $28.38 million with an increased focus in the area of Nanoscale Interdisciplinary Research Teams (NIRT).
- An increase of $5.0 million to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the detection of explosives and related threats.
- An increase of $6.0 million as a result of the transferring of resources from the EEC Division related to the phasing out of Earthquake Engineering Research Centers. These reallocated resources will be used to support research in the Engineering Infrastructure Systems cluster.
- An increase of $960,000 to a total of $21.27 million will continue to accommodate the operations and research phase for the Network for Earthquake Engineering Simulation (NEES).

ELECTRICAL, COMMUNICATIONS AND CYBER SYSTEMS $80,900,000

The FY 2007 Budget Request for the Electrical, Communications and Cyber Systems (ECCS) Division is $80.90 million, an increase of $3.63 million, or 4.7 percent, over the FY 2006 Current Plan of $77.27 million.

Electrical, Communications and Cyber Systems Funding
(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Electrical, Communications and Cyber Systems	**$70.79**	**$77.27**	**$80.90**	**$3.63**	**4.7%**
Major Components:					
Research and Education Grants	59.76	65.65	69.19	3.54	5.4%
Nanoscale Science and Engineering Centers (NSEC)	2.48	3.16	3.16	-	-
National Nanoscale Infrastructure Network (NNIN)	4.55	4.50	4.55	0.05	1.1%
Science and Technology Center (STC)	4.00	3.96	4.00	0.04	1.0%

About ECCS:

The Electrical, Communications and Cyber Systems (ECCS) Division will address fundamental research issues underlying component and device technologies, power, controls, networking, communications and cybersystems technologies. The division will also support the integration and networking of intelligent systems at the nano, micro and macro scales for a variety of applications in healthcare, homeland security, disaster mitigation, energy, telecommunications, environment, transportation, manufacturing, and other systems-related areas. ECCS envisions a research community that will address major technological challenges for the next generation of devices and systems due to convergence of technologies and increased emphasis on interdisciplinary research. One of the goals of the division is the integration of education into programs to support the education of a diverse workforce in the 21st century that will continue innovative advances for the rapid development of emerging technologies as drivers of the global economy.

In general, 81 percent of the ECCS portfolio is available for new awards; the remaining 19 percent funds awards made in prior years.

ECCS will be organized around three programs that will focus on research and educational issues involving device and component technologies, network technologies, and systems engineering: Electronics, Photonics and Device Technologies (EPDT); Power, Controls and Adaptive Networks (PCAN); and Integrative, Hybrid and Complex Systems (IHCS).

ECCS Priorities for FY 2007:
The Electronics, Photonics and Device Technologies program will seek to improve the fundamental understanding of devices and components based on the principles of electronics, photonics, magnetics, electro-optics, electromechanics, and related physical phenomena. The program will continue to invest in advancing the frontiers of spin electronics, molecular electronics, bioelectronics, nonsilicon electronics, flexible electronics, photonics, optoelectronics, power electronics, and microwave and mixed signal devices. EPDT will further support related topics in quantum engineering, revolutionary electromagnetic materials-based device solutions, radio frequency integrated circuits, and reconfigurable antenna for telecommunications, telemedicine and other wireless applications. ECCS will enable discovery and

innovation through new approaches to electronics, beyond the scaling limits of complementary metal oxide semiconductor technology.

The Power, Controls and Adaptive Networks program will invest in the design and analysis of intelligent and adaptive engineering networks including sensing, imaging, controls and computational technologies for a variety of application domains. PCAN will further invest in adaptive dynamic programming, reinforced learning, pattern recognition, and intelligent agents to develop brain-like networked architectures performing real-time learning, computational video and imaging, and embedded control of robotics. Strong emphasis will be placed on critical infrastructure aspects of electric power networks and grids, including generation and integration of renewable, sustainable and distributed energy systems into large power networks, high power electronics and drives, and understanding of associated regulatory and economic structures.

The Integrative, Hybrid and Complex Systems program is intended to spur visionary systems-oriented activities in collaborative research and education environments. IHCS will support innovative research that integrates physical devices and components with computational intelligence and networks in design, development and implementation of new nano/micro/macro complex and hybrid systems with engineering solutions for a variety of domain-specific applications. IHCS will also support integration technologies at the intra- and inter-chip levels, and advanced RF/wireless and optical communications systems.

Emphasis in the IHCS program also will be on the support and development of innovative hardware/software architectures for emerging areas of cyberengineering and cybersystems. Research in cyberengineering systems will support activities that will integrate physical devices with distributed sensing and actuation, communications, storage, computation and control of complex systems; focus on design, integration and implementation of multi-scale and multi-level complex systems; and enable visualizing, analyzing and reconfiguring of complex systems due to emergent behavior to develop reliable and agile infrastructures for domain-specific applications. Some examples include, but are not limited to: multi-scale dynamic system integration for real-time monitoring and control of engineered complex and hybrid systems; self-organizing blackout-free electric power grid; ambient intelligent systems' networks for homes of the future; computer-integrated telemedicine and robotic surgical systems; and a globally interactive environment for engineering education.

The strategic development of ECCS programs in research and education will continue to support NSF three multidisciplinary priority areas. ECCS will continue to provide support for specialized resources and infrastructure that facilitate research and educational activities, including the NNIN, STC, NSEC and NSEE centers, as well as crosscutting activities, such as the WATERS network.

ECCS will support the development of people through Foundation-wide programs, such as CAREER and ADVANCE, and through REU and RET supplements, and will actively participate in the development and management of cross-disciplinary programs. ECCS plans to continue to support Graduate Research Supplements (GRS) to broaden participation of underrepresented Ph.D. students majoring in electrical engineering. ECCS will hold grantees' workshops to assess the results of research and education grants and focused workshops to assess research and technology areas of current and future importance.

Changes from FY 2006:

- Combined with a reallocation of core research funds, support for the National Nanotechnology Initiative (NNI) increases by $2.61 million to a total of $38.56 million with an increased focus in the area of Nanoscale Interdisciplinary Research Teams.
- An increase of $5.0 million to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the detection of explosives and related threats.

INDUSTRIAL INNOVATION AND PARTNERSHIPS $120,080,000

The FY 2007 Budget Request for the Industrial Innovation and Partnerships (IIP) Division is $120.08 million, an increase of $9.52 million, or 8.6 percent, over the FY 2006 Current Plan of $110.56 million.

Industrial Innovation and Partnerships Funding

(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Industrial Innovation and Partnerships	**$113.10**	**$110.56**	**$120.08**	**$9.52**	**8.6%**
Major Components:					
Small Business Innovation Research (SBIR)	91.96	89.84	97.47	7.63	8.5%
Small Business Technology Transfer (STTR)	10.79	10.52	11.41	0.89	8.5%
Grant Opportunities for Academic Liaison with Industry (GOALI)	3.10	3.40	4.40	1.00	29.4%
Industry/University Cooperative Research Centers (I/UCRS)	7.25	6.80	6.80	-	-

About IIP:

The newly created Industrial Innovation and Partnerships Division (IIP) serves the entire foundation by fostering partnerships to advance technological innovation. The division manages the two congressionally mandated small business research programs: the Small Business Innovation Research program; and, the Small Business Technology Transfer program. IIP also manages the Partnerships for Innovation (PFI) program, which stimulates innovation by building partnerships across the scientific and engineering community. In addition, the IIP leverages industrial support through two research programs: Grants Opportunities for Academic Liaison with Industry; and Industry/University Cooperative Research Centers.

Twice each year, SBIR and STTR release their proposals solicitation topics. These solicitations cover technologies that emphasize innovation with commercialization potential. From the business community perspective, SBIR/STTR investments are considered "pre-seed," that is, they support research that is considered too high-risk for even early stage corporate investment. The research topics in the SBIR/STTR solicitations are grouped into three business opportunity areas. These topics are designed to meet the needs of capital/investment markets, strategic partners, and national and societal priorities. They also have the potential to encourage business investments outside of the SBIR/STTR program.

The Grant Opportunities for Academic Liaison with Industry program enables partnerships between industry and academe where there is a common intellectual and educational agenda. The program supports (a) faculty, postdoctoral fellows, and students to conduct research and gain experience in an industrial setting; (b) industry scientists and engineers to bring industrial perspective and integrative skills to academe; and (c) interdisciplinary university/industry teams to conduct long-term projects. The program targets high-risk and high-gain research, with focus on fundamental topics that would not otherwise have been undertaken by industry; the development of innovative, collaborative university/industry educational programs; and the direct exchange of new knowledge between academe and industry.

The Industry/University Cooperative Research Centers program develops long-term partnerships among industry, academe, and government. The centers are catalyzed by a small investment from NSF, and are primarily supported by industry center members, with NSF taking a supporting role in their development

and evolution. Each center is established to conduct research that is of interest to both the industry and the center. An I/UCRC contributes to the Nation's research infrastructure base and enhances the intellectual capacity of the engineering and science workforce through the integration of research and education.

In general, 96 percent of the IIP portfolio is available for new awards. The remaining 4 percent funds awards made in previous years.

IIP Priorities for FY 2007:
Within the SBIR/STTR research topics, Biotechnology, Information Technology, and Electronics Technology are positioned as potentially attractive to the venture capital and "angel network" communities. Advanced Materials and Manufacturing and Chemical Technology research topics are of interest to the large corporations that see the potential for strategic partnerships with the small business community. Selected topics are launched in response to national priorities such as Manufacturing Innovation and Security Technology. To accelerate near term technological innovation, a special topic, Emerging Opportunities, was launched in 2006, and will be continued into FY 2007. SBIR/STTR will explore innovation research opportunities with potential for countermeasure to improvised explosive devices (IED). In FY 2006, SBIR and STTR programs expect to reverse the downward trend in funding rate, which bottomed at 10 percent for SBIR/STTR Phase I proposals in 2004-2005. Highly qualified small business innovation research proposals remained unfunded. Release of focused solicitation topics is reversing the trend. With increased funding in FY 2007, the target is to achieve 20 percent funding rate. IIP is poised to integrate and act on salient recommendations from upcoming studies by the National Academies as well as an OMB analysis of PART (Program Assessment Rating Tool).

An ENG strategy is to increase partnerships between academic and industrial communities. GOALI is well positioned to directly impact this objective through leveraging its $4.40 million budget – with support from other academic research programs – by a factor of four-to-one. In FY 2007, to further build collaboration across academic programs and to increase academic and industrial partnerships, the GOALI program budget will increase by $1.0 million above the FY 2006 Current Plan of $3.40 million. This 30 percent increase in budget is consistent with and supportive of ENG's goal for this program.

The 50 I/UCRCs worked closely with industry to develop enabling technologies needed to manage the electrical power system, improve manufacturing and biological processes, develop new materials, information and telecommunications technologies, and innovate new products and services. The I/UCRC program provides modest seed funds and management expertise to these highly leveraged centers, with states joining in many partnerships to expand the centers' activities to have an impact on local economic development. In FY 2006, I/UCRC is launching a supplemental research initiative to advance the underlying fundamental science and technology of the centers. FY 2007 funding will continue to strengthen the technology base of centers supported by this program.

Changes from FY 2006:
- Increase of $7.63 million, to a total of $97.47 million for the Small Business Innovation program.
- Increase of $890,000, to a total of $11.41 million for the Small Business Technology Transfer program.
- Increase of $1.0 million, to a total of $4.40 million for GOALI program.

ENGINEERING EDUCATION AND CENTERS $125,970,000

The FY 2007 Budget Request for the Engineering Education and Centers (EEC) Division is $125.97 million, an increase of $2.54 million, or 2.1 percent, from the FY 2006 Current Plan of $123.43 million.

Engineering Education and Centers Funding
(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Engineering Education and Centers	**$120.01**	**$123.43**	**$125.97**	**$2.54**	**2.1%**
Major Components:					
Research and Education Grants	39.91	41.18	50.35	9.17	22.3%
Engineering Research Centers (ERC)	62.31	63.42	62.79	-0.63	-1.0%
Earthquake Engineering Research Centers (EERC)	6.00	6.00	-	-6.00	-100.0%
Nanoscale Science and Engineering Centers (NSEC)	8.44	9.48	9.48	-	-
Network for Computational Nanotechnology	3.35	3.35	3.35	-	-

About EEC:

The Engineering Education and Centers (EEC) Division promotes and facilitates university research and curricula by supporting innovative programs that integrate research and education, improve the quality of the engineering workforce, cut across disciplines, and whose breadth of investigation spans from idea inception to proof-of-concept. The division's programs are divided into three major categories: development of interdisciplinary research centers that foster partnerships between academe, government and industry; advancing graduate and undergraduate engineering education; and development of a diverse and capable technical workforce. EEC programs address issues that are critical to all fields of engineering and benefit from a centralized management focus, as well as complement the research and education portfolios of the other divisions of the Engineering Directorate. Included programs benefit from a scope encompassing all of engineering and a scale that both facilitates the incorporation of new scientific knowledge into engineering and requires rigorous monitoring and evaluation systems.

In general, 70 percent of the EEC portfolio is available for new awards; the remaining 30 percent funds awards made in previous years.

EEC Priorities for FY 2007:
In FY 2007, EEC will provide support for Engineering Research Centers, Nanoscale Science and Engineering Centers, engineering education research, and engineering workforce development. Approximately 65 percent of the EEC budget supports center related activities, with the remaining 35 percent supporting engineering education and workforce development programs.

In FY 2006, eighteen Engineering Research Centers were funded. A sample would reveal research and develop of, sensory prostheses that interface to the human nervous system, systems for detection of and warning of severe storms, computer-integrated surgical systems, biomaterials for implants, reconfigurable manufacturing systems, and power electronics. In FY 2006, five new ERCs are being added to the portfolio, enabled by funds released into the ERC program through the graduation to self-sufficiency of five ERCs in FY 2005, and phasing down support to seven ERCs during FY 2005 and 2006 to prepare them for self-sufficiency.

The eight Nanoscale Science and Engineering Centers, fully or partially supported by EEC, perform research to advance the development of the ultra-small technology that will transform electronics, materials, medicine, and many other fields. They involve key partnerships with industry, national laboratories, and other sectors; and support education programs from the graduate to the pre-college level designed to develop a highly skilled workforce. Funds are also provided to smaller interdisciplinary teams and to the Network for Computational Nanotechnology, a web-accessible repository of simulations of nanoscale phenomena for research and education. Funding for the ERCs will see a slight decrease during FY 2007, which will result in small percentage reductions across all the Centers.

EEC programs in engineering education are aimed at transforming engineering education to produce an engineering workforce that is diverse and creative, understands the impacts of its solutions on both technical and social systems, and possesses the ability to adapt to the rapidly evolving technical environment in industry, academe, and society. In FY 2007, research will be supported that contributes to our basic understanding of how students learn engineering. Significant breakthroughs in understanding are sought so that our undergraduate and graduate engineering education can be transformed to meet the needs of the changing economy and society. Topics of particular interest include: the aims and objectives of engineering education, the content and organization of the curriculum, how students learn problem solving, creativity and design, new methods for assessment and evaluation of how students learn engineering, and research that helps us understand how to attract a more talented and diverse student body to all levels of engineering study

Existing programs in Research Experiences for Undergraduates (REU) Sites and Research Experiences for Teachers (RET) Sites, which have been shown to be successful programs for broadening participation in engineering programs at both the undergraduate and graduate levels will continue in FY 2007 with a small increase in their levels.

Changes from FY 2006

- Support for the National Nanotechnology Initiative (NNI) increases by $1.83 million, to a total of $25.23 million with an increased focus in the area of Nanoscale Interdisciplinary Research Teams.
- An increase of $5.0 million to support leading edge, frontier research across NSF on sensors and other research that is potentially relevant to the detection of explosives and related threats.
- Support for the REU Sites program increases by $100,000, to a total of $8.60 million.
- Funding for the RET Sites program increases by $100,000, to a total of $4.10 million.
- Support for the GK-12 program increases by $180,000, to a total of $3.37 million.
- Support for unsolicited engineering education projects increases by $1.99 million to a total of $13.02 million.
- Funding for ERCs decreases by $630,000, to a total of $62.79 million resulting in a slight decrease of support for outreach supplements at each center.
- $6.0 million is reallocated to the Civil, Mechanical and Manufacturing Innovation (CMMI) Division. Funding for three earthquake engineering centers ended in FY 2006. These centers awarded in FY 1997 were a part of the National Earthquake Hazards Reduction Program (NEHRP) and helped to highlight the Nation's need for the Network for Earthquake Engineering Simulation (NEES).

EMERGING FRONTIERS IN RESEARCH AND INNOVATION $25,000,000

The FY 2007 Budget Request for the Office of Emerging Frontiers in Research and Innovation (EFRI) is $25.0 million. This is a new budget line in FY 2007.

Emerging Frontiers in Research and Innovation Funding
(Dollars in Millions)

	FY 2005 Actual	FY 2006 Current Plan	FY 2007 Request	Change over FY 2006 Amount	Change over FY 2006 Percent
Emerging Frontiers in Research and Innovation	**-**	**-**	**$25.00**	**$25.00**	**N/A**

About EFRI:

The Office of Emerging Frontiers in Research and Innovation (EFRI) is a new component of the Directorate for Engineering. It will serve the critical role of helping the directorate focus on important emerging areas in a timely manner. Each year, beginning in FY 2007, EFRI will do this by annually recommending, prioritizing, and funding interdisciplinary initiatives at the emerging frontier of engineering research and education.

This emerging frontier research is frequently found in high-risk, interdisciplinary areas. The divisions within the NSF's Engineering Directorate are not strategically aligned to support this type of research, which often falls outside the usual classifications and research areas. EFRI will enable ENG to pursue these interdisciplinary areas by allowing the engineering community to come forward with new, and hopefully paradigm-shifting proposals at the interface of disciplines and fields. This Office will have the potential to push the frontier in new and emerging areas.

Technological innovations, particularly over the past decade, have given rise to new industries, expanded our access to quality healthcare, and fueled our Nation's prosperity even in the face of growing global competition. Now that global competition is increasing, the technical underpinnings of the past may not be adequate to ensure our continued success. EFRI will provide critical, strategic support of fundamental discovery, especially in areas leading to breakthrough technologies.

The Office also will enable the Engineering Directorate to focus resources on engineering grand challenges. These challenges may include areas such as safe, clean water; sustainable energy resources; technologies to overcome physical limitations from disease or injury; and integrated systems designed to thwart attacks on U.S. interests throughout the world. EFRI will have the necessary flexibility to target our long-term challenges, while retaining the ability to adapt as new challenges demand. In general, 100 percent of the portfolio is available for new awards.

EFRI Priorities for FY 2007:
The role of the Office of Emerging Frontiers in Research and Innovation is to fund research opportunities that would be difficult to fund with current mechanisms, such as Small Grants for Exploratory Research, typical core awards, or large research center solicitations. EFRI support will represent transformative opportunities with high potential payoff leading to: new research areas for NSF, ENG, 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. The successful topics would likely require small- to medium-sized interdisciplinary teams of researchers with significant funding, for a period of

time needed to make substantial progress that would provide evidence for additional follow-on funding through other established funding mechanisms.

Mechanisms:

Potential EFRI topics can arise from a number of sources – the community, ENG leadership, workshops, professional societies, academies, proposals and awards. Yet, in the case of directed specified topics, the ENG program directors will play the central role within NSF.

The Office of Emerging Frontiers in Research and Innovation will operate by the following process:

- At the beginning of each calendar year, NSF program directors will propose frontier research areas that show potential for significant growth or transformative results.
- Program directors will then prioritize these topical areas, which will be reviewed by the ENG leadership.
- Based on the prioritized list of topics, working groups will generate proposed announcements.
- These will be presented as recommendations to the ENG Advisory Committee for feedback at their spring meeting.
- Based on this feedback, the ENG leadership will evaluate the recommendations and make the final EFRI allocation decisions.
- These decisions will be the foundation of EFRI Solicitations and/or Dear Colleague Letters, which will go through the appropriate NSF preparation and clearance processes.

Potential EFRI topics will be evaluated against criteria such as: Does the topic represent an opportunity for a significant leap or paradigm shift in a research area, or have the potential to create a new research area? Is there potential for making significant progress on a current national need or grand challenge? Is the financial and research scope beyond the capabilities of one division? Is the community able to organize and effectively respond?

Topics:

EFRI research in FY 2007 will better enable the Engineering Directorate to meet NSF's strategic goal of fostering frontier research. Topics for EFRI support will mirror the five key frontier research areas identified during ENG's recent strategic-planning process. These are: *Biology in Engineering,* which covers research at the critical interface between engineered and biological systems; *Complexity in Engineered and Natural Systems,* where a system yields unexpected, emergent properties; *Critical Infrastructure Systems,* which encompasses research on how our national infrastructures can withstand threats and meet future demands; *Manufacturing Frontiers,* where device innovations help ensure U.S. leadership in a global marketplace; and *New Frontiers in Nanotechnology,* which applies our current fundamental knowledge of the nanoscale in new and innovative directions.

These frontier research areas will guide the decision-making process throughout the ENG Directorate, but specifically within the Office of Emerging Frontiers in Research and Innovation. The EFRI Office will identify and prioritize emerging frontier areas of research and education, and provide resources for pursing these priorities.

Changes from FY 2006: The major change for FY 2007 is the creation of the Office of Emerging Frontiers for Research and Innovation within the Engineering Directorate. A portion of the overall ENG increase combined with reallocations from the ENG Divisions provide the funding for EFRI.