Engineering at the NSF

Scott F. Midkiff (smidkiff@nsf.gov)
Electrical, Communications and Cyber Systems Division
Directorate for Engineering
National Science Foundation

NSF Regional Grants Conference
Portland, Oregon ■ October 22-23, 2007

Topics

- **National Trends**
- NSF and Engineering (ENG) Trends
- ENG Organization (Core Programs)
- Funding Opportunities
- Getting Started

America COMPETES

- America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science Act was passed in August 2007 by Congress and signed by President Bush
- The Act states: “support and promote innovation research in the United States through high-risk, high-reward projects that meet fundamental scientific and technological challenges, involve multidisciplinary work, and involve a high degree of novelty”

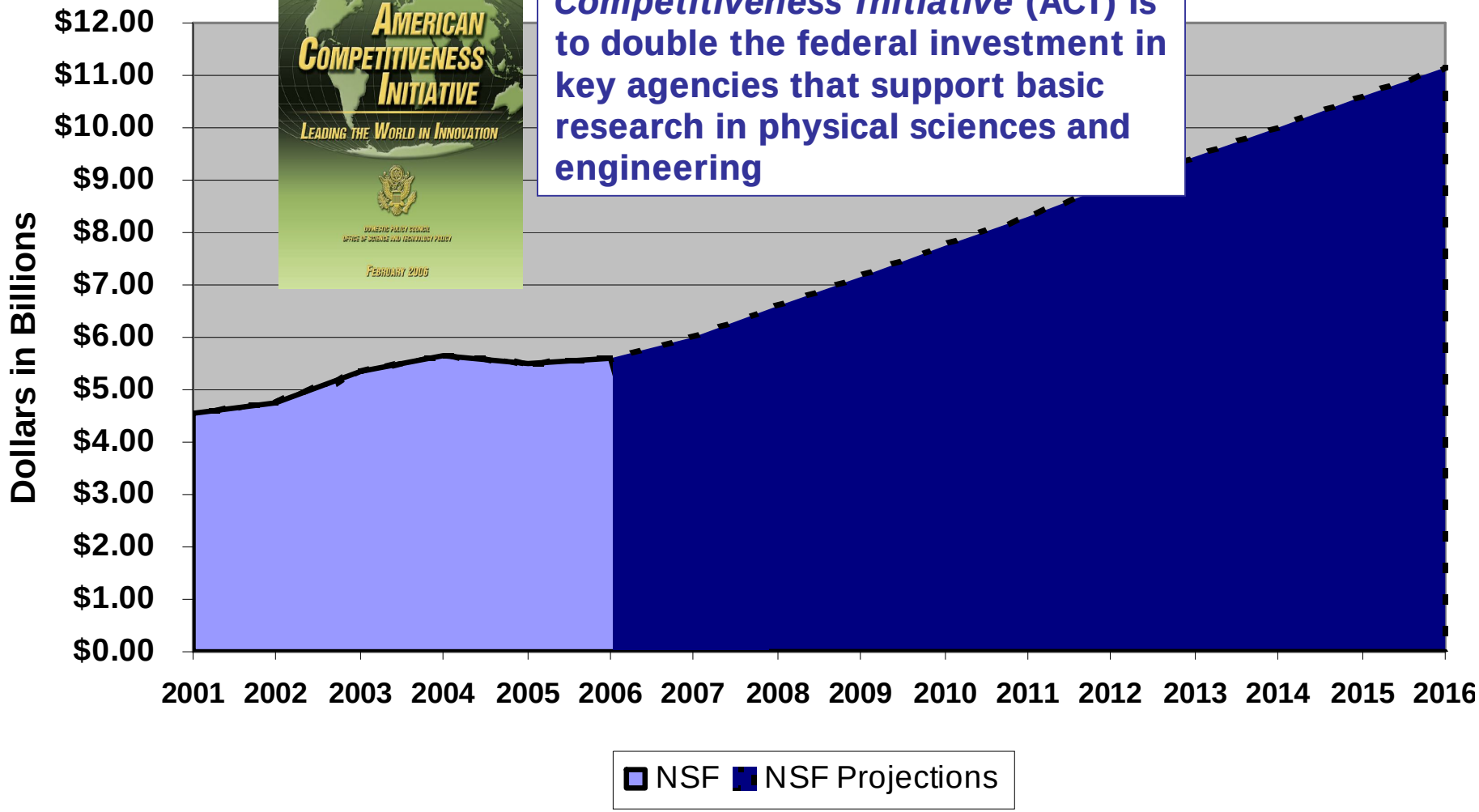
Education plays a significant role in America COMPETES. Pictured are two students at the University of Texas-El Paso. *Zubia, 0521650.*

America COMPETES

- Authorizes funding that would increase the NSF budget by 20 percent between FY 2007 and FY 2009
  - Authorizes $115M for Major Research Instrumentation program in FY 2008 and $123.1M for FY 2009
- Calls on NSF to give priority in selecting awards that meet “critical national needs” in innovation, competitiveness, safety and security, physical and natural sciences, technology, engineering, social science and mathematics

ACI-Driven NSF Budget Projections

The centerpiece of the *American Competitiveness Initiative* (ACI) is to double the federal investment in key agencies that support basic research in physical sciences and engineering



FY 2006 through FY 2016 budgets are estimates based on White House data

Topics

- National Trends
- **NSF and Engineering (ENG) Trends**
- ENG Organization (Core Programs)
- Funding Opportunities
- Getting Started

NSF Budget by Research Directorate

Directorate	FY 2006 Actual	FY 2007 Plan	FY 2008 Request	FY 2008 Request			
				Change over FY 2006 Actual		Change over FY 2007 Request	
				Amt	%	Amt	%
BIO	$580.90	$607.85	$633.00	$52.10	9.0%	$25.15	4.1%
CISE	$496.35	526.69	574.00	77.65	15.6%	47.31	9.0%
ENG *(less SBIR/STTR)*	$486.01	519.67	566.89	80.50	16.6%	47.22	9.1%
SBIR/STTR	$99.45	108.88	116.41	17.34	17.5%	7.53	6.9%
GEO	$703.95	744.85	792.00	88.05	12.5%	47.15	6.3%
MPS	$1,086.61	1,150.30	1,253.00	166.39	15.3%	102.70	8.9%
SBE	$201.23	213.76	222.00	20.78	10.3%	8.24	3.9%
OCI	$127.14	182.42	200.00	72.86	57.3%	17.58	9.6%
OISE	$42.61	40.61	45.00	2.39	5.6%	4.39	10.8%
OPP	$390.54	438.10	464.90	74.37	19.0%	26.80	6.1%
IA	$233.30	231.37	263.00	29.70	12.7%	31.63	13.7%
U.S. Arctic Research Commission	$1.17	$1.45	$1.49	0.32	27.4%	0.04	2.8%
Research & Related Activities	$4,449.25	$4,765.95	$5,131.69	$682.44	15.3%	$365.74	7.7%

Dollars in millions

ENG FY 2008 Budget Request

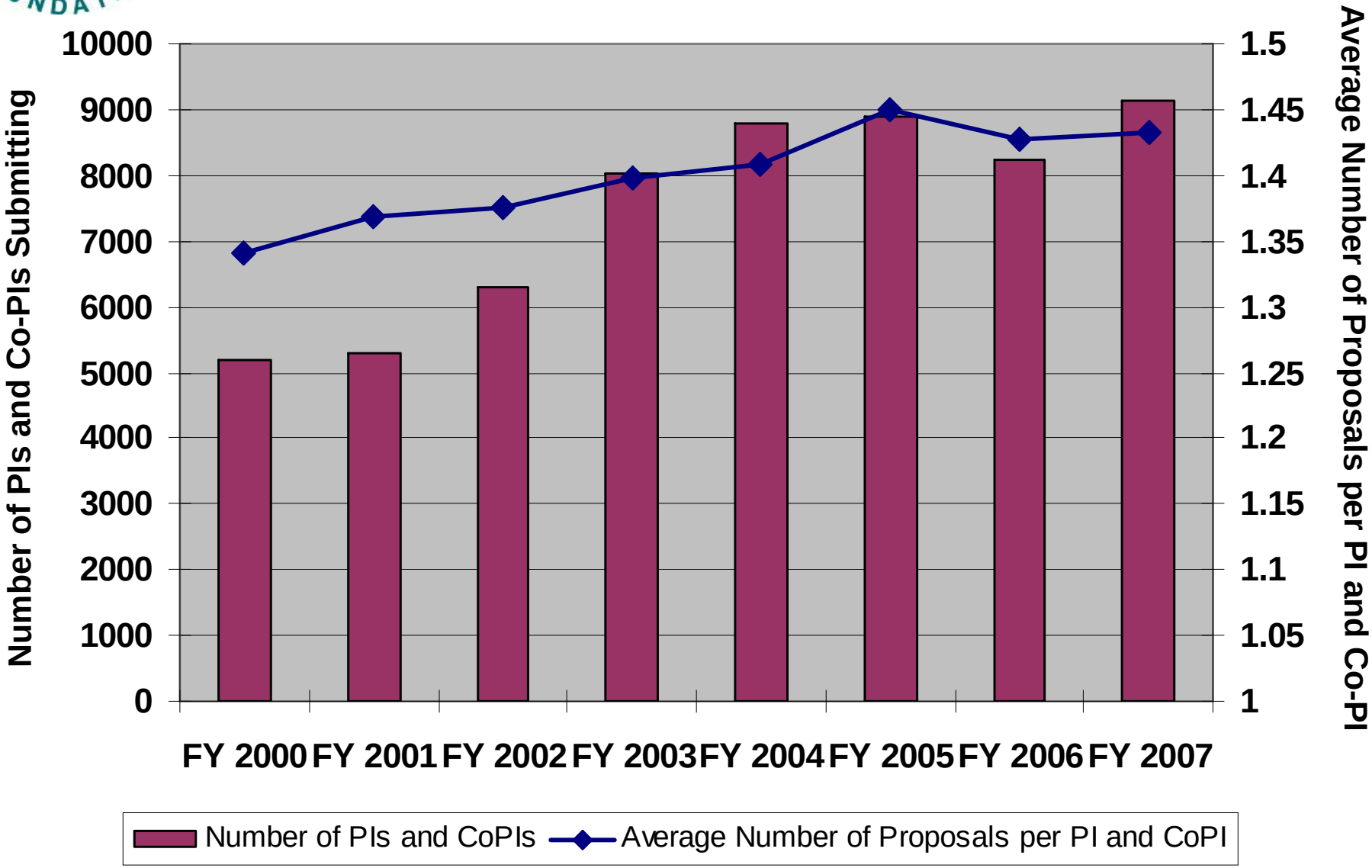
Dollars in Millions

	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Change over FY 2007 Request	
				Amt	%
CBET	**$125.09**	**$124.44**	**$144.97**	**$20.53**	**16.5%**
CMMI	**148.82**	**152.16**	**174.08**	**21.92**	**14.4%**
ECCS	**77.91**	**80.90**	**93.96**	**13.06**	**16.1%**
IIP	**109.65**	**120.08**	**128.39**	**8.31**	**6.9%**
Small Business Innovation Research (SBIR)	***99.45***	***108.88***	***116.41***	**7.53**	**6.9%**
EEC	**123.99**	**125.97**	**116.90**	**-9.07**	**-7.2%**
EFRI	**-**	**25.00**	**25.00**	**-**	**-**
Total, ENG	**$585.46**	**$628.55**	**$683.30**	**$54.75**	**8.7%**

(Amounts may not add due to rounding)

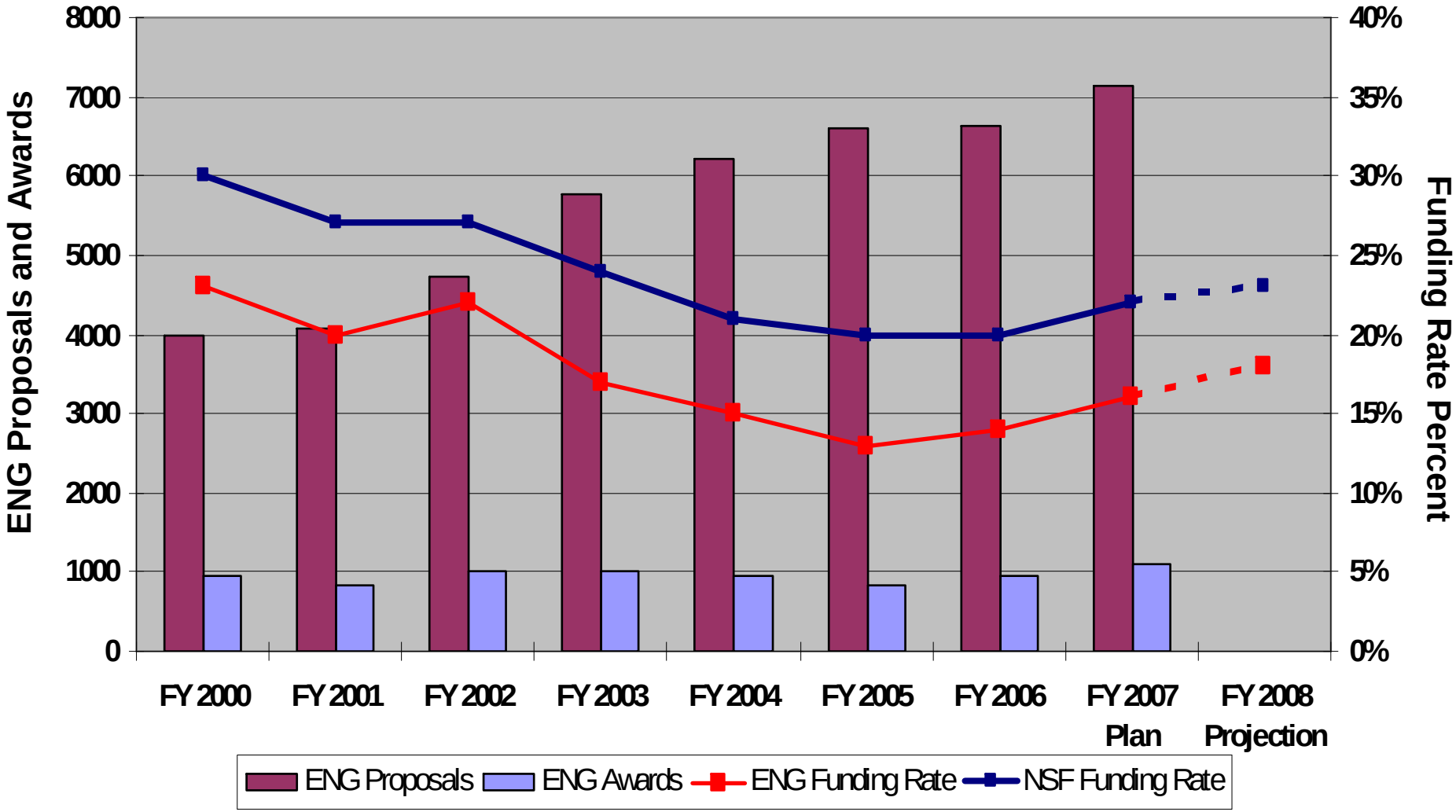
PI and Co-PI Submissions

ENG Research Grants



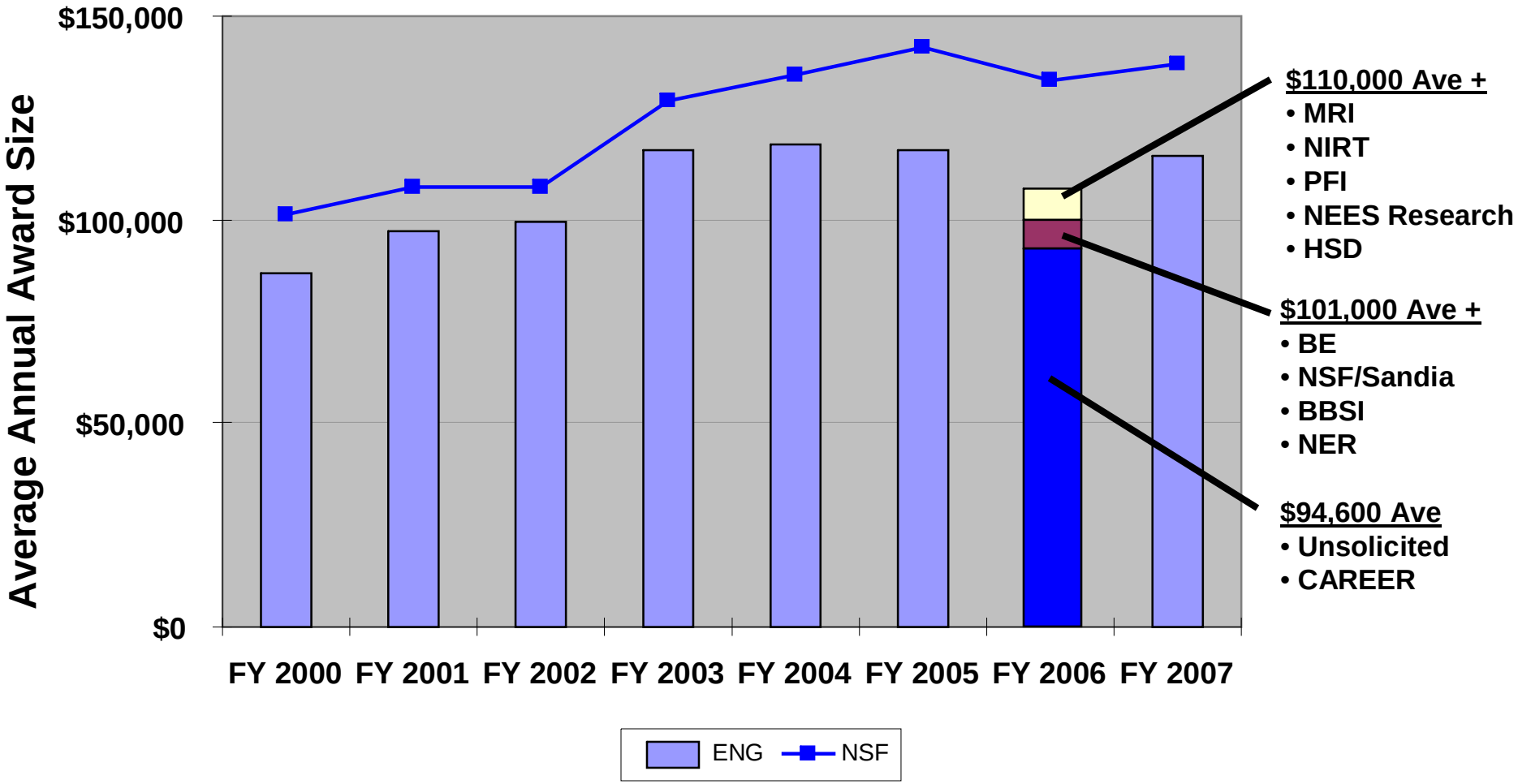
ENG and NSF Funding Rates

Research Grants



Annual Award Size

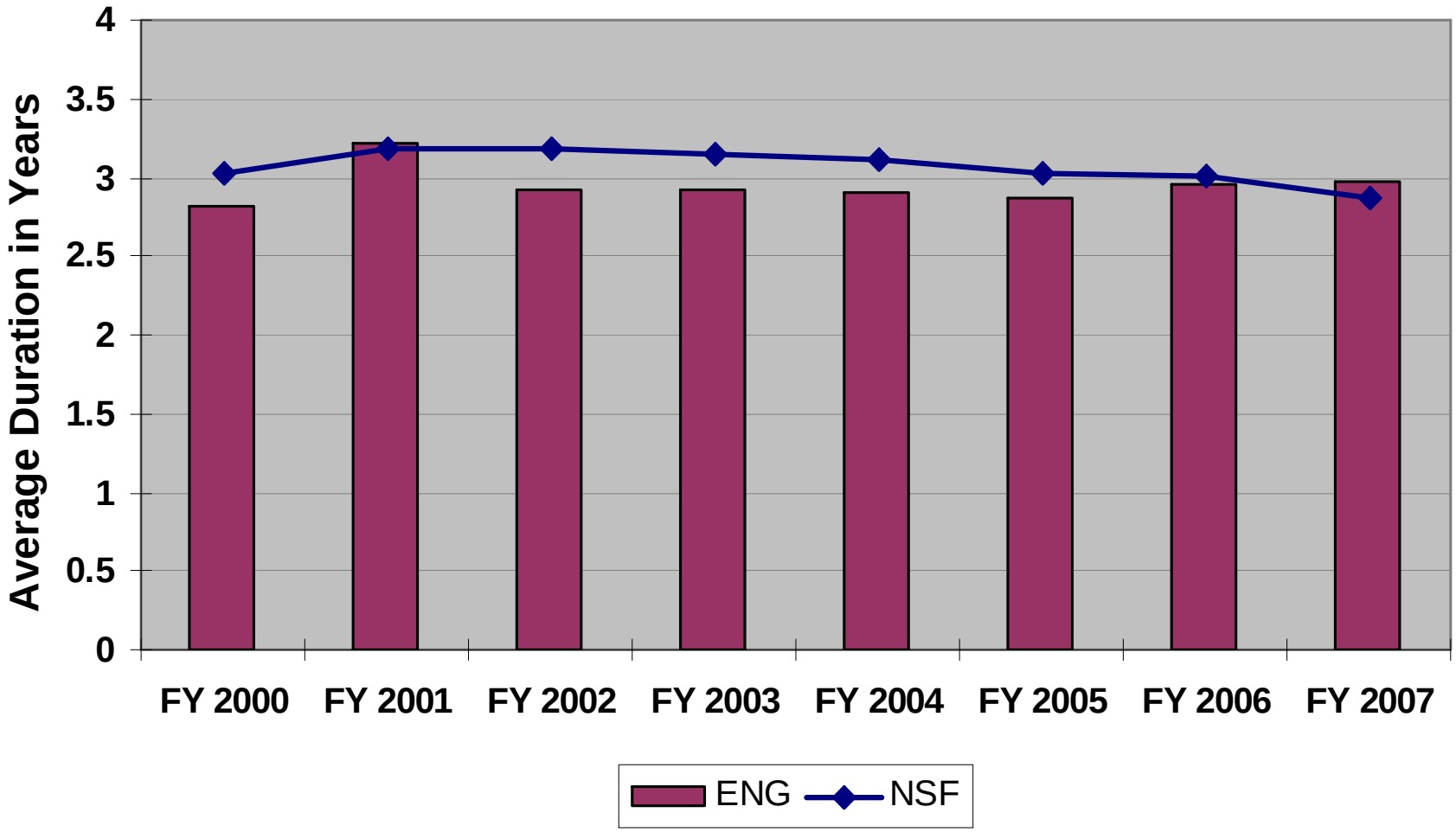
Averages for ENG Research Awards



Award size data annualized

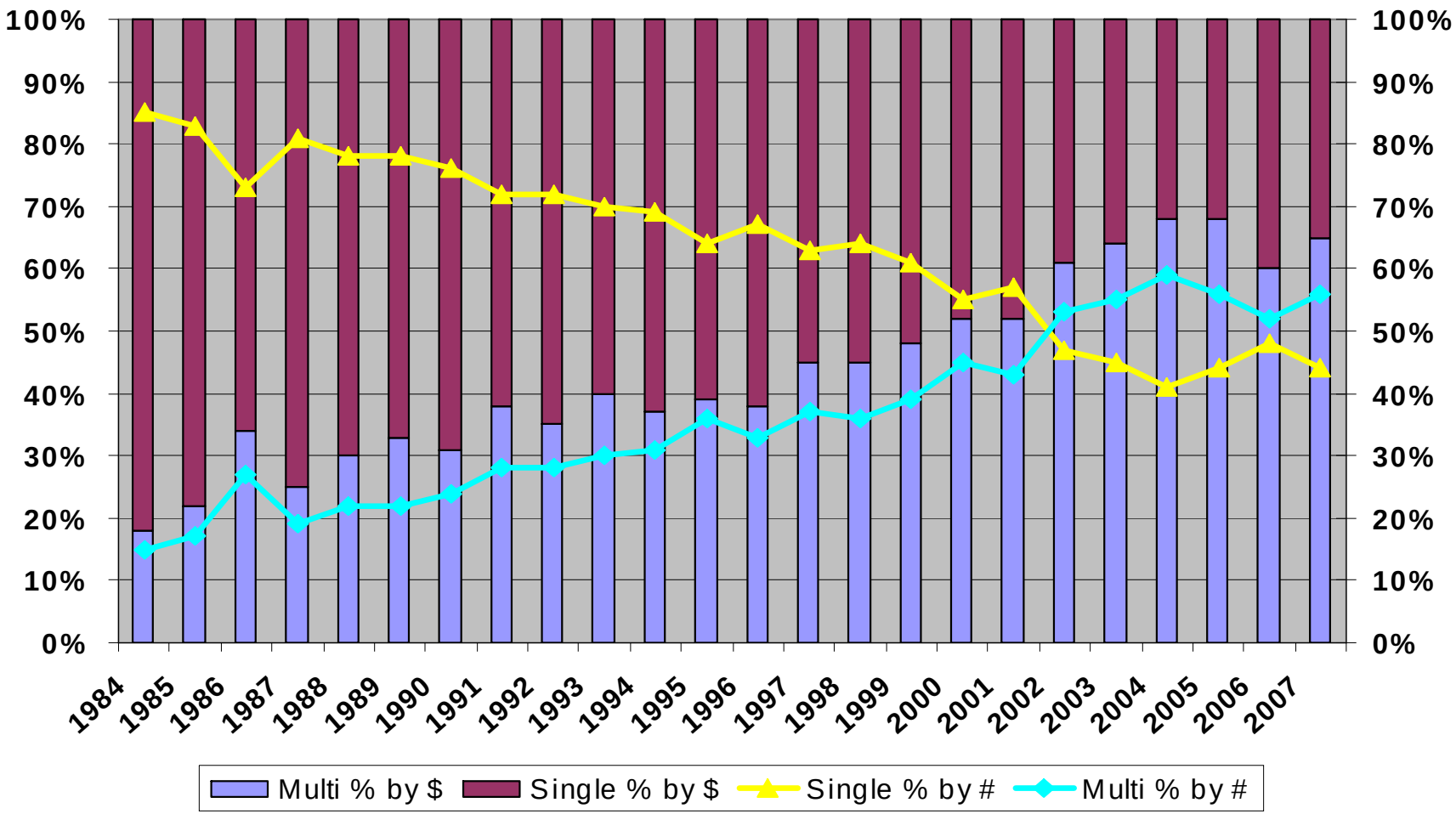
Average Award Duration in Years

ENG Research Grants in Comparison to NSF



ENG Research Collaborations

Percent of Single PI vs. Multiple Investigator Awards

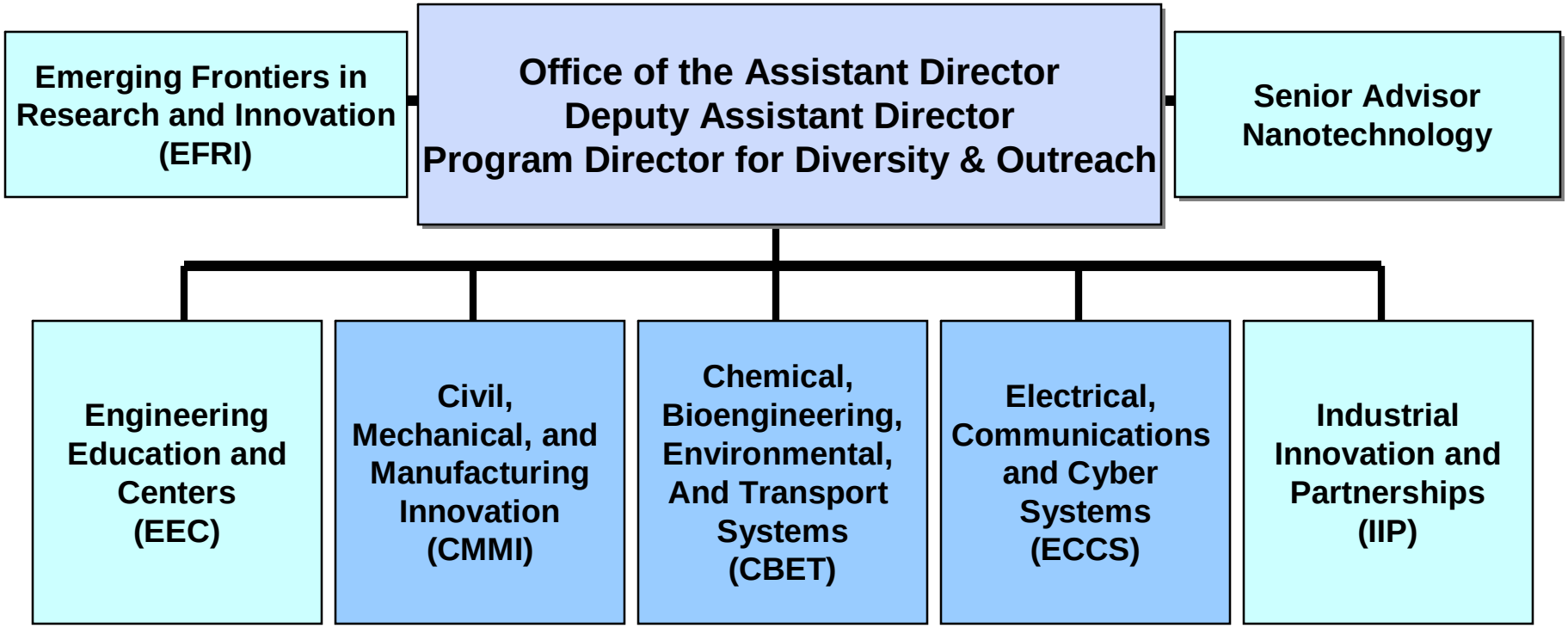


Topics

- National Trends
- NSF and Engineering (ENG) Trends
- **ENG Organization (Core Programs)**
- Funding Opportunities
- Getting Started

Directorate for Engineering

FY 2008



Assistant Director: Richard Buckius
Deputy Assistant Director: Michael Reischman
Program Director for Diversity & Outreach: Mary Juhas
Senior Advisor for Nanotechnology: Mihail Roco

Chemical, Bioengineering, Environmental, and Transport Systems (CBET)

Deputy Division Director
Bob Wellek

Division Director
Judy Raper

Senior Advisor
Marshall Lih

Chemical, Biochemical, and Biotechnology Systems

- **Process and Reaction Engineering** — Maria Burka
- **Catalysis and Biocatalysis** — John Regalbuto
- **Biotechnology** — Fred Heineken
- **Chemical and Biological Separations** — Rose Wesson

Transport and Thermal Fluids

- **Thermal Transport Processes** — Pat Phelan
- **Interfacial Processes And Thermodynamics** — Bob Wellek
- **Particulate and Multiphase Processes** — Marc Ingber
- **Fluid Dynamics** — Bill Schultz
- **Combustion, Fire, and Plasma Systems** — Phil Westmoreland

Biomedical Engineering and Engineering Healthcare

- **Research to Aid Persons With Disabilities** — Bob Jaeger
- **Biomedical Engineering** — Semahat Demir
- **Advanced Imaging and Sensing For Human Health** — Leon Esterowitz

Environmental Engineering and Sustainability

- **Environmental Engineering** — Vacant
- **Environmental Technology** — Cindy Ekstein
- **Energy for Sustainability** — Trung Van Nguyen
- **Environmental Sustainability** — Bruce Hamilton

Civil, Mechanical, and Manufacturing Innovation (CMMI)

Division Director
Adnan Akay
Deputy Director
George Hazelrigg

Engineering Infrastructure Systems

- **Geoenvironmental and Geohazard Mitigation**
  Richard Fragaszy
- **Information Technology And Infrastructure Systems**
  Vacant
- **Infrastructure Systems Management and Hazard Response**
  Dennis Wenger
- **Manufacturing Machines and Equipment**
  George Hazelrigg
- **Network for Earthquake Engineering Simulation Research**
  Joy Pauschke
- **Structural Systems and Hazard Mitigation of Structures**
  M. P. Singh

Materials Transformation and Mechanics

- **Geomechanics and Geotechnical Systems**
  Richard Fragaszy
- **Infrastructure Material And Structural Mechanics**
  Vacant
- **Materials Processing and Manufacturing**
  Joycelynn Harrison
- **Mechanics and Structures of Materials**
  Ken Chong
- **Nano/Bio Mechanics**
  Vacant
- **NanoManufacturing**
  Vacant
- **Materials Design and Surface Engineering**
  Clark Cooper

Innovation Sciences and Decision Engineering

- **Control Systems**
  Suhada Jaya-Suriya
- **Dynamic Systems**
  Edward Misawa
- **Engineering Design**
  Judy Vance
- **Manufacturing Enterprise Systems**
  Cerry Klein
- **Operations Research**
  Stephen Nash
- **Service Enterprise Engineering**
  Cerry Klein
- **Sensor Innovation and Systems**
  Shih Chi Liu

Electrical, Communications and Cyber Systems (ECCS)

Division Director
Usha Varshney

Senior Advisor
Lawrence Goldberg

Electronics, Photonics and Device Technologies

Optoelectronics; Nanophotonics; Ultrafast and Extreme Ultra-Violet Technologies
Rongqing Hui

Micro/Nanoelectronics; Bioelectronics; NEMS/MEMS; Sensors
Rajinder Khosla

Micro/Nanoelectronics; Molecular Electronics; Spin Electronics; Organic Electronics; Micromagnetics; Power Electronics
Vacant

Power, Controls and Adaptive Networks

Embedded, Distributed and Adaptive Control; Sensing and Imaging Networks; Systems Theory; Telerobotics
Radhakisan Baheti

Power and Energy Systems and Networks; Interdependencies of Power and Energy on Critical Infrastructures; Power Drives; Renewable and Alternative Energy Sources
Dagmar Niebur

Adaptive Dynamic Programming; Neuromorphic Engineering; Quantum and Molecular Modeling and Simulations of Devices and Systems
Paul Werbos

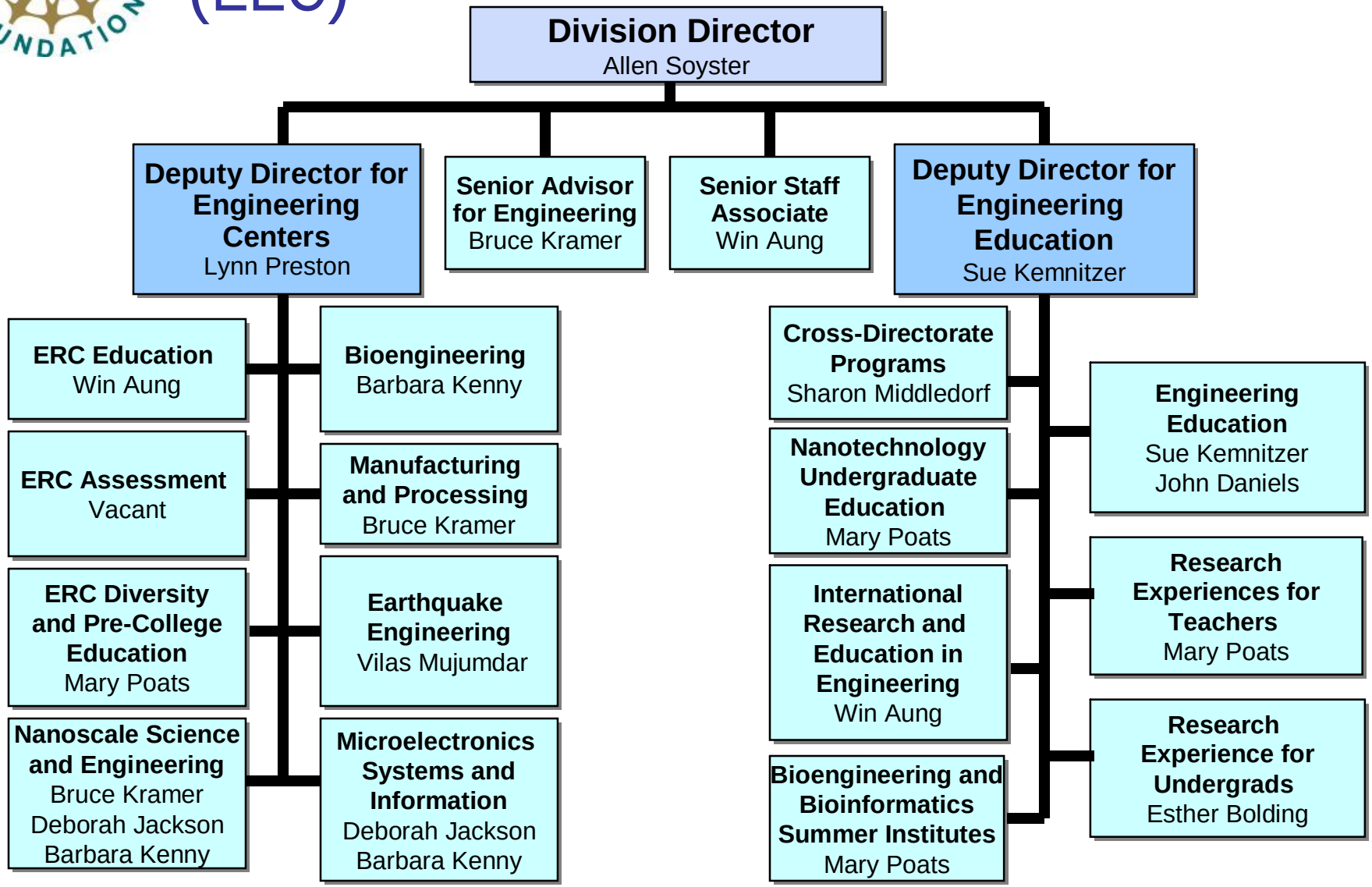
Integrative, Hybrid and Complex Systems

RF and Optical Wireless and Hybrid Communications Systems; Inter and Intra-chip Communications ; Mixed Signals
Vacant

Micro and Nano Systems; Systems-on-a-chip; System-in-a-Package; Diagnostic and Implantable Systems
Yogesh Gianchandani

Cyber Systems; Signal Processing
Scott Midkiff

Engineering Education and Centers (EEC)



Industrial Innovation and Partnerships (IIP)

Division Director
Kesh Narayanan

Senior Advisor
Joe Hennessey

Industry/University Cooperative Research Centers
Alex Schwarzkopf
Edward Clancy
Glenn Larsen

- **Advanced Electronics**
- **Advanced Manufacturing**
- **Advanced Materials**
- **Biotechnology**
- **Civil Infrastructure Systems**
- **Energy and the Environment**
- **Fabrication and Processing Technology**
- **Health and Safety**
- **Information and Communications**
- **Quality, Reliability and Maintenance**
- **System Design and Simulation**

Grant Opportunities for Academic Liaison with Industry
Donald Senich

Partnerships for Innovation
Sara Nerlove

Office of Industrial Innovation SBIR/STTR

- **Advanced Materials, Manufacturing, and Chemical Technology**
  Cheryl Albus, Deepak Bhat, Rathindra DasGupta
- **Biotechnology**
  Thomas Allnutt, Ali Andalibi, George Vermont
- **Electronics**
  Juan Figueroa, Murali Nair, William Haines, James Rudd
- **Information Technology**
  Errol Arkilic, Ian Bennett
- **Special Topics**
  Bob Norwood

Emerging Frontiers in Research and Innovations (EFRI) Office

- EFRI will support higher risk, higher payoff opportunities leading to:
  - New research areas for NSF, ENG, and other agencies
  - New industries/capabilities resulting in a leadership position
  - Significant progress on advancing a “grand challenge”
- Successful topics would likely require:
  - Small- to medium-sized interdisciplinary teams
  - The necessary time to demonstrate substantial progress and evidence for follow-on funding through other established mechanisms
- The current investment for EFRI totals $25 million for 4 year awards at $500k per year

EFRI Office

Office Director
Sohi Rastegar

FY 07
Auto-Reconfigurable Engineered Systems (ARES)

FY 08
Cognitive Optimization and Prediction (COPN)
Understanding subsymbolic intelligence can lead to the development of new designs and algorithms for optimal decision making and prediction in engineered systems

ENG Programs and Divisions Define Topics & Teams

FY 07
Cellular and Biomolecular Engineering (CBE)

FY 08
Resilient and Sustainable Infrastructures (RESIN)
Design, renew, expand, monitor, and control critical interdependent infrastructures to be both resilient and sustainable

Topics

- National Trends
- NSF and Engineering (ENG) Trends
- ENG Organization (Core Programs)
- **Funding Opportunities**
- Getting Started

Environmental Sustainability

CBET

Environmental Sustainability
Bruce Hamilton

- Supports engineering research with the goal of promoting sustainable engineered systems that support human well-being and that also are compatible with sustaining natural (environmental) systems, which provide ecological services vital for human survival
- Two submission windows each year – September 15, 2007 and March 1, 2008
- 48 proposal received in one window in FY 2007
- Areas supported include:
  - Green Engineering
  - Ecological Engineering
  - Industrial Ecology
  - Earth Systems Engineering
  - Other

Energy for Sustainability

CBET

Energy for Sustainability
Trung Van Nguyen

- Supports fundamental research and education in the areas of
  - Energy production, conversion, and storage, and
  - Focused on energy sources that are environmentally friendly and renewable
- Two submission windows each year – September 15, 2007 and March 1, 2008
- 190 proposals reviewed in FY 2007
- Areas supported include:
  - Fuel Cells
  - Hydrogen storage
  - Bio-related
  - Others – solar-related, renewable energy sources, wind

Cyber Systems

ECCS

Cybersystems
Scott Midkiff

- Supports fundamental research that integrates physical devices with distributed sensing and actuation, communications, storage, computation and control of complex systems that enables visualization, analysis and reconfiguration for reliable and agile infrastructures for domain-specific applications
- Two submission windows each year – October 7, 2007 and February 7, 2008
- 63 proposals reviewed in FY 2007
- Areas supported include
  - Hybrid and integrative networks
  - Integrated signal processing for high-performance computing and networking, and
  - New algorithms and architectures for secure and robust computing

Cyber-Enabled Discovery & Innovation (CDI)

- Employ advances in computational concepts, methods, models, algorithms, and tools (computational thinking) for revolutionary science and for generating and applying new knowledge
- CDI seeks ambitious, transformative, multidisciplinary research proposals within or across the following three thematic areas:
  - From Data to Knowledge: enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data
  - Understanding Complexity in Natural, Built, and Social Systems: deriving fundamental insights on systems comprising multiple interacting elements
  - Building Virtual Organizations: enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries

Cyber-Enabled Discovery & Innovation (CDI)

- A competitive CDI proposal will:
  - Describe an ambitious research and/or education agenda that, through computational thinking, promises paradigm-shifting advances in more than one field of science or engineering
  - Provide a compelling rationale for how innovations in, and/or innovative use of, computational thinking will yield the desired project outcomes
  - Draw on productive intellectual partnerships that capitalize upon synergies of knowledge and expertise. These partnerships will cross multiple fields or sub-fields of science or engineering, and/or multiple types of organizations, including academic, for-profit, and not-for-profit entities, both foreign and domestic

CDI review criteria are fully compliant with the updated NSF review criteria, which can be found at http://www.nsf.gov/pubs/2007/in130/in130.jsp

National Nanotechnology Initiative (NNI) Funding Opportunities at NSF in FY 2008

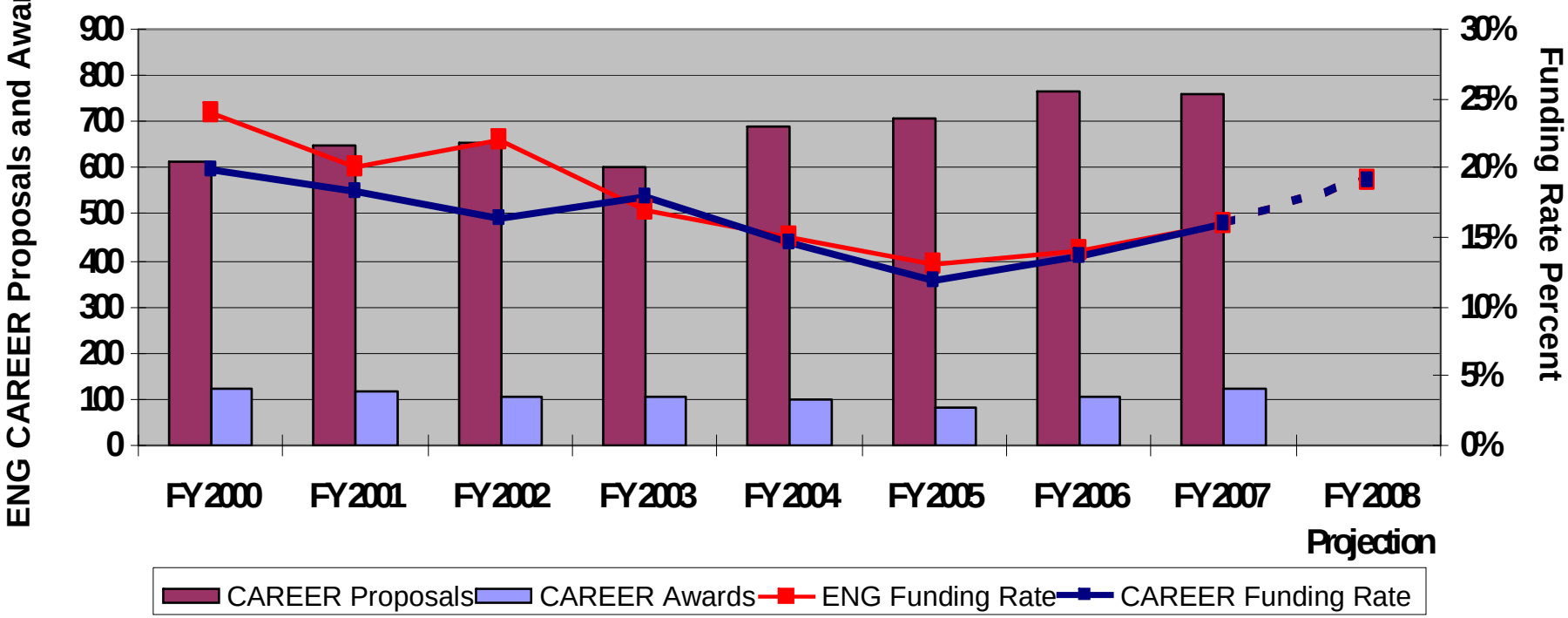
- NSF supports nanoscale science and engineering in FY 2008 through:
  - Competitive awards in existing (core) programs, including interdisciplinary team research proposals
  - Competitive awards via the FY 2008 “Center for the Environmental Implications of Nanotechnology (CEIN)” solicitation (NSF 07-590)
  - FY 2008 EPA-NSF-DOE research solicitation: “Nanotechnology Research Grants Investigating Fate, Transport, Transformation, and Exposure of Engineered Nanomaterials”
  - FY 2008 “NSF-SIA/NRI Graduate Student and Postdoctoral Fellow Supplements to NSF Centers in Nanoelectronics” (NSF 07-051)

http://www.nsf.gov/nano/

CAREER Awards

ENG CAREER Proposals and Awards

- Must have a well thought-out plan for integration of research and education, in addition to a significant research project
- ENG provides approximately 1/4 of all NSF CAREER awards



Solicitations of Potential Interest

- ADVANCE: Increasing the Participation of Women in Academic Science and Engineering Careers—NSF 07-582, Jan. 7, 2008 (Partnerships for Adaptation, Implementation and Dissemination, or PAID).
- ARI: Joint Domestic Nuclear Detection Office/National Science Foundation: Academic Research Initiative— 07-545, first Wednesday in April, annually through 2011
- BRIGE: Broadening Participation Research Initiation Grants in Engineering—07-589, Feb. 8, 2008
- CEIN: Center for the Environmental Implications of Nanotechnology—07-590, Prelim. Proposals; March 17, 2008
- CDI: Cyber-Enabled Discovery and Innovation—07-603, Letter of Intent Oct. 30, 2007–Nov. 30, 2007
- GOALI: Grant Opportunities for Academic Liaison with Industry—07-522
- RET and REU (Research Experiences for Teachers, Undergraduates)—07-557, 07-569, Nov. 19, 2007; June 6, 2008

GOALI

- GOALI mechanisms for building long-term relationships
  - Faculty and Students in industry
  - Industry Scientists and Engineers in Academe
  - Industry-University Collaborative Research Projects
- Industry-university collaborative research projects
  - Industry co-PI -- must present a real industry commitment
  - Detailed plan for industry-university collaboration, with a division of research tasks
  - Industry cost-sharing and technological relevance are essential evaluation criteria
  - Proprietary issues – agreement on intellectual property is required
  - Dissemination plan

Topics

- National Trends
- NSF and Engineering (ENG) Trends
- ENG Organization (Core Programs)
- Funding Opportunities
- **Getting Started**

Engaging with the NSF

- Web information
  - Funding opportunities – solicitations and descriptions
  - NSF staff contact information
  - Awards database
  - Policies and procedures
- Talk and/or visit with relevant NSF program directors
  - Plan your visit
- Volunteer for panels

http://www.nsf.gov/