



Engineering at NSF

National Science Foundation
Directorate for Engineering



Presentation Outline

- Directorate for Engineering (ENG) overview
- Funding opportunities
- Successful proposals
- Resources



ENG Mission and Vision

- Mission: To enable the engineering and scientific communities to advance the frontiers of engineering research, innovation and education, in service to society and the nation.
- Vision: ENG will be the global leader in advancing the frontiers of fundamental engineering research, stimulating innovation, and substantially strengthening engineering education.



Funding

- Proposals must address NSF goals
 - Discovery
 - Learning
 - Research infrastructure
 - Stewardship
- Funding may be found in ENG and crosscutting/interdisciplinary programs



Funding Opportunities

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



ENG Core Programs

- ENG divisions
- Faculty Early Career Development (CAREER)
- Broadening Participation

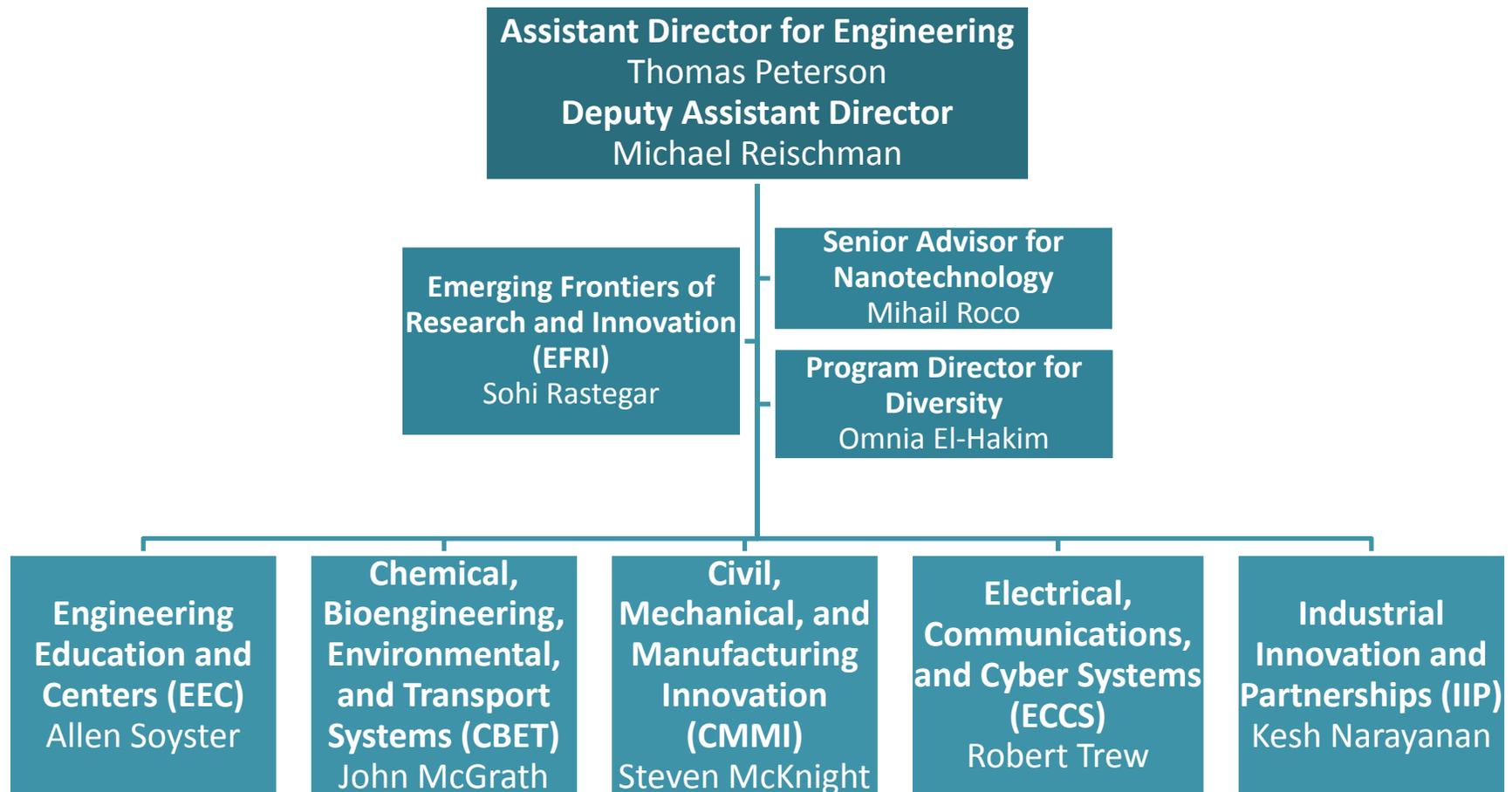


Proposals to ENG Divisions

- Proposals may be unsolicited or in response to a solicitations
- Submission windows and processes vary by division
- Awards are typically \$240-300K for three years

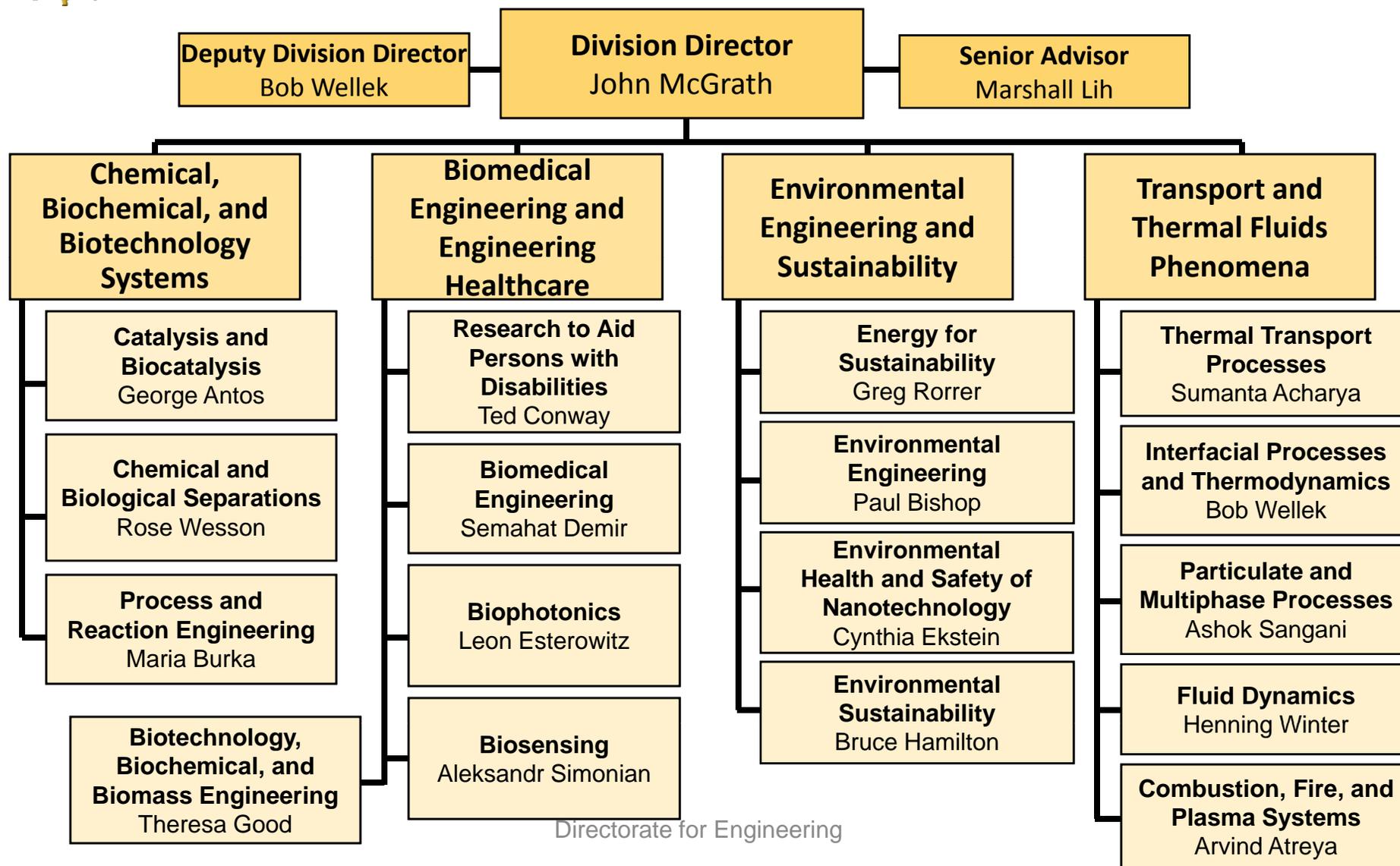


ENG Organization





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





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.



Water Sustainability and Climate

- Seeks to understand and predict the interactions between the water system and climate change, land use, the built environment, and ecosystem function and services through place-based research and integrative models.
- New solicitation in FY 2011

ENG Contacts
Paul Bishop
Bruce Hamilton



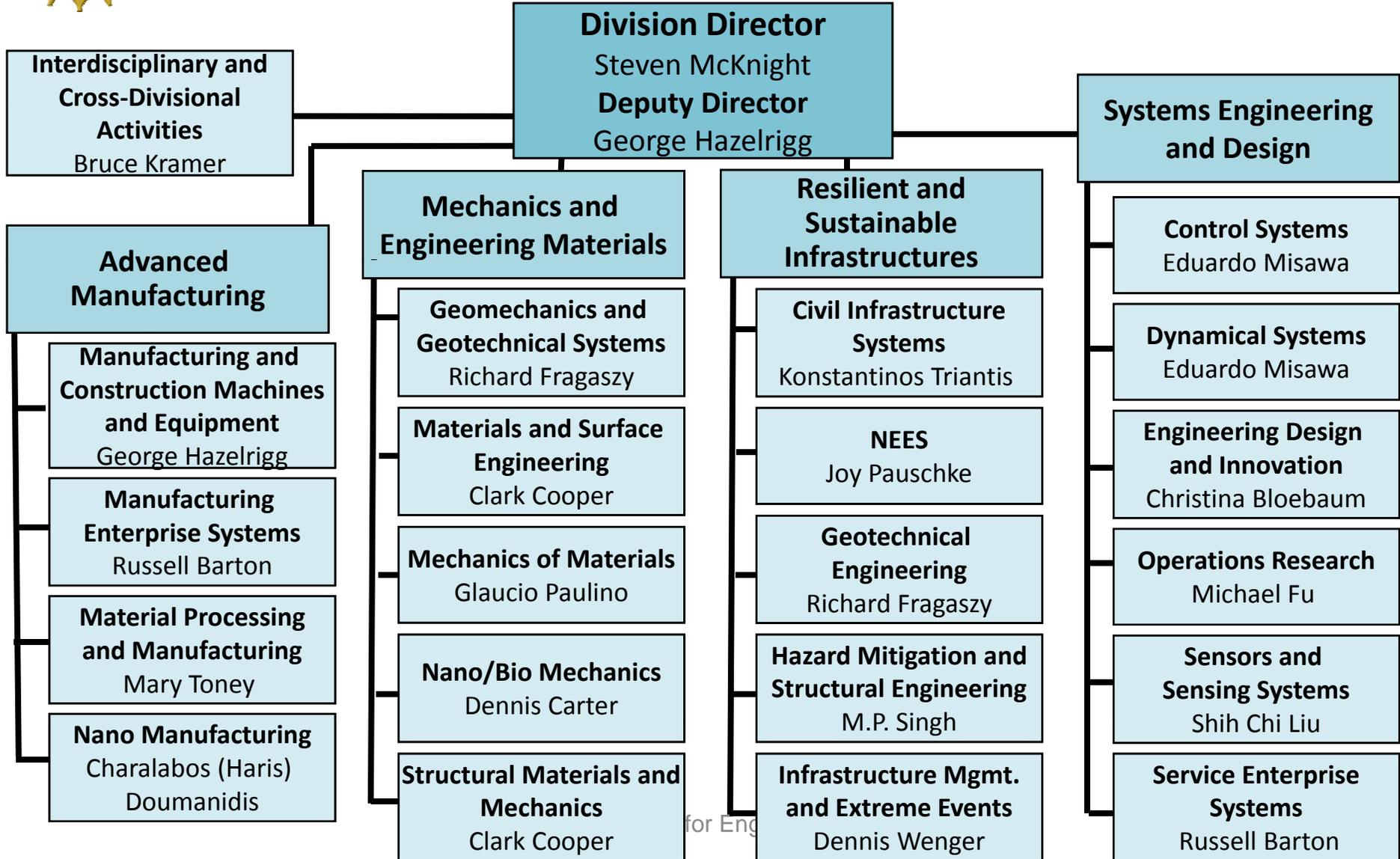
NSF/DOE Partnership in Basic Plasma Science and Engineering

- 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
Arvind Atreya



Civil, Mechanical, and Manufacturing Innovation (CMMI)





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 14 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
- New solicitation in mid-November

NEES
Joy Pauschke



Electrical, Communications, and Cyber Systems (ECCS)

Senior Engineering Advisor
Lawrence Goldberg

Division Director
Robert Trew

Energy, Power, and Adaptive Systems

Electronics, Photonics, and Magnetic Devices

Micro/nanoelectronics; Advanced integrated circuits; Beyond silicon CMOS; Quantum-level devices; Electromagnetics/microwave/THz simulations and models

Samir El-Ghazaly

Molecular electronics; Organic and flexible electronics; Energy-efficient green electronics and photonics

Pradeep Fulay

Bioelectronics and biomagnetics; Spintronics and magnetics; Sensor technologies

Usha Varshney

Optoelectronics/photonics; Nanophotonics; Plasmonics and metamaterials; Large-scale photonic integration; Ultrafast phenomena

John Zavada

Communications, Circuits, and Sensing Systems

Cyber-physical systems; Next-generation cyber systems; Signal processing

Zygmunt Haas

MEMS/NEMS systems-on-a-chip; Diagnostic and implantable devices; Biological and medical devices; Environmental monitoring; Micro-power and energy

Rajinder Khosla

RF to optical communication systems; Inter- and intra-chip communication/networks; Mixed signal systems; Millimeter wave and terahertz systems

Andreas Weisshaar

Systems & control theory and hybrid dynamical systems; Energy systems reliability & control; Distributed & mobile networked control; Sensor & transportation networks; Estimation in sensing & imaging; Human-robot interaction; Stochastic modeling

Radhakisan Baheti

Energy collection, conversion, and storage; Renewable energy; Power conversion, generators, motors, & network interfacing; Energy and power sensing; High voltage, high power switching and conversion

George Maracas

Adaptive/intelligent systems; T&D systems; Intelligent power grid; High-performance & multi-scale modeling; Quantum systems & modeling; Neural networks; Cognitive optimization & prediction; Intelligent vehicles/robots

Paul Werbos



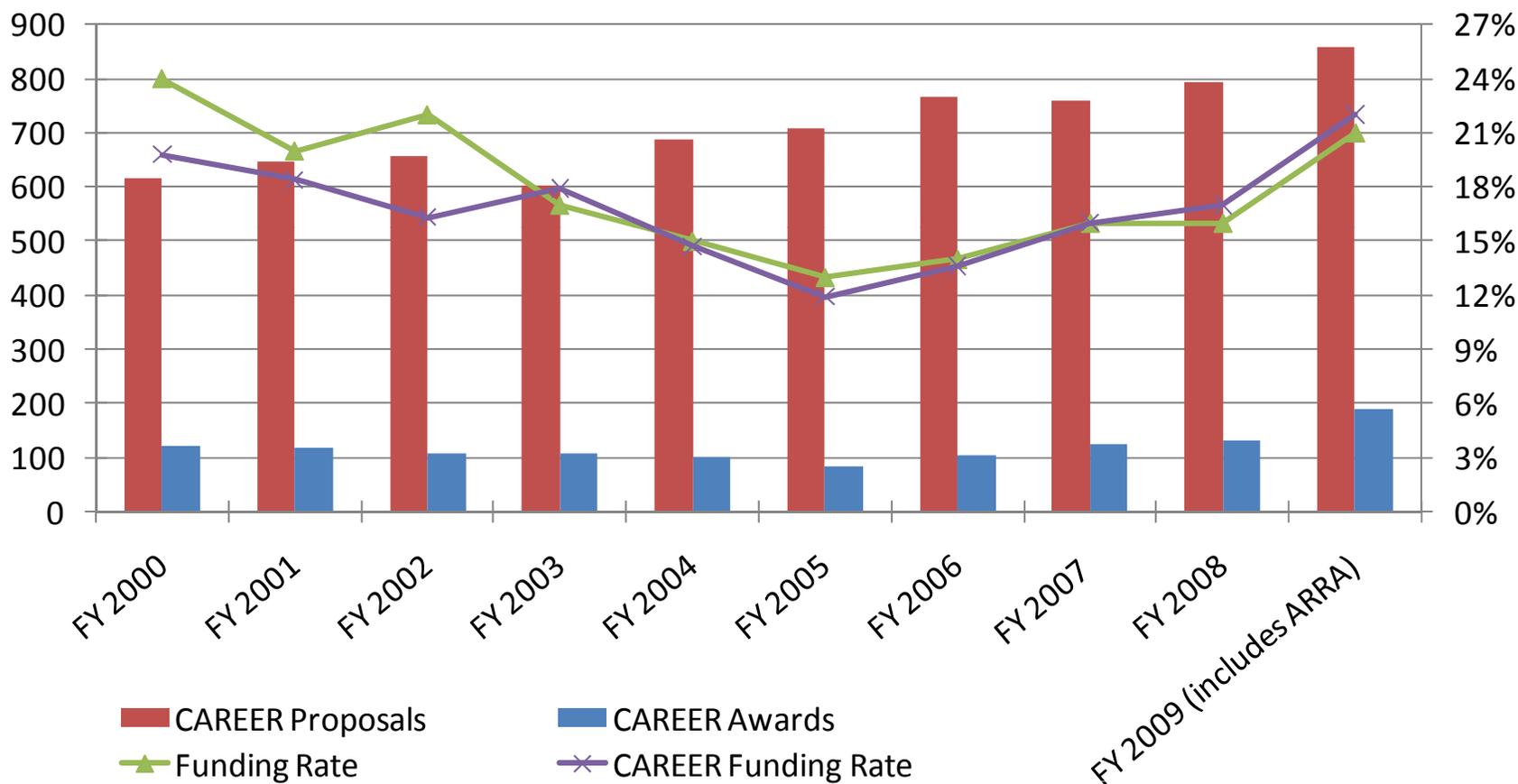
Faculty Early Career Development (CAREER) Program

- 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
- ENG awards are \leq \$400K for 5 years
- New solicitation in spring 2011
- Deadlines vary by directorate;
ENG proposals due in July 2011

ENG Contact
Sharon Middendorf



ENG CAREER Proposals and Awards





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



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
- Proposals due Jan. 24, 2011



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

- **Partnerships for Adaptation, Implementation, and Dissemination (PAID):** adaptation, implementation, dissemination, and diffusion of effective materials and practices; and to advance understanding of gender in the STEM academic workforce (PAID-Research)
- **Institutional Transformation (IT):** systemic organizational approaches for institution-wide change
- **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
- PAID letters of intent due Oct. 4, proposals due Nov. 8, 2010
- IT/IT-Catalyst letters of intent due Oct. 3, proposals due Nov. 7, 2010



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
- 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 2011 are:
 - Multicellular and InterKingdom Signaling (MIKS)
 - Mind, Machines and Motor Control (M3C)
- \$29M investment for 4-year awards at ~\$500K per year
- Informational webcast and request for topic suggestions in Sept./Oct.
- 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





Funding Opportunities

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ENG Collaborative and Interdisciplinary Research

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



Interdisciplinary Research Is...

“... a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.”

Facilitating Interdisciplinary Research, The National Academies Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering, and Public Policy, The National Academies Press, Washington, D.C., 2004.

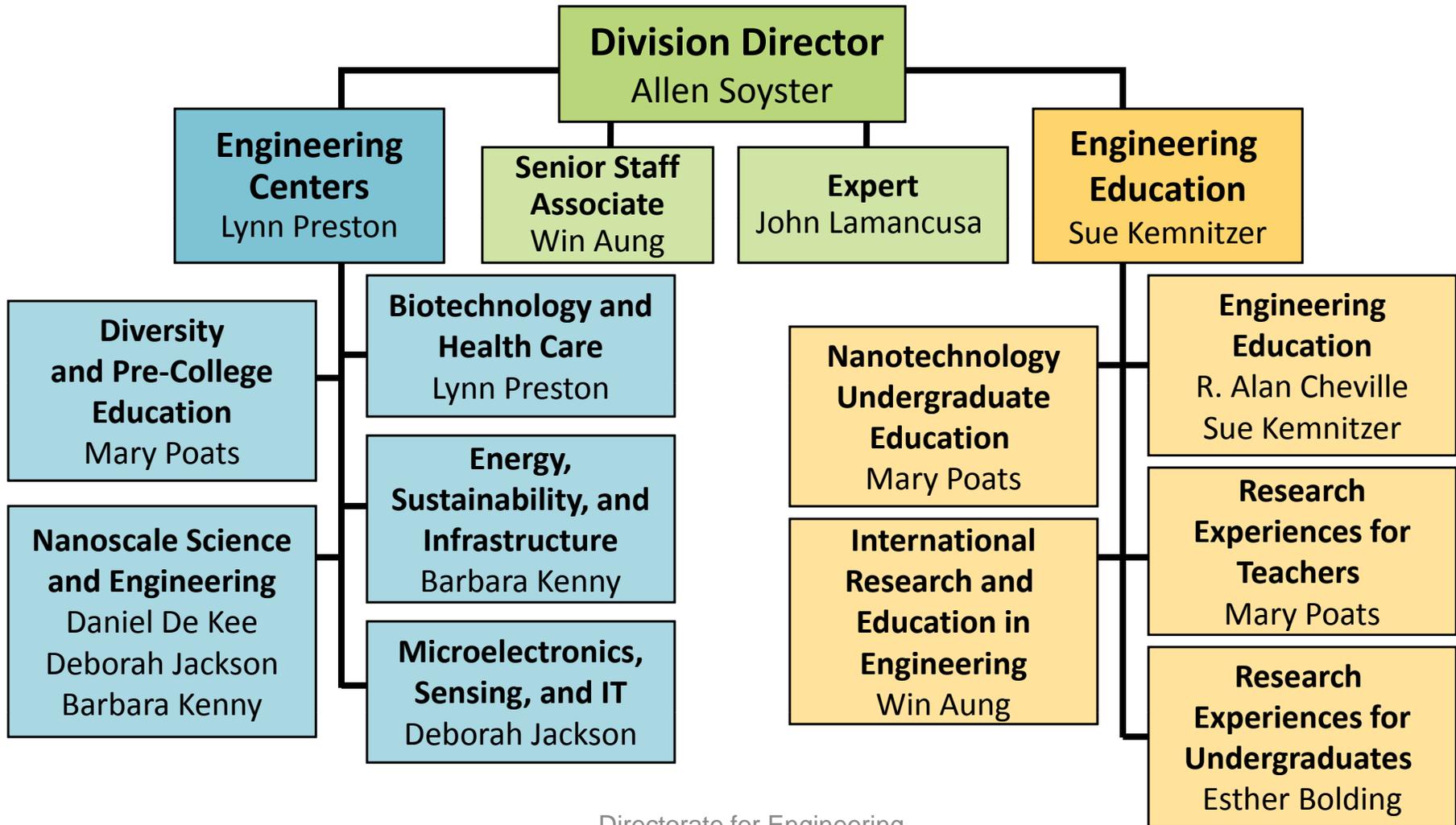


ENG Interdisciplinary Research (IDR) Proposals

- Propose a level of interdisciplinary content not covered in the core programs of ENG, on any topic relevant to engineering
- Must attract funding from at least two divisions of NSF, with primary funding from ENG
- Usually involve a team of 2–4 investigators.
- Typically \$400–600K for up to three years, although awards up to \$1M are considered
- Full proposals due during unsolicited proposal window of primary ENG division



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
May 5, 2010

ENG Contact
Lynn Preston



Engineering Education Research

- Seeks to enable a system of engineering education, equally open to all members of society, that dynamically and rapidly adapts to meet changing needs. Research areas include:
 - Increasing our understanding of how engineering students learn and the capacity that supports such discovery
 - Understanding how to increase the diffusion and impact of engineering education research
 - Understanding engineering education in broader frameworks such as sustainability
 - Diversifying pathways to and through engineering degree programs
- Full proposals due Feb. 11, 2011

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
- New solicitation in fall 2010
- Full proposals due in March 2011

ENG Contact
Sue Kemnitzer

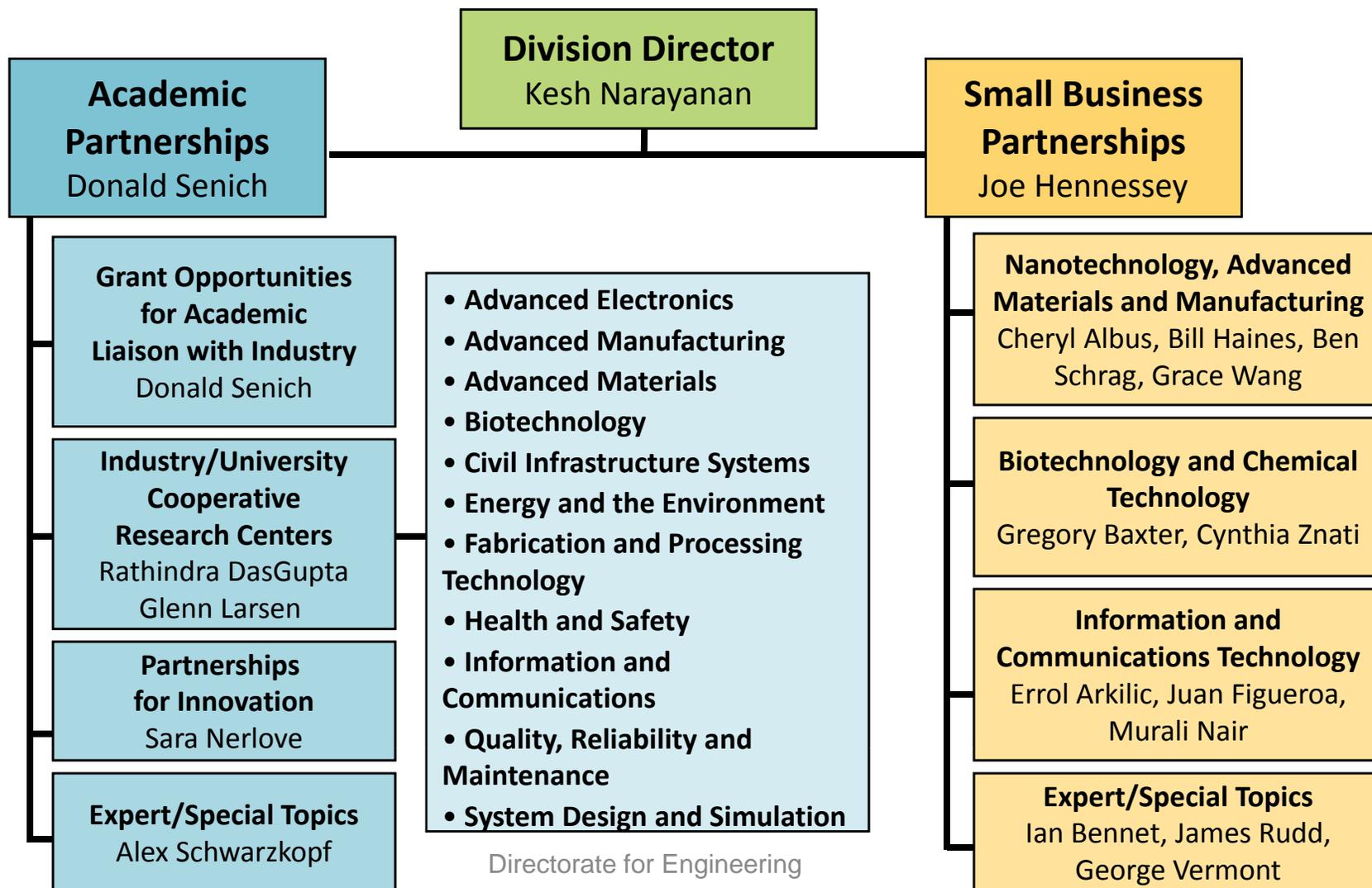


Human Resource Development

- Research Experiences for Undergraduates (REU)
 - Supports the involvement undergraduates in ongoing research
 - \$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 to bring knowledge of engineering and technological innovation into their classrooms
 - \$4M/year available; deadline in Nov. each year



Industrial Innovation and Partnerships (IIP)





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

- 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 between academic institutions and small businesses
- Builds capacity for innovation through exploration, re-definition, and creation of novel platforms for translating research and moving it towards impact
- \$7M to fund 9–11 awards each year; grants are up to \$600,000 for 2–3 years
- Letters of intent due Oct. 1, 2010; full proposals due Dec. 4, 2010

ENG Contact
Sally Nerlove



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
- \$45M for 200–300 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
- \$5M for ~35 awards
- Proposals due Nov. 17, 2010



Accelerating Innovation Research (AIR)

- Aims to spur translation of fundamental research, to encourage collaboration between academia and industry, and to train students who understand innovation and entrepreneurship.
- Seeks proposals for pursuing one of two options:
 - **Technology Translation Plan Competition** provides an opportunity for investigators to complete the necessary research and prepare a Technology Translation Plan for their new product or process concept
 - **Research Alliance Competition** will foster collaboration between an NSF-funded innovation research alliance and at least one partner entity to form a synergistic relationship that will accelerate the innovation of a product, a process or system
- ~\$12M investment for up to 18 grants for small, medium, and large projects
- Letters of Intent due Dec. 1, 2010; full proposals due Feb. 1, 2011

ENG Contact
Rathindra DasGupta



Funding Opportunities

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



Crosscutting and NSF-wide Opportunities

- Cyber-Physical Systems (CPS)
- Domestic Nuclear Detection Office/NSF Academic Research Initiative (ARI)
- Major Research Instrumentation (MRI) Program
- Nanoelectronics for 2020 and Beyond
- Pan-American Advanced Studies Institutes Program (PASI)
- Partnerships for International Research and Education (PIRE)
- Scalable Nanomanufacturing
- Science, Engineering, and Education for Sustainability (SEES)



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 March 10, 2011

ENG Contact
Kishan Baheti



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
- New solicitation in winter 2011

ENG Contact
Geoff Prentice



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 in Jan. 2011

ENG Contact
Lawrence Goldberg



Nanoelectronics for 2020 and Beyond (NSF and NRI)

- Aims to advance the forefront of computation, information processing, sensor technologies, and communications infrastructure beyond current physical and conceptual limitations
- Supports interdisciplinary collaborations by 3 or more investigators that address aspects of at least two of the research themes:
 - Exploring new chemistries and materials for nanoelectronics
 - Exploring alternative state variables and heterogeneous integration for nanoelectronic devices and systems
 - Exploring novel paradigms of computing
- ~\$20M investment for 10–15 grants
- Full proposals due Jan. 19, 2011

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, 2011

**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
- New solicitation in fall 2010

**Office of International
Science and
Engineering**
Elizabeth Lyons



Scalable Nanomanufacturing

- Supports the identification and demonstration of nanomanufacturing processes with high potential to scale to economically and industrially relevant production levels.
 - Novel processes and techniques for continuous and scalable nanomanufacturing;
 - Directed self-assembly processes for the high-rate production of heterogeneous nanostructures;
 - Principles and design methods for machines and processes to manufacture nanoscale structures, devices and systems; and/or
 - Long-term societal and educational implications of the large-scale production and use of nanomaterials, devices and systems.
- \$10M for 5 to 10 projects, each up to \$500K per year for four years
- Proposals due January 10, 2011

ENG Contact
Bruce Kramer



Science, Engineering, and Education for Sustainability (SEES)

- Integrates energy, environment, and climate research and education
- Supports advances in:
 - Materials engineering and device technologies
 - Manufacturing for energy, particularly from renewable sources
 - Micro-grid and smart-grid approaches to power distribution and control systems
 - Resilience and sustainability of complex, interdependent infrastructure systems



Steps towards Successful Proposals

- Begin with
 - Dialog with program officer
 - White paper
 - Short biography
- Get involved with NSF reviews

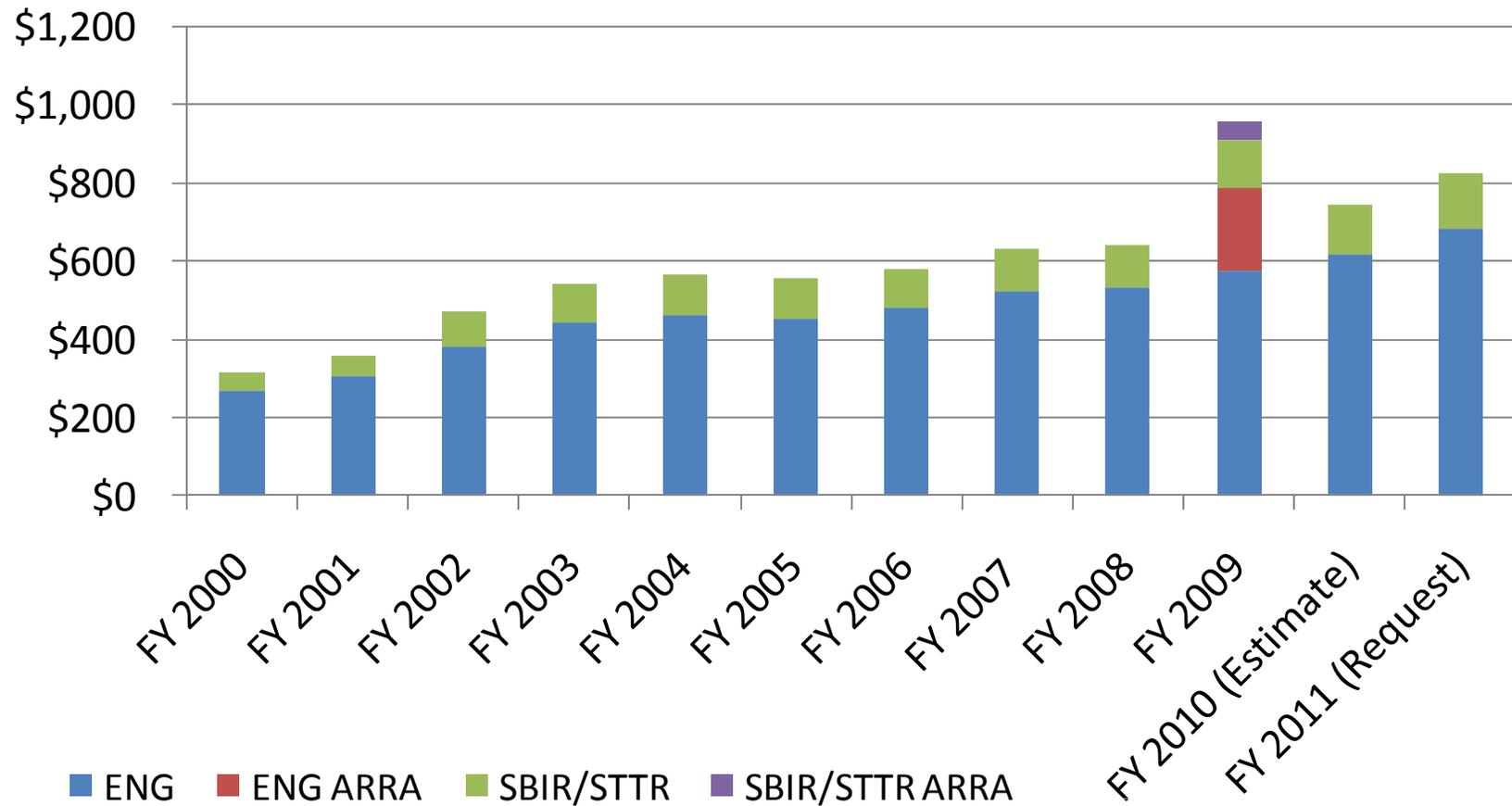


What Do Reviewers Look For?

- Proposals that address one or more NSF goals:
 - Discovery
 - Learning
 - Research infrastructure
 - Stewardship
- Intellectual merit
- Broader impact

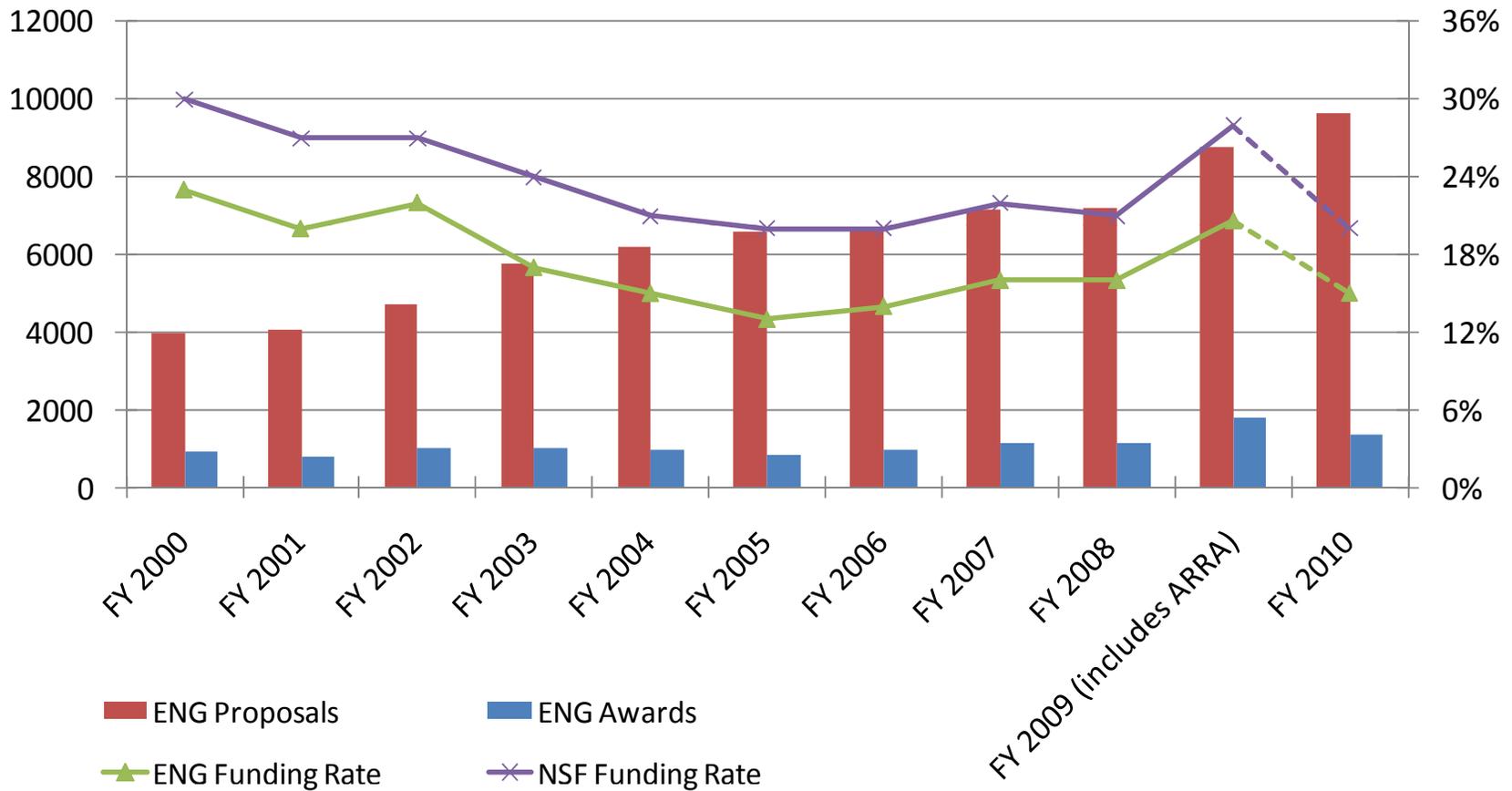


ENG and SBIR/STTR Budgets (\$M)



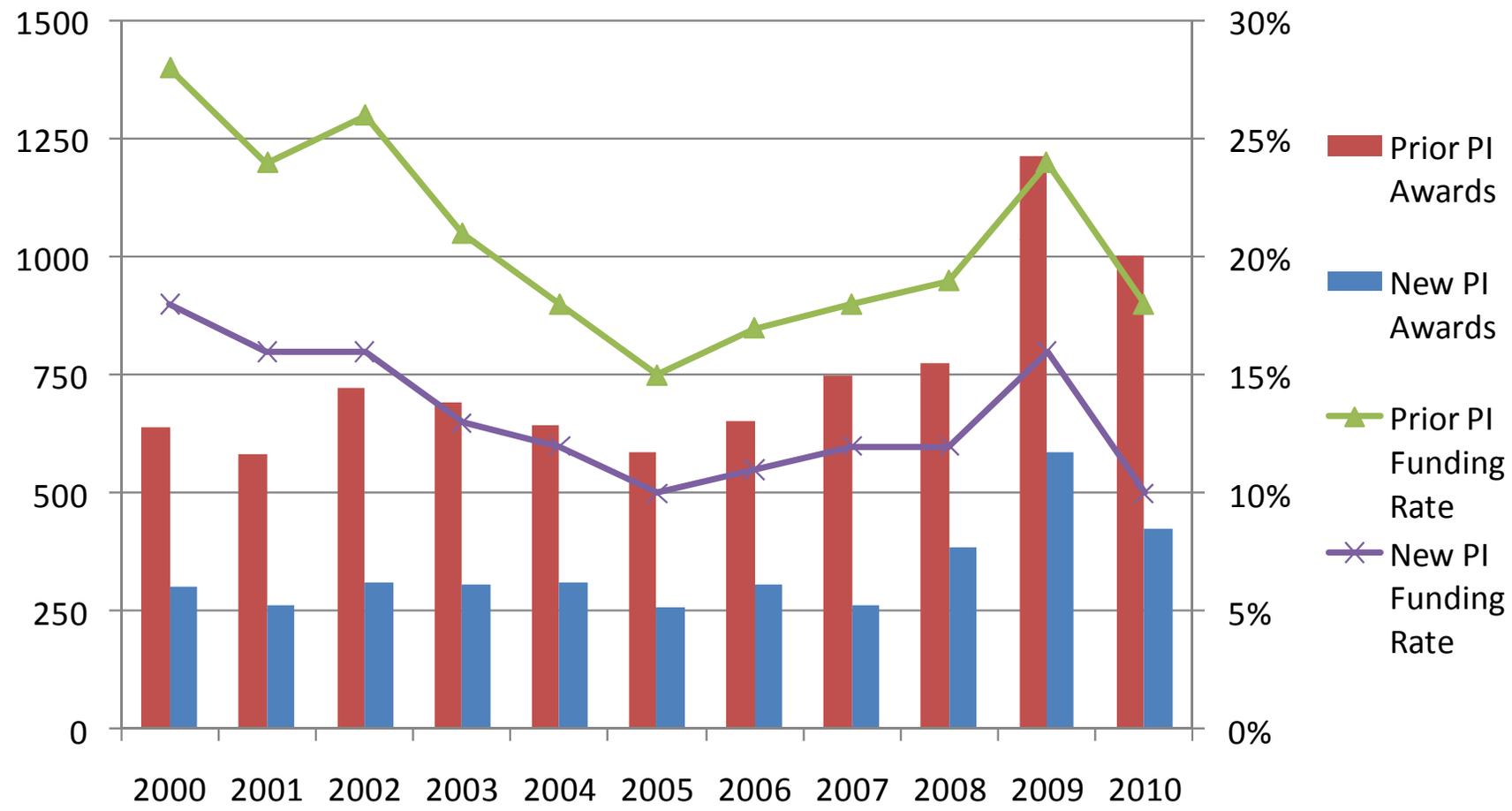


ENG Research Grant Proposals and Awards



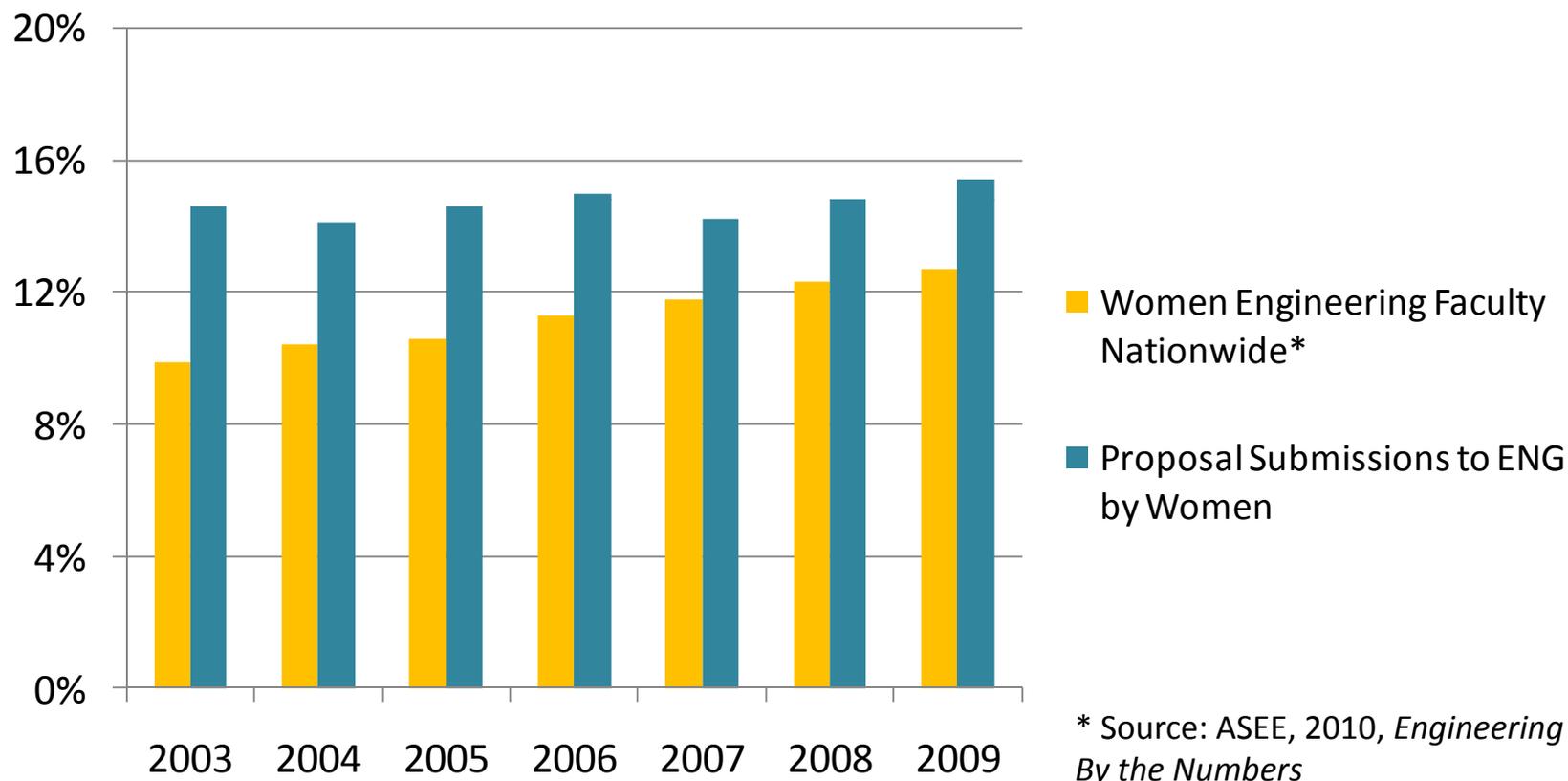


ENG Awards and Funding Rates for Prior and New PIs



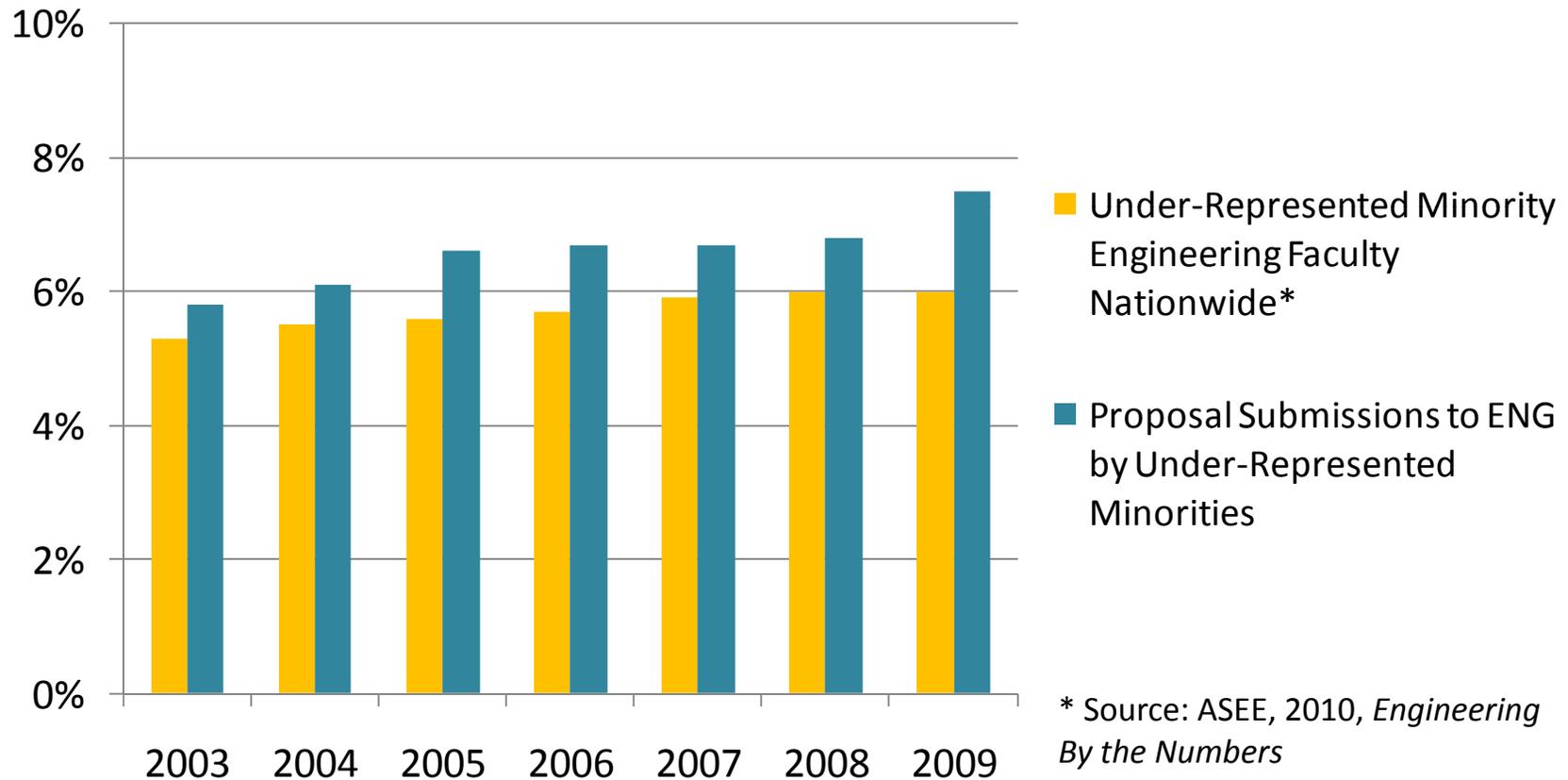


Proposal Submissions to ENG by Women



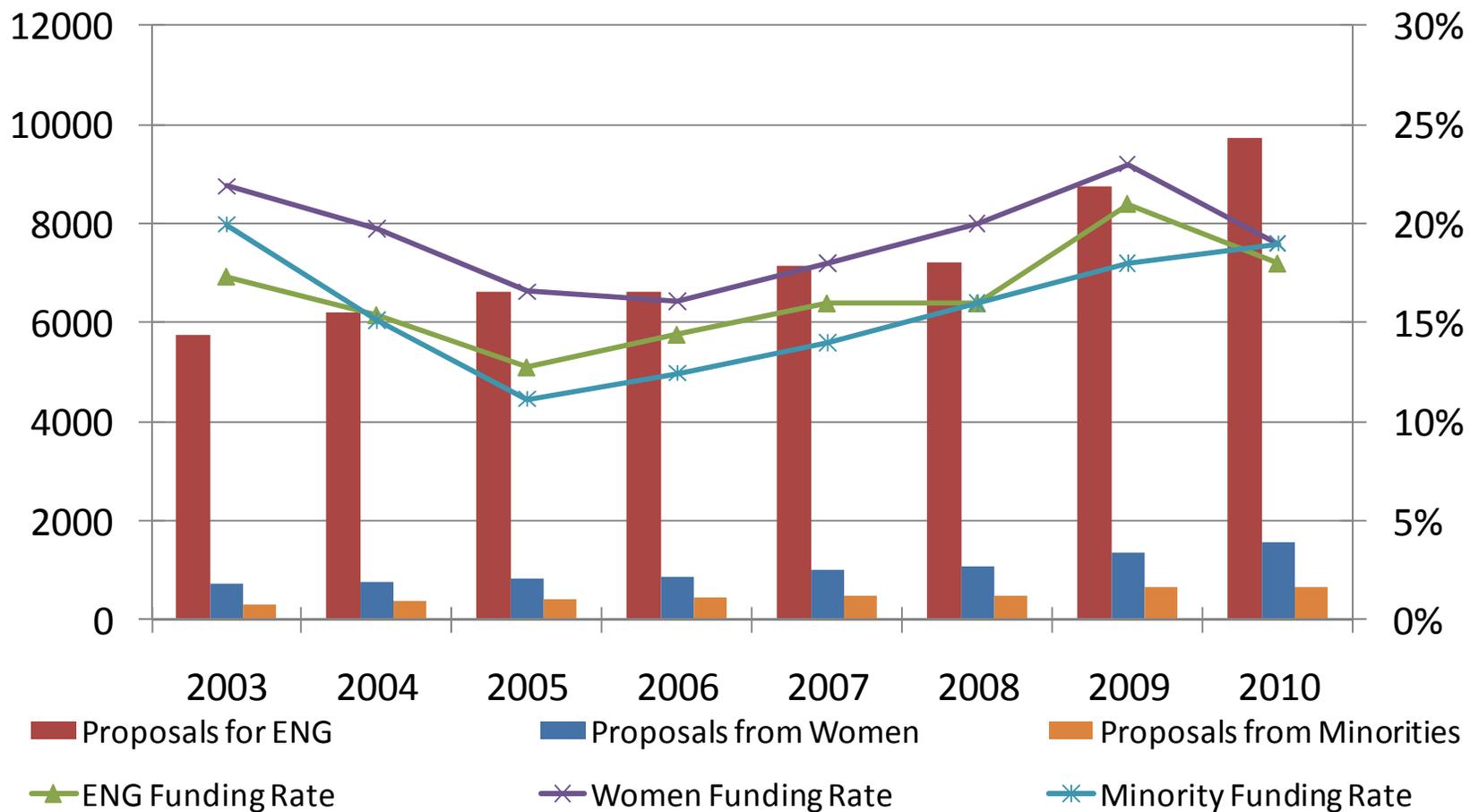


Proposal Submissions to ENG by Under-Represented Minorities





Research Proposal Funding Rates for All ENG, Women, and Under-Represented Minorities





Resources

- Directorate for Engineering:
<http://www.nsf.gov/eng>
- Funding Opportunities:
<http://www.nsf.gov/funding/>
- NSF Email Updates: www.nsf.gov