



Our World is **ENGINEERED**

**Update from the
NSF Directorate for
Engineering**

**Michael Reischman
Acting Assistant Director**

**Engineering Advisory Committee Meeting
October 15–16, 2008**



AdCom Meeting Agenda

- ◉ Directorate for Engineering Update
- ◉ ECCS Overview and COV Report
- ◉ Emerging Frontiers in Research and Innovation (EFRI) Update and Discussion of Emerging Areas
- ◉ Broadening Participation
 - > EHR Programs
 - > Subcommittee Report and ENG Plan
- ◉ Discussion with Arden Bement, Director



Directorate for Engineering Update

- ◉ Action Items
- ◉ New Staff Introductions
- ◉ Budget and Trends
- ◉ Research and Education Themes
- ◉ Broadening Participation





Action Items from AdCom

- ◉ Developing EFRI topics
 - > Invite community to submit ideas
 - > Recognize importance of energy and the environment
- ◉ Broadening participation
 - > EHR collaboration
 - > Graduate student/post doc support
 - > RET/REU
 - > Metrics
- ◉ Recommendations of University–Industry Partnerships subcommittee



Industry-University Partnerships





Staff Introductions





ENG Leadership

Emerging Frontiers in Research and Innovation (EFRI)
Sohi Rastegar

Office of the Assistant Director

Michael Reischman*

Diversity and Outreach
Vacant

Senior Advisor for Nanotechnology
Mihail Roco

Engineering Education and Centers (EEC)
Allen Soyster

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

Civil, Mechanical, and Manufacturing Innovation (CMMI)
Adnan Akay

Electrical, Communications, and Cyber Systems (ECCS)
Lawrence Goldberg*

Industrial Innovation and Partnerships (IIP)
Kesh Narayanan

*Acting



New Staff in ENG/OAD

- ◎ **Thomas Peterson**, Assistant Director, University of Arizona (January 2009)
- ◎ **Cecile Gonzalez**, Science Writer–Editor
- ◎ **Stefan Little**, Program Specialist



New Staff in ENG/CBET

- ◎ **John McGrath**, Division Director, University of Arizona
- ◎ **Theodore Bergman**, Program Director for Thermal Transport Processes, University of Connecticut
- ◎ **Ted Conway**, Program Director for Biomedical Engineering and Engineering Healthcare
- ◎ **Aleksandr Simonian**, Bioengineering, Interdisciplinary, and Engineering Centers Activities, Auburn University



New Staff in ENG/CMMI

- ◎ **Meghan Durham**, Program Assistant
- ◎ **Candace Owens**, Secretary to Division Director
- ◎ **Robert Smith**, Program Director for Operations Research, University of Michigan
- ◎ **Angela Speight**, IT/Program Assistant



New Staff in ENG/ECCS

- ◉ **Nergiz Knox**, Program Assistant
- ◉ **Andreas Weisshaar**, Program Director for Integrative, Hybrid, and Complex Systems, Oregon State University





New Staff in ENG/IIP

- ◉ **Gregory Baxter**, Program Director for SBIR/STTR Biotechnology, Hurel Corp.
- ◉ **James Brown**, AAAS Fellow, Wabash College
- ◉ **Denise Hundley**, Secretary to Division Director
- ◉ **Cynthia Znati**, Program Director for SBIR/STTR Chemical Technology, EXPORTech Company



Other New NSF Staff

- ◉ **Tim Killeen**, Assistant Director for Geosciences, National Center for Atmospheric Research
- ◉ **Edward Seidel**, Director, Office of Cyberinfrastructure, Louisiana State University





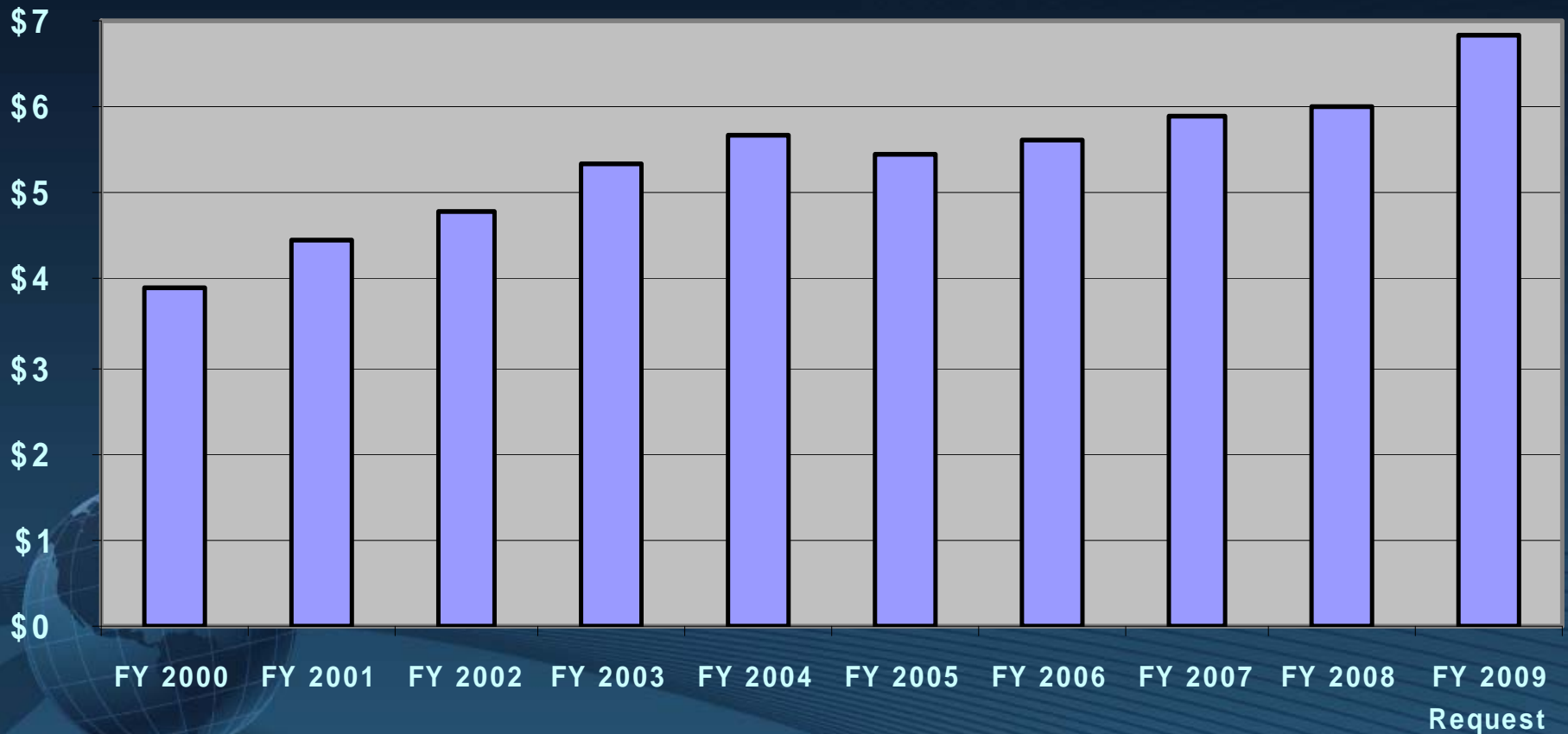
NSF/ENG Budget and Trends

- ◉ Budget history and request
- ◉ Proposals, awards, and funding rates



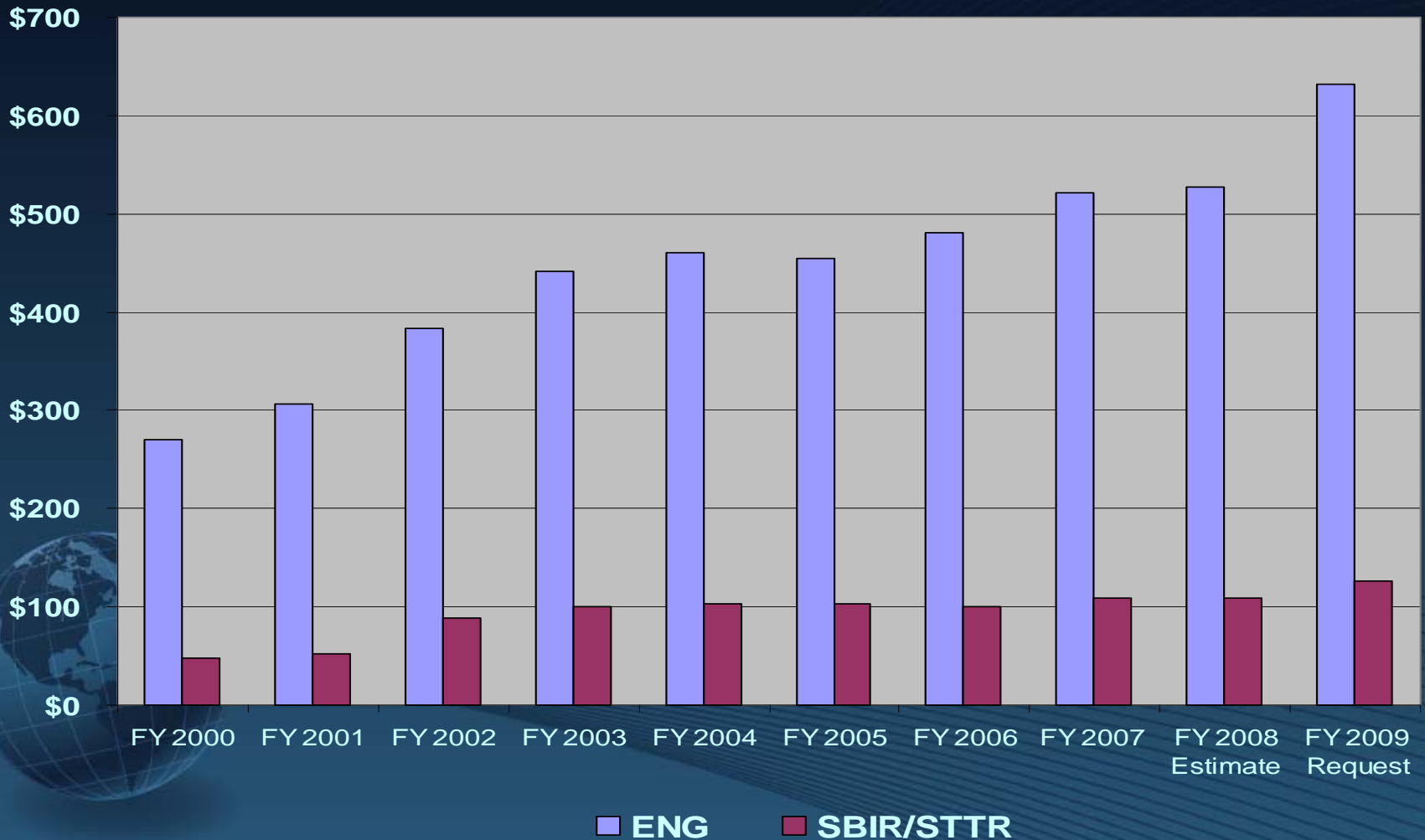


NSF Budget History (\$B)





ENG and SBIR/STTR Budget History (\$M)





NSF Budget by Directorate (\$M)

Directorate/Office	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	FY 2009 Request			
				Change over FY 2007 Actual		Change over FY 2008 Estimate	
				Amt	%	Amt	%
BIO	\$608.54	\$612.02	\$675.06	\$66.52	10.9	\$63.04	10.3%
CISE	526.68	534.53	638.76	112.08	21.3	104.23	19.5
ENG (<i>less SBIR/STTR</i>)	521.33	527.50	632.33	111.00	21.3	104.83	19.9
SBIR/STTR	108.67	109.37	127.00	18.33	16.9	17.63	16.1
GEO	745.85	752.66	848.67	102.82	13.8	96.01	12.8
MPS	1,150.73	1,167.31	1,402.67	251.94	21.9	235.36	20.2
SBE	214.54	215.13	233.48	18.94	8.8	18.35	8.5
OCI	182.42	185.33	220.08	37.66	20.6	34.75	18.8
OISE	40.36	41.34	47.44	7.08	17.6	6.10	14.8
OPP	438.43	442.54	490.97	52.54	12.0	48.43	10.9
IA	219.45	232.27	276.00	56.55	25.8	43.73	18.8
U.S. Arctic Research Commission	1.45	1.47	1.53	0.08	5.5	0.06	4.1
Research & Related Activities	\$4,758.44	\$4,821.47	\$5,593.99	\$835.55	17.6%	\$772.52	16.0%



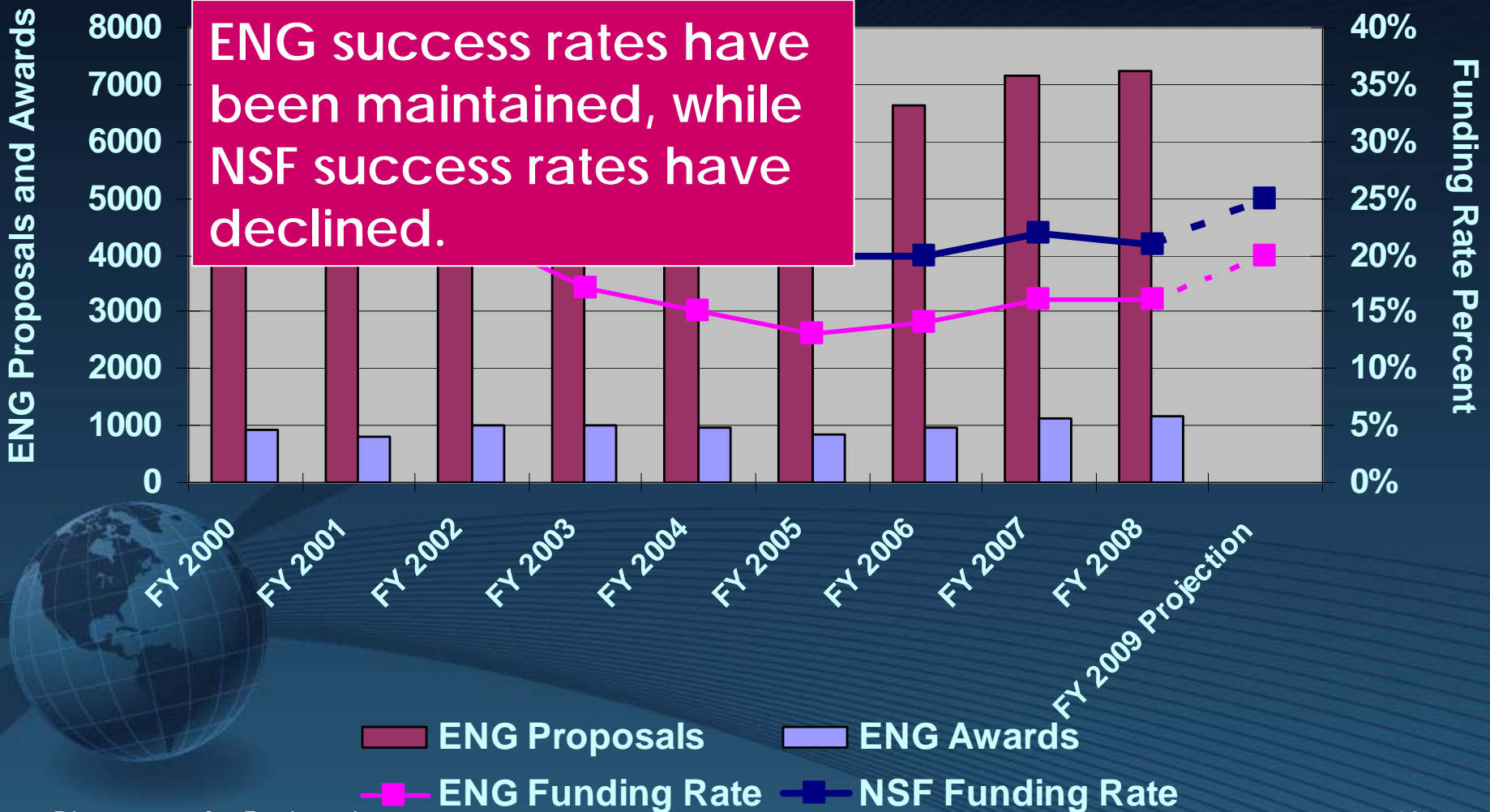
ENG FY 2009 Budget Request (\$M)

	FY2007 Actual	FY 2008 Estimate	FY 2009 Request	Change over FY 2008 Estimate	
				Amt	%
CBET	\$128.27	\$131.00	\$173.34	\$42.34	32.3%
CMMI	157.30	159.81	201.88	42.07	26.3
ECCS	83.24	83.50	94.36	10.86	13.0
IIP	120.78	121.67	140.90	19.23	15.8
<i>Small Business Innovation Research (SBIR)</i>	<i>108.67</i>	<i>109.37</i>	<i>127.00</i>	<i>17.63</i>	<i>16.1</i>
EEC	115.16	115.89	119.85	3.96	3.4
EFRI	25.00	25.00	29.00	4.00	16.0
Total, ENG	\$630.00	\$636.87	\$759.33	\$122.46	19.2%

(Columns may not total due to rounding.)

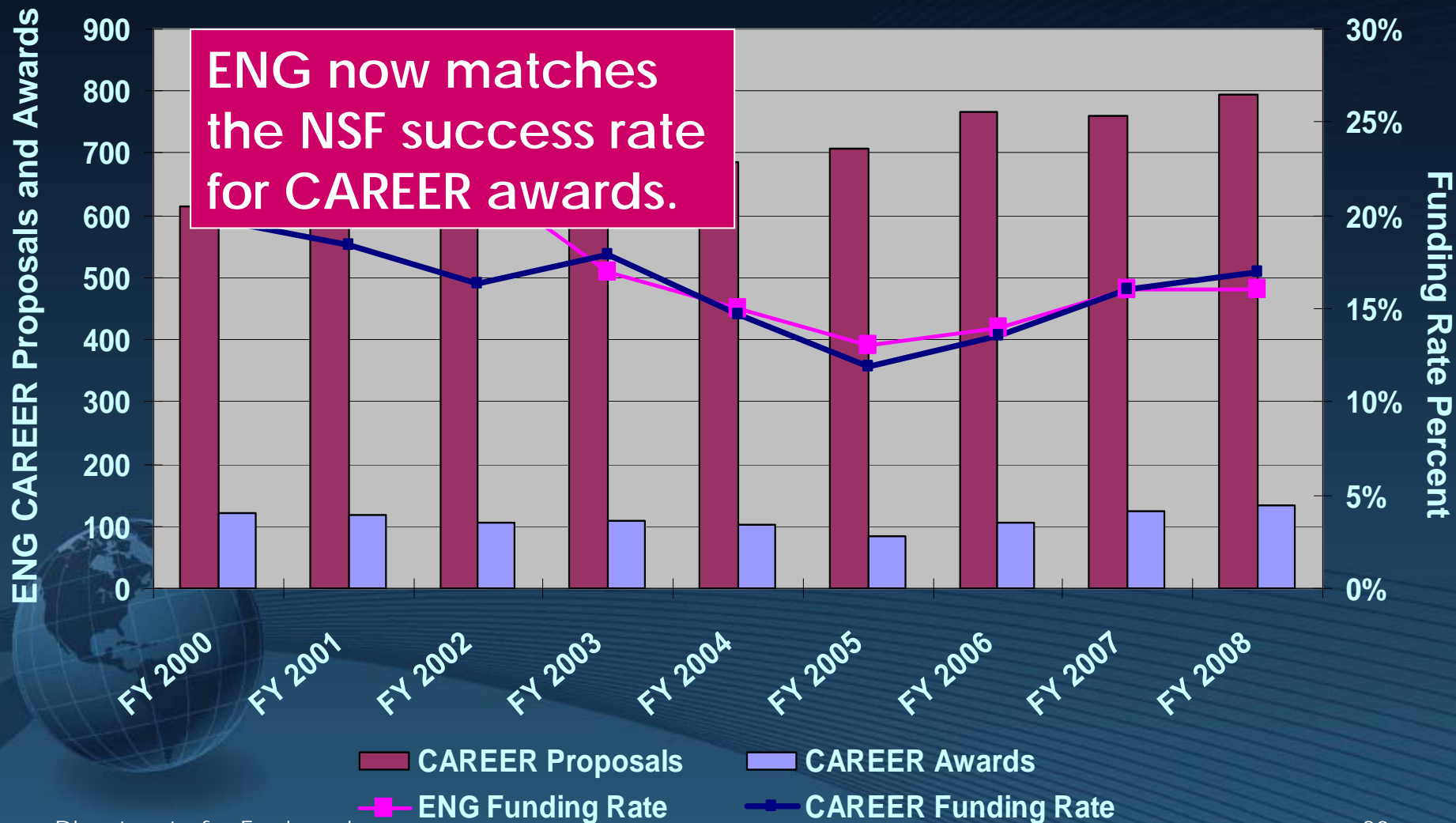


ENG and NSF Research Grant Proposals and Awards



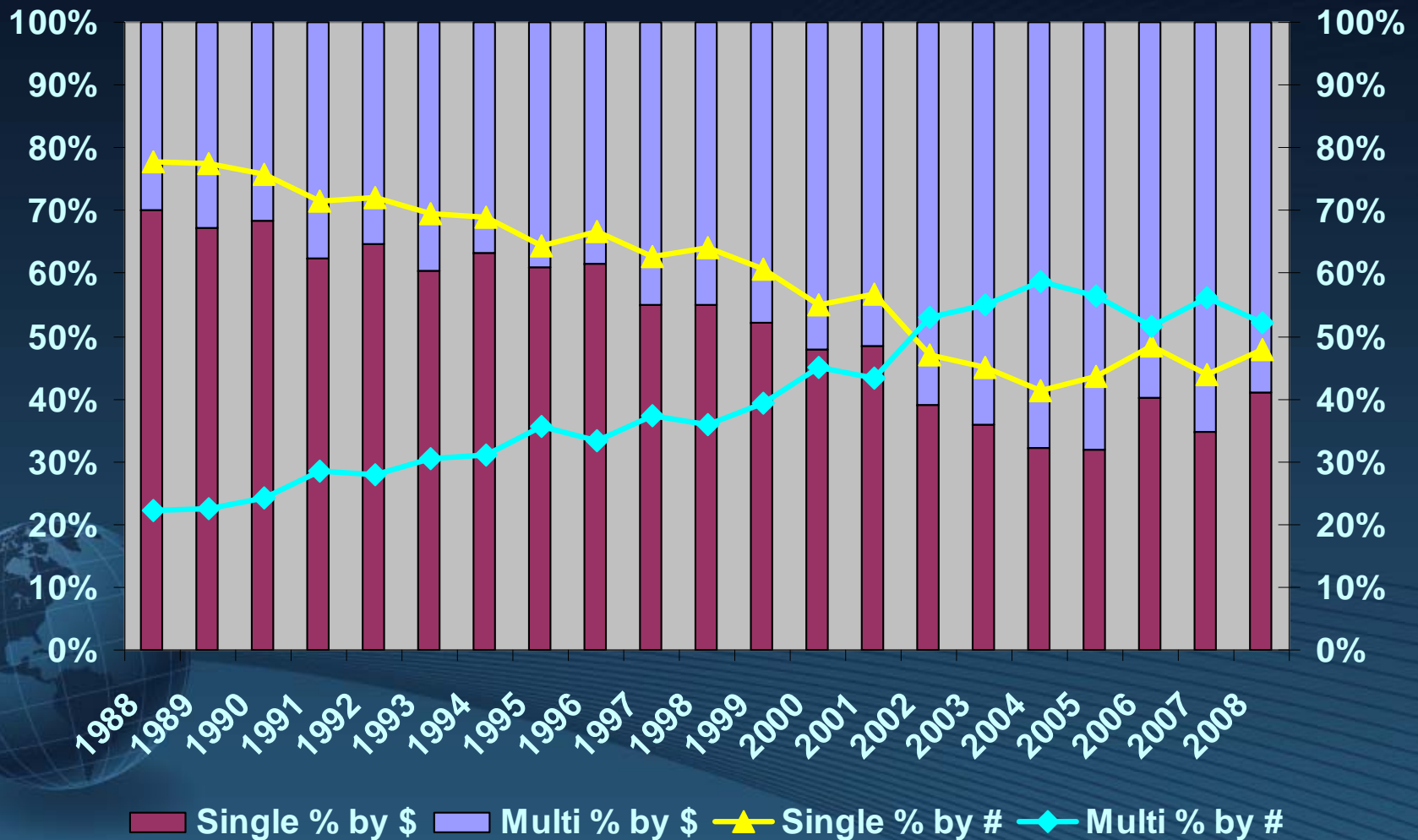


ENG and NSF CAREER Proposals and Awards





Single vs. Multiple Investigator ENG Awards





ENG Research and Education Themes

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



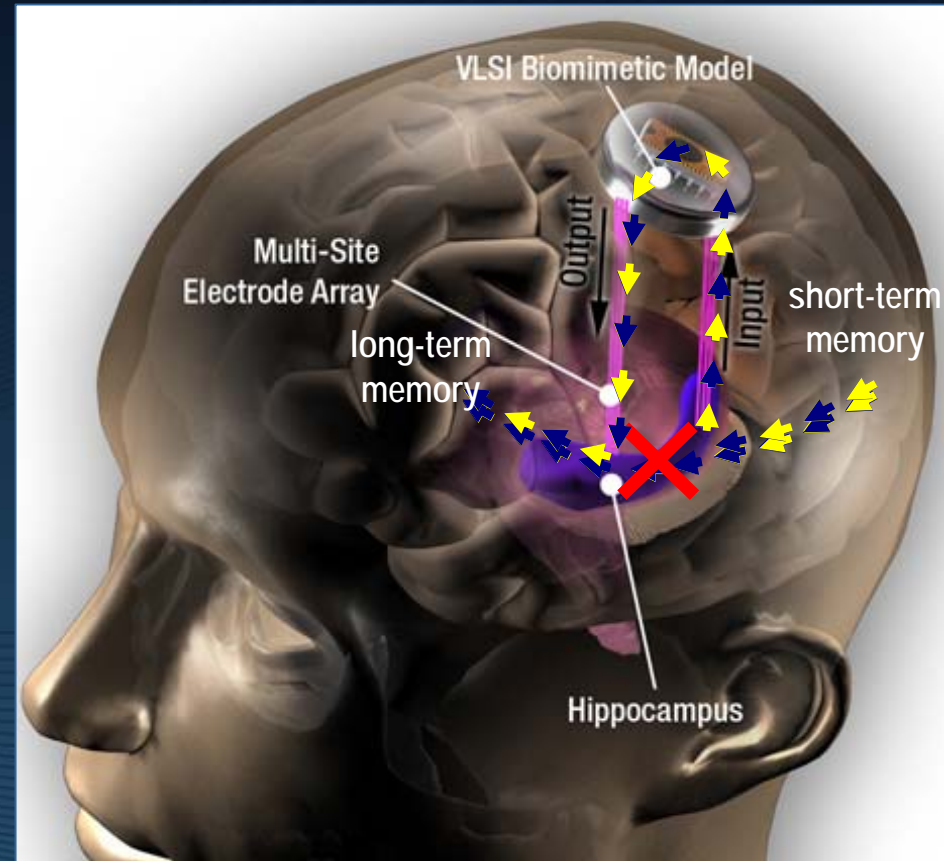
Developing ENG Themes





Cognitive Engineering

- ENG 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 (from fundamental metrology through atomic-scale control of raw materials), and service delivery
- Examples include:
 - > Achieving perfect atomic- and molecular-scale manufacturing
 - > Understanding & optimizing decision-making in service industries

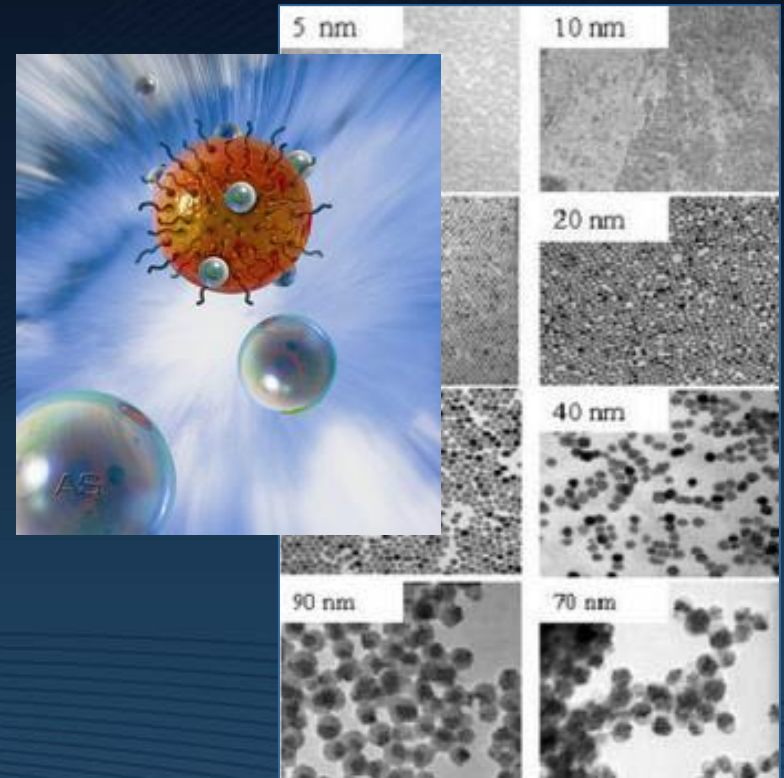


The time needed for vaccine design, production, and administration must all be balanced.



Competitive Manufacturing and Service Enterprises

- Commercial-scale production of affordable, high-quality, multi-use nanomaterials
 - Nanocrystals for separations and pollution control
 - Nanotubes for medical therapies and chemical and biological sensors



Various sizes of high quality Fe₃O₄ nanocrystals and Fe₃O₄ beads.



Complexity in Engineered and Natural Systems

- ◎ ENG research addresses unifying principles that enable modeling, prediction, and control of emergent behavior in complex systems
- ◎ Engineering seeks
 - › Predictable behavior
 - › Optimization
 - › Consistency of operation



Complex robotic systems can self-assemble, self-organize, and exhibit emergent behavior. These structures will self-assemble at disaster sites.



Complexity in Engineered and Natural Systems

○ Infrastructure systems

- › How do complex systems respond to unplanned events?
- › How can we make infrastructure systems more resilient and sustainable?

Map and density of cell-phone usage (shown as red and yellow 3-D peaks) are combined. *Dahleh, 0735956.*





Energy, Water, and the Environment

- ◎ ENG supports breakthroughs essential to the provision of energy and water in an environmentally sustainable and secure manner.
- ◎ Examples include:
 - › Developing quantitative understanding of energy–environment interactions
 - › Researching materials and systems to increase use of alternative energy sources

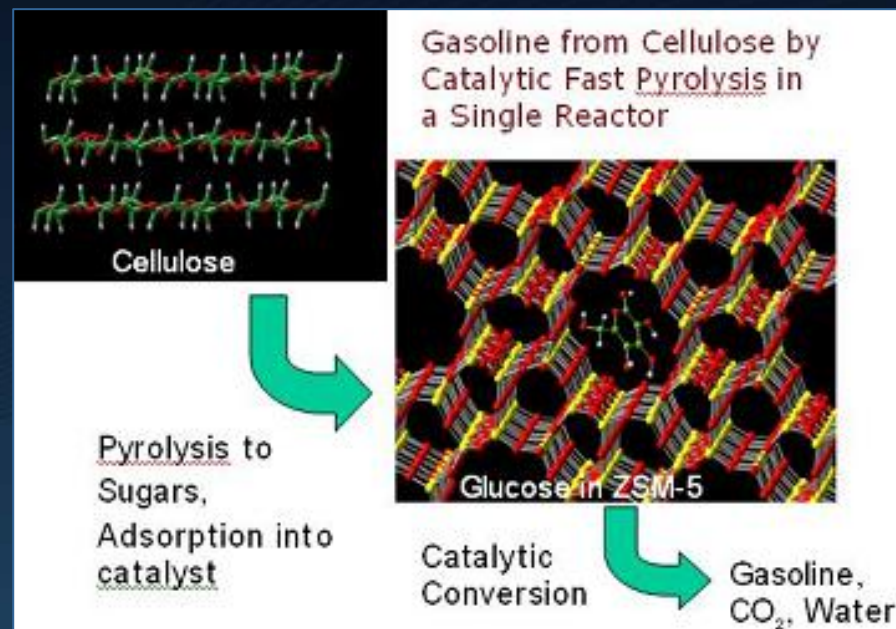


Dr. Efraín O'Neill-Carrillo describes solar energy and power quality to a group of Hispanic high school students. His CAREER project contributes to the research and workforce development needed to move towards a more sustainable energy future.



Energy, Water, and the Environment

- Biofuels
 - > Catalysis
 - > Synthetic biology

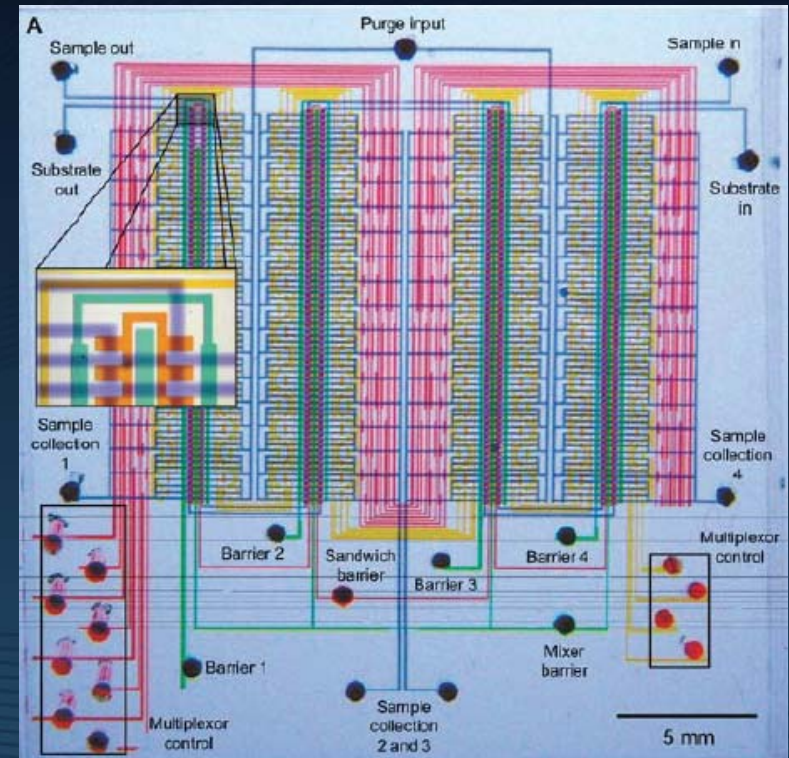


In one reactor, cellulose is broken up into sugar fragments which interact with a catalyst to become aromatic compounds used for gasoline.



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.*



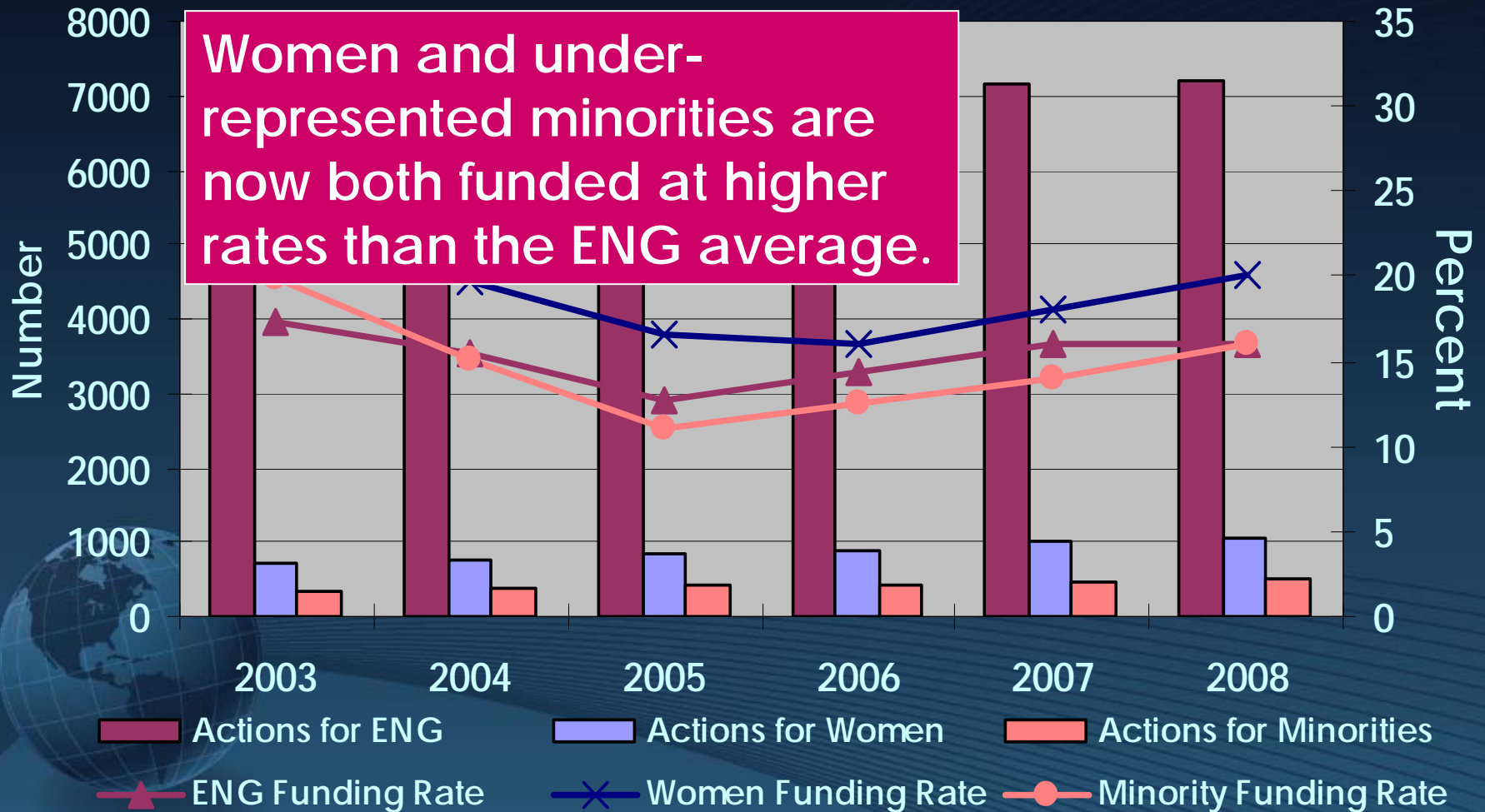
Broadening Participation

- Trends for Women and Under-Represented Minorities
- Initiatives in Engineering



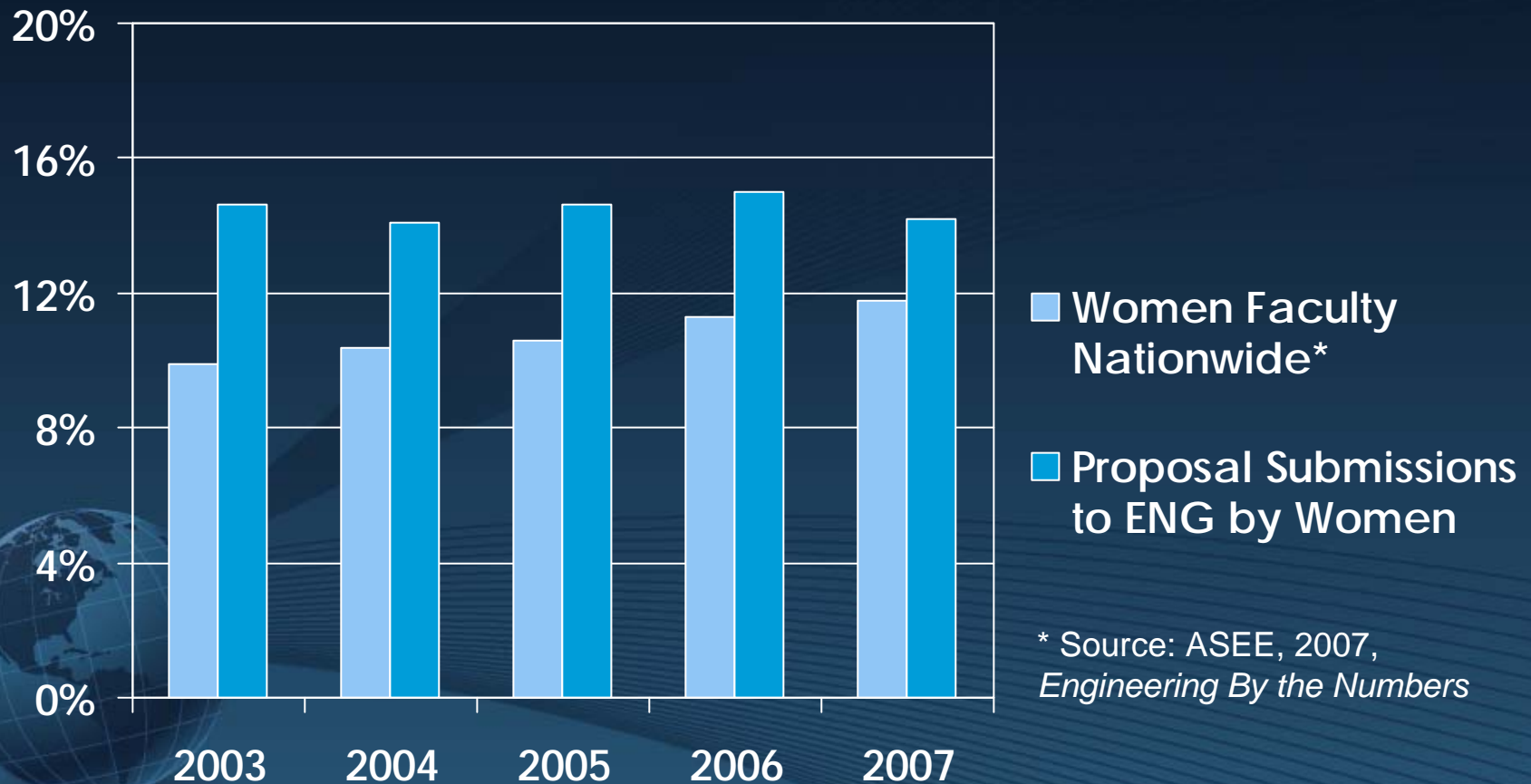


Research Proposal Funding Rates for All ENG, Women, and Minorities





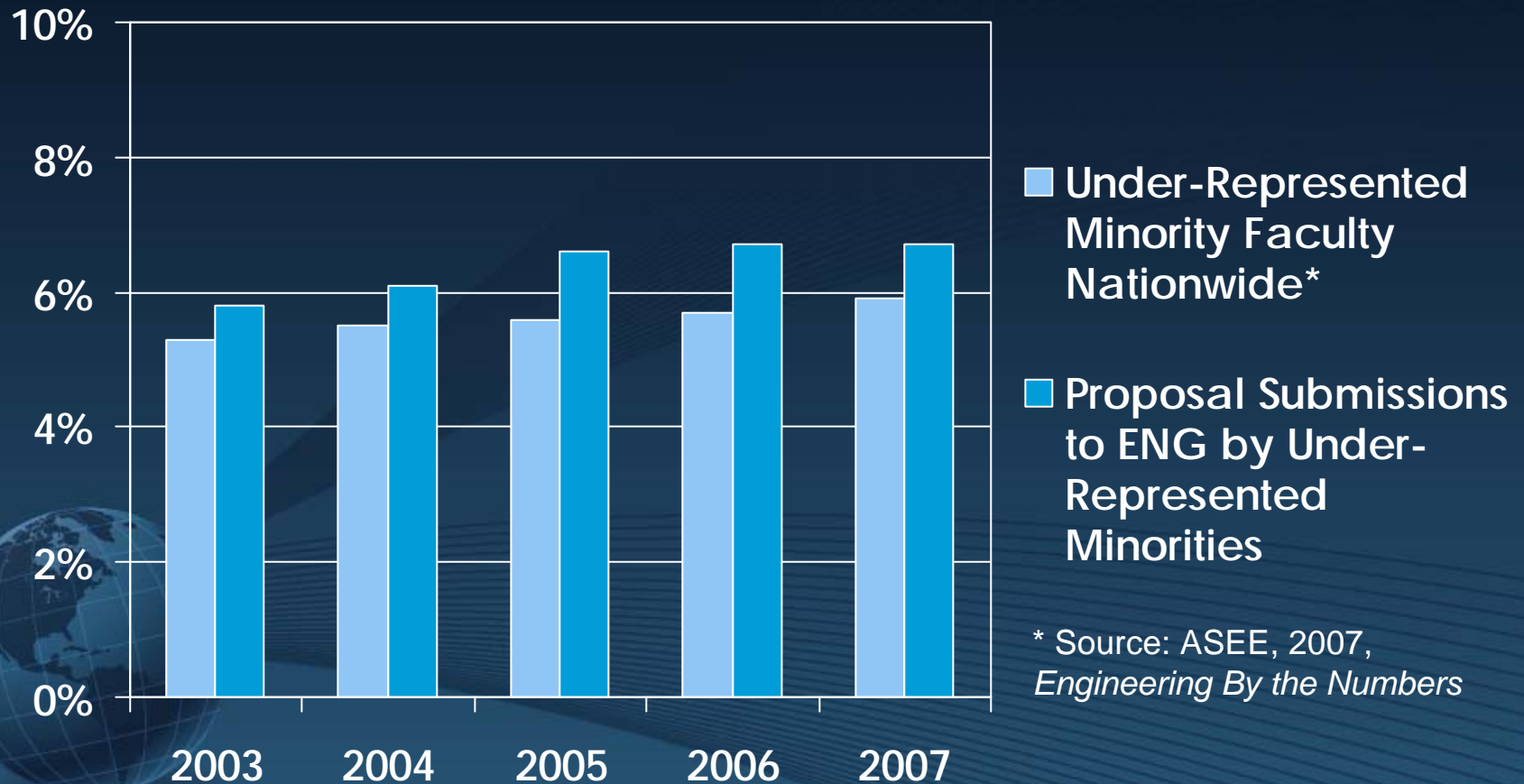
Proposal Submissions to ENG by Women



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

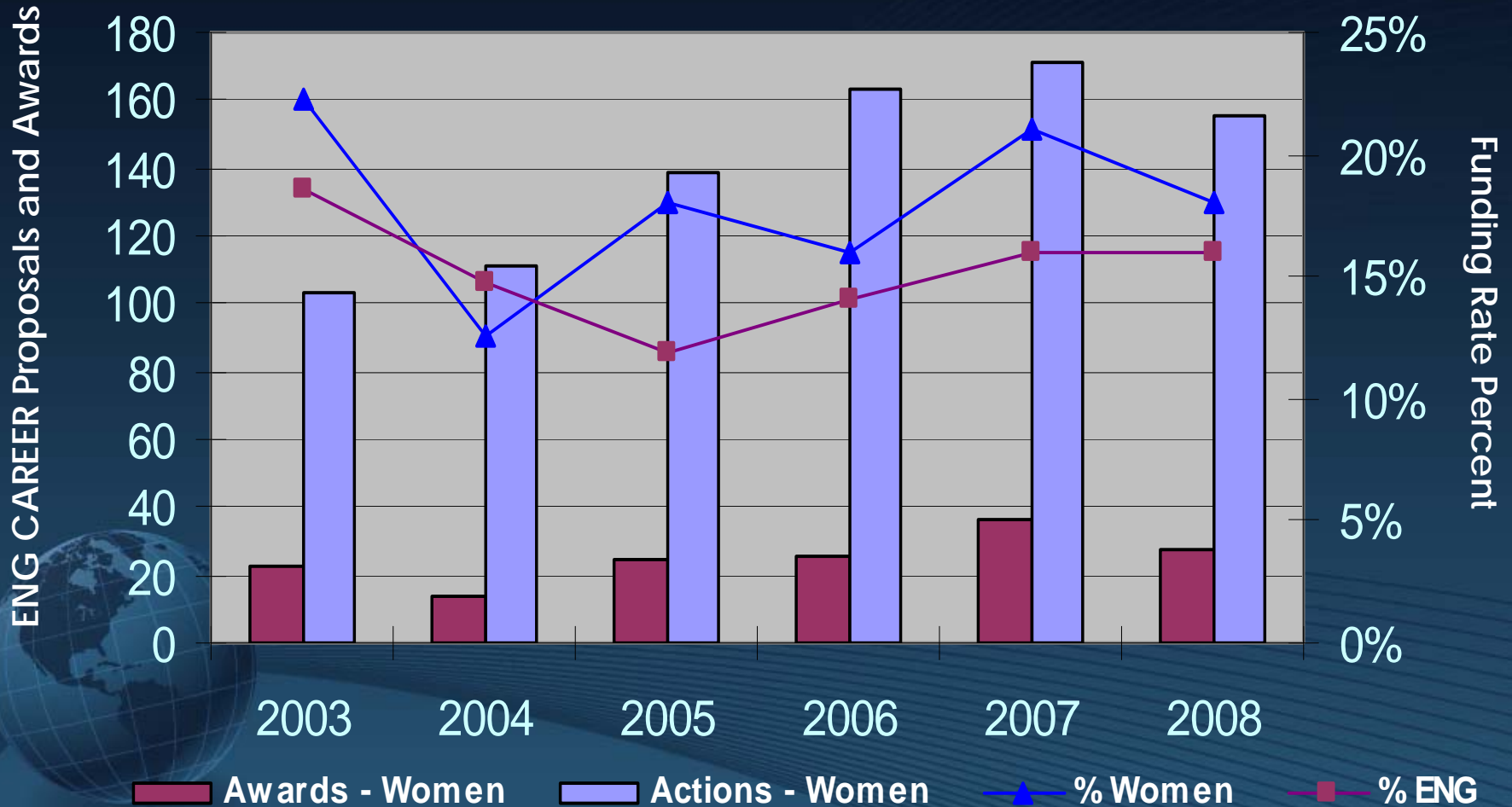


Proposal Submissions to ENG by Under-Represented Minorities





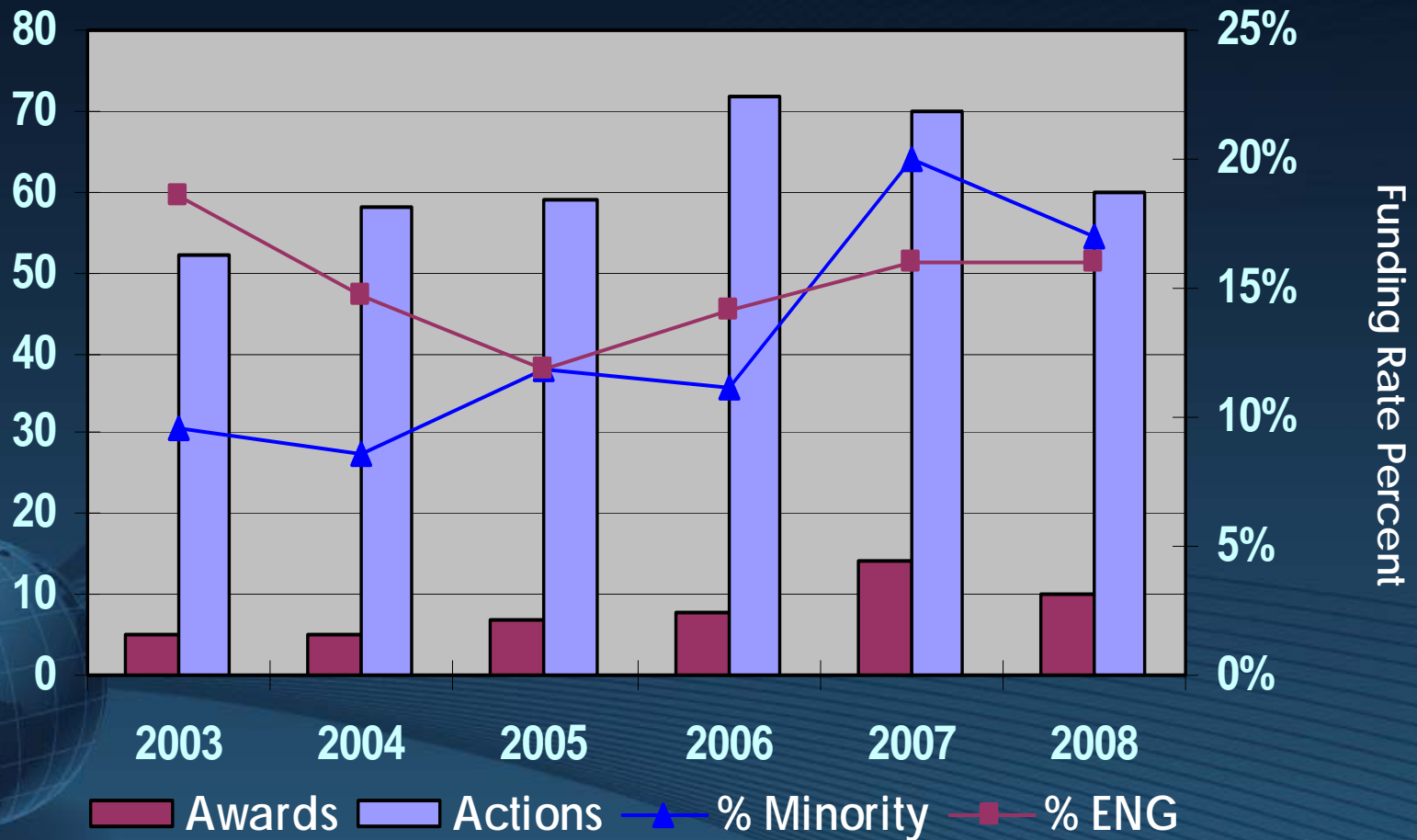
CAREER Funding Rates for Women and All ENG





CAREER Funding Rates for Under-Represented Minorities and All ENG

ENG CAREER Proposals and Awards





Broadening Participation in Engineering

- ◉ Broadening Participation Research Initiation Grants in Engineering (BRIGE)
- ◉ Directorate Plan for Broadening Participation
- ◉ ERC Diversity Plan
- ◉ ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers
- ◉ Graduate Research Fellowships for Women
- ◉ Graduate Research Supplements
- ◉ Tribal Colleges Initiative



Research Experiences for Undergraduates (REU)

- REU had a variety of significantly positive effects on the undergraduates who participated in them, including
 - › Gains in awareness, confidence, skills, and understanding;
 - › Increased interest in related careers; and
 - › Raised academic expectations.
- Among the several racial/ethnic groups, Hispanics were the most likely to report these various positive effects.

From "REU in ENG: 2003-2006 Participant Survey Executive Summary"



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



BRIGE awardee Stephanie Luster-Teasley (L) and NC A&T students Desiree Gordon and Patrick Onochie discuss preliminary research for the development of controlled-release polymers for environmental remediation.



AdCom Discussion Topics

- ◎ EFRI
 - > Process
 - > Outreach
 - > Emerging Areas
- ◎ Broadening Participation
 - > Metrics
 - > EHR Collaboration