Engineering at NSF: Priorities and Opportunities

A Presentation for Auburn University October 16, 2009

Michael M. Reischman
Deputy Assistant Director
Directorate for Engineering

Staff Offices

- Office of Management and Budget
- Science Advisor, Office of Science and Technology Policy
- Other Boards and Councils

Major Departments

- Homeland Security
- Agriculture
- Commerce
- Defense
- Energy
- Health and Human Services
- Interior
- Transportation

Independent Agencies

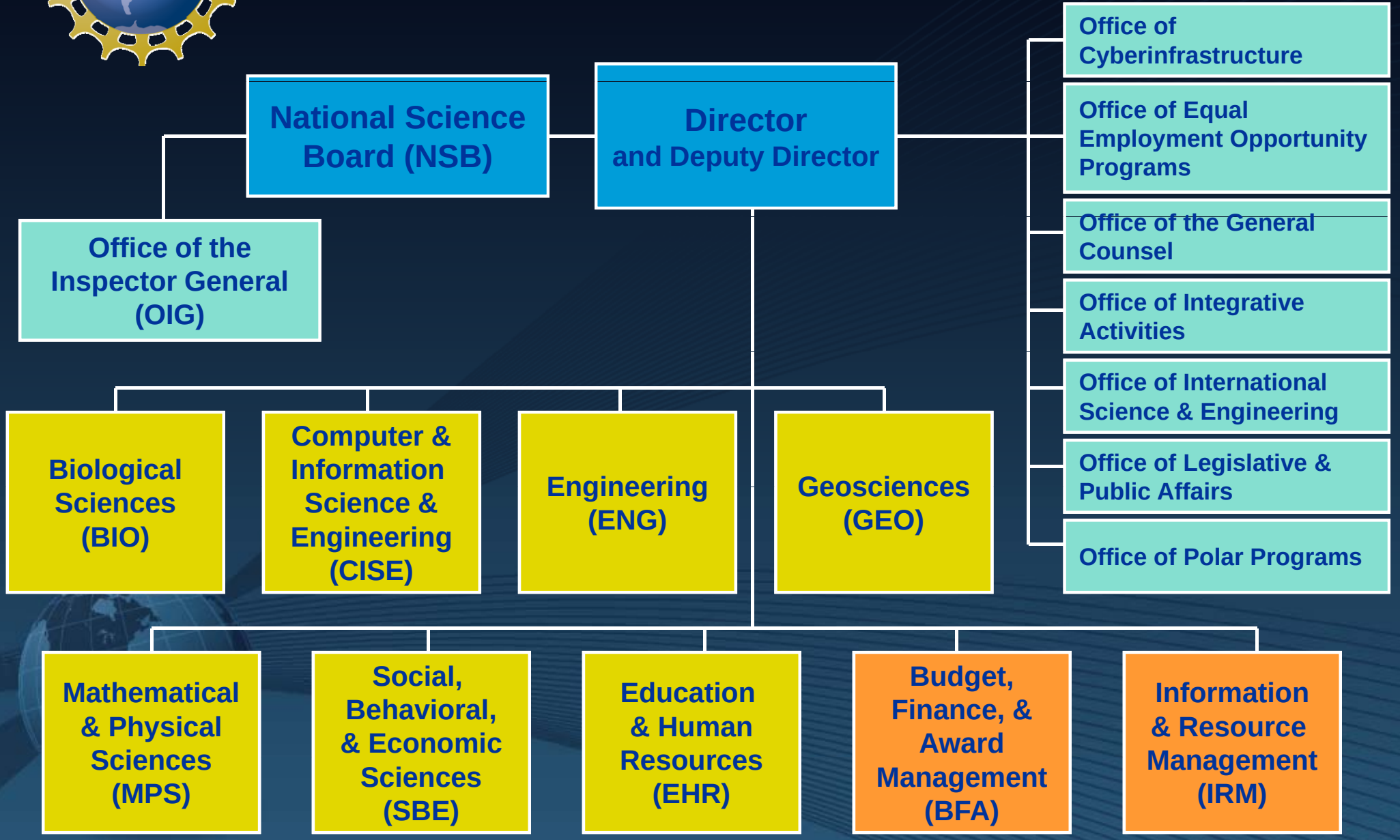
- National Science Foundation (NSF)
- National Aeronautic and Space Administration
- Environmental Protection Agency
- Nuclear Regulatory Commission
- Smithsonian Institution
- Other Agencies

NSF's Origin, Mission, and Goals

- Independent agency established in 1950 by NSF Act:

  "To Promote Progress of Science," and "Advance National Health, Prosperity, and Welfare," and "Secure the National Defense"
- Support basic research and education across science and engineering
- Uses grant mechanism
- Maintains low overhead and extensive automation
- Discipline-based structure with cross-disciplinary mechanisms
- Uses "rotators" or IPAs
- Works with the National Science Board

National Science Foundation



NSF Research and Related Activities

	FY 2008 Actual	FY 2009 Plan	FY 2009 ARRA	FY 2010 Request	Amount Change
Biological Sciences	$615.62	$655.81	$260.00	$733.00	77.19
Computer & Information Science & Engineering	535.26	573.74	235.00	633.00	59.26
Engineering (includes SBIR/STTR)	649.49	693.34	265.00	764.52	71.18
Geosciences	757.87	807.13	347.00	909.00	101.87
Mathematical & Physical Sciences	1,171.13	1,255.96	490.00	1380.00	124.04
Social, Behavioral & Economic Sciences	227.87	240.30	85.00	257.00	16.70
Office of Cyberinfrastructure	185.15	199.28	80.00	219.00	19.72
Office of International Science and Engineering	47.77	44.03	14.00	49.00	4.97
U.S. Polar Research Programs	447.13	470.67	174.00	516.00	45.33
Integrative Activities	214.48	241.34	550.00	271.12	29.78
Arctic Research Commission	1.47	1.50	0.00	1.60	0.10

Totals may not add due to rounding.

OSTP/OMB 2009 Research Challenges*

- **Innovation**
  - Applying science and technology strategies to drive economic recovery, job creation and economic growth
- **Energy**
  - Promoting innovative energy technologies to reduce dependence on energy imports and mitigate the impact of climate-change while creating green jobs and new businesses
- **Healthcare**
  - Applying biomedical science and IT to help Americans live longer, healthier lives while reducing health care costs
- **Security**
  - Assuring we have the technologies needed to protect our troops, citizens, and national interests, including those needed to verify arms control and nonproliferation agreements essential to our security

*See www.ostp.gov/html/M-09-27.pdf

OSTP/OMB 2009 Research Requirements*

- **Increased Research Productivity**
  - Increasing the productivity of our research institutions**,** including research universities and major public and private labs and research centers
- **STEM Education**
  - Strengthening science, technology, engineering, and math education at every level from pre-college to post-graduate to lifelong learning
- **Resilient Infrastructure**
  - Improving and protecting our information, communication, and transportation infrastructure, which is essential to our commerce, science, and security
- **Space Utilization**
  - Enhancing our capabilities in space, which are essential for communications, geopositioning, intelligence gathering, Earth observation, and national defense, as well for increasing our understanding of the universe and our place in it

*See www.ostp.gov/html/M-09-27.pdf

NAE Grand Challenges

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery

Developing ENG Themes

Ideas and Capabilities of Engineering Research Community (Advisory Committee, Workshops, PDs, PIs, NAE, other agencies)

National R&D Needs (OSTP, America COMPETES Act, ARRA, Obama/Biden S&I Plan)

ENG Research & Education Themes

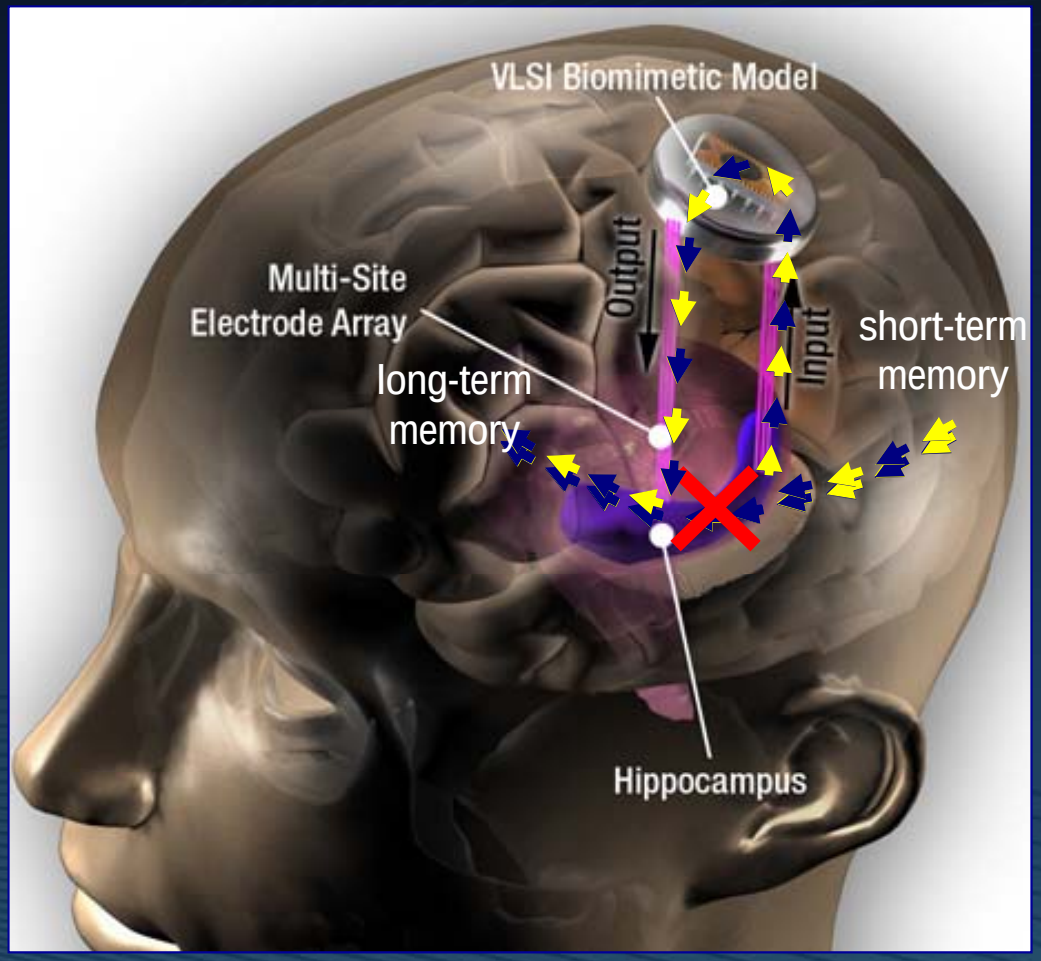
Financial Guidance (Office of Management and Budget)

ENG Research and Education Themes

- Cognitive engineering: Intersection of engineering and cognitive sciences
- Competitive manufacturing and service enterprises
- Complexity in natural and engineered systems
- Energy, water, and the environment
- Systems nanotechnology

Cognitive Engineering

- Invests in improving **understanding of the brain and nervous system** to enable the engineering of **novel systems and machines**
- Examples include:
  - Devices that augment the senses
  - Intelligent machines that analyze and adapt



A neural prosthesis restores cognitive function lost due to damage or degenerative disease.

Credit: Biomimetic MicroElectronic Systems ERC, University of Southern California

Competitive Manufacturing and Service Enterprises

- ENG enables research to catalyze and optimize **multi-scale manufacturing and service delivery**
- Examples include:
  - Achieving perfect atomic- and molecular-scale manufacturing
  - Understanding & optimizing decision-making in service industries

The time needed for vaccine design, production, and administration must all be balanced.

Credit: James Gathany, courtesy of CDC.

Complexity in Engineered and Natural Systems

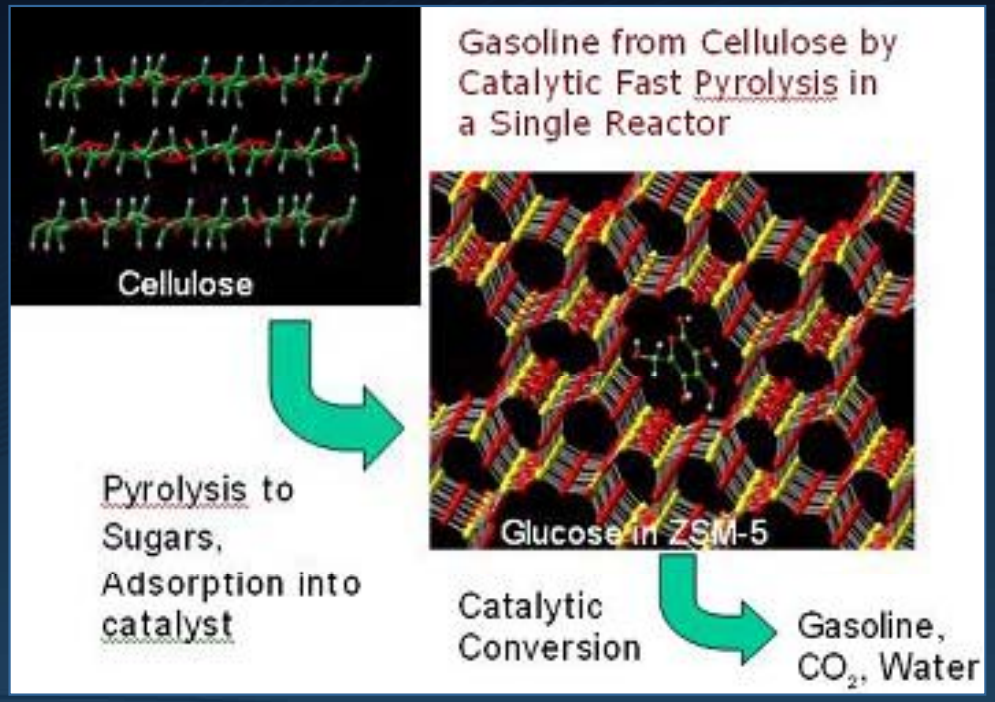
- Addresses unifying principles that enable **modeling, prediction, and control** of emergent behavior
- Examples include:
  - Improving structural performance during disasters through advanced materials
  - Advancing quantum information processing
  - Making infrastructure more resilient and sustainable

Design of sustainable distributed energy systems relies on modeling diverse waveforms.

Credit (T to B): Microsoft; Computational Science & Engineering, LLC

Energy, Water, and the Environment

- Biofuels
  - Catalysis
  - Synthetic biology

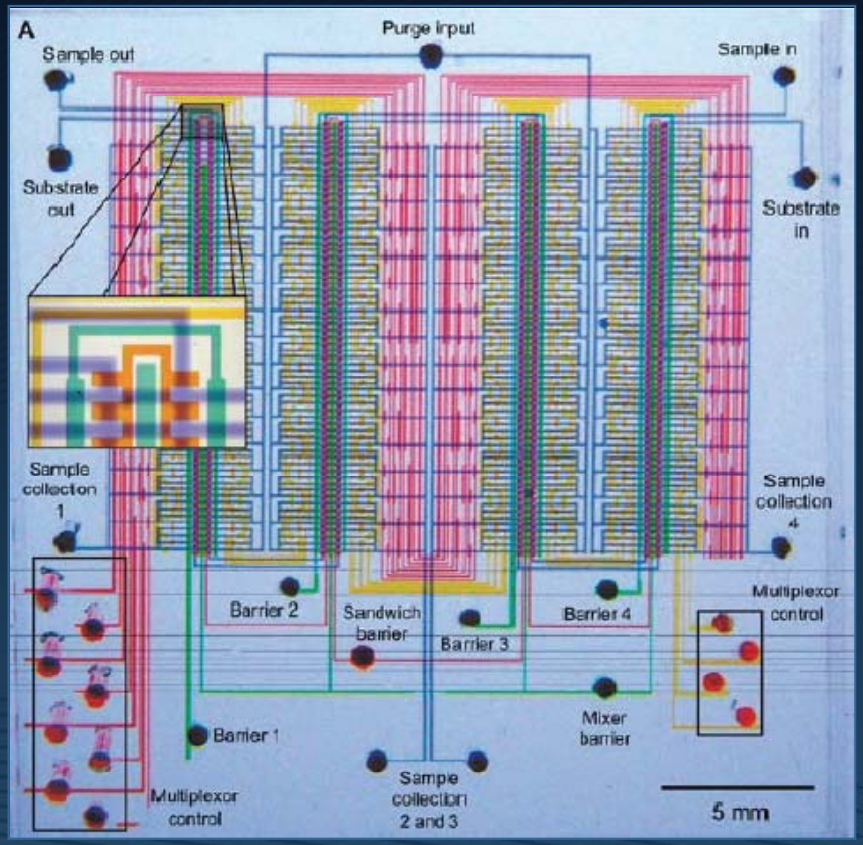


In one reactor, cellulose is broken up into sugar fragments which interact with a catalyst to become aromatic compounds used for gasoline.

Credits (L to R): DOE; George Huber, University of Massachusetts-Amherst.

Systems Nanotechnology

- ENG supports research to develop **active and complex nanosystems** and integrate them into:
  - Biology and medicine
  - Computing
  - Communications
  - Energy
- Examples include:
  - Nanomechanical systems for control and sensing
  - Smart tools for medical diagnosis and treatment



Integrated circuits that are smaller and faster are possible with microfluidics systems built from or incorporating nanocomponents. *Ferreira, 0328162.*

ENG Divisions

Dollars in Millions

Assistant Director
Dr. Thomas Peterson
Deputy Assistant Director
Dr. Michael Reischman
Program Officer for Diversity
Dr. Omnia El-Hakim

$764.52

Emerging Frontiers in Research and Innovation (EFRI)

$29.00

Senior Advisor for Nanotechnology

Program Director for Diversity & Outreach

Engineering Education and Centers (EEC)

$132.00

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

$160.11

Civil, Mechanical, and Manufacturing Innovation (CMMI)

$191.66

Electrical, Communications, and Cyber Systems (ECCS)

$95.75

Industrial Innovation and Partnerships (IIP)

$156.00

Funding Opportunities

- **Core programs**
- Exploratory research
- Collaborative/interdisciplinary areas
- Crosscutting and NSF-wide programs

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

Deputy Division Director
Bob Wellek

Division Director
John McGrath

Senior Advisor
Marshall Lih

Chemical, Biochemical, and Biotechnology Systems

- **Catalysis and Biocatalysis**
  George Antos
- **Chemical and Biological Separations**
  Rose Wesson
- **Process and Reaction Engineering**
  Maria Burka
- **Biotechnology, Biochemical, and Biomass Engineering**
  Vacant

Biomedical Engineering and Engineering Healthcare

- **Bioengineering, Interdisciplinary, and Centers**
  Aleksandr Simonian
- **Biomedical Engineering**
  Semahat Demir
- **Biophotonics, Advanced Imaging, and Sensing for Human Health**
  Leon Esterowitz
- **Research to Aid Persons with Disabilities**
  Ted Conway

Environmental Engineering and Sustainability

- **Energy for Sustainability**
  Gregg Rorrer
- **Environmental Engineering**
  Paul Bishop
- **Environmental Implications of Emerging Technologies**
  Cynthia Ekstein
- **Environmental Sustainability**
  Bruce Hamilton

Transport and Thermal Fluids

- **Thermal Transport Processes**
  Theodore Bergman
- **Interfacial Processes and Thermodynamics**
  Bob Wellek
- **Particulate and Multiphase Processes**
  Marc Ingber
- **Fluid Dynamics**
  Henning Winter
- **Combustion, Fire, and Plasma Systems**
  Theodore Bergman *

* Acting

CBET Areas of Interest

- **Chemical, biochemical, and biotechnology:** research on the processing and manufacture of products by effectively utilizing chemical and renewable resources, often with the aid of bioinformatics from genomic and proteomic information
- **Biomedical engineering and engineering healthcare:** research to develop novel projects that integrate engineering and life science to solve biomedical problems that serve humanity
- **Environmental engineering and sustainability:** research that aims to reduce adverse effects of solid, liquid, and gaseous discharges into land, water, and air that result from human activity and impair the ecological value of those resources
- **Transport and thermal fluids phenomena:** research on thermal, mass, and momentum transport that enable new technological solutions to understand pressing issues in energy, the environment, manufacturing, health care, and other fields
- Two submission deadlines per year: Sept. and Mar.

NSF/DOE Partnership in Basic Plasma Science and Engineering

- Focuses on **fundamental issues of plasma science and engineering that may impact other areas or disciplines** in which improved basic understanding of the plasma state is needed
  - Proposals should discuss effective ways in which education is integrated within the research programs
  - Proposals directly related to fusion energy studies are not eligible
- Full proposals **due in October through FY 2012**
- ~$15 M investment for 30–35 awards

ENG Contact
Ted Bergman
(acting)

Civil, Mechanical, and Manufacturing Innovation (CMMI)

Division Director
Steven McKnight
Deputy Director
George Hazelrigg

Interdisciplinary and Cross-Divisional Activities
Bruce Kramer

Advanced Manufacturing

- **Manufacturing and Construction Machines and Equipment**
  George Hazelrigg
- **Manufacturing Enterprise Systems**
  Cerry Klein
- **Material Processing and Manufacturing**
  Mary Toney
- **Nano Manufacturing**
  Shaochen Chen

Mechanics and Engineering Materials

- **Geomechanics and Geotechnical Systems**
  John Daniels
- **Materials and Surface Engineering**
  Clark Cooper
- **Mechanics of Materials**
  Glaucio Paulino
- **Nano/Bio Mechanics**
  Demitris Kouris
- **Structural Materials and Mechanics**
  Lawrence Bank

Resilient and Sustainable Infrastructures

- **Civil Infrastructure Systems**
  Dennis Wenger *
- **NEES**
  Joy Pauschke
- **Geotechnical Engineering**
  John Daniels
- **Hazard Mitigation and Structural Engineering**
  M.P. Singh
- **Infrastructure Mgmt. and Extreme Events**
  Dennis Wenger

* Acting

Systems Engineering and Design

- **Control Systems**
  Suhada Jayasuriya
- **Dynamical Systems**
  Eduardo Misawa
- **Engineering Design and Innovation**
  Christina Bloebaum
- **Operations Research**
  Robert Smith
- **Sensors and Sensing Systems**
  Shih Chi Liu
- **Service Enterprise Systems**
  Cerry Klein

CMMI Areas of Interest

- **Advanced manufacturing:** research leading to transformative advances in manufacturing and building technologies, with emphases on efficiency, economy, and sustainability
- **Mechanics and engineering materials:** research aimed at advances in the transformation and use of engineering materials efficiently, economically, and sustainably
- **Resilient and sustainable infrastructures:** research to advance fundamental knowledge and innovation for resilient and sustainable civil infrastructure and distributed infrastructure networks
- **Systems engineering and design:** research on the decision-making aspects of engineering, including design, control, and optimization
- Two submission deadlines each year: Oct. 1 and Feb. 15

George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Research

- NEES is a network of 15 earthquake engineering experimental equipment sites available for experimentation on-site or in the field
- Advances knowledge discovery and innovation for:
  - Earthquake and tsunami loss reduction of our nation's civil infrastructure
  - New experimental simulation techniques and instrumentation for NEES
- Submission deadline in March each year
- ~$7M investment for 8–12 awards

NEES
Joy Pauschke

Electrical, Communications, and Cyber Systems (ECCS)

Senior Engineering Advisor
Lawrence Goldberg

Division Director
Robert Trew

Electronics, Photonics, and Device Technologies

Optoelectronics; Nano-photonics; Ultrafast/Extreme Ultra-Violet Technologies
Eric Johnson

Micro/Nanoelectronics; NEMS/MEMS; Bioelectronics; Sensors
Samir El-Ghazaly

Molecular, Spin, Organic, and Flexible Electronics; Micro/Nanomagnetics; Power Electronics
Pradeep Fulay

Microwave Photonics; Millimeter, Sub-millimeter, and Terahertz Frequency Devices and Components
Usha Varshney

Integrative, Hybrid, and Complex Systems

Optical, Wireless, and Hybrid Communications Systems; Inter and Intra-chip Communications; Mixed Signals
Andreas Weisshaar

Micro and Nano Systems; Systems-on-a-chip; Diagnostic and Implantable Systems
Vacant

Cyber-Physical Systems; Next-Generation Cyber Systems; Signal Processing
Vacant

Power, Controls, and Adaptive Networks

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

Power and Energy Systems and Networks and their Inter-dependencies; Power Drives; Renewable/Alternative Energy Sources
Dagmar Niebur

Adaptive Dynamic Programming; Quantum and Molecular Modeling and Simulations; Neuromorphic Engineering
Paul Werbos / Pinaki Mazumder

ECCS Areas of Interest

Electronics, Photonics, and Device Technologies EPDT

- ✓Bioelectronics
- ✓Electromagnetics
- ✓Flexible Electronics
- ✓MEMS/NEMS
- ✓Micro/Nanoelectronics
- ✓Micro/Nanomagnetics
- ✓Microwave Photonics
- ✓Molecular Electronics
- ✓Nanophotonics
- ✓Optoelectronics
- ✓Power Electronics
- ✓Sensors and Actuators
- ✓Spin Electronics

Power, Controls, and Adaptive Networks PCAN

- ✓ Adaptive Dynamic Programming
- ✓ Alternate Energy Sources
- ✓ Embedded, Distributed and Adaptive Control
- ✓ Neuromorphic Engineering
- ✓ Power and Energy Systems and Networks
- ✓ Quantum and Molecular Modeling and Simulation of Devices and Systems
- ✓ Sensing and Imaging Networks
- ✓ Telerobotics

Integrative, Hybrid, and Complex Systems IHCS

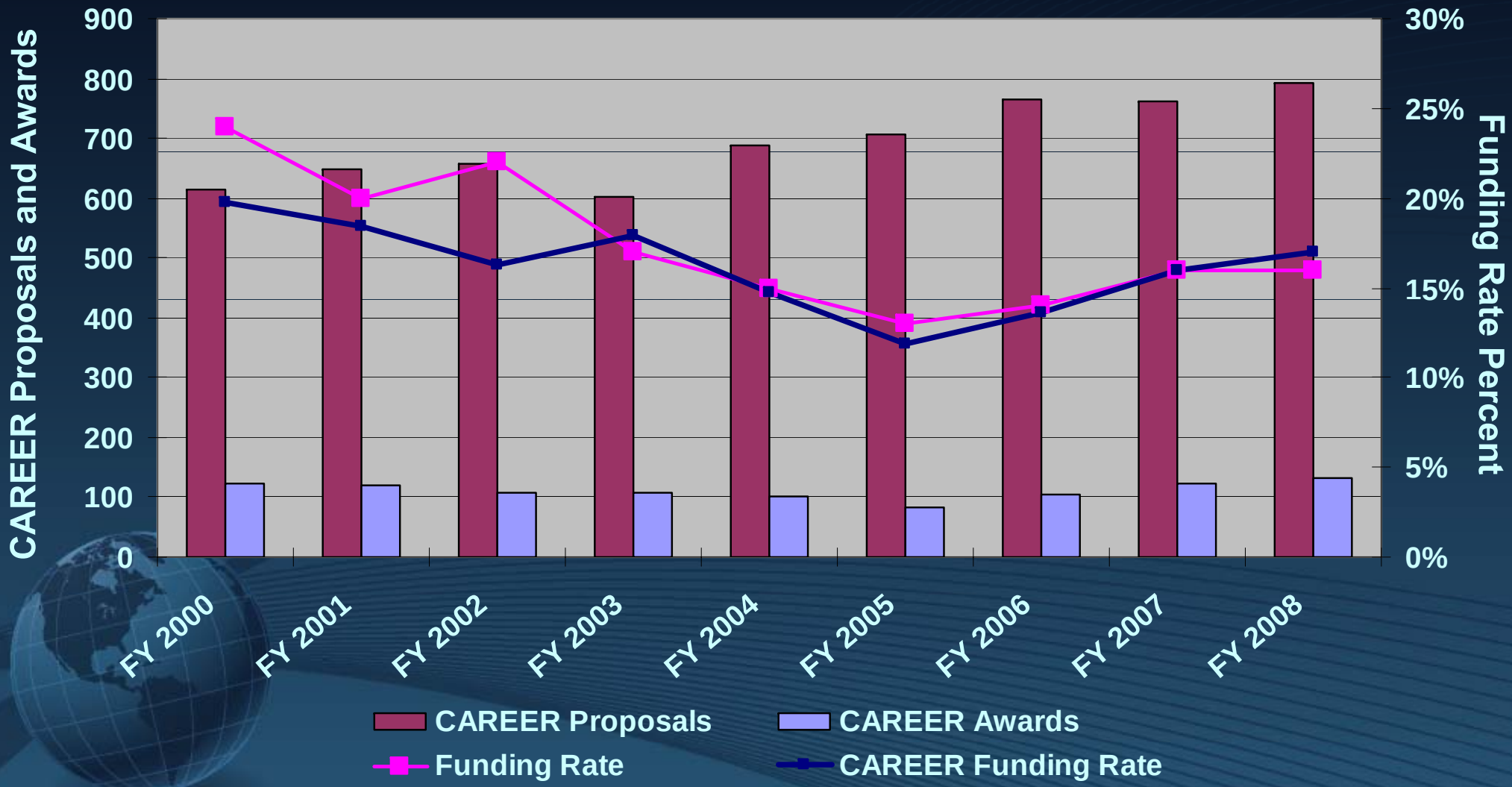
- ✓Nanosystems/Microsystems/ Macrosystems
- ✓Cyber Systems and Signal Processing
- ✓Nano and Microsystems
  - ✓System-on-a-chip
  - ✓System-in-a-package
- ✓RF and Optical Wireless and Hybrid Communications Systems
  - ✓Inter- and Intra-chip Communications
  - ✓Mixed Signals

Faculty Early Career Development (CAREER) Program

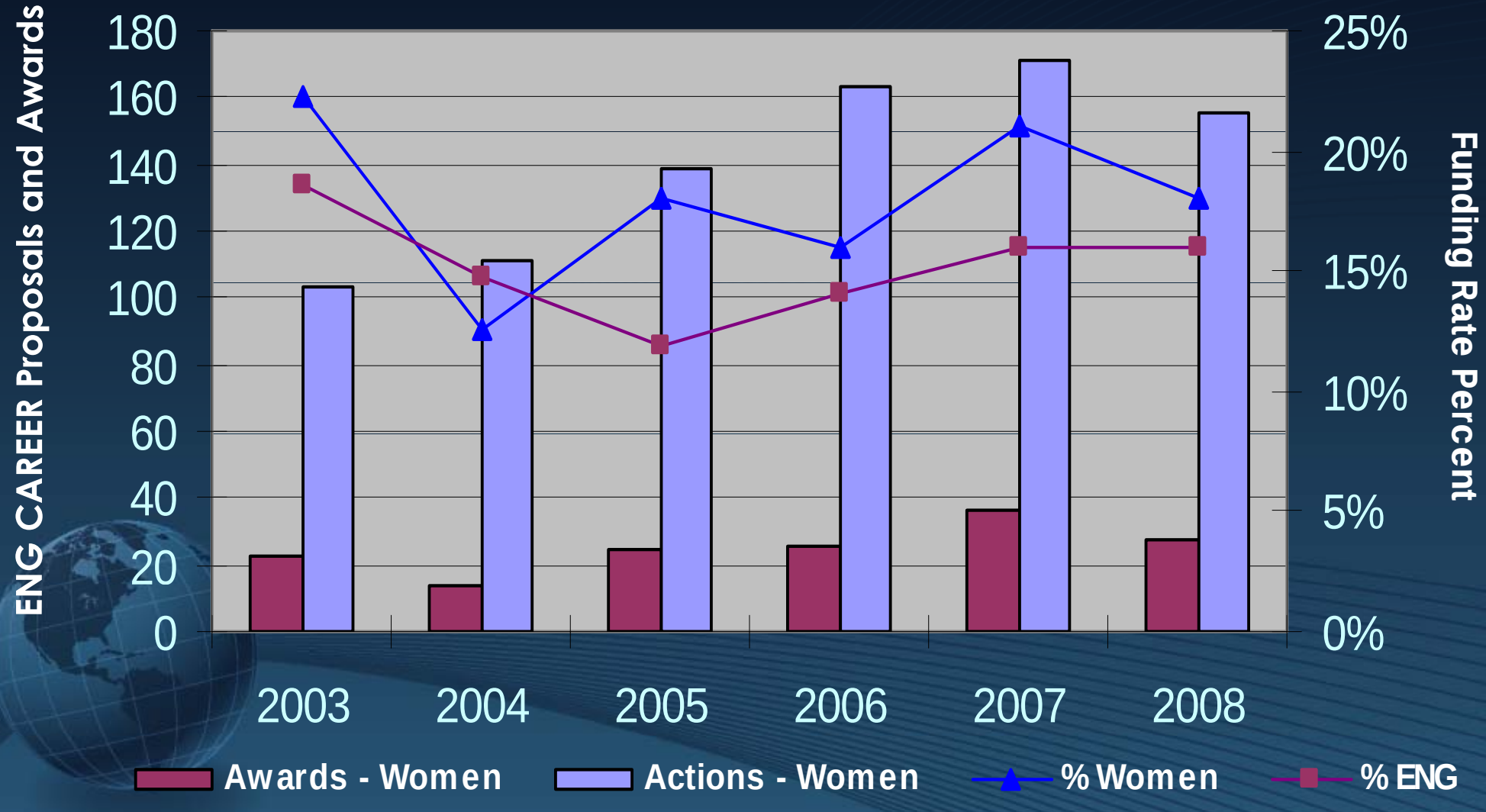
- Supports **junior faculty** who exemplify the role of **teacher-scholars** through
  - outstanding research
  - excellent education
  - integration of education and research
- Encourages women, members of under-represented minority groups, and persons with disabilities to apply
- $80M invested each year for **425 new awards**
- ENG awards are ≤**$400K for 5 years**
- Deadlines vary by directorate;
  ENG proposals due July 21, 2010

ENG Contact
Sharon Middledorf

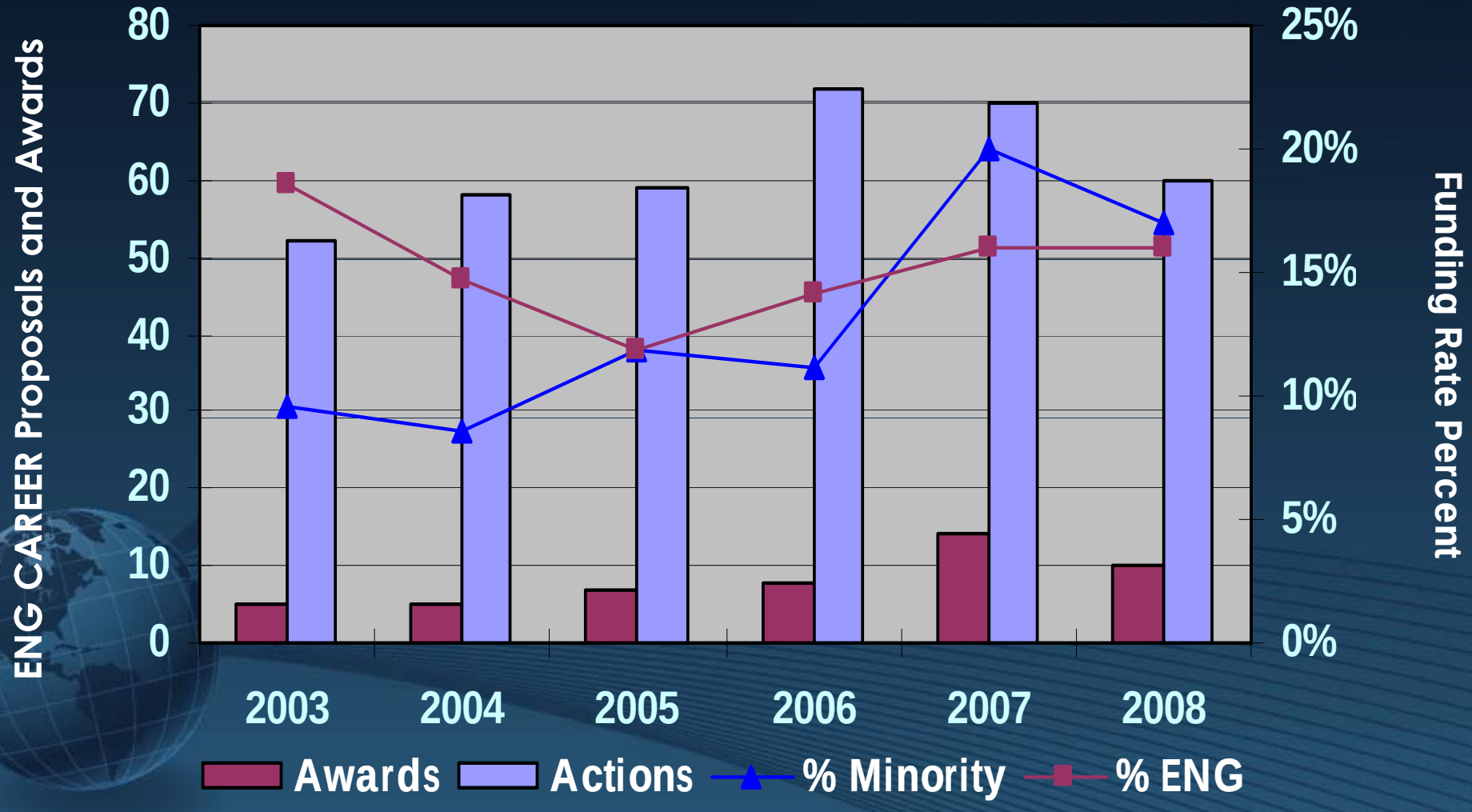
ENG CAREER Proposals and Awards



CAREER Funding Rates for Women and All ENG



CAREER Funding Rates for Under-Represented Minorities and All ENG



Broadening Participation

- Broadening Participation Research Initiation Grants in Engineering **(BRIGE)**
- **ADVANCE**: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers
- Graduate Research Fellowships for Women
- Graduate Research Supplements **(GRS)**

Broadening Participation Research Initiation Grants in Engineering (BRIGE)

- Funding opportunity intended to increase the diversity of researchers through research program support **early in their careers**
- Encourages support of under-represented groups, engineers at minority serving institutions, and persons with disabilities
- Up to $**175,000 over two years**
- Full proposals due **Feb. 14, 2010**

ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers

ADVANCE supports three types of activities:

- **Partnerships for Adaptation, Implementation, and Dissemination (PAID)**
  - the adaptation, implementation, dissemination, and diffusion of effective materials and practices; and to advance understanding of gender in the STEM academic workforce (PAID-Research)
  - Letters of Intent due Jan. 20, 2009; full proposals due Feb. 24, 2009
- **Institutional Transformation (IT)**
  - Systemic organizational approaches for **institution-wide change**
  - Letters of Intent due Aug. 4, 2009; full proposals due Nov. 12, 2009
- **Institutional Transformation Catalyst (IT-Catalyst)**
  - institutional **self-assessment activities** to identify specific issues in the recruitment, retention, and promotion of women faculty in STEM academics
  - Letters of Intent due Aug. 4, 2009; full proposals due Nov. 12, 2009

Funding Opportunities

- Core programs
- **Exploratory and urgent research**
- Collaborative/interdisciplinary areas
- Crosscutting and NSF-wide programs

Exploratory and Urgent Research

- Early-Concept Grants for Exploratory Research **(EAGER)**
- Grants for Rapid Response Research **(RAPID)**
- Emerging Frontiers in Research and Innovation **(EFRI)**

Early-Concept Grants for Exploratory Research (EAGER)

- Supports **high-risk, exploratory**, and potentially transformative research
- Began Jan. 1, 2009
- Up to **$300K over two years**
- May be **submitted any time**; contact program officer prior to proposal submission

Grants for Rapid Response Research (RAPID)

- Supports **research of great urgency** with regard to data, facilities, or equipment, such as research on disasters
- Up to **$200K over one year**
- May be **submitted any time**; contact program officer prior to proposal submission

Emerging Frontiers in Research and Innovation (EFRI)

- Supports **higher-risk, higher-payoff** opportunities that:
  - Are potentially **transformative**
  - Address a **national need or grand challenge**
- **Topic areas for FY 2010** are:
  - Science in Energy and Environmental Design (SEED): Engineering Sustainable Buildings
  - Renewable Energy Storage (RESTOR)
- $29M investment for **4-year awards at ~$500K per year**
- Letters of Intent due in Oct.; preliminary proposals due in Nov.; invited full proposals due in March
- EFRI Web site: www.nsf.gov/eng/efri

EFRI
Sohi Rastegar

Science in Energy and Environmental Design (SEED): Engineering Sustainable Buildings [Preliminary Ideas]

- To understand how to model and control, in real-time, the critical flows (e.g., energy, heat, water, light, sound, air and occupants) through building materials and building spaces.
- To understand how do to create new paradigms for designing, constructing, operating, maintaining, and retiring buildings that will minimize fossil fuel consumption and adverse environmental effects.
- To enable integrated multidisciplinary science, engineering and systems research in areas of (1) Materials and Sensing, (2) Modeling and Simulation, and (3) Concepts for Autonomy and Interdependence.

RENEWABLE ENERGY STORAGE (RESTOR) [Preliminary Ideas]

- To seek transformative research from fundamentals to systems to design large-scale storage for renewable sources, such as solar and wind.
- Fundamental breakthrough research for large scale storage:
  a) Employing new electrode materials capable of multi-electron transfer
  b) Transport and reaction mechanisms
  c) Interrelated mechanisms of electron and ion transfer influencing material decomposition and energy conversion processes

Funding Opportunities

- Core programs
- Exploratory research
- **Collaborative/interdisciplinary areas**
- Crosscutting and NSF-wide programs

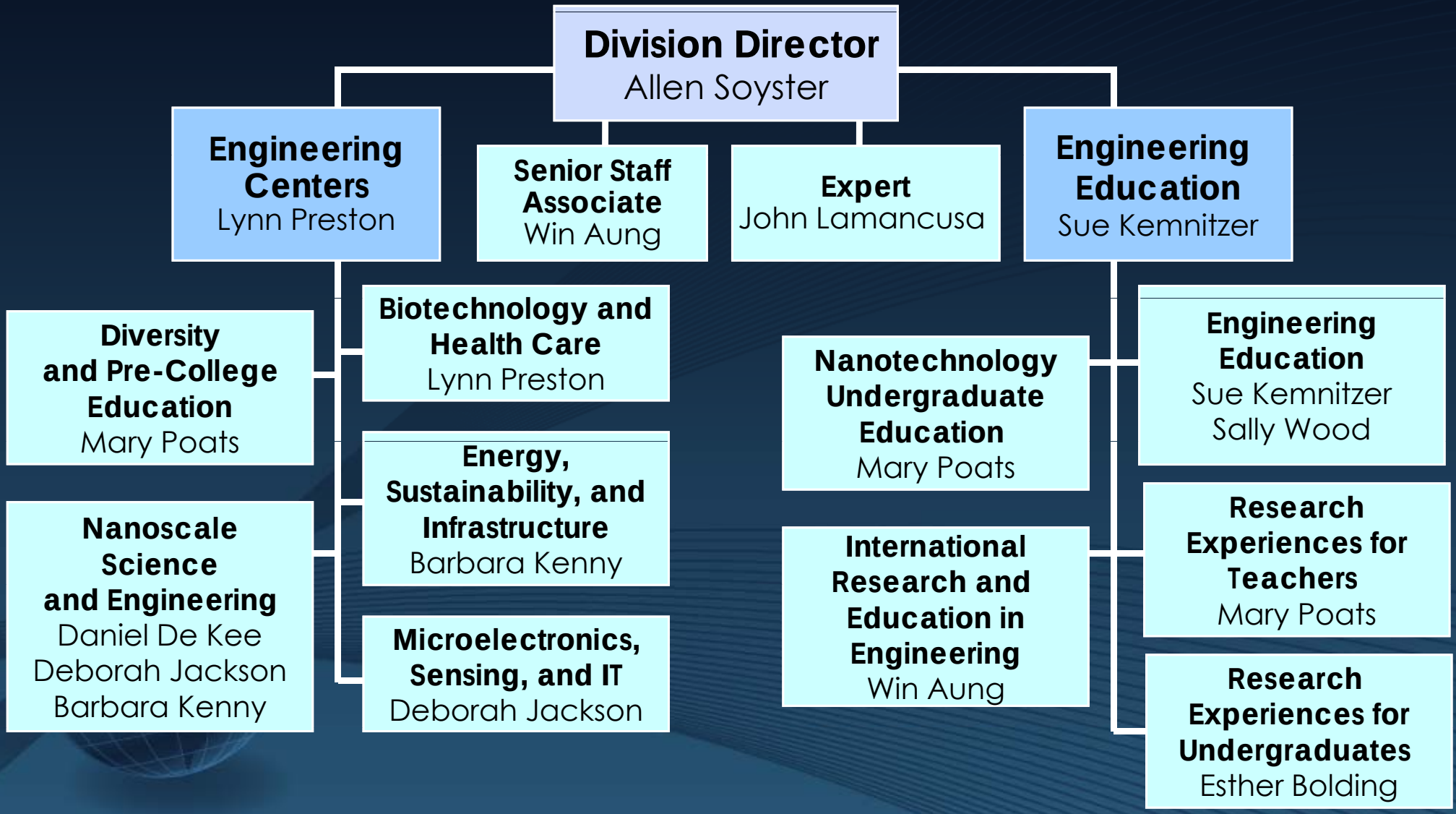
ENG Collaborative and Interdisciplinary Research

- ENG interdisciplinary research (IDR)
- Engineering Education and Centers
- Industrial Innovation and Partnerships

ENG Interdisciplinary Research (IDR) Proposals

- Must attract funding from **at least two divisions** of the NSF, with primary funding from ENG.
- Are usually submitted by a team of 2–4 investigators.
- Typically **$300–500K for up to three years**, although awards up to $1M are considered.
- See submission guidelines at http://nsf.gov/eng/general/IDR/index.jsp

Engineering Education and Centers (EEC)



Engineering Centers

- Supports **collaboration with industry** to promote **innovative research and education**
- Engineering Research Centers
  - 15 in operation, including 5 new for 2008
    - Funding for 10 years
  - 2-year process from solicitation to funding
  - FY **2010 competition is underway**
- Nanoscale Science and Engineering Centers
  - 6 of 10 are engineering
  - 2007 solicitation to establish a Center for the Environmental Implications of Nanotechnology

Engineering Research Centers

- FY 2010 awards will be made in the following topic areas:
  - Complex, coupled physical civil infrastructure systems under stress
  - Energy systems for a sustainable future
  - Transformational engineered systems — open category with topic chosen by the proposing ERC team
- ~$13M to fund 2–4 awards
- Letters of Intent due May 15, 2009; preliminary proposals due July 15, 2009; invited full proposals due Jan. 12, 2010

ENG Contact
Lynn Preston

Engineering Education Research

- Addresses educational goals of the engineering community
- Supports focused efforts that integrate research into **advances in undergraduate and PhD engineering education, and partner with K–12** pipeline innovators

Innovations in Engineering Education, Curriculum, and Infrastructure

- Supports research that addresses four aspects of engineering education:
  - **how students best learn** to become creative and innovative engineers, and how this learning is measured
  - **how cyber-learning resources can be used** to develop tools and systems that significantly improve learning
  - **integration of sustainability** into engineering education
  - future directions of U.S. engineering doctoral programs
- Look **for new announcement in fall 2009**

ENG Contact
Sue Kemnitzer

NSF-wide Education Programs

- Integrative Graduate Education and Research Traineeship **(IGERT)**
  - ~20 awards each year
  - Pre-proposals due in March, full proposals due in Sept.
- Graduate Teaching Fellows in K-12 Education **(GK-12)**
  - ~20 awards each year
  - Letters of Intent due in May, full proposals due in June
- Graduate Research Fellowships **(GRF)**
  - ~1000 fellowships awarded each year
  - Engineering and interdisciplinary proposals due in Nov. each year

Ethics Education for Science and Engineering

- Invests in **research and education projects to improve ethics education** in all of the fields of science and engineering that NSF supports, especially in interdisciplinary or inter-institutional contexts
- Focuses on improving ethics education **for graduate students**, although proposed programs may benefit undergraduates as well
- **~$2.4M for 6–12 awards**
- Full proposals due **March 1, 2010**

ENG Contact
Sue Kemnitzer

Human Resource Development

- Research Experiences for Undergraduates **(REU)**
  - Supports the involvement undergraduates in meaningful ways in ongoing research programs or in research projects specifically-designed for the REU program
  - **$10M/year** available for engineering
  - Deadline for site proposals in **Aug. each year**
- Research Experiences for Teachers **(RET)** in Engineering
  - Supports the active involvement of K-12 teachers and community college faculty in engineering research in order to bring knowledge of engineering and technological innovation into their classrooms
  - **$4M/year** available
  - Deadline in **Nov. each year**

Industrial Innovation and Partnerships (IIP)

Division Director
Kesh Narayanan

Academic Partnerships
Donald Senich

- **Grant Opportunities for Academic Liaison with Industry**
  Donald Senich
- **Industry/University Cooperative Research Centers**
  Rathindra DasGupta
  Glenn Larsen
- **Partnerships for Innovation**
  Sara Nerlove
- **Expert/Special Topics**
  Alex Schwarzkopf

- **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**

Small Business Partnerships
Joe Hennessey

- **Nanotechnology, Advanced Materials and Manufacturing**
  Cheryl Albus, Bill Haines, Ben Schrag, Grace Wang
- **Biotechnology and Chemical Technology**
  Gregory Baxter, Josephine Yuen, Cynthia Znati
- **Information and Communications Technology**
  Errol Arkilic, Juan Figueroa, Murali Nair
- **Expert/Special Topics**
  Ian Bennet, James Rudd, George Vermont

Grant Opportunities for Academic Liaison with Industry (GOALI)

- Effectively promotes the **transfer of knowledge** between academe and industry, student education, and the **exchange of culture**
- Supports:
  - Faculty and students in industry (≤ 1 year)
  - Industry engineers/scientists in academe (≤ 1 year)
  - Industry-university collaborative projects (≤ 3 years)
- $5M available for co-funding with all NSF Directorates
- Proposals accepted anytime; **~70 awards** each year

Industry/University Cooperative Research Center (I/UCRC) Program

- I/UCRC promotes **long-term partnerships** among industry, academe, and government
- Centers are catalyzed by a small investment from NSF and are **primarily supported by industry center members** during their development and evolution
- ~$9M for **2-8 full center** awards ($55-80K/year for up to 5 years) and **4-12 planning grant** awards ($10K for 1 year)
- Two windows per year: Letters of Intent due in Jan. and June; full proposals due in March and Sept.

Partnerships for Innovation (PFI)

- **Catalyzes partnerships** among colleges and universities, the private sector, and governments
- Supports one or more of the following activities:
  - research, knowledge transfer, and/or commercialization
  - workforce education and training
  - establishing the infrastructure for innovation
- **$9.5M** to fund **12–15 awards** each year; grants are up to **$600,000 for 2–3 years**
- New solicitation in 2010

Small Business Innovation Research (SBIR) Programs

- Encourages **small firms to undertake cutting-edge** research with the potential for significant economic and public benefits
- Supports
  - Biotechnologies and chemical technologies
  - Education applications
  - Information and communication technologies
  - Nanotechnology, advanced materials, and manufacturing
- **$25M** for **170–250 awards**
- Full proposals due in **June and Dec**.

Small Business Technology Transfer (STTR) Programs

- Encourages small firms to undertake cutting-edge research with the potential for significant economic and public benefits
- **Enables university researchers** to spin off commercially promising ideas while remaining employed primarily at the research institution
- Supports multi-functional materials
- **$5M** for **~35 awards**
- Full proposals due **Nov. 17, 2009**

Funding Opportunities

- Core programs
- Exploratory research
- Collaborative/interdisciplinary areas
- **Crosscutting and NSF-wide programs**

Crosscutting and NSF-wide Opportunities

- Cyber-Enabled Discovery and Innovation **(CDI)**
- Cyber-Physical Systems **(CPS)**
- Domestic Nuclear Detection Office/NSF Academic Research Initiative **(ARI)**
- Major Research Instrumentation **(MRI)** Program
- Pan-American Advanced Studies Institutes Program **(PASI)**
- Partnerships for International Research and Education **(PIRE)**

Cyber-Enabled Discovery and Innovation (CDI)

- CDI is a five-year initiative to create revolutionary science and engineering research outcomes made possible by **innovations and advances in computational thinking**
- Seeks proposals within or across the following three thematic areas:
  - From Data to Knowledge
  - Understanding Complexity in Natural, Built, and Social Systems
  - Virtual Organizations
- ~$40M investment in FY2008 for 36 grants
- **New solicitation coming in fall 2009**

ENG Contact
Maria Burka
Eduardo Misawa

Cyber-Physical Systems (CPS)

- Refers to the **tight conjoining of and coordination between computational and physical resources**
- Seeks proposals that address a CPA research theme:
  - **Foundations** research to develop new principles, algorithms, models, and theories
  - **Methods and Tools** research to bridge gaps between approaches to the cyber and physical elements of systems through innovations
  - **Components, Run-time Substrates, and Systems** research motivated by grand challenge applications
- **~$30M** investment for **30–40 grants** for small, medium, and large projects
- Full proposals due **Feb. 26, 2010**

ENG Contact
Scott Midkiff

Domestic Nuclear Detection Office/NSF Academic Research Initiative (ARI)

- Focused on **detection systems, individual sensors** or other research for the detection of nuclear weapons or material, radiation dispersal devices, and related threats
- **Possible topics** include:
  - Detector materials, concepts and designs for new sensors and sensing systems
  - Non-intrusive active interrogation systems; particle generators and accelerators, associated detectors, and algorithms for improved data analysis
  - Nuclear forensics and attribution
- **7–8 awards** for **up to $400K annually** per award for up to five years
- Full proposals due **April 26, 2010**

ENG Contact
Suhada Jayasuriya

Major Research Instrumentation (MRI) Program

- Goals of the program are to:
  - Support the **acquisition or development** of major state-of-the-art instrumentation
  - **Improve access to and increase use** of modern research and research training instrumentation
  - Enable the creation of **well-equipped learning environments** that integrate research with education
  - Foster the development of the next generation of instrumentation
  - **Promote partnerships**
- Typically ~$110M investment for **approximately 225 awards**
- Letters of Intent due in Dec.; full proposals due **Jan. 28, 2010**

ENG Contact
Lawrence Goldberg

Pan-American Advanced Studies Institutes (PASI) Program

- Aims to **disseminate advanced scientific and engineering knowledge and stimulate training** and cooperation among researchers of the Americas
- Supports courses that
  - Ranging in length from ten days to one month duration,
  - Involve lectures, demonstrations, research seminars and discussions
  - Are taught at the advanced graduate and post-doctoral level
- ~$500K annual investment for **6–8 grants**
- Full proposals due **Jan. 15, 2010**

Office of International Science and Engineering
Harold Stolberg

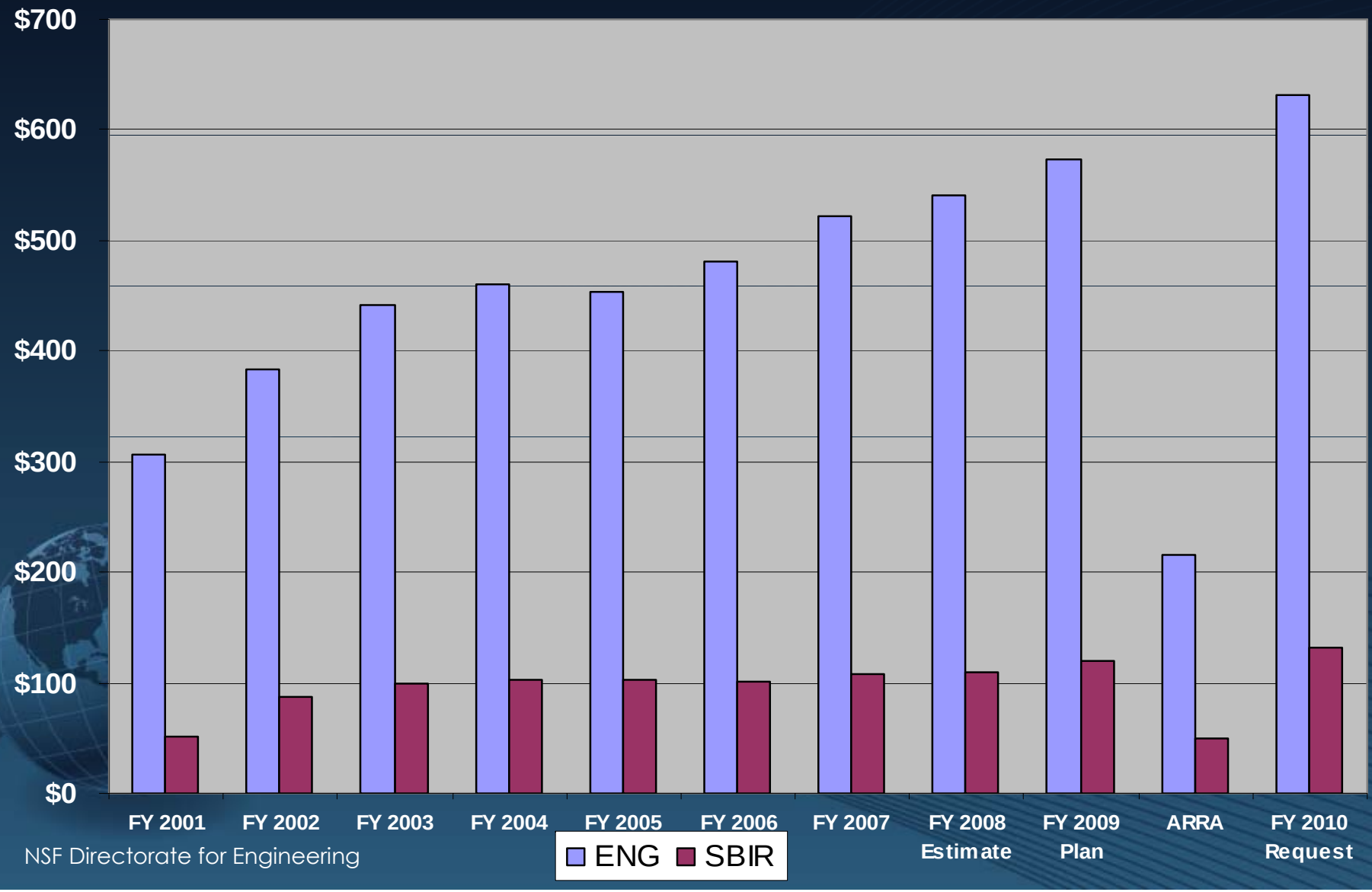
Partnerships for International Research and Education (PIRE)

- Seeks to **catalyze a cultural change in U.S. institutions** by establishing innovative models for international collaborative research and education
- Other objectives include to:
  - Provide **international research experiences** for U.S. students and faculty
  - Build strong international **partnerships**
  - Develop new **replicable models** for international collaborative research and education
  - **Raise the profile** and increase the importance of international collaborative research and education
- **Preliminary proposals due in Feb**.

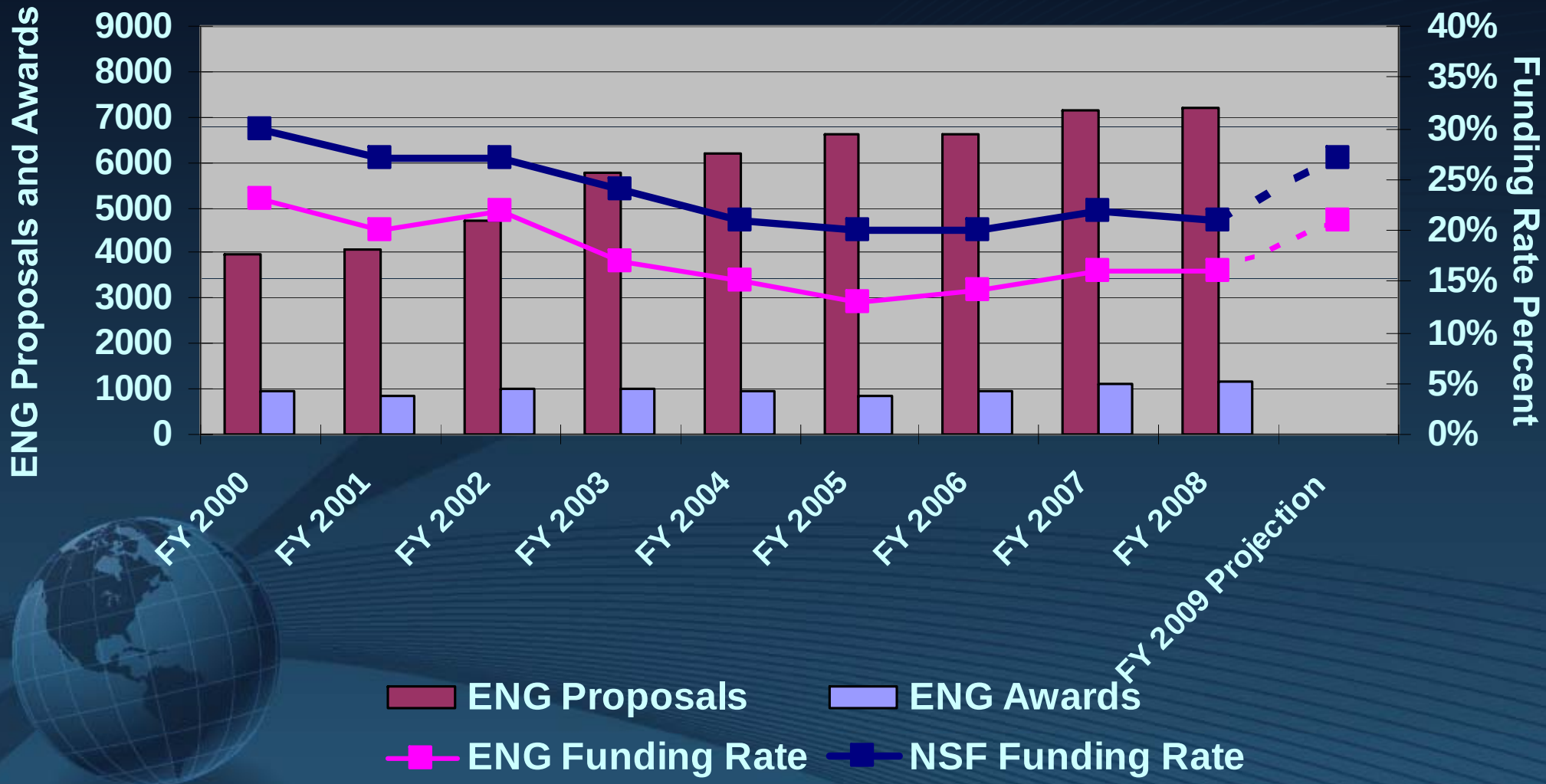
Office of International Science and Engineering
Elizabeth Lyons

ENG and SBIR/STTR Budget History

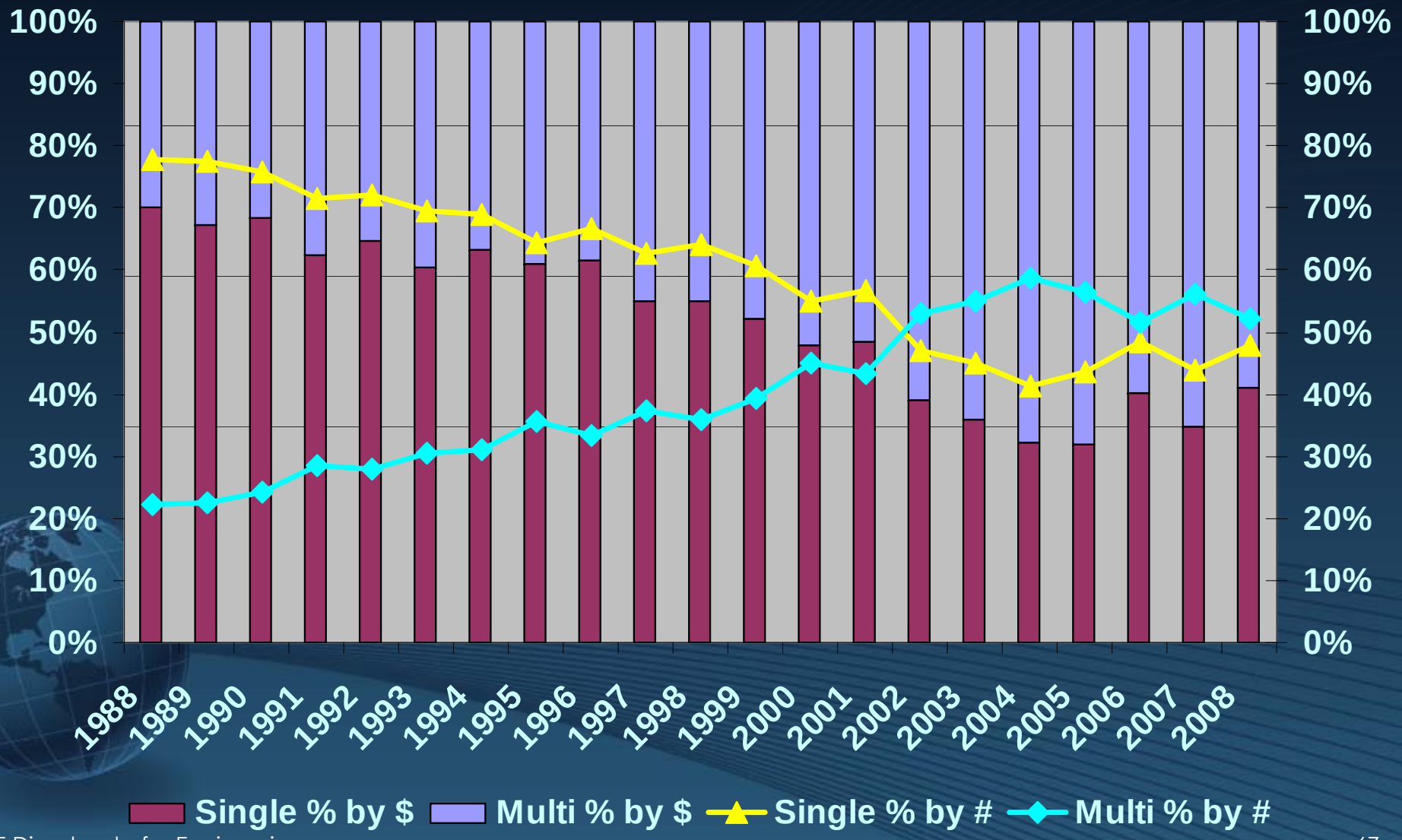
Dollars in Millions



ENG and NSF Research Grant Proposals and Awards

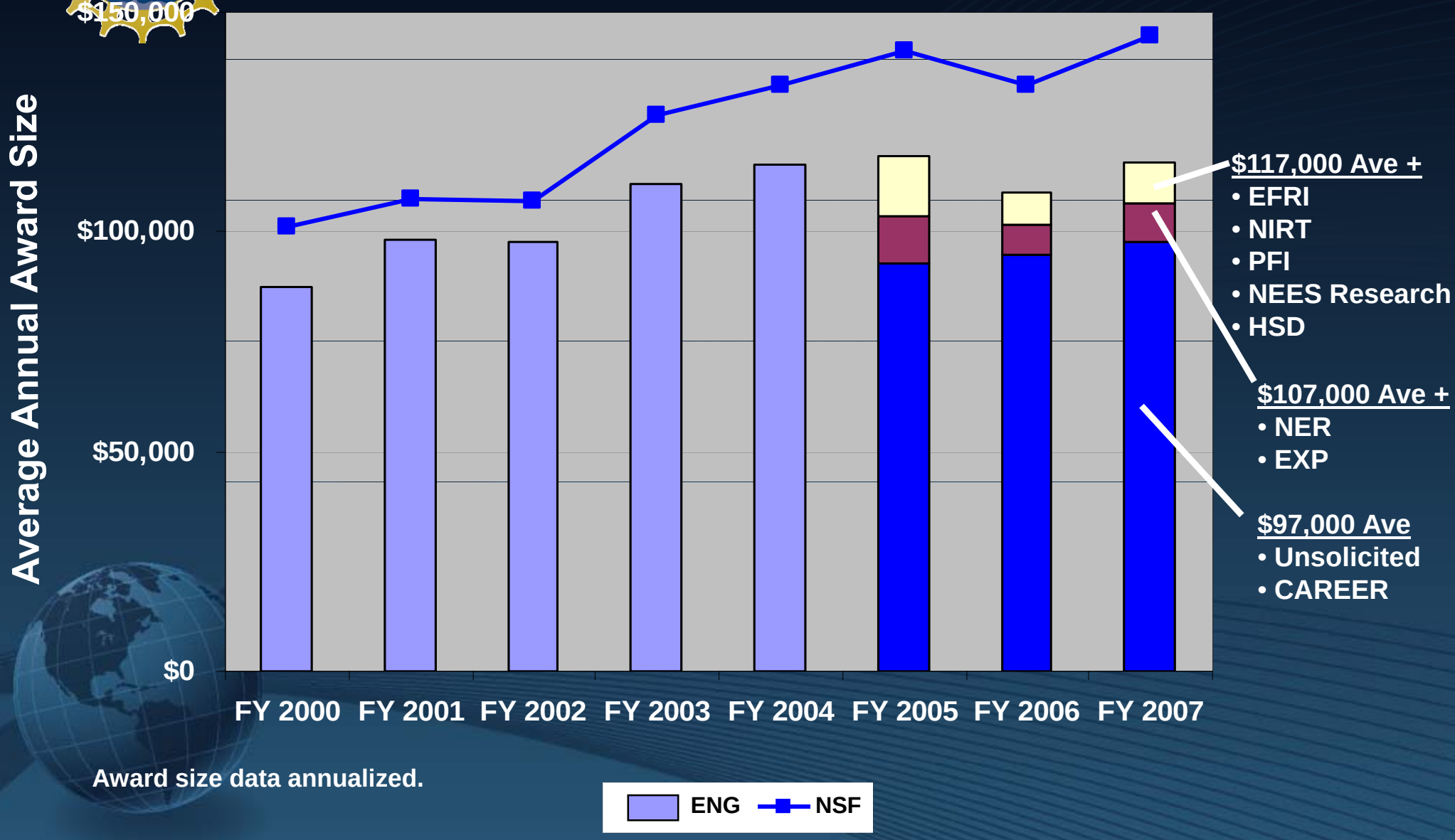


Single vs. Multiple Investigator ENG Awards



Annual Award Size

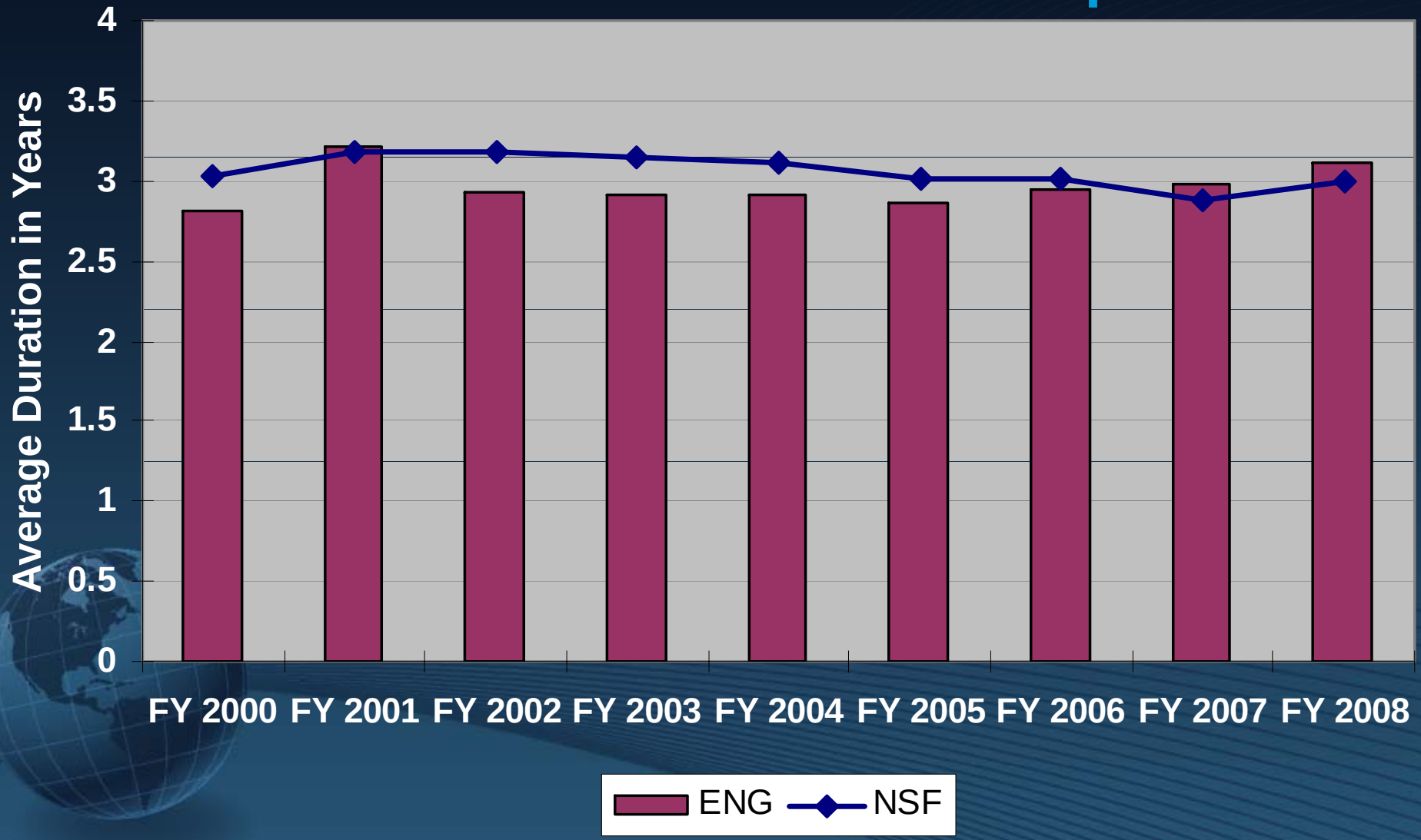
Averages for ENG Research Grants



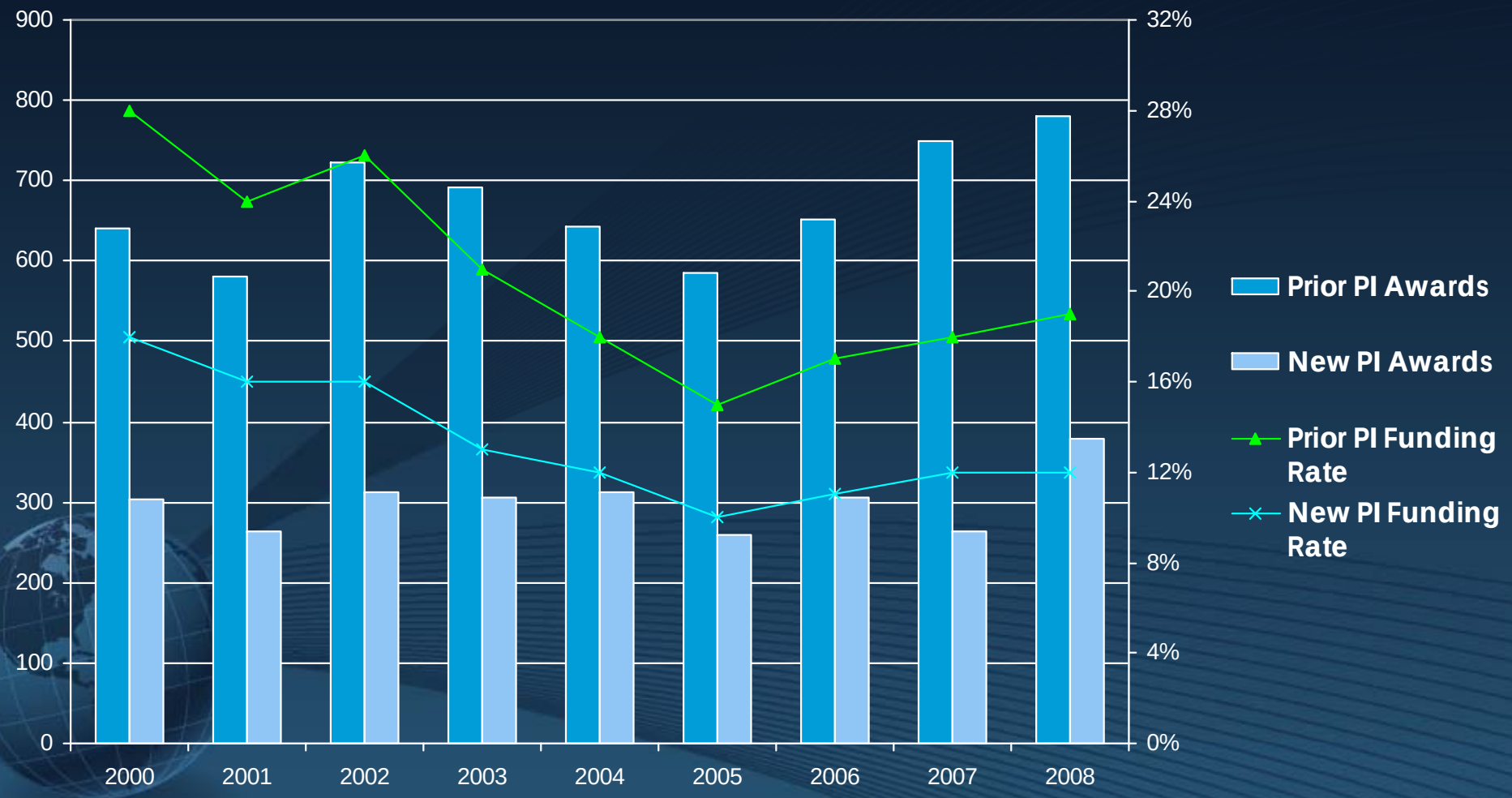
Award size data annualized.

Average Award Duration in Years

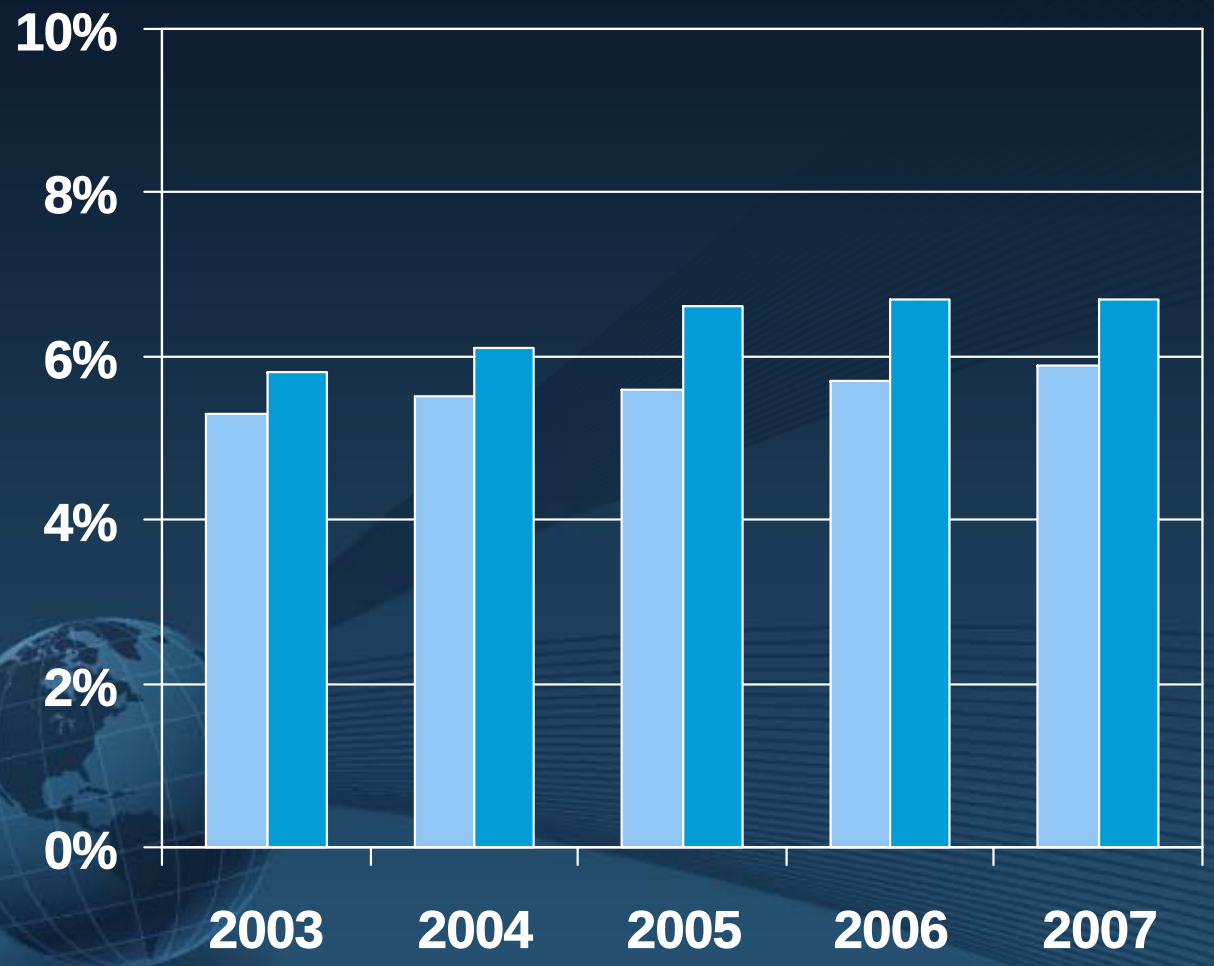
ENG Research Grants in Comparison to NSF



ENG Success Rates for Prior and New PIs



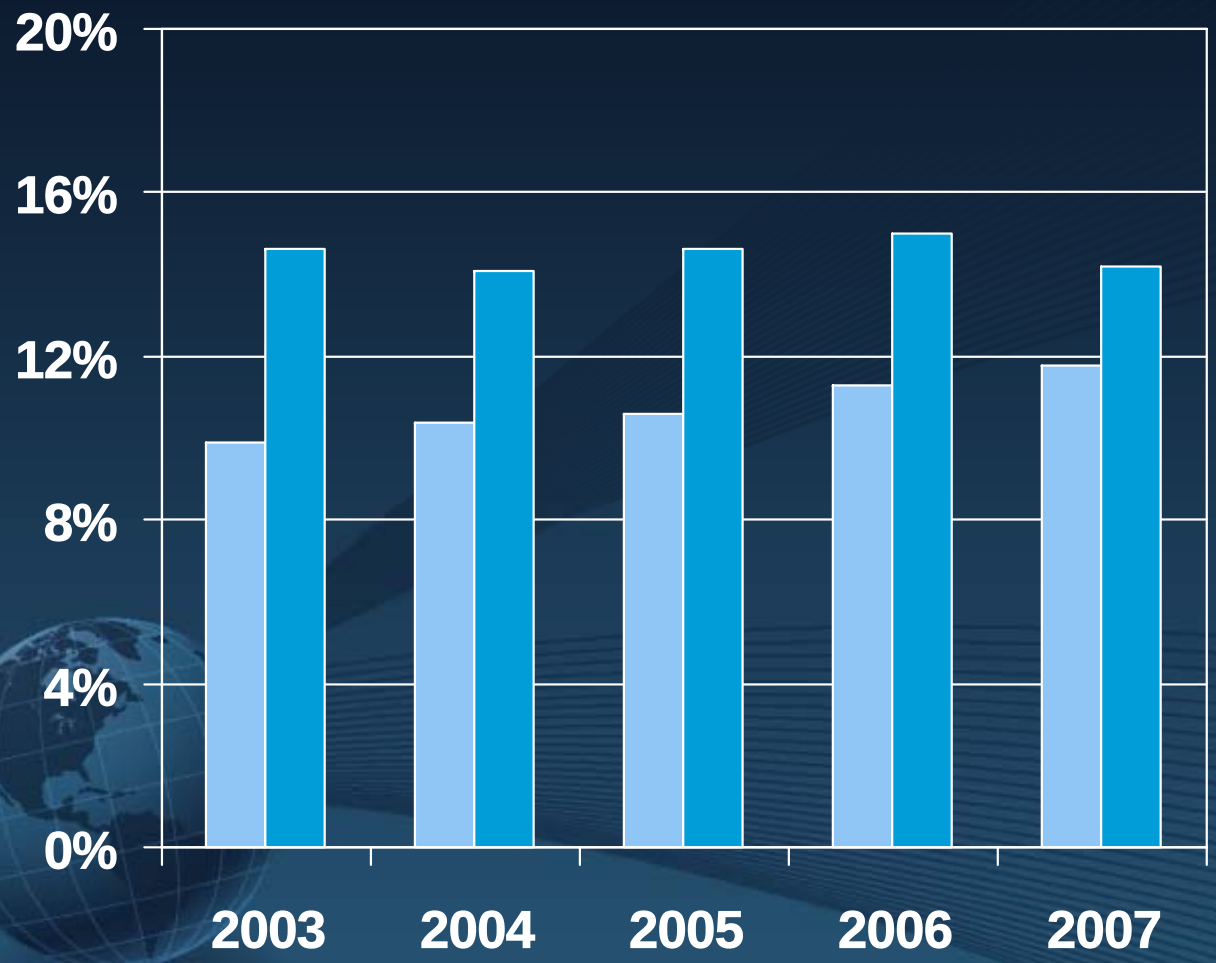
Proposal Submissions to ENG by Under-Represented Minorities



- Under-Represented Minority Faculty Nationwide*
- Proposal Submissions to ENG by Under-Represented Minorities

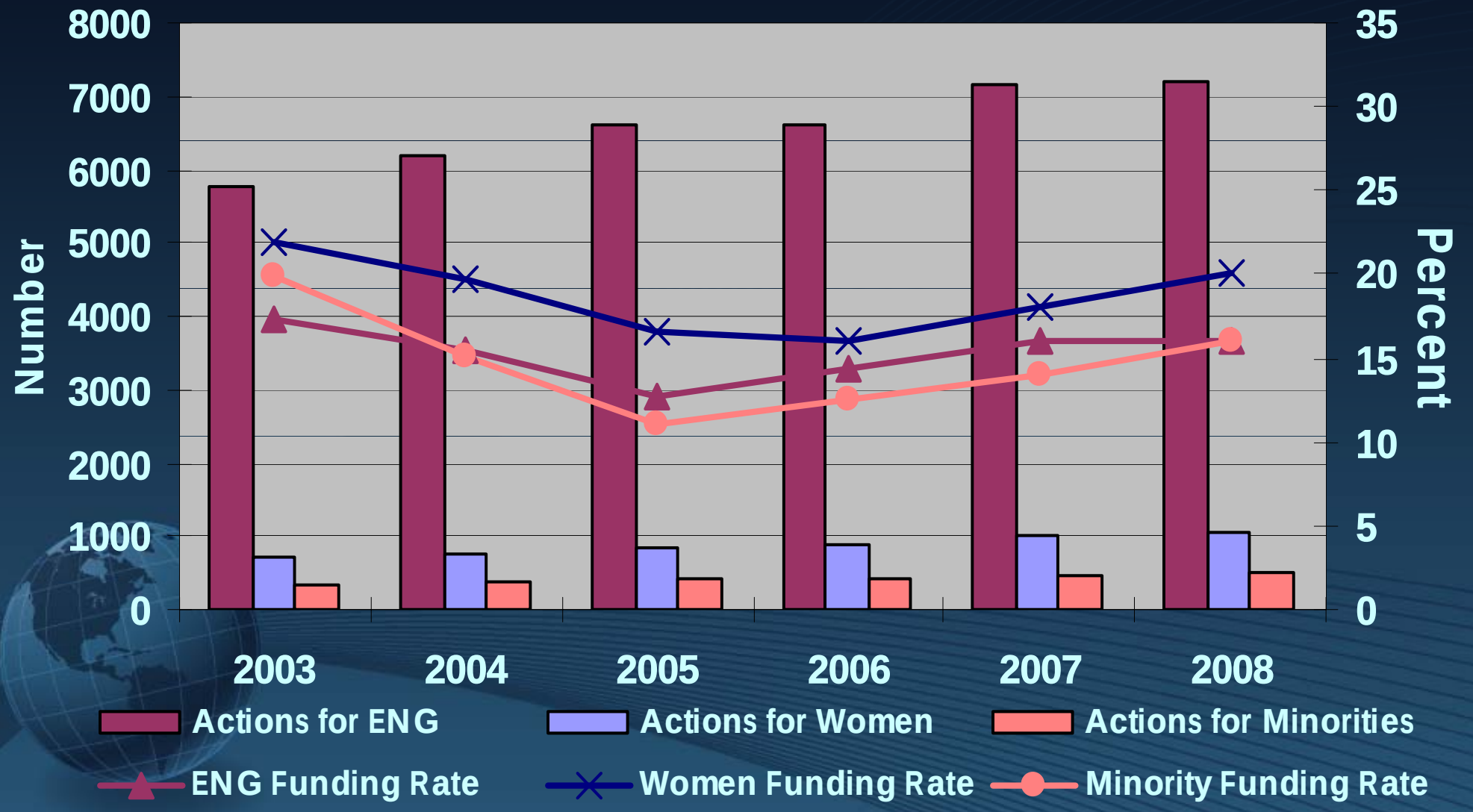
* Source: ASEE, 2007, *Engineering By the Numbers*

Proposal Submissions to ENG by Women



* Source: ASEE, 2007, *Engineering By the Numbers*

Research Proposal Funding Rates for All ENG, Women, and Minorities



Free Advice for Success…

or "I'm from the government and I'm here to help"

- It all starts with Dialog, a White Paper and a Short Bio
- Get involved in NSF Reviews: Panel or Mail
- Don't be afraid of Teams
- Spread Your Research Wings
- Deliver on Your Promises
- "No" is not Forever…Seek Feedback
- "….don't ever give up"