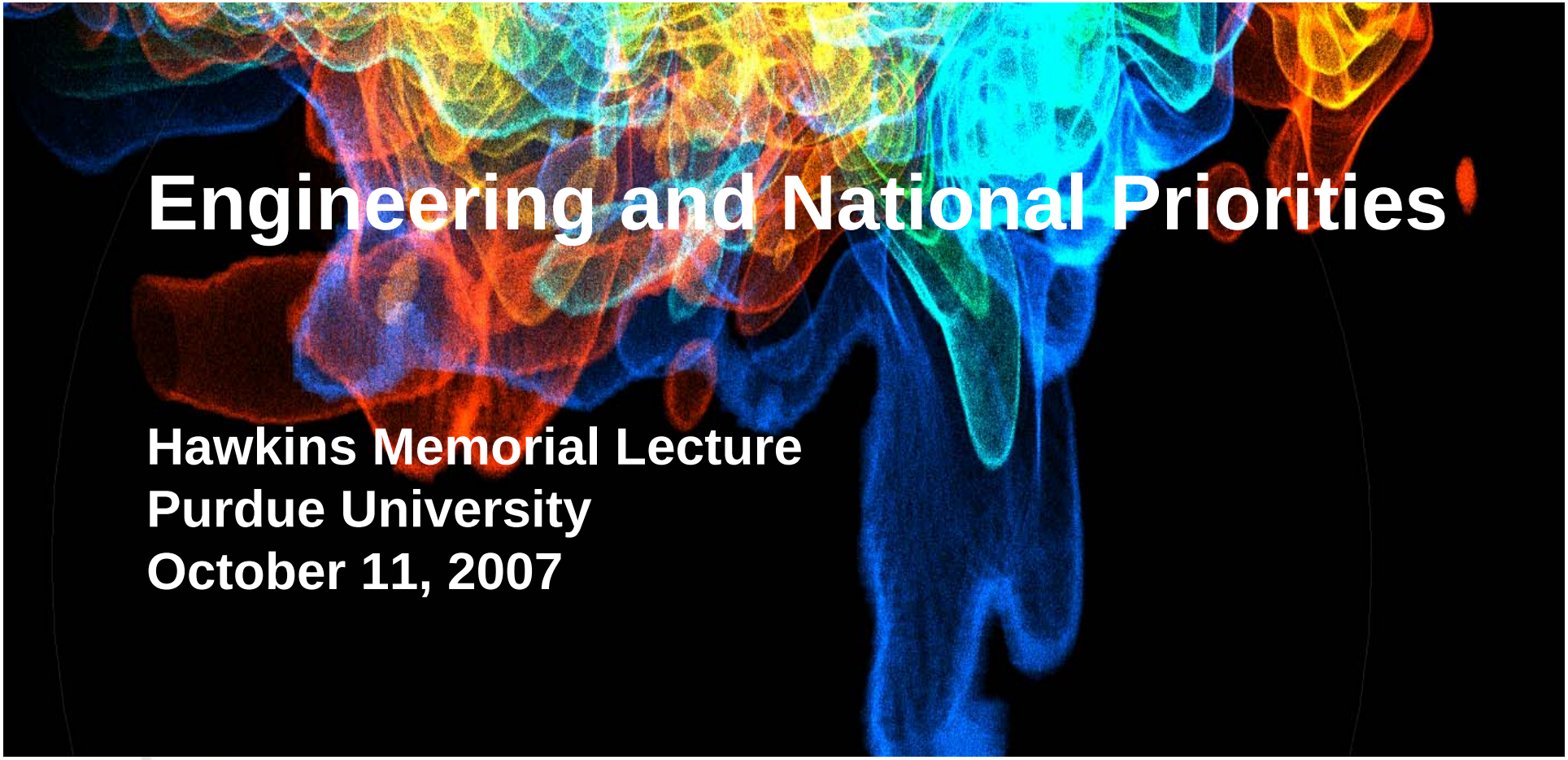


Engineering and National Priorities

Hawkins Memorial Lecture
Purdue University
October 11, 2007

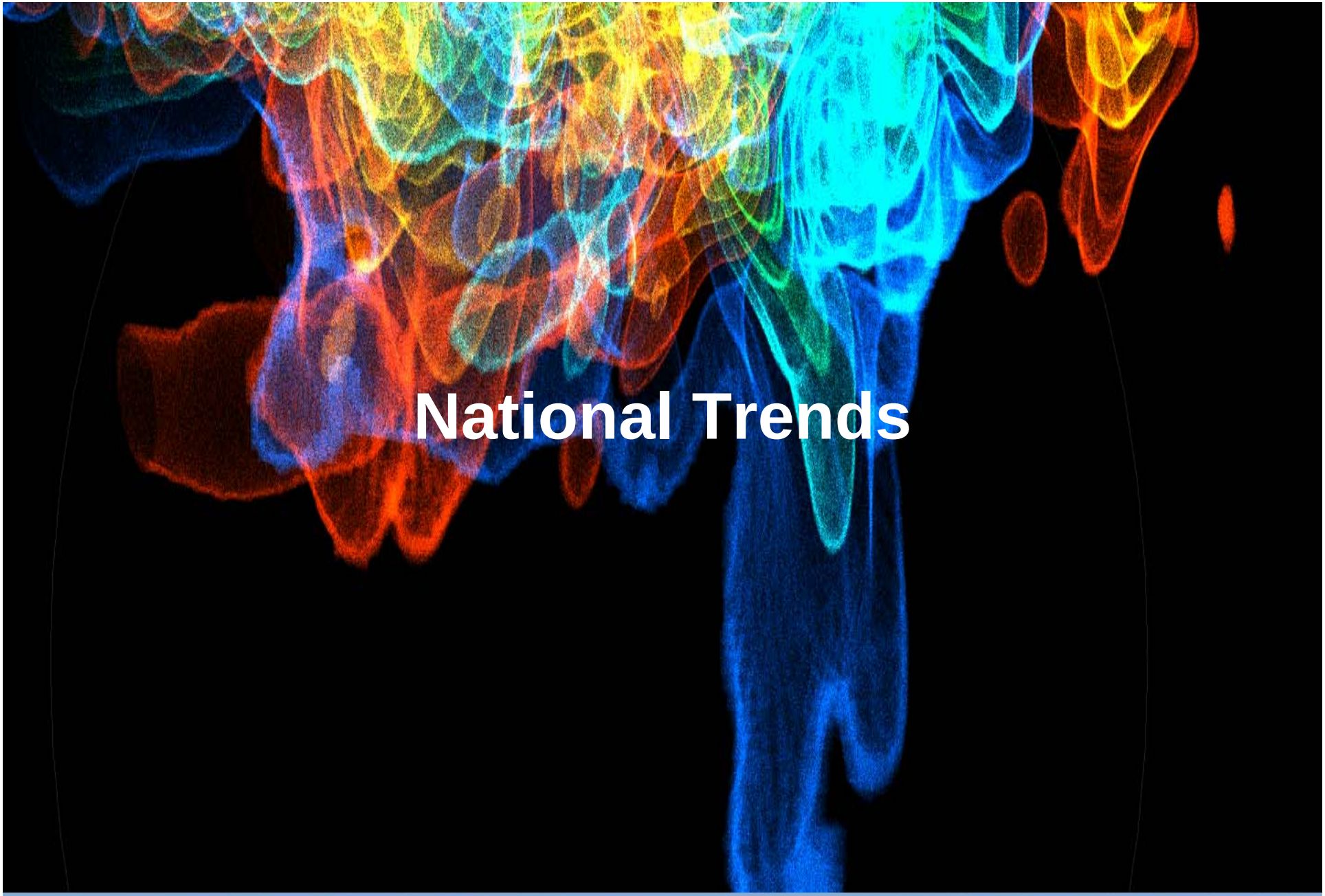
National Science Foundation
Directorate for Engineering

Richard O. Buckius
Assistant Director

Engineering and National Priorities

Topics

- National Trends
- Engineering Trends
  - Engineering Education
  - Engineering Research
- NSF and ENG Trends
- Summary


National Trends

Engineering Perceptions

- According to a 2006 Harris Poll, engineering has less prestige than a number of other professions.
- Top five are firefighter, doctor, nurse, scientist and teacher.
- Engineer just above Member of Congress.

OCCUPATION	PERCENT
	63
	58
	55
	54
	52
	51
	43
	40
	36
Engineer	34
	28
	27
	23
	21
	18
	17
	17
	16
	10
Real Estate Agent	6

1. Firefighter
2. Doctor
3. Nurse
4. Scientist
5. Teacher

8. Priest
9. Farmer
10. Engineer
11. Congress Member

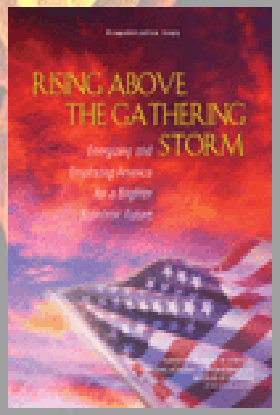
Engineering Perceptions

- More recent survey by BBMG Global Strategy Group associated phrases with engineering.
- Surveyed 1,234 U.S. adults and teens (ages 14–17).
- Top phrases include "must be good at math and science," and "creative."
- Low association with "nerdy" and "have a positive effect on people's everyday lives."

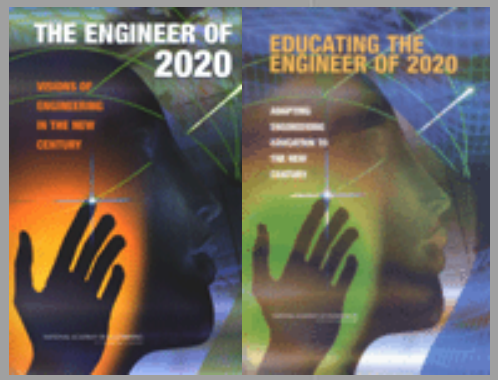
Phrases	Adults	Teens
Must be good at math and science		
Problem solvers	59	62
Creative		
Get results	44	42
Must be smart to get into this field	43	56
Original thinkers	43	45
Hard working	42	62
Well-respected	39	34
The work is rewarding	36	32
Positive effect on people's lives		
Leaders	23	22
Often work outdoors	17	20
Entrepreneurial	12	18
Mostly white	12	11
Requires too many years of school to get a degree	10	15
Nerdy		
Boring	4	12
Sits at desk all day	2	6

External Reports

- The National Academies' *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* recommends enhancements in
  - K–12 education
  - Research
  - Higher Education
  - Economic policy



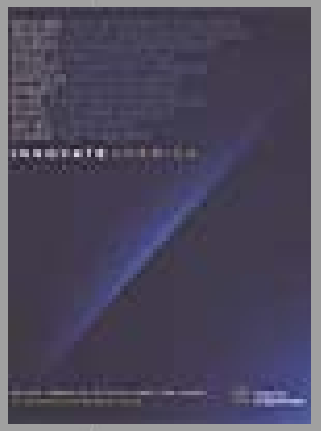
- *The Engineer of 2020* (NAE, 2004) and *Educating the Engineer of 2020* (NAE, 2005) asks "how to enrich and broaden engineering education so that those technically grounded graduates will be better prepared to work in a constantly changing global economy."



External Reports

- ***Engineering Research and America's Future*** **(NAE, 2005): Committee to Assess the Capacity of the U.S. Engineering Research Enterprise**
  - **Recommends increased research support for engineering and physical sciences.**
  - **Seeks enhanced partnership, infrastructure and workforce activities.**

- ***Innovate America: National Innovation Initiative Final Report*** **(Council on Competitiveness, 2005)**
  - **Recommends increased support for workforce, research investments and infrastructure.**
  - **Stresses importance of frontier and interdisciplinary research.**



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.

American Competitiveness Initiative

- The centerpiece of *American Competitiveness Initiative* (ACI) is to double the federal investment in key agencies that support basic research in physical sciences and engineering.
- Over the next 10 years, the Federal agencies impacted are NSF, DOE Science, and NIST.

- ACI includes three broad components:
  - Research in physical sciences and engineering (including 12 specific goals with 7 related to NSF).
  - Research and Development tax incentives.
  - Education and workforce.

ENG Research

ACI topic

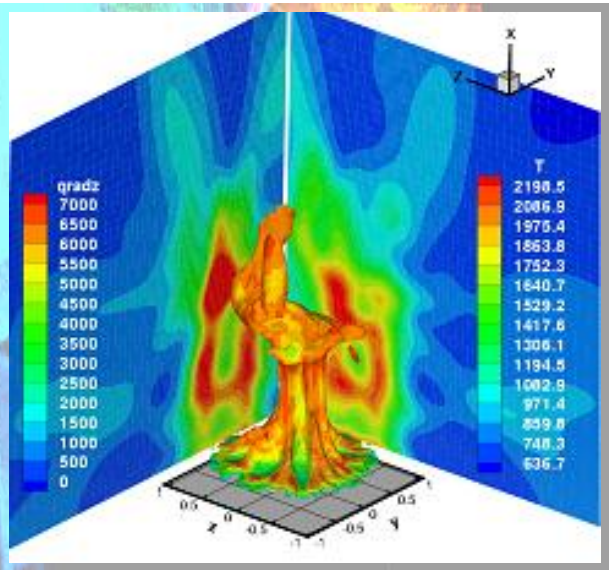
- Advance modeling and simulation in a broad range of disciplines.
  - Significant investments throughout engineering programs on topics ranging from individual investigations to large facilities.
  - Large NSF efforts include:
    - NCN is developing new algorithms, approaches, and software tools to span atomistic treatments of materials to macroscopic description of systems.
    - NEES incorporates a shared use network of 15 large-scale, experimental facilities connected through cyberinfrastructure.

Network for Earthquake Engineering Simulation Leon, 0402490

ENG Research

ACI topic

- **Advance modeling and simulation in a broad range of disciplines (continued).**
  - **Modeling turbulence-chemistry-radiation interactions for a multiphase flow in large hydrocarbon pool fires.**
  - **Recent activities include the *Simulation-based Engineering Science* report and the NSF-wide initiative Cyber-enabled Discovery and Innovation.**

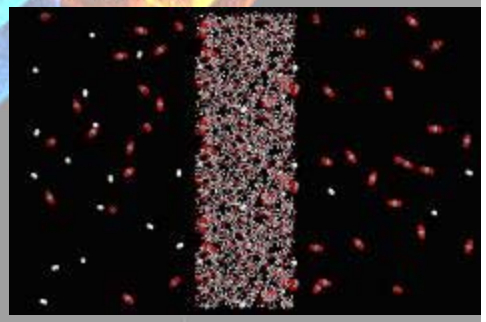


DesJardin, 0348110

ENG Research

ACI topic

- **Efficient, economic and sustainable use of energy.**
  - **A central activity for engineering.**
  - **NSF and ENG has and will continue to "catalyze" fundamental discoveries and innovations vital to a new energy future.**
  - **The estimated total NSF investment in energy research and education in FY 2003 was $20 million, and has more than doubled to approximately $53 million in FY 2005.**
  - **These totals for energy research reflect nearly every NSF funding mechanism and NSF Directorate.**



Freeman, 0515425

ENG Research

ACI Topic

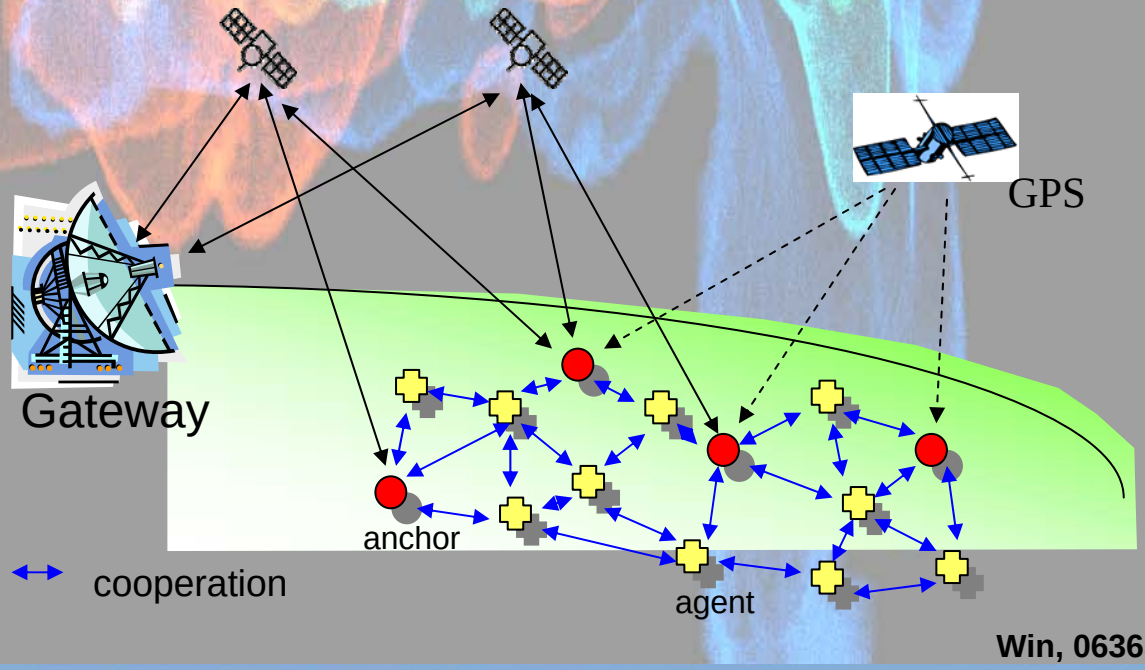
- **Advances to improve structural performances during natural disasters.**
  - **Very diverse and important area including natural, technological, and human-generated hazards such as earthquakes, hurricanes, tsunamis, and fires.**
  - **7-story reinforced concrete building test at UCSD NEES outdoor shake table showed that a structural wall with half the amount of reinforcing steel required by most building codes, but with more optimal layout, can better resist seismic loads.**

Restrepo, 0217293

ENG Research

ACI topic

- **Addressing cyber security and information assurance.**
  - **Seamless location-awareness and robust wireless communication for dynamic networks in harsh environments and over large geographic areas.**
  - **Hybrid Satellite/Terrestrial Network for Seamless Communication and Localization.**

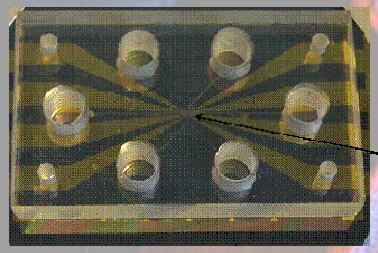


Win, 0636519

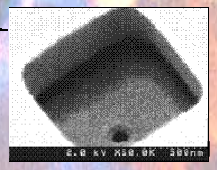
ENG Research

ACI Topic

➔ **World-class capability in nanofabrication and nanomanufacturing.**



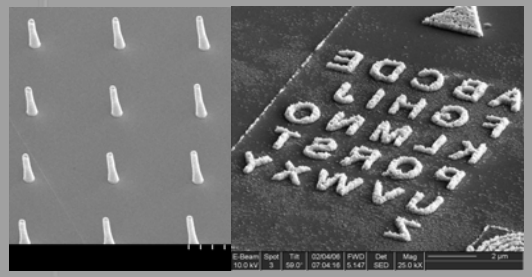
2x1 Inch²



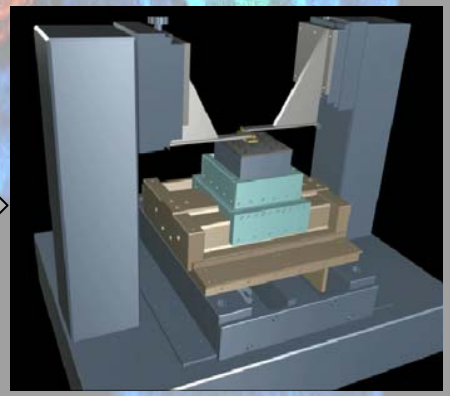
80 nm pore in PMMA

Molecular Gate Toolbit

Electro-jet Writing



Electro-chemical Processes



Ferreira, 0328162

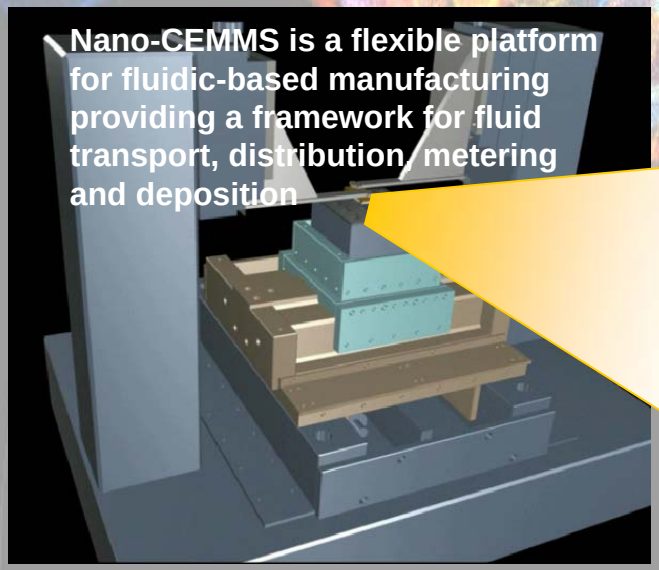
Component Fabrications → **Assembly** → **Product**

ENG Research

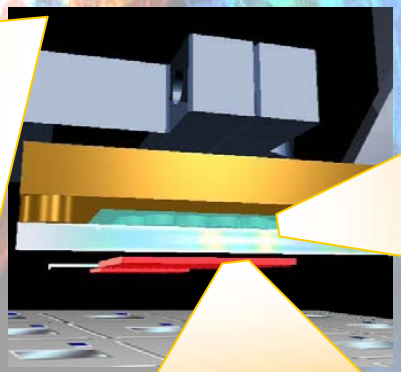
ACI topic

- **World-class capability in nanofabrication and nanomanufacturing (continued).**

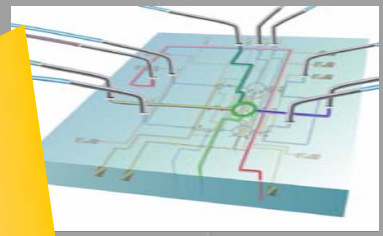
Nano-CEMMS is a flexible platform for fluidic-based manufacturing providing a framework for fluid transport, distribution, metering and deposition



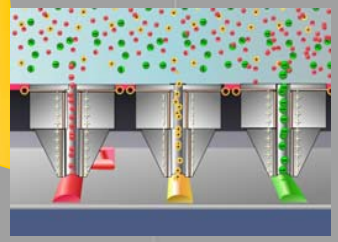
An interchangeable toolbit provides process flexibility and helps bridge scales from the macroscale to the meso and microscales.



VLSI microfluidic circuits in the toolbit are responsible for transport, distribution and downsizing

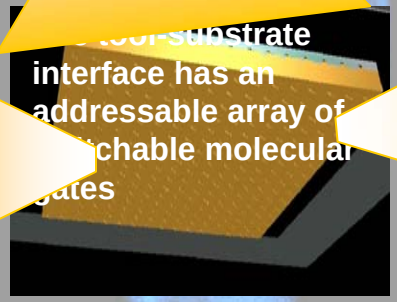


The molecular gates provide selectivity and switching capabilities during deposition



Sensing at the interface allows for the transduction of the state of the structure

Ferreira, 0328162



ENG Research

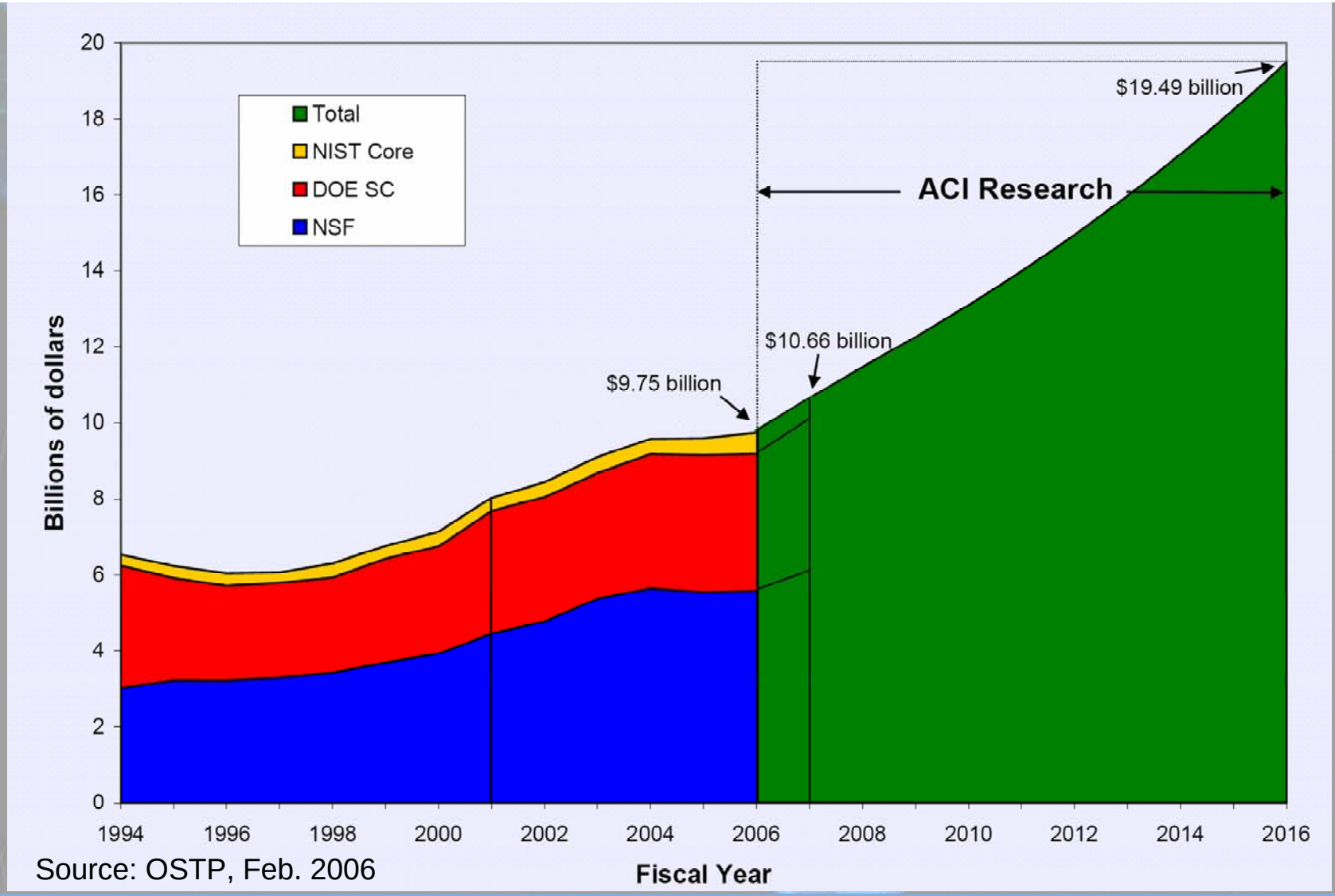
- Improved sensor and detection capabilities.
  - Engineering is central to cutting-edge research on sensors.
  - Current long-range weather radars have limited ability to observe the lower part of the atmosphere so one in five tornadoes goes undetected.

Simulation of the formation of an F3 tornado.
National Center for Supercomputing Applications, UIUC

  - Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) is building a network of low-power, ground-level Doppler radar systems.
  - The accuracy of the CASA predictions is due to new mathematical algorithms that use radar data to dynamically detect tornadoes close to the ground and then provide information to optimize radar scanning.

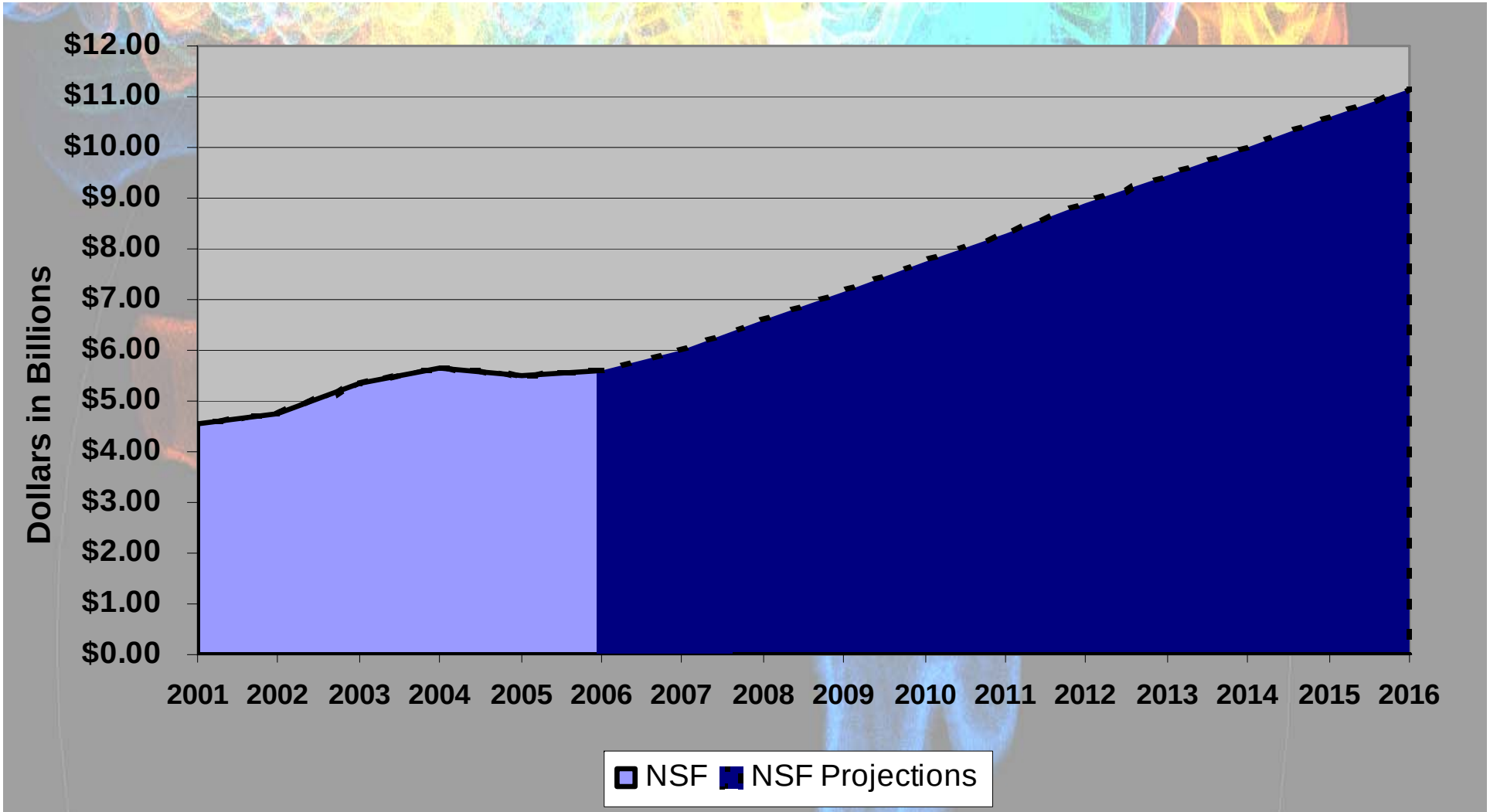
American Competitiveness Initiative

FY 2007–FY 2016

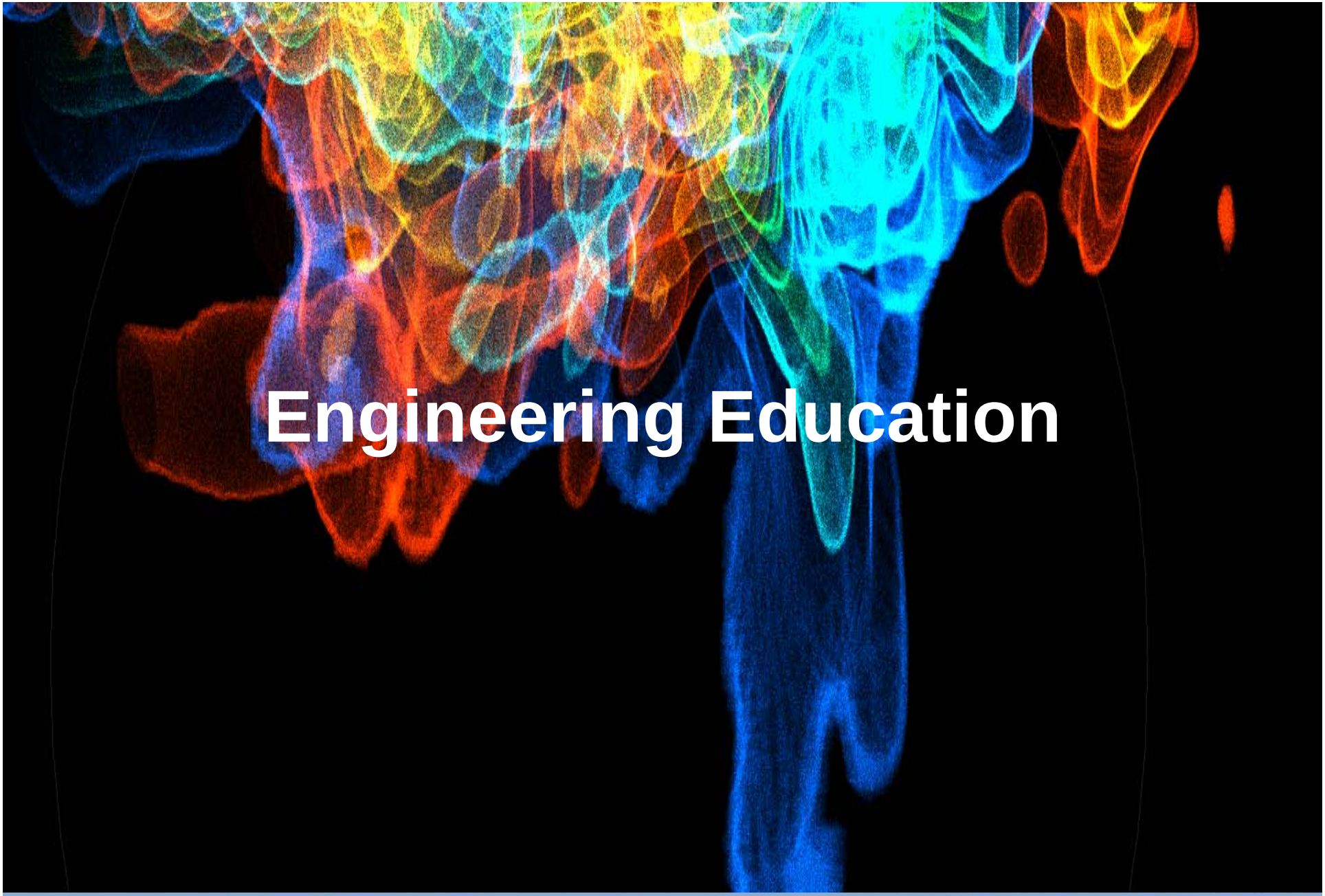


Source: OSTP, Feb. 2006

ACI-Driven NSF Budget Projections



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


Engineering Education

Engineering Education

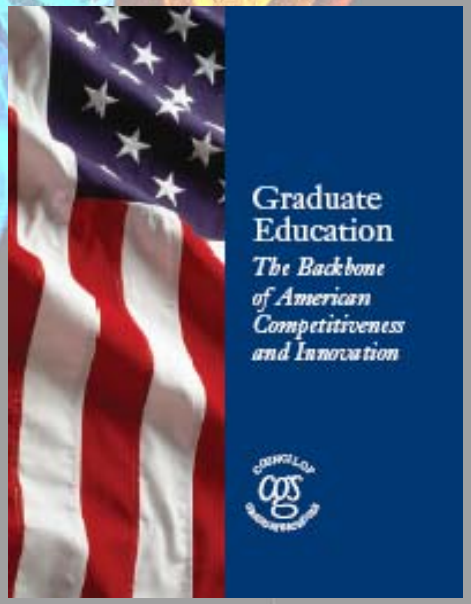
NSB report

- The National Science Board has an *ad hoc* task group discussing engineering education.
- Two workshops have been held over the last two years at MIT and Georgia Tech.
- Focused on
  - Changing global context for engineering.
  - Perceptions of engineering.
  - Retention of engineering students.
- Final report due soon.

Doctoral Engineering Education

External Reports

- Council of Graduate Schools released a report on April 26, 2007 entitled *Graduate Education – The backbone of American Competitiveness and Innovation.*

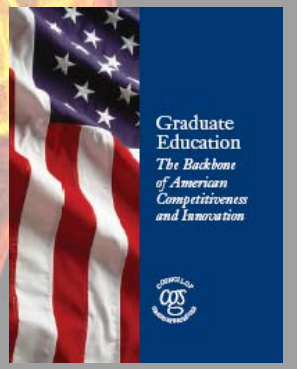


- Recommendations include:
  - Develop a highly skilled workforce through collaboration among leaders in higher education, business and government.
  - Produce a highly educated workforce with advanced skills and the flexibility to compete in an interdisciplinary environment at the frontier of knowledge creation.

Doctoral Engineering Education

Council of Graduate Schools

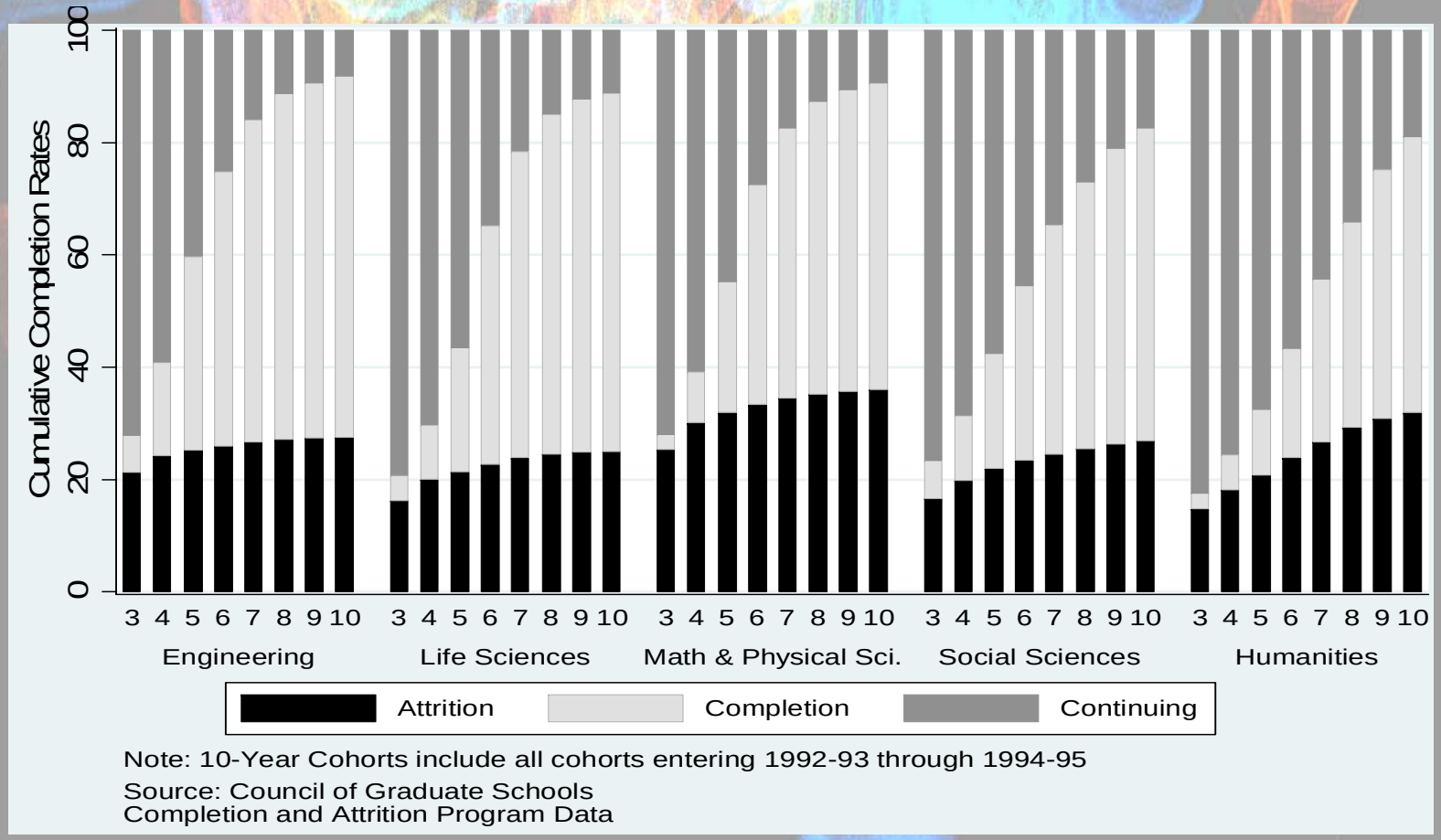
- Additional specifics include:
  - Encourage graduate schools to urge their students to become citizen scholars by using their knowledge and skills in a real-world setting to gain experience through service to the community, the state, the nation and the world
  - Identify successful models that incorporate entrepreneurship across graduate curricula, as well as future directions for exploring the power of entrepreneurship in graduate education
  - Build management structures that encourage inter-program as well as cross-program collaborations.



Doctoral Engineering Education

External Reports

- **Cumulative Attrition, Completion, and Continuing Rates (for years since entering doctoral study)**



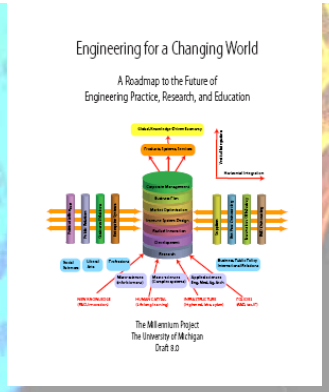
Note: 10-Year Cohorts include all cohorts entering 1992-93 through 1994-95

Source: Council of Graduate Schools
Completion and Attrition Program Data

Engineering Education

Engineering for a Changing World

- James Duderstadt is preparing a report entitled ***Engineering for a Changing World—A Roadmap to the Future of Engineering Practice, Research, and Education.***



- Recommendations include:
  - Establishing engineering practice as a profession that is similar in rigor, intellectual breadth, preparation, stature, and influence to law and medicine, with extensive post-graduate education.
  - Establish engineering as a true liberal arts discipline, similar to the natural sciences, social sciences, and humanities, by imbedding engineering into general education requirements of a college graduate.
  - Goal: develop graduates prepared for a society increasingly dependent on and driven by technology.
  - Consider practice-oriented Master of Engineering or Doctor of Engineering as accredited degrees for professional practice.

Engineering Education

NSF Investment Timeline

- President eliminates education programs at NSF

- Coalitions
- ABET
- Graduate Engineering Fellowships & Traineeships
- Course & Curriculum Development
- Instrumentation & Laboratory Improvement
- UG Faculty Enhancement

- NAE Center for Advancement of Scholarship in Engineering Education
- Science, Technology, Engineering & Mathematics Talent Expansion Program
- Department Level Reform
- Research Experiences for Teachers
- Centers for Teaching and Learning

1980 1985 1990 1995 2000 2005

- National Science Board Homer Neal Report
- Presidential Young Investigators
- Engineering Research Centers
- Calculus Reform
- Instructional Labs
- Research Experiences for Undergraduates

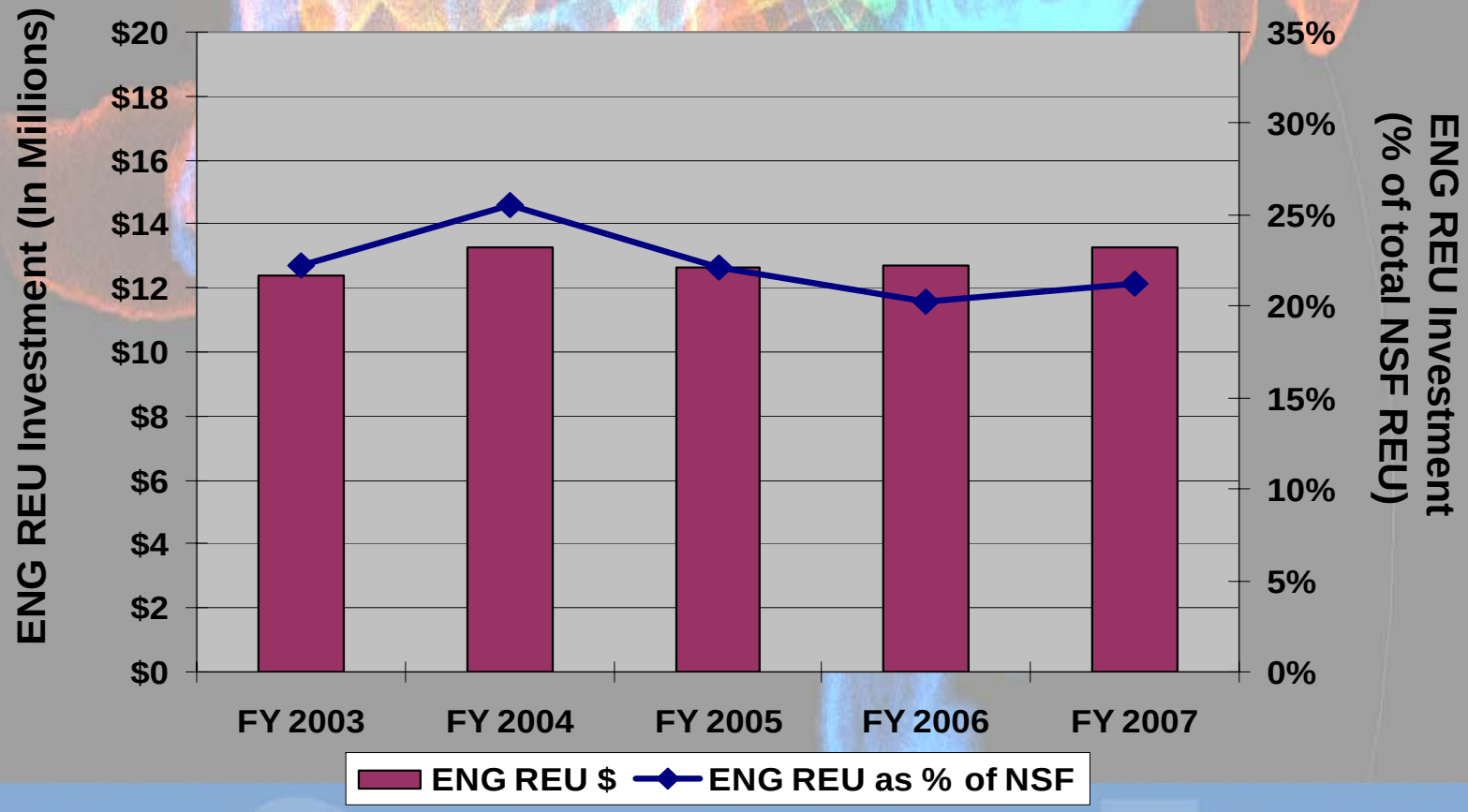
- Model Institutions for Excellence
- ADVANCE
- Louis Stokes Alliances for Minority Participation
- Alliances for Graduate Education and the Professoriate
- Advanced Technological Education

- American Competitiveness Initiative
- NAS Rising Above the Gathering Storm
- NAE Engineer of 2020 and Educating the Engineer of 2020
- Engineering Education Departments
- Research Agenda for Engineering Education

Research Experiences for Undergraduates

REU Background

- To encourage U.S. citizens to pursue doctoral studies by engaging them in research as undergraduates.
- Includes both REU sites and supplements.



Research Experiences for Undergraduates

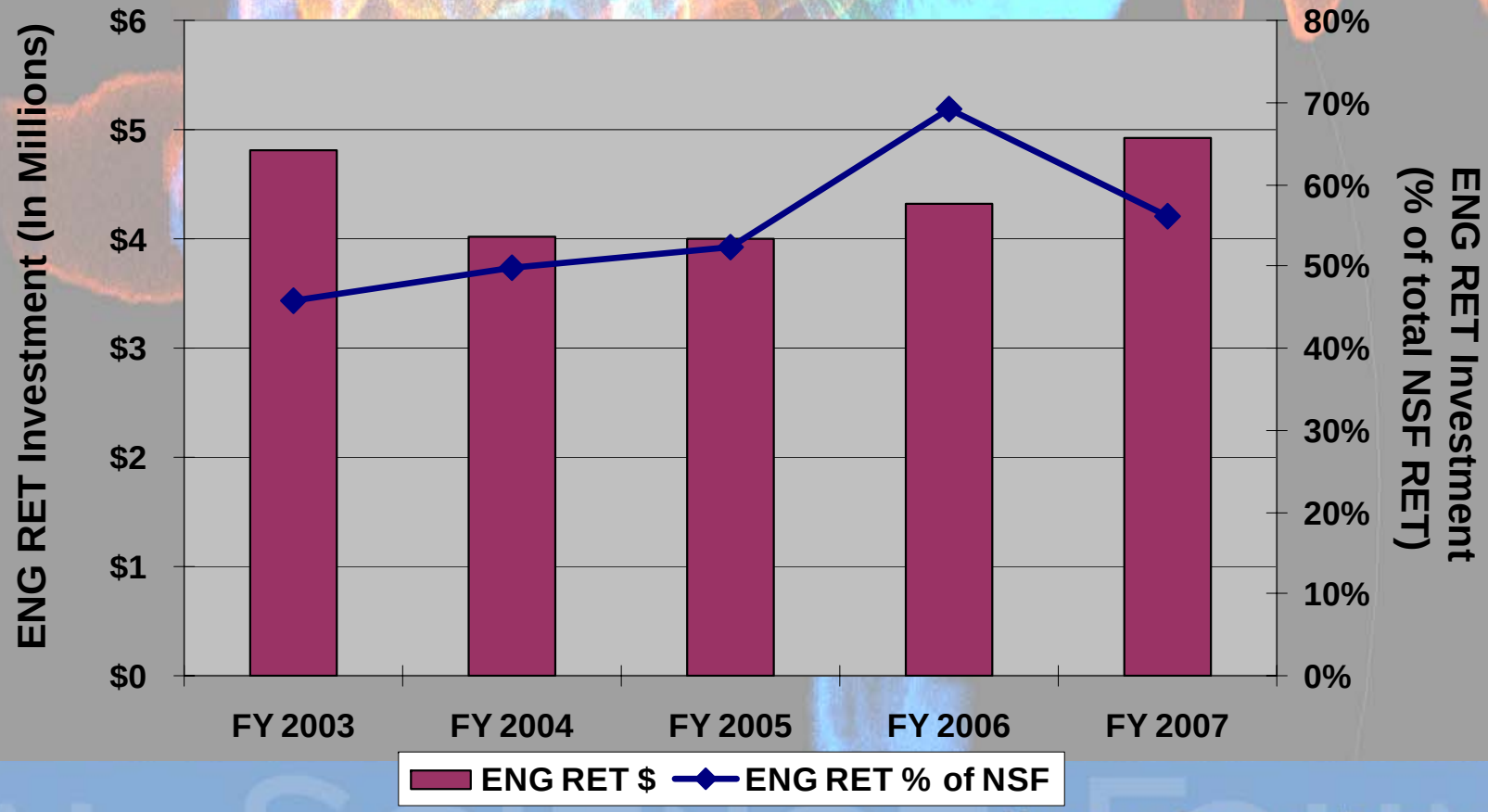
Findings

- SRI evaluated the NSF-wide program in 2006
  - Included almost 15,000 respondents
  - Engineering-specific results were not obtained
  - In general, there is significantly higher graduate school attendance, increased understanding of research processes, and increased awareness and interest in academic and research careers
  - For example,
    - 6 in 10 participants indicated that REUs were important in their decision to apply to graduate school.
    - Half to two-thirds of the respondents reported that their REUs increased their interest in STEM careers and research.
  - Recommendations include REUs and inquiry-based activities earlier in student's programs.

Research Experiences for Teachers

RET Background

- Supports the active involvement of K–12 teachers and community college faculty in engineering research.
- Brings knowledge of engineering and technological innovation into pre-college classrooms.



Research Experiences for Teachers

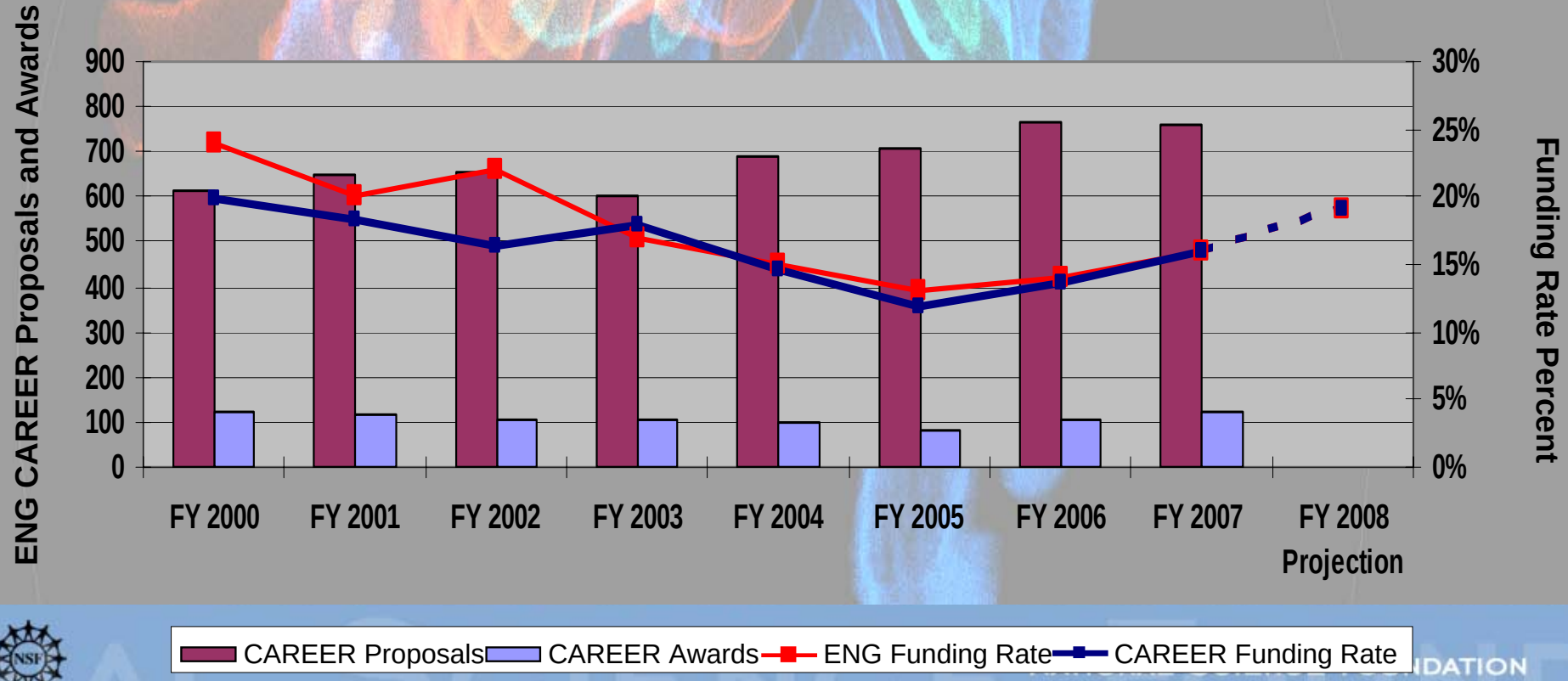
Findings

- **SRI completed an assessment of RET in selected fields of engineering in 2006 finding:**
  - **Teachers add engineering content and process to their pre-college courses. 94 percent of teachers reported increased motivation to find ways to improve student learning, and 89 percent of teachers reported increased confidence in teaching science and math.**
  - **Teachers report dramatic increase in understanding of engineering. They are much better prepared to counsel students to pursue engineering.**
  - **Need to provide continuing opportunities for teachers and faculty interactions.**

CAREER Awards

ENG CAREER Proposals and Awards

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



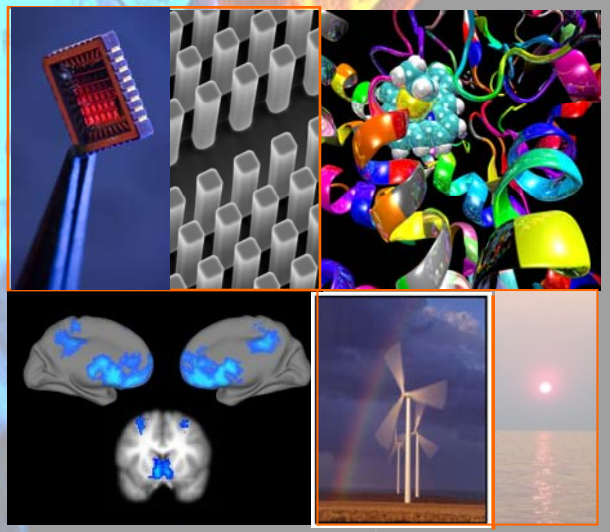

Research Themes

Directorate for Engineering

Research and Education Themes FY 2008

Engineering research spans the frontiers

- To more effectively support fundamental research and education, the Directorate for Engineering (ENG) has identified five Research and Education Themes for FY 2008.
- The themes represent a convergence of fields, disciplines, and frontier opportunities that crosscut divisions, and give general guidance on the potential future directions of engineering research.
- Theme designations will evolve over time, reflecting the maturation of certain fields, the emergence of new fields, and the shift in demand from society for significant progress on grand challenges.



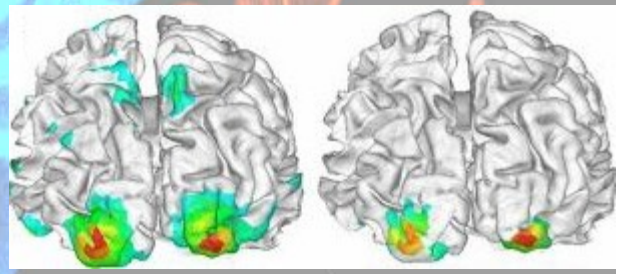
Engineering contributes at all scales. Examples are nanotechnology, computational simulation, health, and alternative energy.

Directorate for Engineering

Research and Education Themes

Cognitive Engineering: Intersection of Engineering and Cognitive Sciences

- Supports engineering methods and systems for improving understanding of brain and nervous system.
- Enables research on how to mimic nervous system processes to engineer better systems, machines and technologies.
- Provides a foundation for competitive innovations—such as intelligent machines that analyze and adapt—called for in ACI.



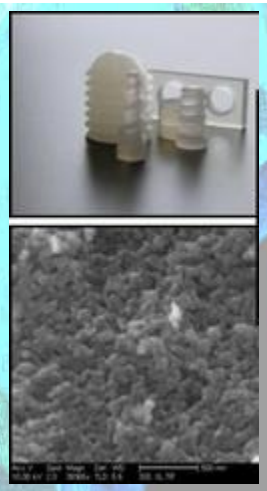
Combining EEG with functional MRI data (left image is EEG, right image shows both) enables precise mapping of brain activity. *He, 0411898.*

Directorate for Engineering

Research and Education Themes

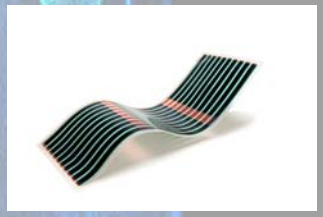
Competitive Manufacturing and Service Enterprises

- Research supports innovation for understanding and thus specifying how materials are made at many scales.
- Development of efficient systems provides foundation for better delivery of services, such as making health care and health information more accessible.
- ACI goal for advances in materials science and engineering; and to create world-class capacity in nanomanufacturing.

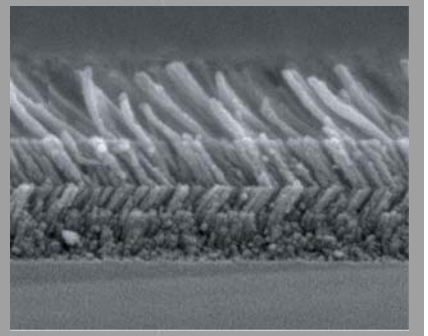


Groza, 0523063.

Nanoparticles compose a lightweight biocompatible material for bone implants (left); or they enhance the efficiency of a flexible solar cell (middle). Nanorods can be layered as a coating (bottom) that reflects almost no light and could potentially increase solar cell efficiency.



Konarka Technologies Inc., 0450532.



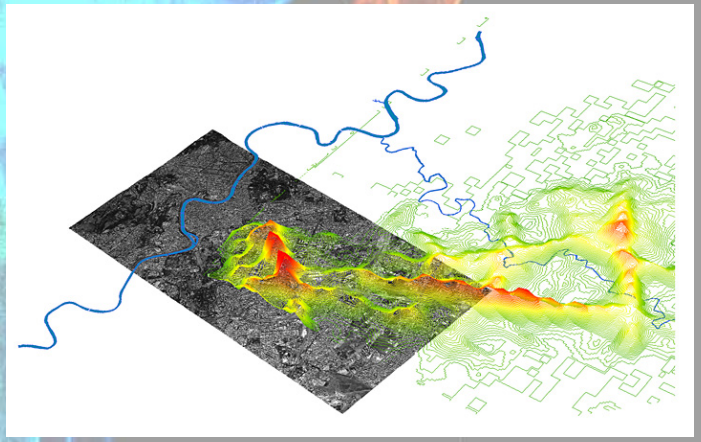
Schubert, 0725615.

Directorate for Engineering

Research and Education Themes

Complexity in Engineered and Natural Systems

- Addresses unifying principles that enable modeling, prediction, and control of emergent behavior in complex systems.
- Impacts specific national research goals, including materials for improving structural performances during natural disasters, overcoming barriers to quantum information processing, and world-leading automation and control technologies.
- This research enhances our ability to understanding of natural systems, engineered systems, and interface of natural and engineered systems.



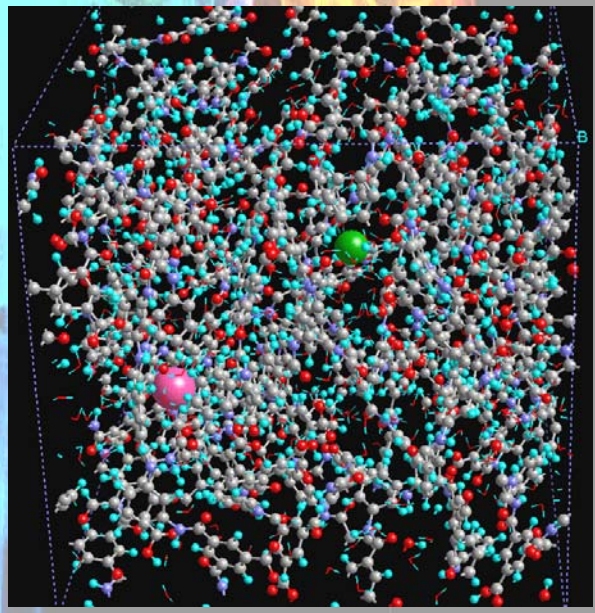
Combining maps (gray square) and density of cell-phone usage (shown as red and yellow 3-D peaks) can yield complex system response unplanned events. ***Dahleh, 0735956*** .

Directorate for Engineering

Research and Education Themes

Energy, Water and the Environment

- Enables breakthroughs essential to harness, efficiently store, and economically distribute energy from alternative sources.
- Fosters research on materials and methods for assuring a supply of clean water.
- Develops new technologies needed to make energy use more efficient and thus to lessen energy demand.
- Meets the ACI goal of efficient, economic and sustainable use of energy.



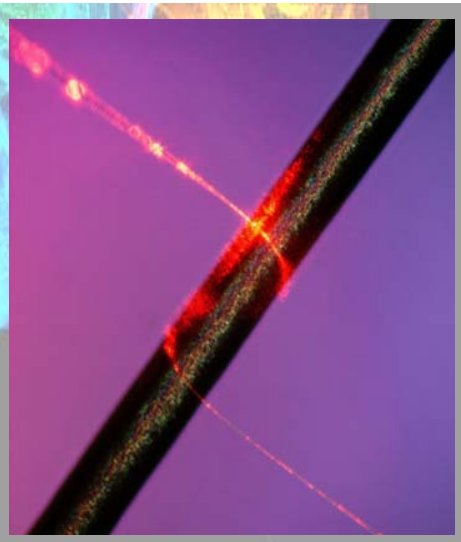
Advanced water purification and desalinization begins with a detailed understanding of how ions in water interact with purification membranes. This dynamic computer simulation shows sodium (pink) and chlorine (green) ions inside a polyamide membrane. *Shannon, 0120978.*

Directorate for Engineering

Research and Education Themes

Systems Nanotechnology

- Next frontier: create controllable systems built from nanoscale components.
- Wide application: new materials, petascale computing, organ regeneration, biological sensors for health monitoring, high-specificity sensors for national security.
- Meets the ACI goal for nanomanufacturing, as well as for developing high-end computing capability; overcoming technological barriers to efficient and economic use of energy; and improvement of sensor detection capabilities.



Light moves along a nanowire, pictured here wrapped around a human hair. Controlling light at the nanoscale could allow many applications, such as high-resolution sensors and optical transistors. ***Mazur, 0601520***.

NSF and ENG Trends

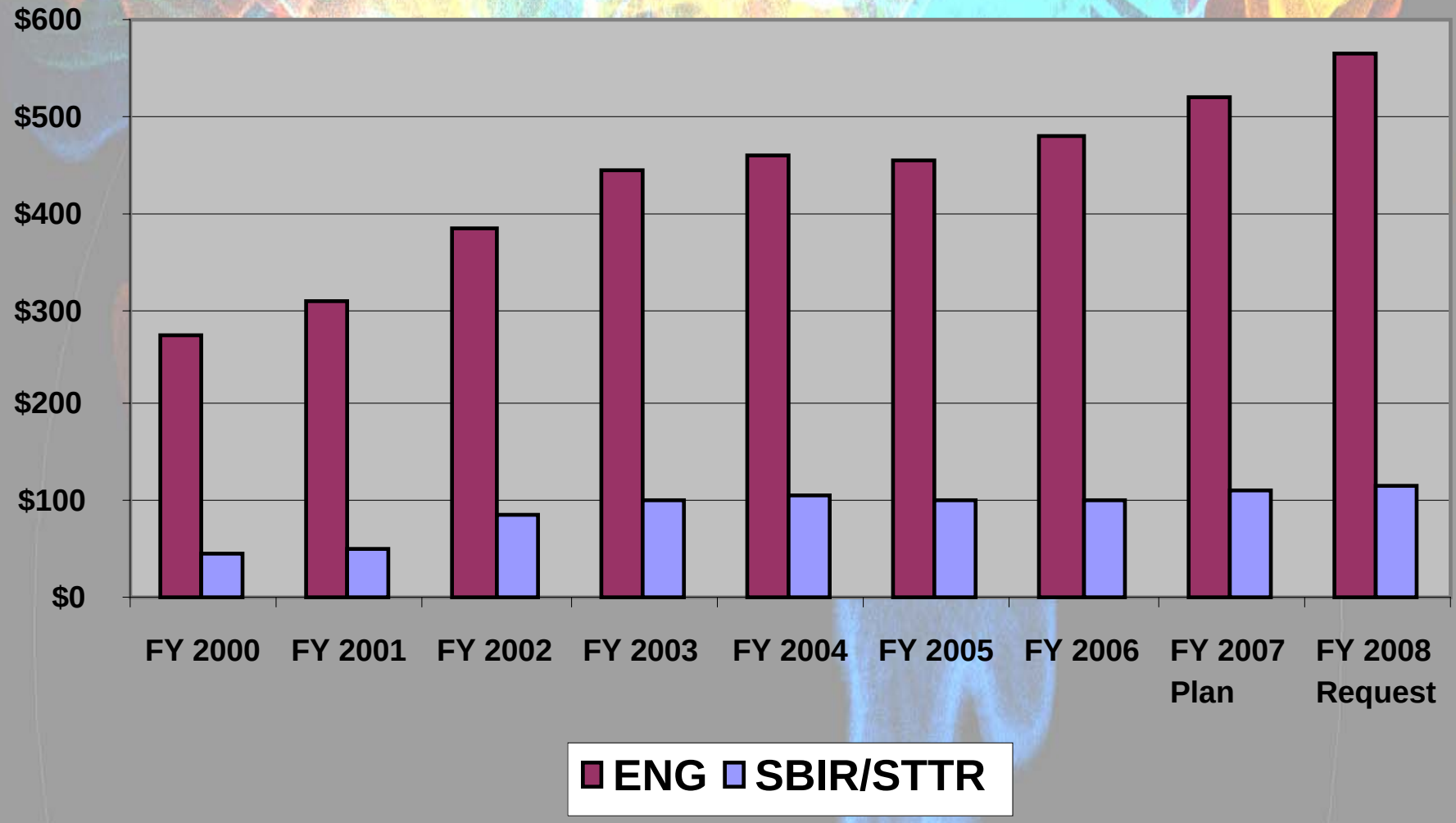
NSF Budget by Research Directorate

Dollars in Millions

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%

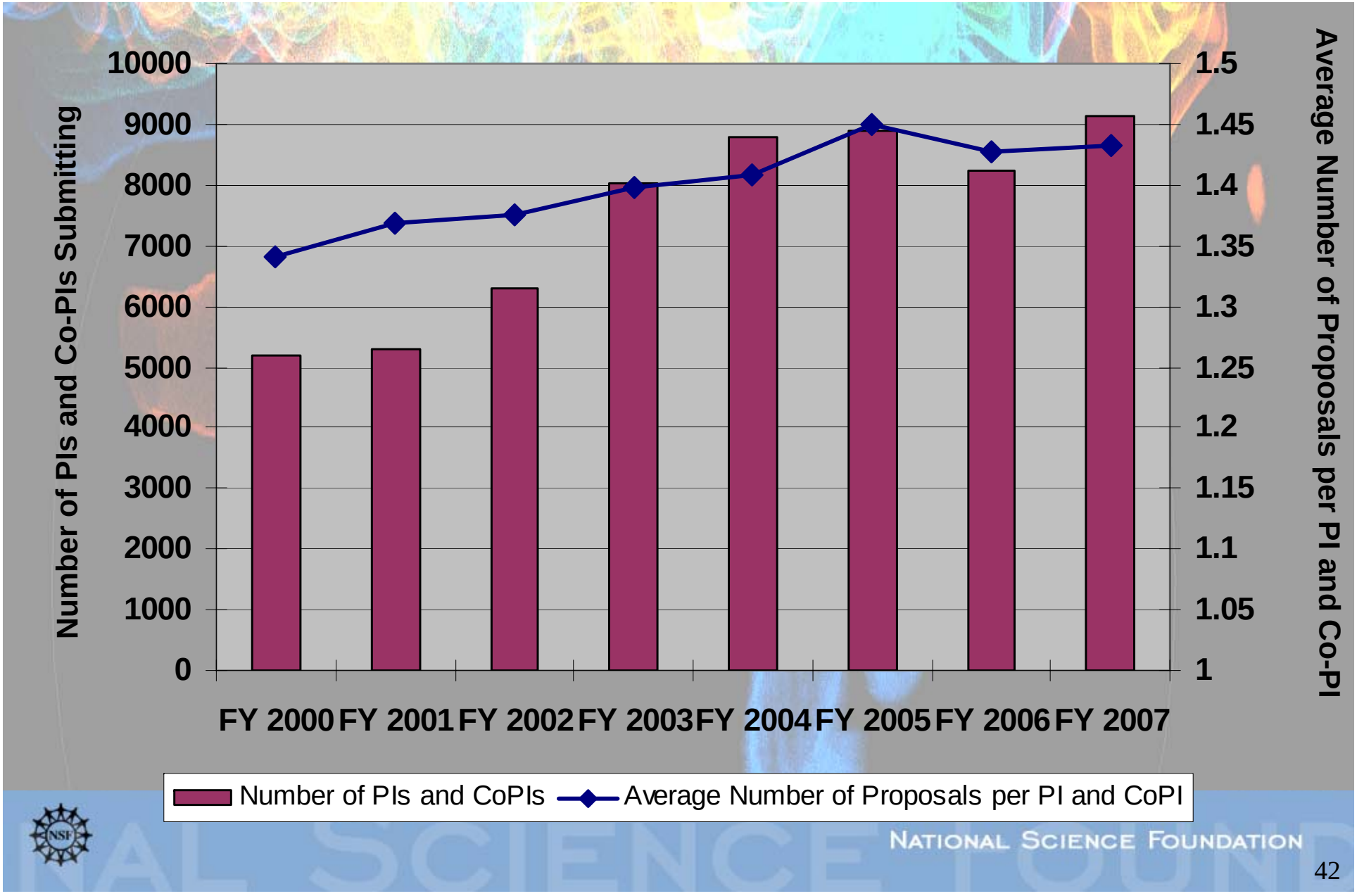
ENG and SBIR/STTR Budgets

Dollars in Millions



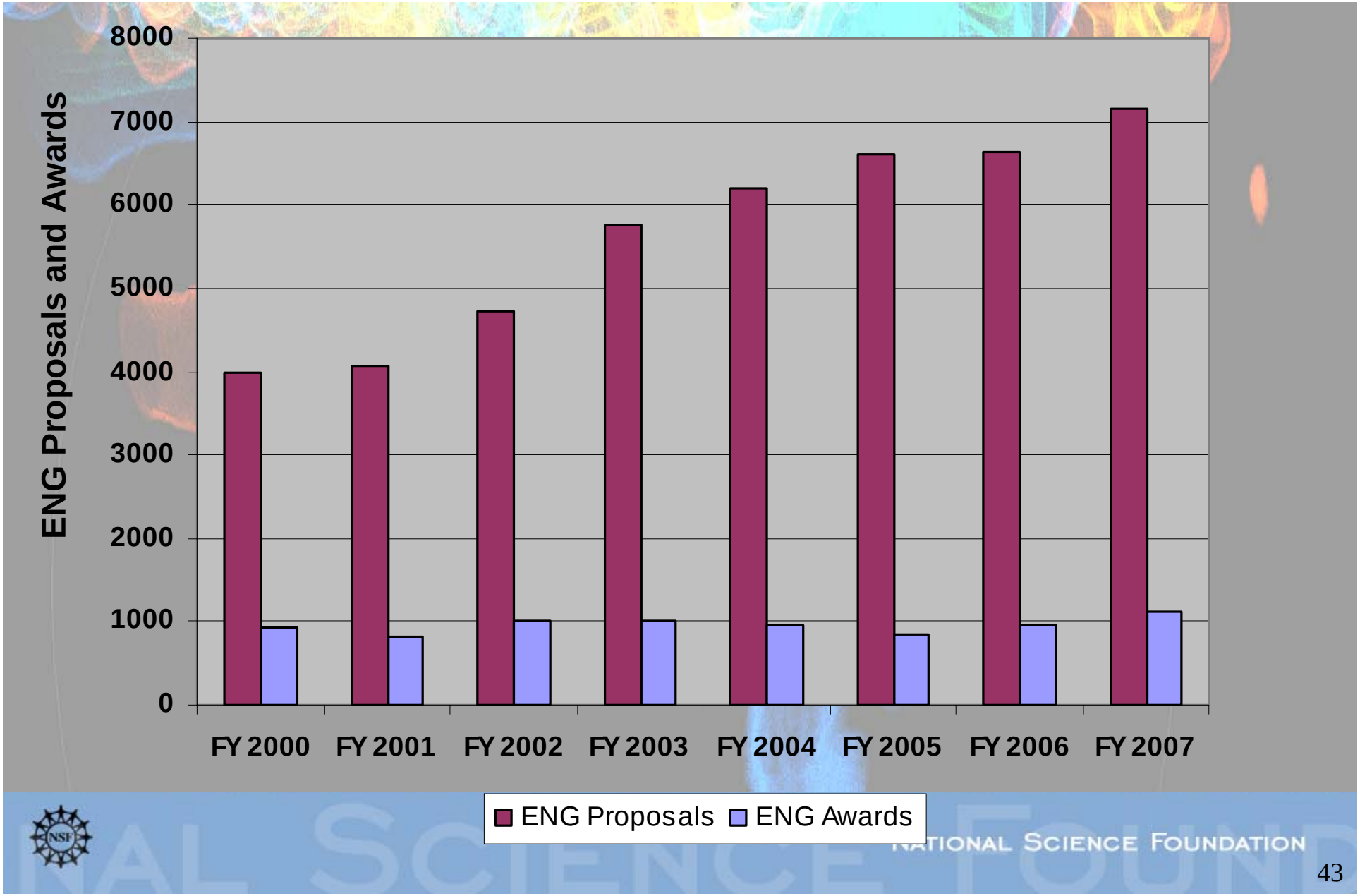
PI and Co-PI Submissions

ENG Research Grants



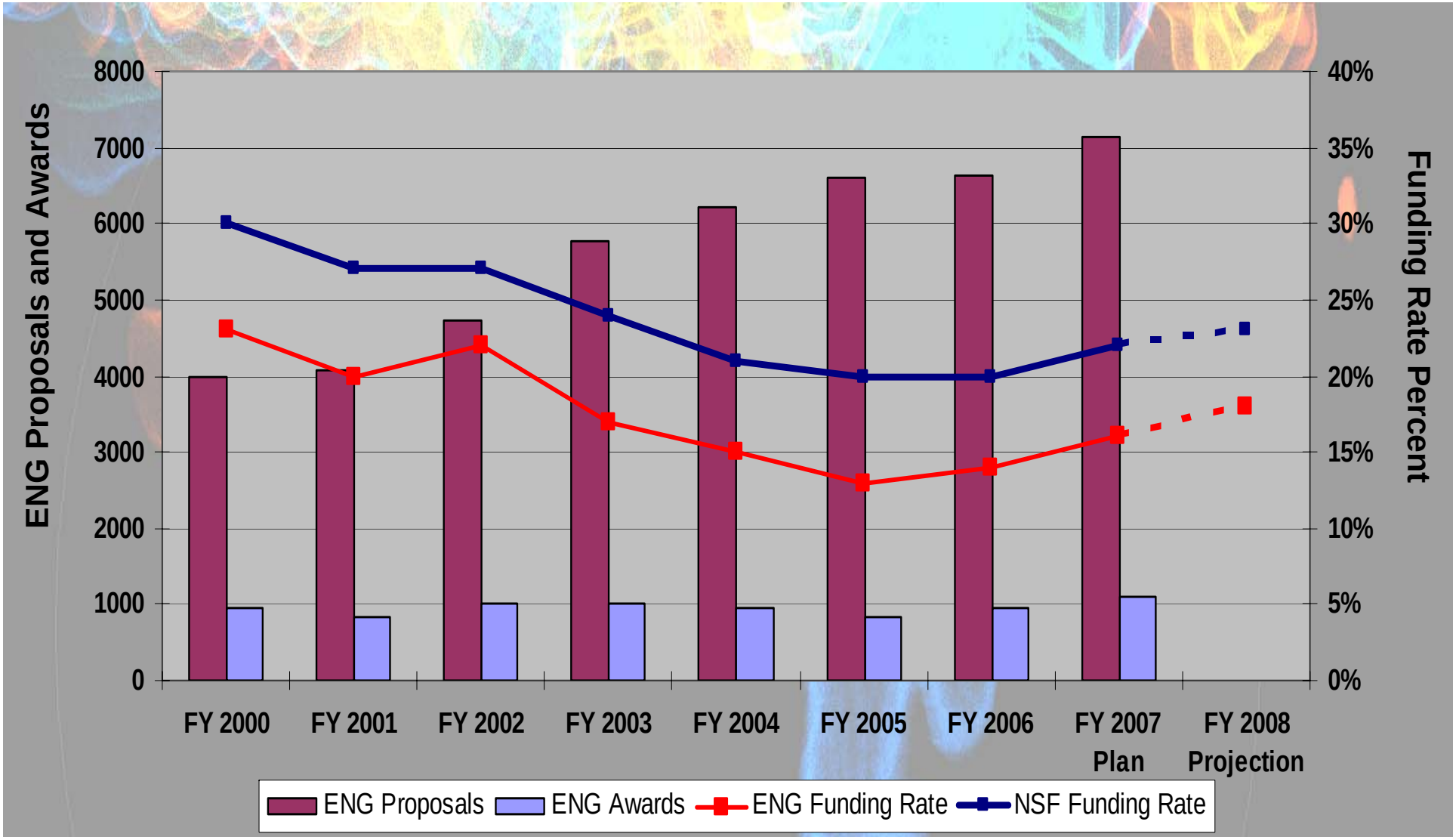
ENG Proposals and Awards

Research Grants



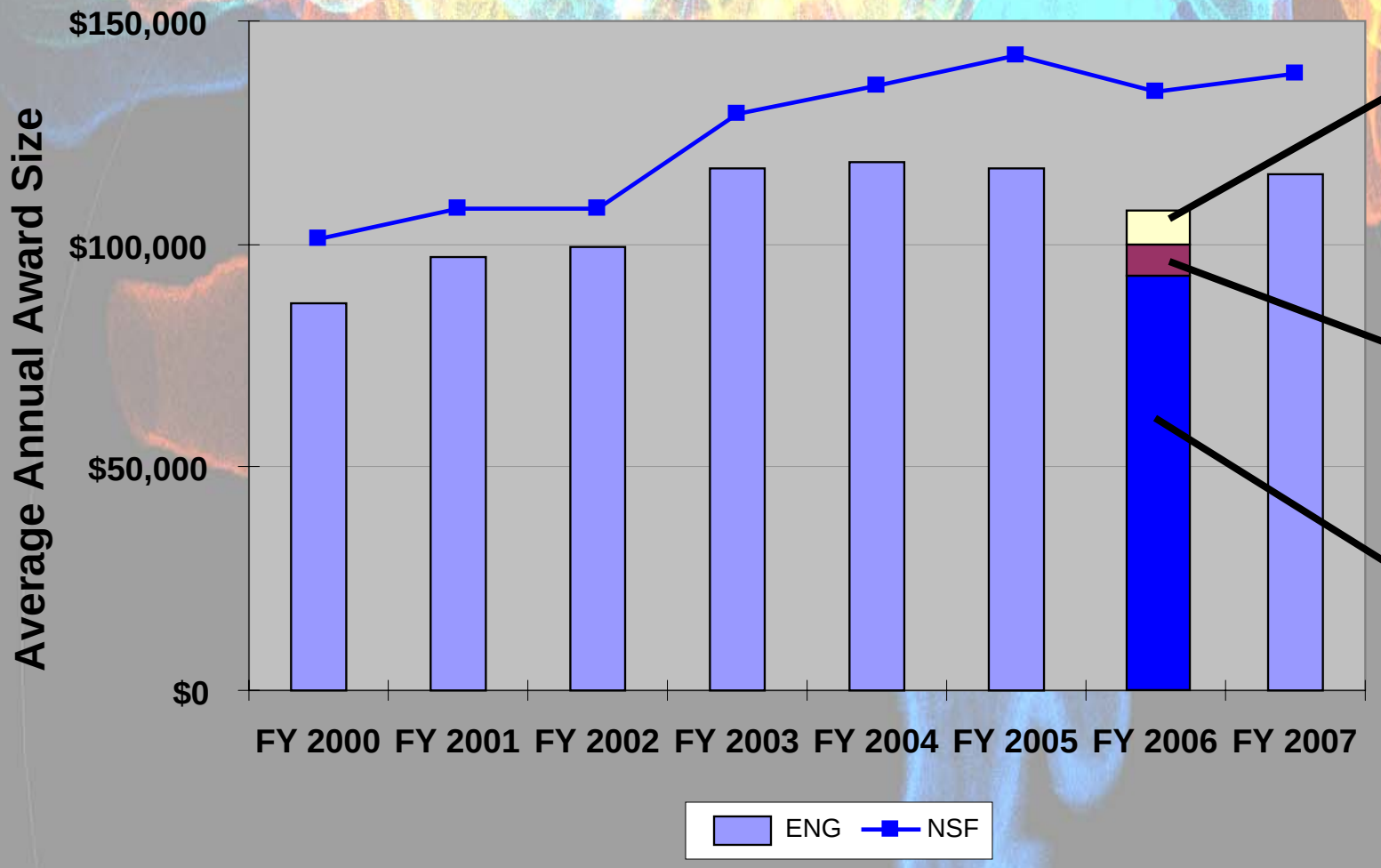
ENG and NSF Funding Rates

Research Grants



Annual Award Size

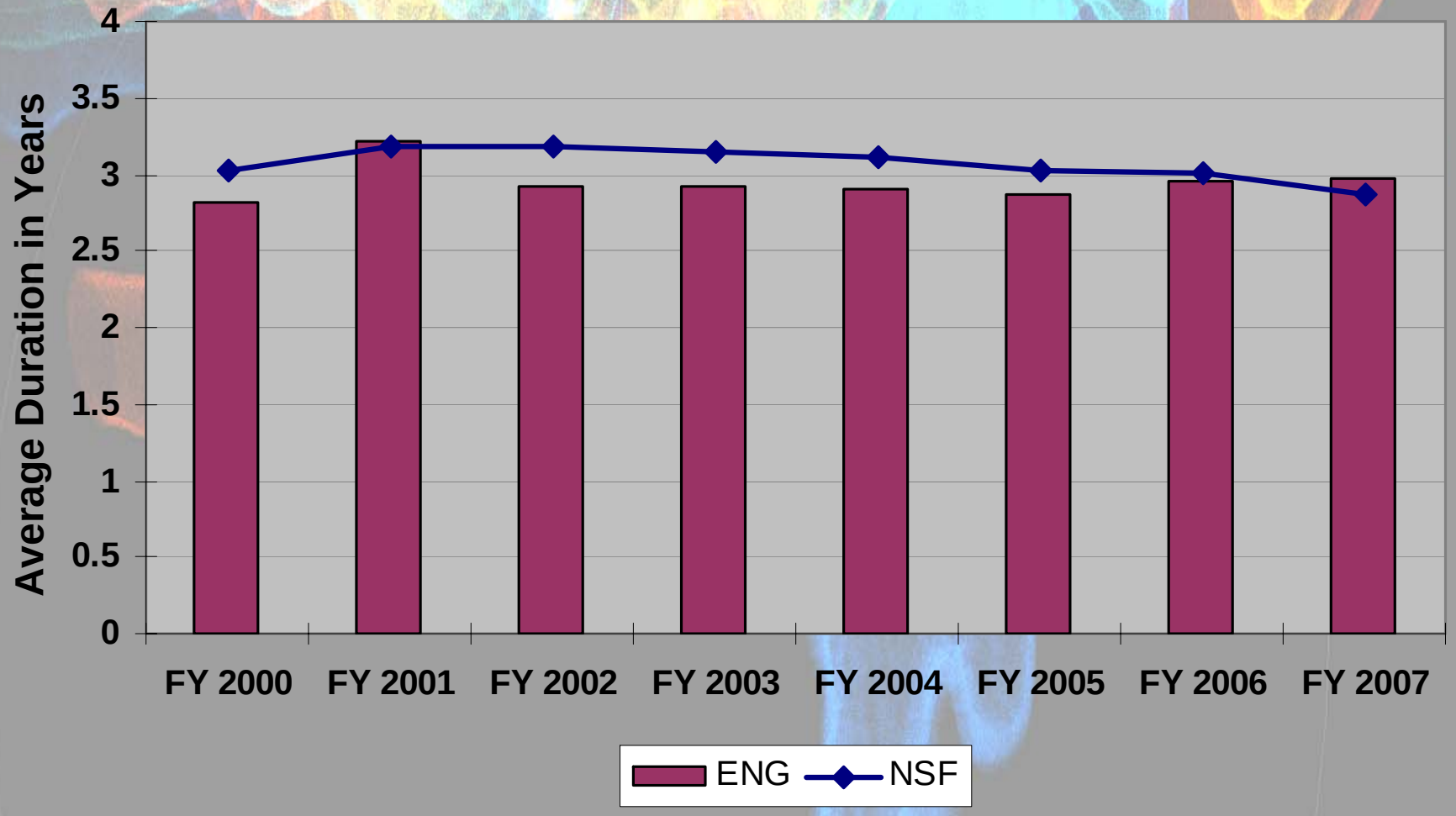
Averages for ENG Research Grants



Award size data annualized.

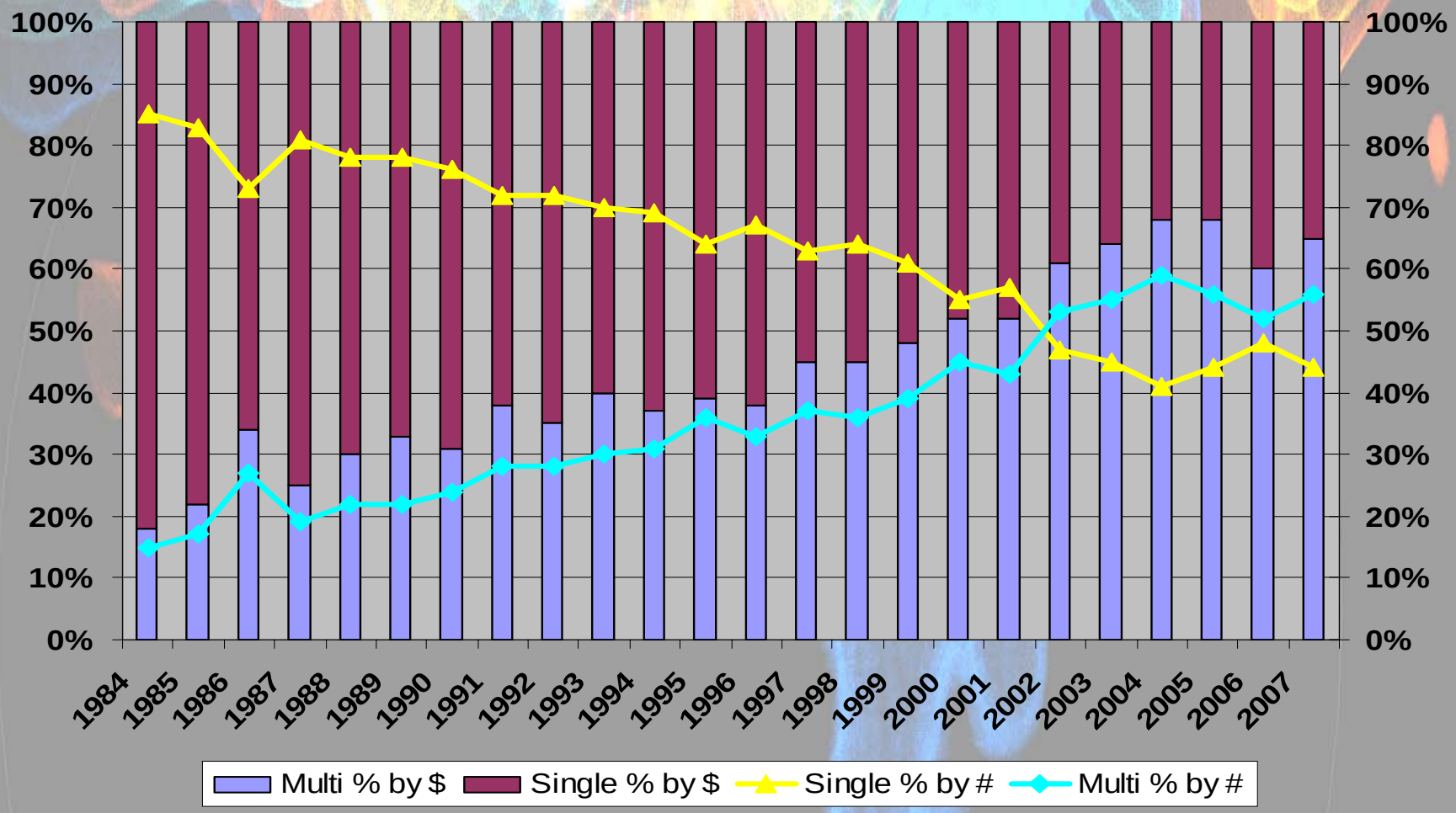
Average Award Duration in Years

ENG Research Grants in Comparison to NSF



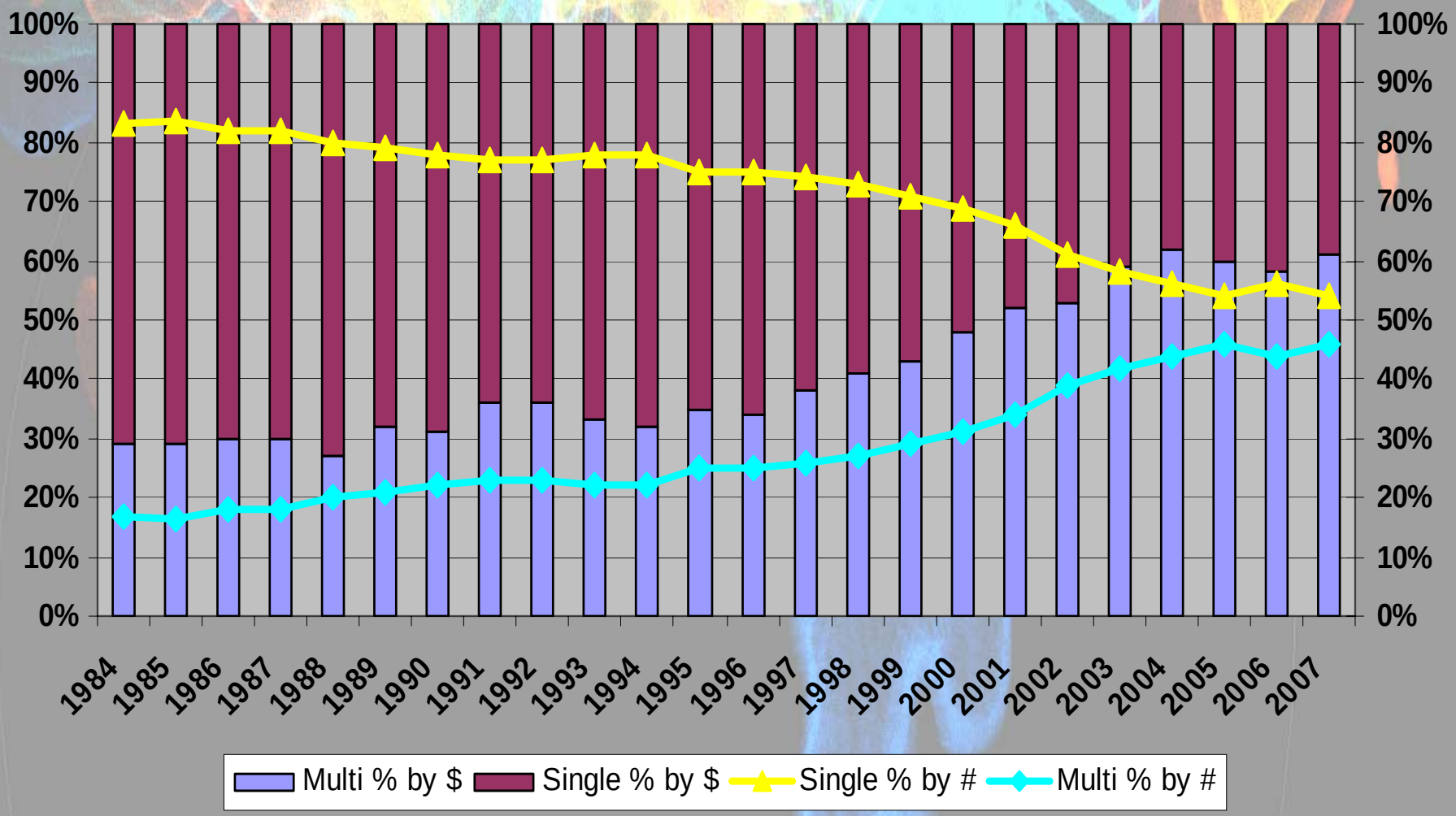
ENG Research Collaborations

Percent of Single PI vs. Multiple Investigator Awards



NSF Research Collaborations

Percent of Single PI vs. Multiple Investigator Awards



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

- 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

Energy for Sustainability
Trung Van Nguyen

Cybersystems

ECCS

- 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.

Cybersystems
Scott Midkiff

ENG Diversity and Outreach

BRIGE

- Excellence and innovation through diversity
- To enable the integration and success of a diverse engineering workforce
- To make the demographics in engineering disciplines representative of the US census
- Broadening Participation Research Initiation Grants in Engineering (BRIGE)
  - Research initiation grant funding opportunity intended to increase the diversity of researchers through research program support early in their careers, including under-represented groups, engineers at minority serving institutions, and persons with disabilities.
  - NSF 07-58 at http://www.nsf.gov/pubs/2007/nsf07589/nsf07589.htm

Recent Solicitations

- 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.

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; and,
  - 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.
- Please note, CDI review criteria are fully compliant with the updated NSF review criteria, which can be found on: http://www.nsf.gov/pubs/2007/in130/in130.jsp

National Nanotechnology Initiative

Funding Opportunities at NSF in FY 2008

www.nsf.gov/nano

- 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).

Summary

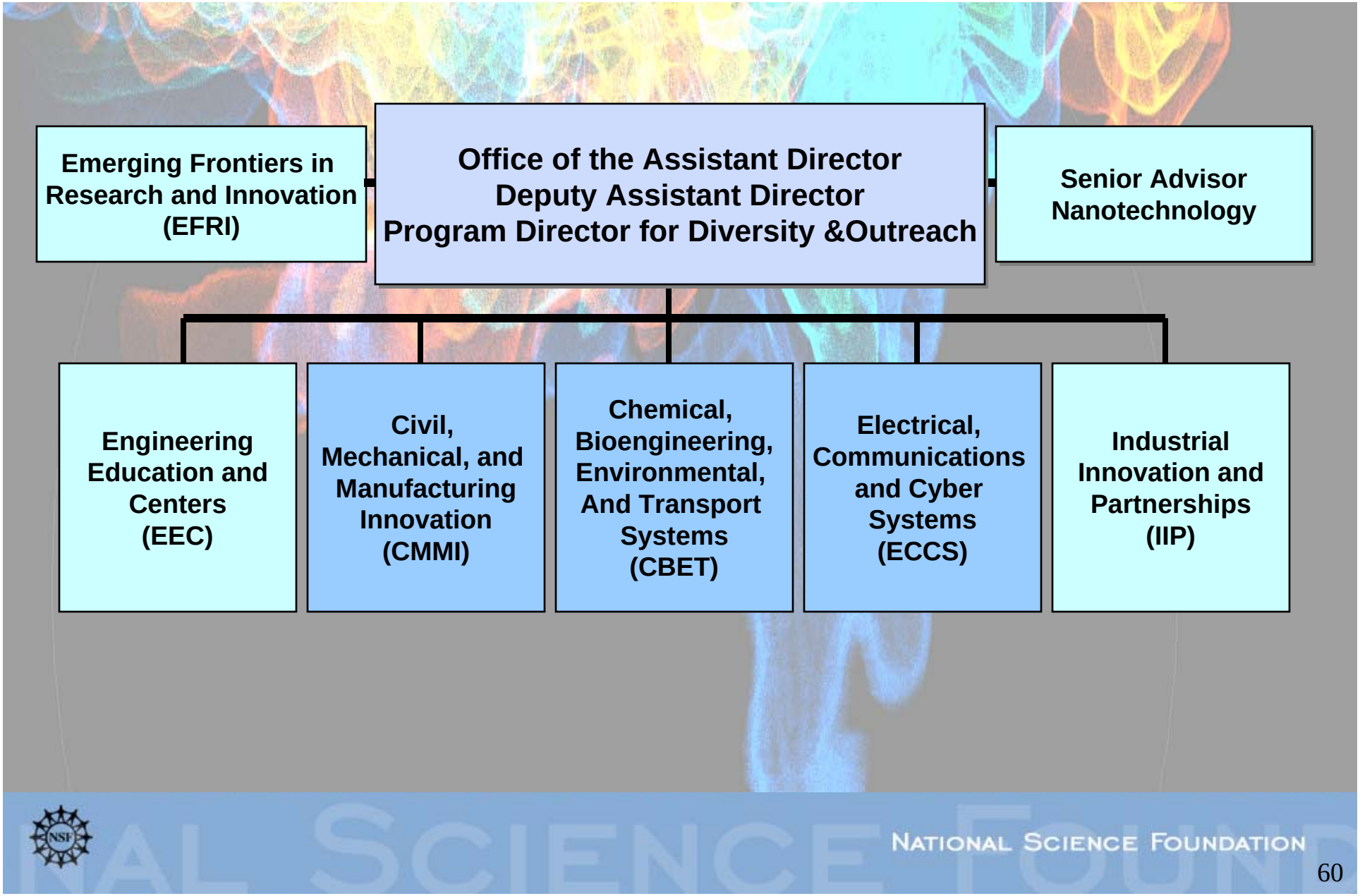
- Engineering research and education will continue to have significant impact on the nation's innovation and competitiveness.
- Engineering education activities have been broad in scope and impact, yet more needs to be done.
- Engineering research is central to the nation's competitiveness.
- With increasing opportunities in the future, there are also increasing responsibilities for engineering.
- Clearly defined priorities will be essential for the future of engineering, particularly where ENG can take a leadership role.


Thank you

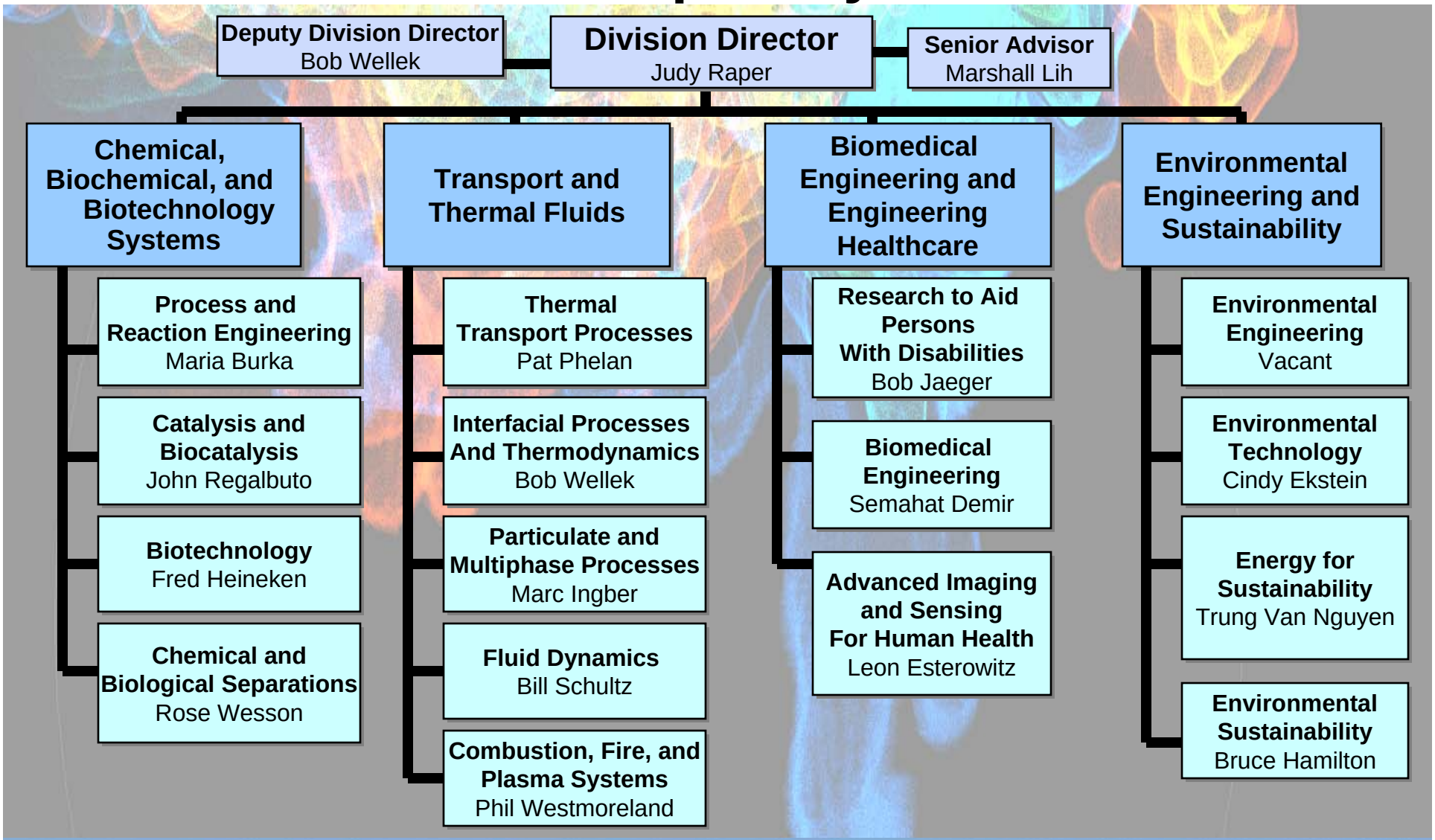
ENG Organization

Directorate for Engineering

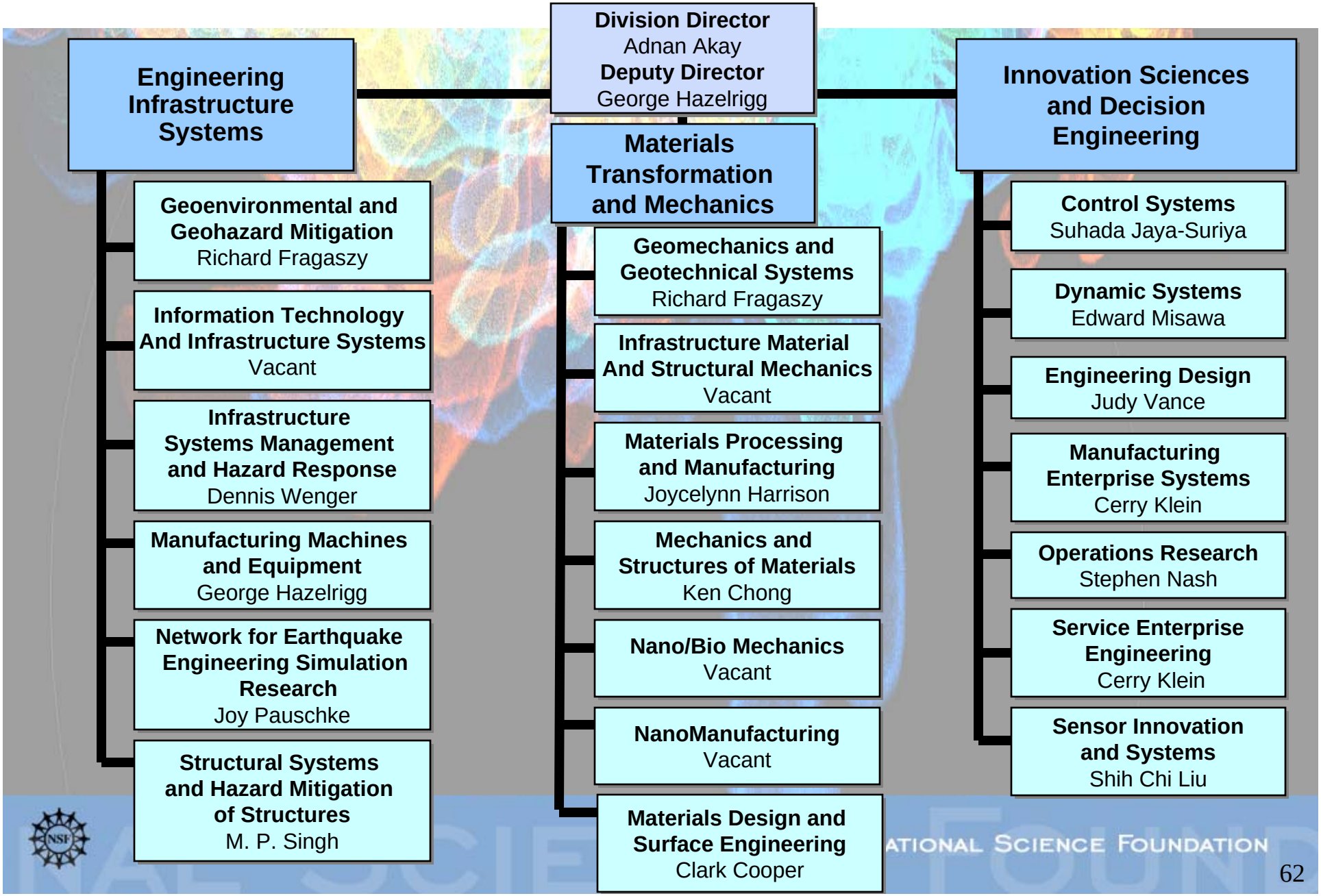
FY 2008



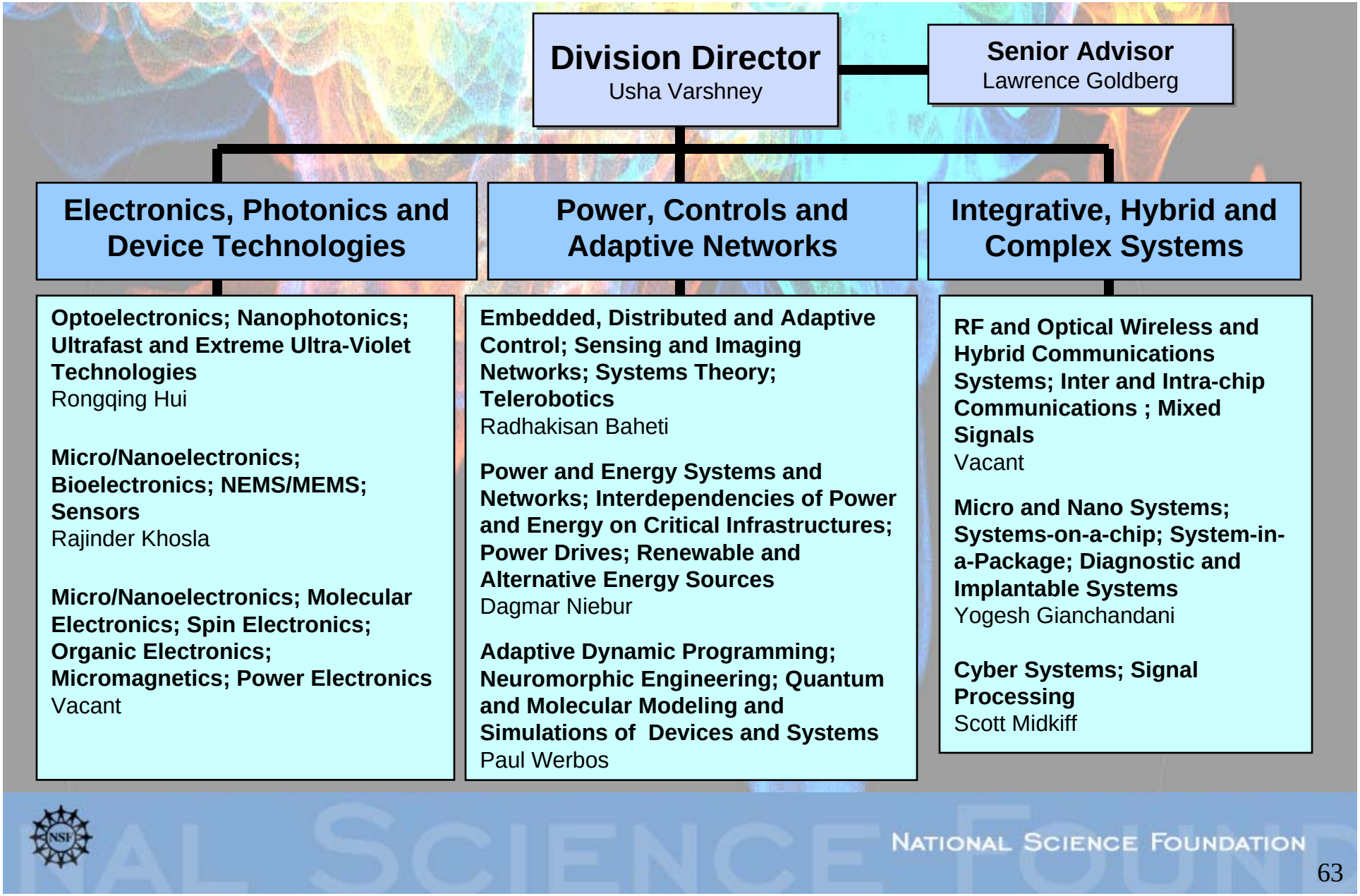
Chemical, Bioengineering, Environmental, and Transport Systems



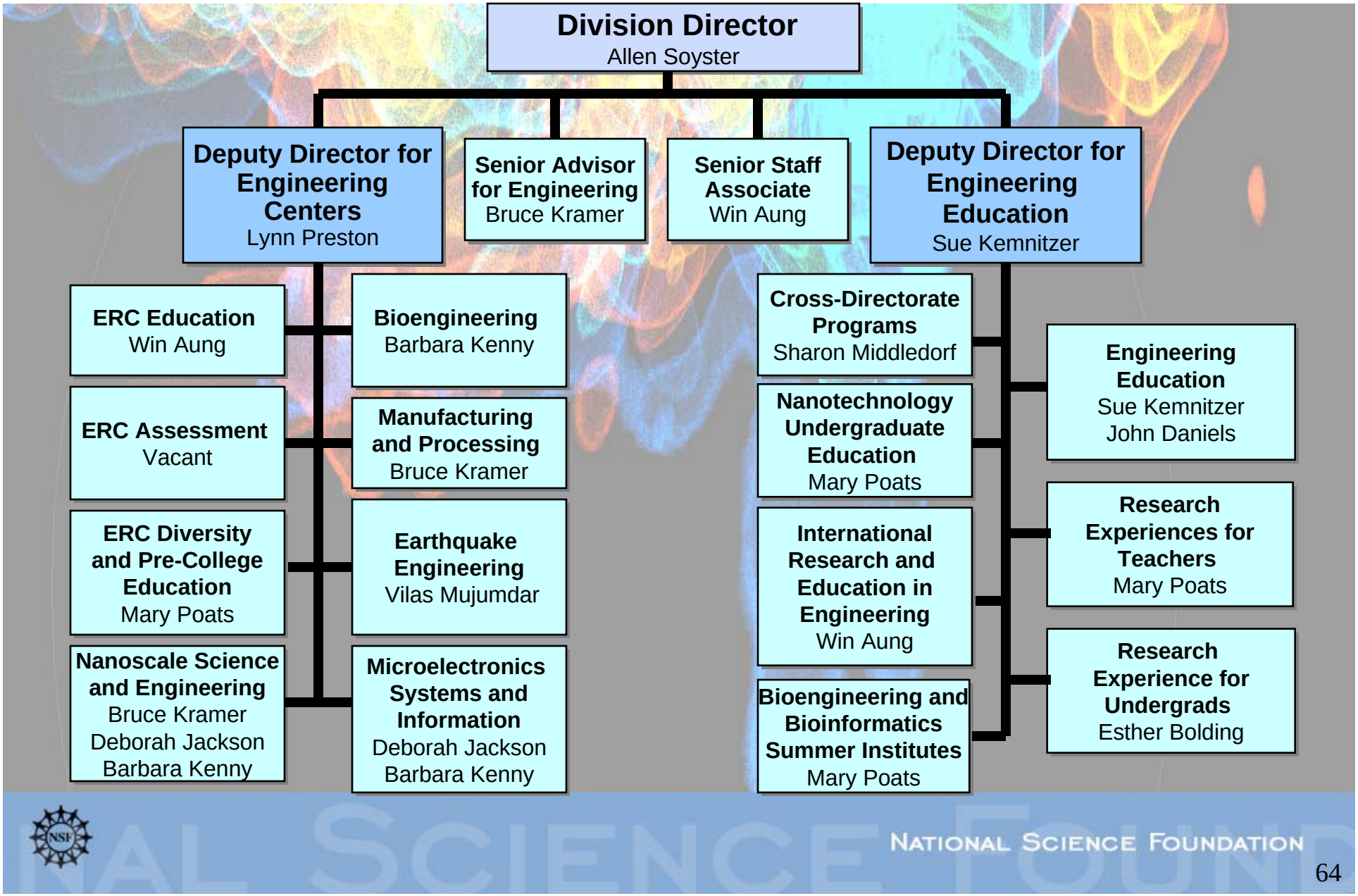
Civil, Mechanical, and Manufacturing Innovation



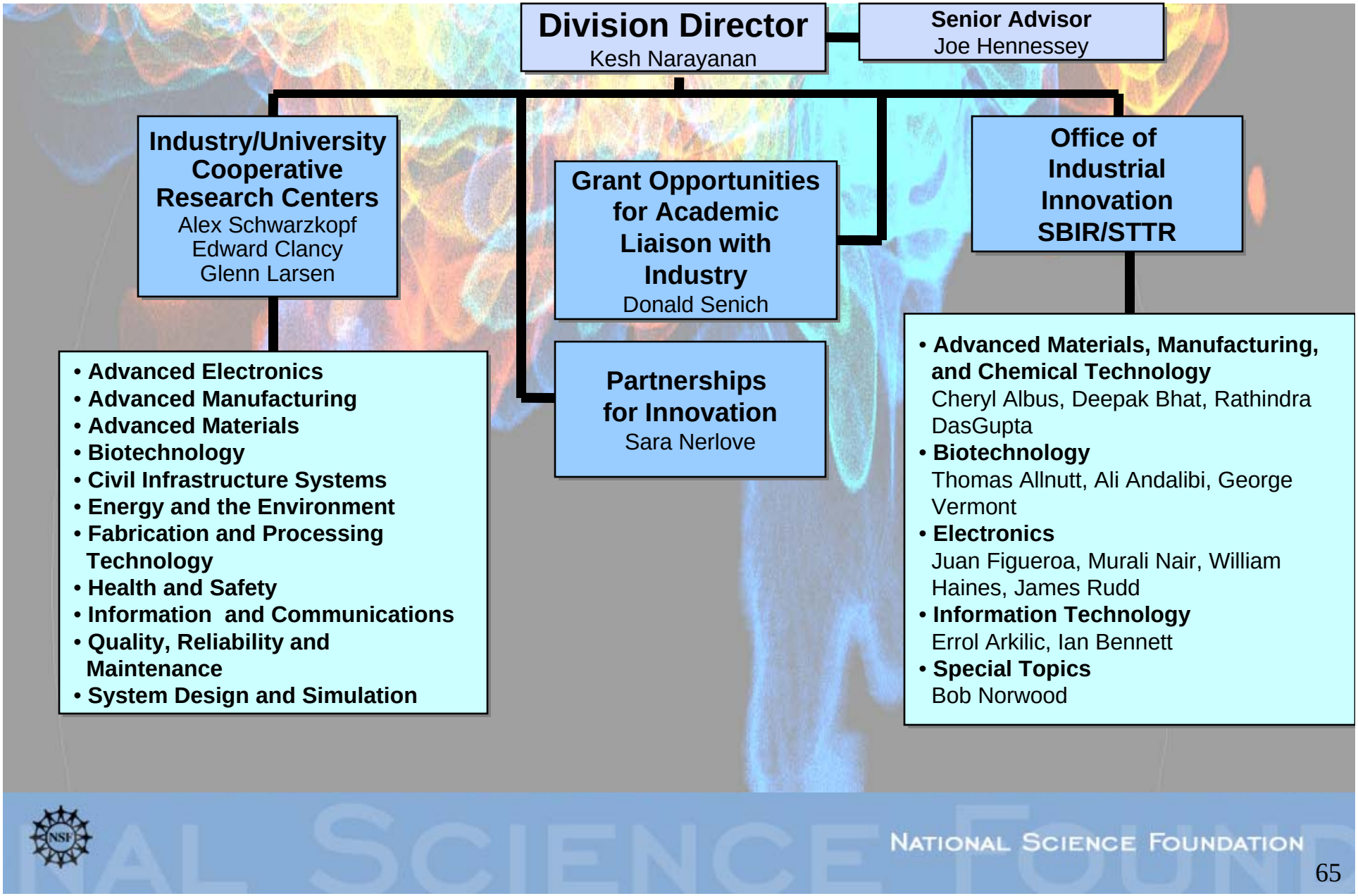
Electrical, Communications and Cyber Systems



Engineering Education and Centers



Industrial Innovation and Partnerships



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.

Emerging Frontiers in Research and Innovation