Update to the ENG Advisory Committee

Thomas W. Peterson
Assistant Director for Engineering
October 20, 2010

ENG Update

- AdCom business
- New ENG staff
- Budget and trends
- Collaborative investments
- Broadening participation
- Emerging Frontiers of Research and Innovation
- RAPIDs
- Status of strategic planning

AdCom Business

Future Meeting Dates

- April 13–14, 2011
- October 26–27, 2011

Fall Meeting Agenda

- ENG Update
- ENG Strategic Planning
- IIP COV

New ENG Staff

New NSF Director

- Subra Suresh
- Sworn in Monday
- Former Dean of Engineering at MIT
- Member of NAE

Directorate for Engineering (ENG)

Office of the Assistant Director
Thomas Peterson, Assistant Director
Michael Reischman, Deputy Assistant Director

Emerging Frontiers in Research and Innovation (EFRI)
Sohi Rastegar

Senior Advisor for Nanotechnology
Mihail Roco

Program Director for Diversity
Omnia El-Hakim

Engineering Education and Centers (EEC)
Allen Soyster

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

Civil, Mechanical, and Manufacturing Innovation (CMMI)
Steven McKnight

Electrical, Communications, and Cyber Systems (ECCS)
Robert Trew

Industrial Innovation and Partnerships (IIP)
Kesh Narayanan

CBET

- **Sumanta Acharya**, Program Director for Thermal Transport Processes (Louisiana State University)
- **Judy Chu**, Science Assistant
- **Sapun Parekh**, AAAS Fellow
- **Ashok Sangani**, Program Director for Particulate and Multiphase Processes (Syracuse University)

CMMI

- **Russell Barton**, Program Director for Manufacturing Enterprise Systems and for Service Enterprise Systems (Penn State)
- **Elinor Bruno**, Program Assistant
- **Dennis Carter**, Program Director for Nano and Bio Mechanics (Stanford)
- **Haris Doumanidis**, Program Director for Nanomanufacturing (Polymeric Composites Laboratory/FREEDOM)
- **Michael Fu**, Program Director for Operations Research (University of Maryland)
- **Konstantinos Triantis**, Program Director for Civil Infrastructure Systems (Virginia Tech)
- **Kevin Webster**, STEP Student

ECCS

- **Dana Denick**, Science Assistant
- **Zygmunt Haas**, Program Director for Communications, Circuits, and Sensing Systems (Cornell University)
- **Alexandria Hale**, STEP Program Assistant
- **John Zavada**, Program Director for Electronics, Photonics, and Magnetic Devices (NC State)

EEC

- **Theresa Maldonado**, Division Director
- **Marshall Horner**, Program Assistant

IIP

- **Joshua Abbott**, SCEP Program Specialist
- **Katie Bearden**, SCEP Program Specialist
- **Lawrence Hornak**, Program Director for I/UCRCs (West Virginia University)
- **Bernadine Okoro**, Einstein Fellow
- **Malathi Srivatsan**, AAAS Fellow

Open Recruitments

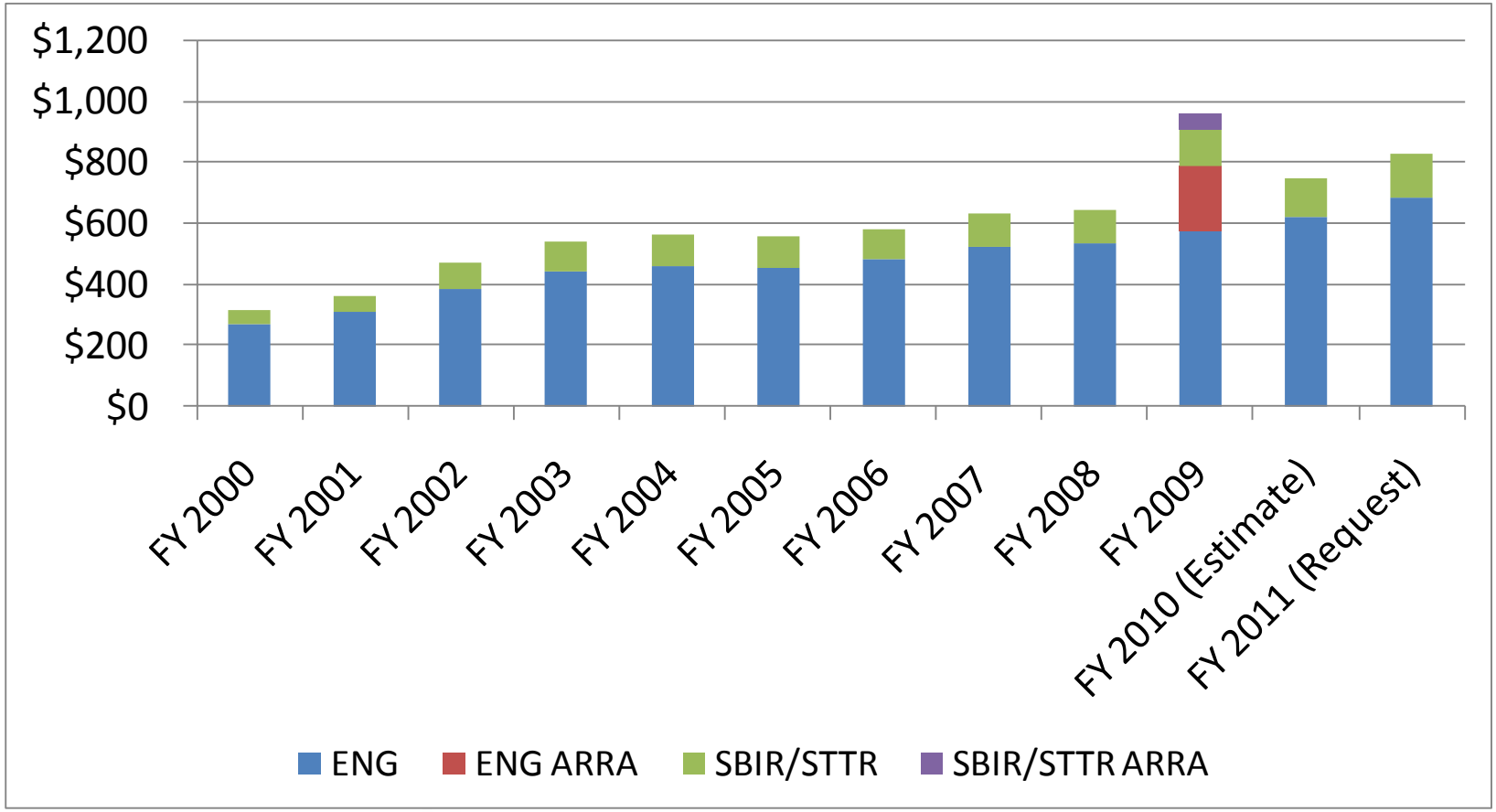
- CBET – Associate Program Director for Biomedical Engineering
- CBET – Program Director for Environmental Health and Safety of Nanotechnology
- CMMI – Program Director for Structural Materials and Mechanics
- CMMI – Program Director for Control Systems
- IIP – Program Director for SBIR/STTR (Biotechnologies and Chemical Technologies)

ENG Budget and Trends

NSF R&RA Budget ($M)

Directorate	FY 2009 Omnibus Actual	FY 2009 ARRA Actual	FY 2010 Estimate	FY 2011 Request	FY 2011 Request			
					Change over FY 2009 Omnibus		Change over FY 2010 Estimate	
					Amt	%	Amt	%
BIO	$656.62	$260.00	$714.54	$767.81	$111.19	16.9	$53.27	7.5
CISE	574.50	235.00	618.83	684.51	110.01	19.1	65.68	10.6
ENG *(less SBIR/STTR)*	574.60	215.08	618.16	682.81	108.21	15.8	64.65	10.5
SBIR/STTR	90.39	49.91	125.77	142.86	52.47	36.7	17.09	13.6
GEO	808.53	347.00	889.64	955.29	146.76	18.2	65.65	7.4
MPS	1243.88	474.97	1,351.84	1,409.91	166.03	13.3	58.07	4.3
SBE	240.56	84.97	255.25	268.79	28.23	11.7	13.54	5.3
OCI	199.23	80.00	214.28	228.07	28.84	14.5	13.79	6.4
OISE	47.45	13.98	47.83	53.26	5.81	12.2	5.43	11.4
OPP	473.55	171.89	505.16	527.99	54.44	11.5	22.83	4.5
IA	241.58	129.85	275.04	295.93	54.35	22.5	20.89	7.6
U.S. Arctic Research Commission	1.50	0.00	1.58	1.60	0.10	6.7	0.02	1.3
Research & Related Activities	$5,152.39	$2,062.64	$5,617.92	$6,018.83	$866.44	16.8	$400.91	7.1

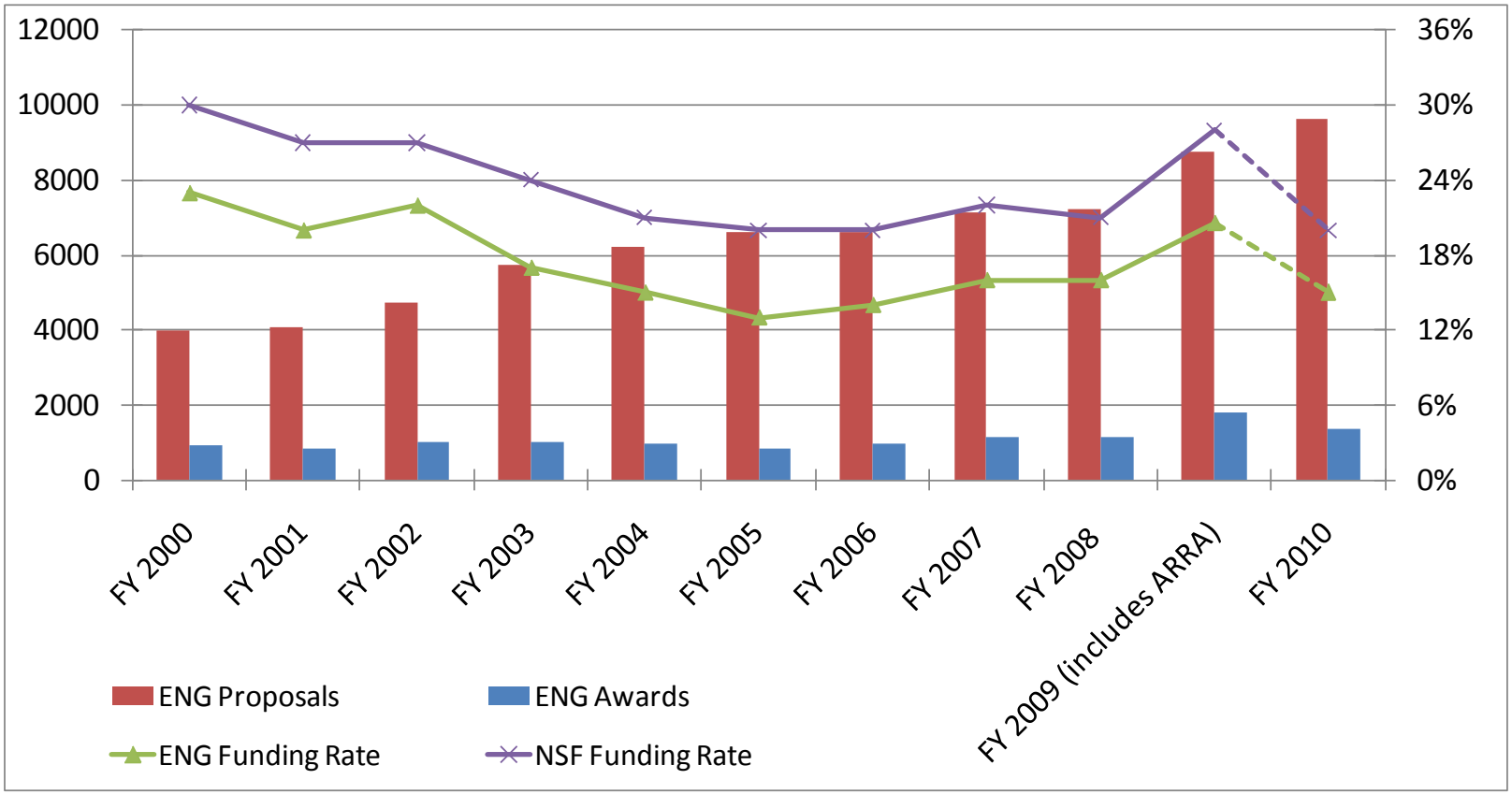
ENG and SBIR/STTR Budgets ($M)



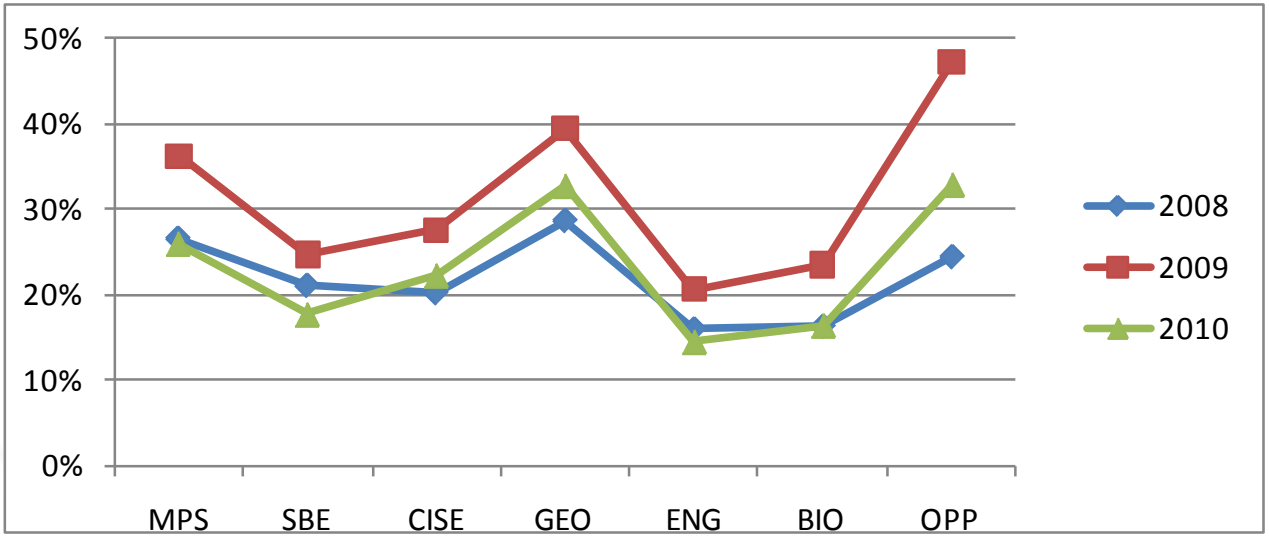
ENG Budget ($M)

	FY 2009 Omnibus Actual	FY 2009 ARRA Actual	FY 2010 Estimate	FY 2011 Request	Change over FY 2009 Omnibus		Change over FY 2010 Estimate	
					Amt	%	Amt	%
CBET	$146.00	$60.57	$156.82	$169.07	$23.07	15.8	$12.25	7.8%
CMMI	174.93	57.96	188.00	206.50	31.57	18.0	18.50	9.8
ECCS	87.21	45.57	94.00	103.00	15.79	18.1	9.00	9.6
EEC	118.23	32.18	124.11	138.40	20.17	17.1	14.29	11.5
IIP	112.12	54.70	152.00	177.70	65.58	58.5	25.70	16.9
SBIR/STTR	*90.39*	*49.91*	*125.77*	*142.86*	*52.47*	*58.0*	*17.09*	*13.6*
EFRI	26.50	14.00	29.00	31.00	4.50	17.0	2.00	6.9
ENG TOTAL	$664.99	$264.99	$743.93	$825.67	$160.68	24.2%	$81.74	11.0%

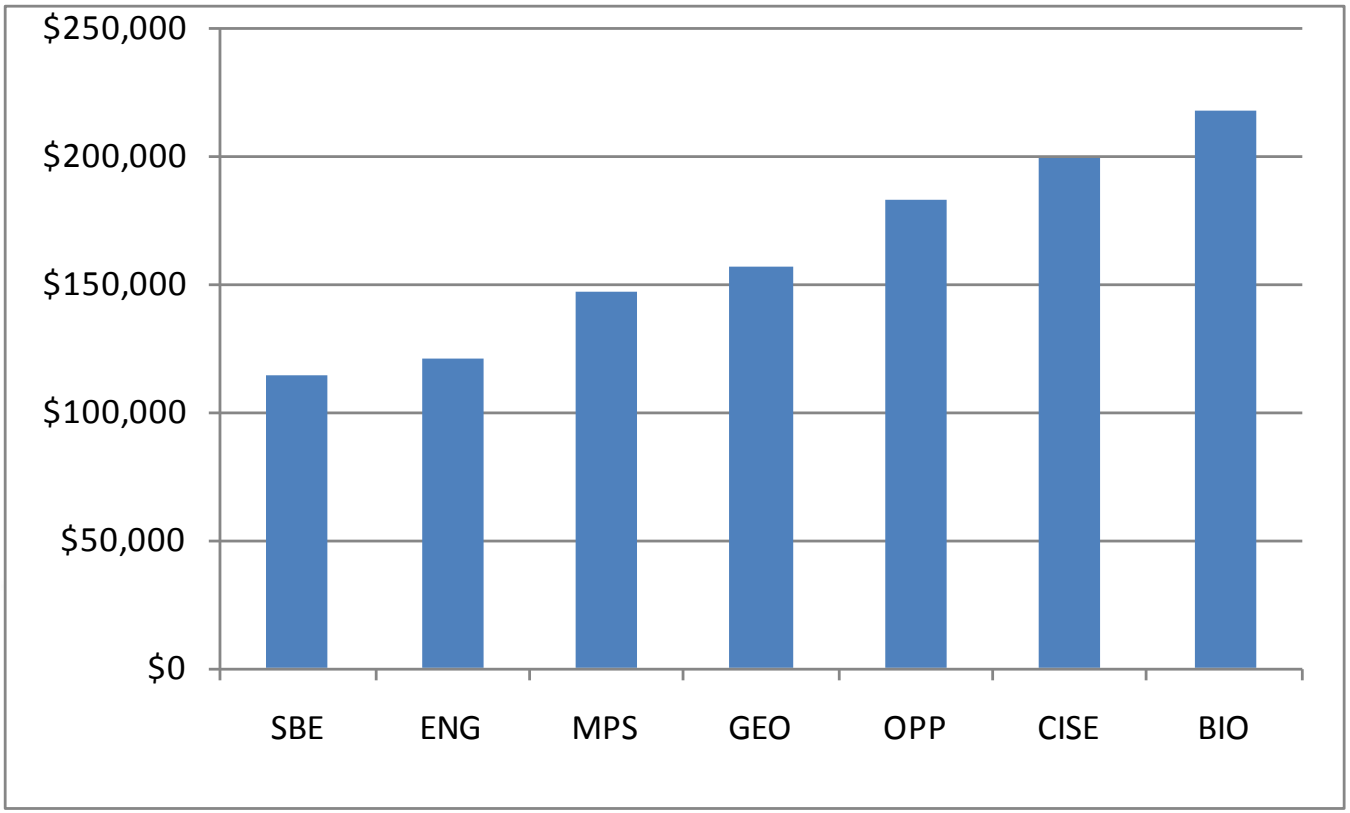
ENG Research Grant Proposals and Awards



Success Rates for Competitive Research Awards



FY 2010 Average Annual Research Award Size



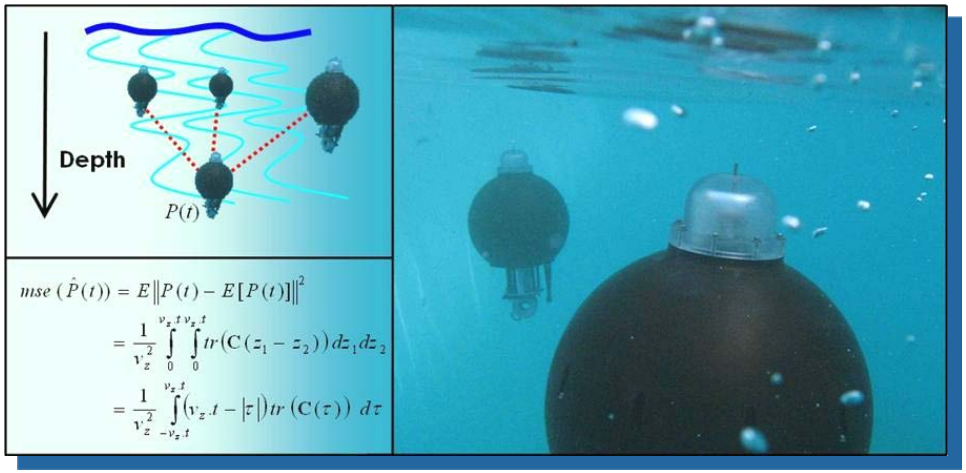
ENG Collaborative Investments

Advanced Manufacturing

- Transformative manufacturing technologies, including
  - **Nanomanufacturing** research and the application of nanotechnology to existing manufacturing industries;
  - Fundamental research associated with **Science and Engineering Beyond Moore's Law** (SEBML), its manufacturing challenges and opportunities; and
  - Basic research efforts on **manufacturing enterprise systems** and **complex systems design and manufacturing**

Cyber–Physical Systems

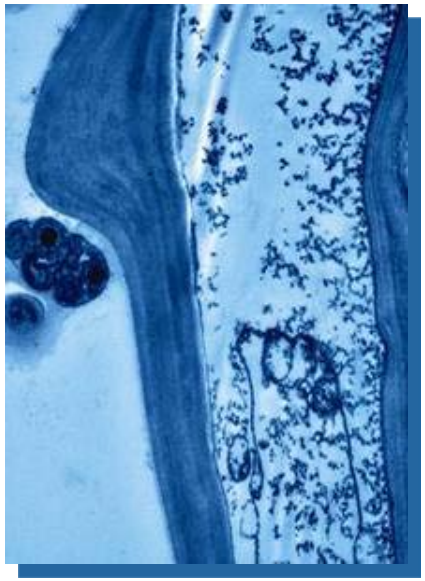
- Integration of information and control agents with physical hardware.
  - Devices
  - Components
  - Systems with built-in intelligence
- Applications in
  - Healthcare
  - Education and training
  - Energy distribution and control
  - Environmental monitoring and sensing
- Joint activity between ENG and CISE
- NSF workshop in March involved OSTP, DOD, DOE, NASA, NIH, and other agencies



Sensor-equipped underwater drifters self-localize through networked underwater communications and smart formation selection. *Credit: UCSD*

National Nanotechnology Initiative

- Nanomaterials and nanodevices
  - Computing
  - Communications
  - Sensing
  - Energy (for example, solar)
- Nanosystems
- Nanomanufacturing
- Environment, health, and safety



Uptake of C70 nanoparticles and their aggregation within a rice plant leaf cell.
Credit: JoAn Hudson, Sijie Lin, and Pu Chun Ke, Clemson University

Science and Engineering Beyond Moore's Law (SEBML)

- Doubling ENG support to $20 million for investigations into:
  - Devices
  - Systems and architecture
  - Multi-scale modeling and simulation research
  - Quantum information science and engineering
  - Design of efficient and sustainable manufacturing equipment, processes, and facilities

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

NSF ENG Collaborations with other Agencies

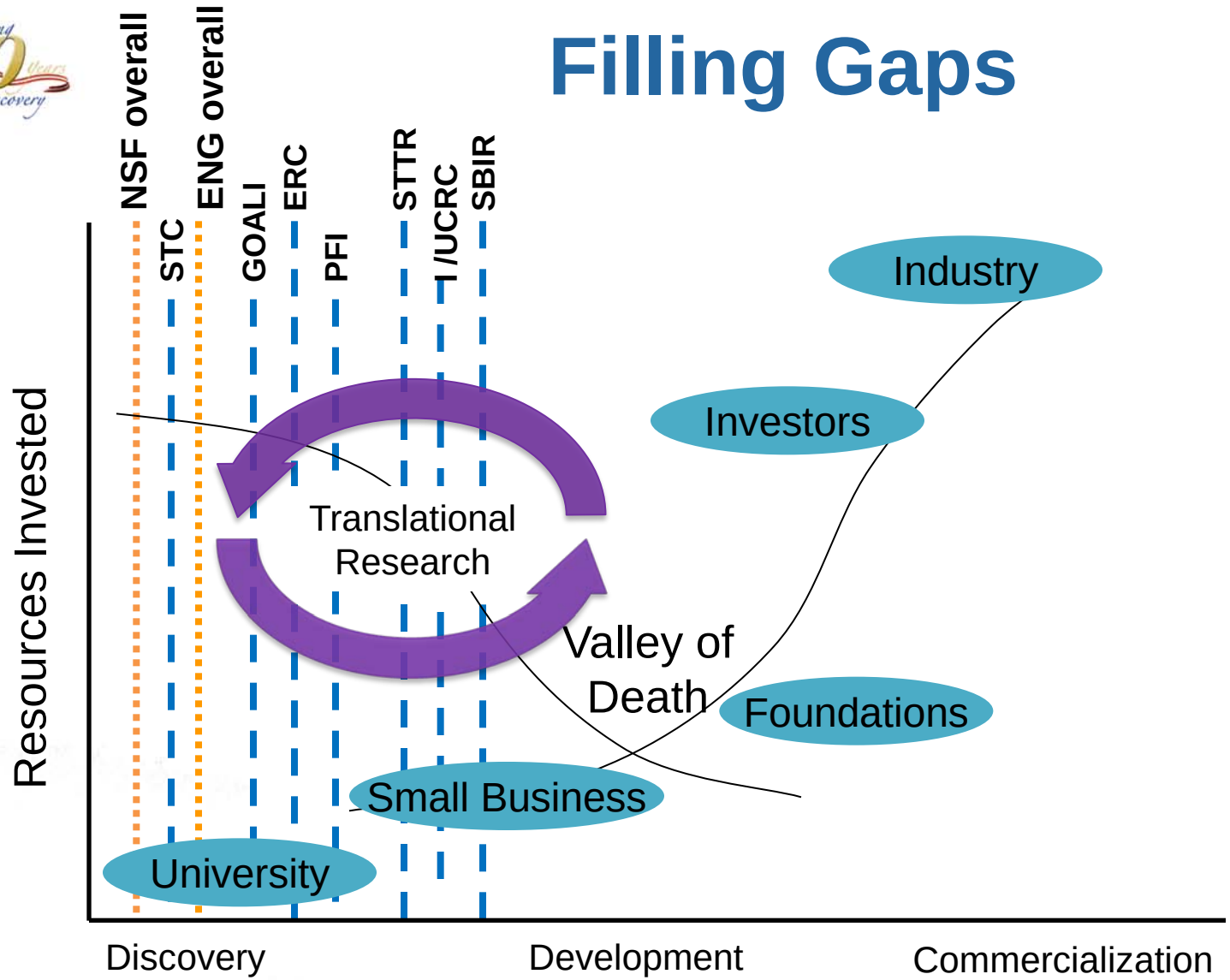
- CBET
  - $3.3M from DHS Domestic Nuclear Detection Office for the Academic Research Initiative
  - $1.5M from DOE for the Partnership on Thermoelectric Devices for Vehicle Applications
- CMMI
  - $900K for the Natural Hazards Center at the Univ. of Colorado from DHS, USGS, NOAA, FEMA, DOT, the Army Corps of Engineers, the United State Forest Service, and others
  - $3.0M from USDA for a two-year solicitation on Disaster Resilience for Rural Communities
  - $750K from the NIH National Cancer Institute for two NSEC supplements

NSF ENG Collaboration (cont.)

- EFRI
  - $500K from DOE for SEED awards ($1.5M committed over next 3 years)
  - $900K from EPA for SEED awards
- IIP
  - $4.0M from various federal/state agencies for investments/ memberships in particular I/UCRCs (57 individual transfers ranging from $23K to $396K)

Innovation Ecosystem

Filling Gaps



Technology Investments to Spur Economic Growth: Highlights in the FY 2011 Budget

Promote the commercialization of promising technologies: The Budget proposes $12 million for the National Science Foundation (NSF) for a new Innovation Ecosystem in which universities partner with other institutions to increase the impact of the most promising innovations through commercialization, industry alliances, and start-up formation.

Office of Science and Technology Policy (OSTP)
February 1, 2010

Translational Research in the Academic Community (TRAC)

- To sustain U.S. competitiveness, there is an urgent need to accelerate the innovation potential of research supported by NSF
- TRAC was an FY 2010 PILOT that provided targeted resources to academic researchers (active GOALI awardees) to translate results from fundamental research into potential commercial applications

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

Partnerships for Innovation (PFI)

- Builds capacity for innovation through exploration, re-definition, and creation of novel platforms for translating research and moving it towards economic and social impact
- Provides grants to universities in partnership with other institutions to:
  - Increase the engagement of faculty and students across all disciplines in the innovation and entrepreneurship process;
  - Increase the impact of the most promising university innovations through commercialization, industry alliances, and start-up formulation; and
  - Develop a regional community that supports the “innovation ecosystem” around the university.
- $7M to fund 9–11 awards, with each up to $600,000 for 2–3 years

Broadening Participation in Engineering

AdCom Recommendations from Fall 2008

- Investigate a Faculty Research Advancement program for individuals not eligible for BRIGE
- Establish a workshop series
- Conduct outreach activities with the professional engineering societies
- Research Initiation Grants for postdocs
- Continue the GRS
- Expand RET and REU activities
- Expand the Tribal College Initiative

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BRIGE Program

- Engages support from across ENG
- Increasing geographic diversity of grantees
- Held grantee conference in August 2010

- FY 2010
  - 129 proposals
  - 31 awards (26% success rate)
- FY 2009 (includes ARRA)
  - 135 proposals
  - 38 awards (31% success rate)
- FY 2008
  - 130 proposals
  - 28 awards (25% success rate)

Graduate Research Supplements

- $1.3M investment in FY 2010
  - Funded 35: 13 CBET, 9 CMMI, 6 ECCS, 5 EEC, and 2 EFRI
- $1.2M investment in FY 2009
  - Funded 29: 12 CBET, 9 CMMI, 5 ECCS, 2 EEC, and 1 EFRI
- In FY 2011, GRS renamed Graduate Research Diversity Supplements (GRDS)

Workshops for Broadening Participation

- Seamless Admission: engineering bridge program for underrepresented minority students (Summer 2010)
- “Effective Negotiation Skills” workshop for ASME women and underrepresented minorities (Aug. 2010)
- BRIGE grantee conference (Aug. 2010)
- Enabling student participation in SACNAS and SHPE annual meetings (Sept. and Oct. 2010)

Tribal Colleges and Universities Programs (TCUP)

- Program to enhance quality of STEM instructional and outreach programs at Tribal Colleges and Universities
- New Pre-engineering Education Collaboratives (PEEC) track for pilot efforts to:
  - Develop and/or enhance pre-engineering curricula
  - Provide pathways from 2-year colleges to 4-year universities
  - Provide internships, research experiences, extramural learning opportunities, and faculty development
- Planned 2–3 awards for up to $1M per year ($250K/institution) for up to five years

TCUP PEEC Awards, FY 2010

- **Hawaii**: Lead institution Kapiolani Community College (partners: Manoa, Honolulu CC, Leeward CC, Maui CC, Windward CC)
- **North Dakota**: Lead institution Cankdeska Cikana Community College (partners: Sitting Bull, Turtle Mountain, Fort Berthold, NDSU)
- **South Dakota**: Lead institution Oglala Lakota College (partners: SDSU, SDSMT)
- **Wisconsin**: Lead institution College of Menominee Nation (partners: UW-Madison, UW-Platteville)

Total funding/year for all states: $3.50M

Total for EPSCoR states: $2.75M

Emerging Frontiers of Research and Innovation (EFRI)

Office of Emerging Frontiers in Research and Innovation

- MANDATE: Serve a critical role in helping the Directorate for Engineering focus on important emerging areas in a timely manner.
- TOPICS:
  - Auto-Reconfigurable Engineered Systems (ARES)
  - Cellular and Biomolecular Engineering (CBE)

  FY 2007
  - Cognitive Optimization (COPN)
  - Resilient and Sustainable Infrastructures (RESIN)

  FY 2008
  - Biosensing and Bioactuation (BSBA)
  - Hydrocarbon from Biomass (HyBi)

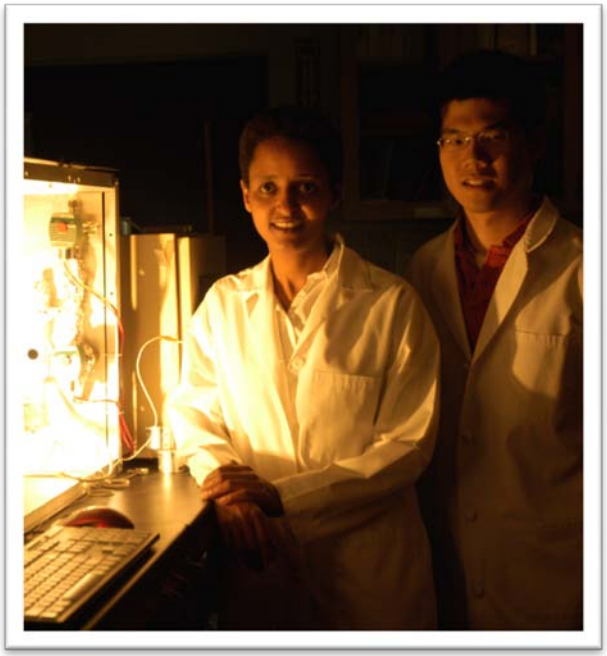
  FY 2009
  - Science in Energy and Environmental Design (SEED)
  - Renewable Energy Storage (RESTOR)

  FY 2010
- TOPIC LEADERS: ENG PDs in collaboration with PDs from other Directorates and Agencies when appropriate
- http://nsf.gov/staff/staff_list.jsp?org=EFRI&from_org=EFRI

EFRI RESTOR:
Offering the sun's energy on demand

Thermochemical Routes to Efficient and Rapid Production of Solar Fuels (1038307) will be led by Sossina Haile of CalTech.

- Changes in temperature can induce certain metal oxides to store and release oxygen.
- This phenomenon may be harnessed to produce a chemical fuel that may then be converted to electricity.
- The team will optimize the oxide's thermodynamic and kinetic characteristics and construct a prototype reactor to demonstrate feasibility and efficiency.

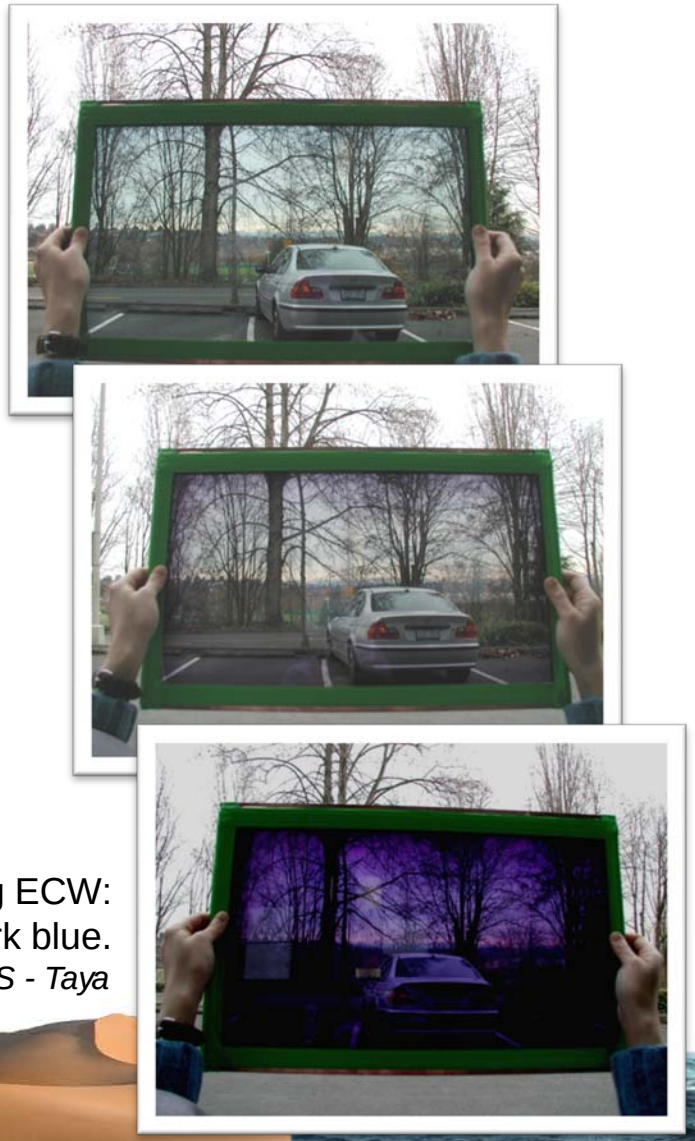


In the pursuit of solar energy storage, researchers will test materials in a thermochemical reactor. *Credit: Sossina M. Haile, California Institute of Technology*

EFRI SEED:
Controlling and generating energy with windows

Toward Zero-energy Buildings Based on Electrochromic Windows (ECW) and Energy-harvesting ECW (1038165) will be led by Minoru Taya of the University of Washington.

- The team will develop ECWs and energy-harvesting ECWs based on new switchable dyes and polymers.
- Dye-sensitized solar cell technologies will locally power the ECWs and other electrical systems.
- The goal is to substantially reduce the energy needed for cooling and heating.

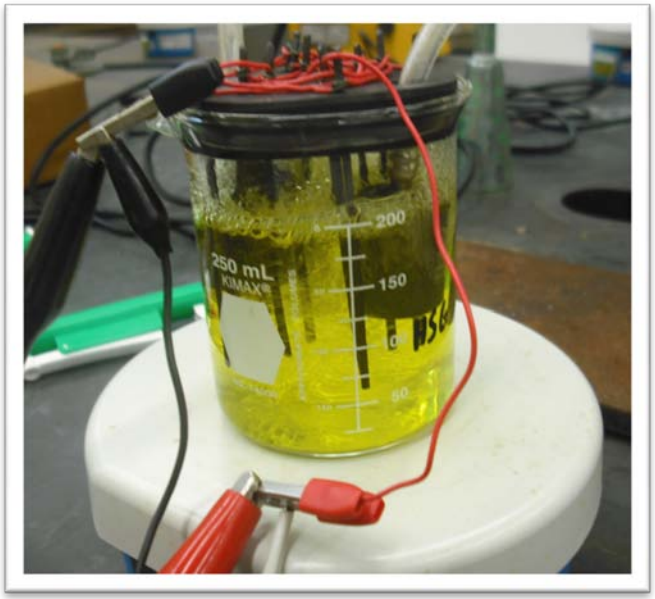


Three cases of a dimming ECW: transparent, medium, and dark blue.
Credit: University of Washington, CIMS - Taya

EFRI SEED:
Buildings, off the water grid

Design for Autonomous Net-Zero Water Buildings (1038257) will be led by James Englehardt of the University of Miami.

- The team will build on current technologies to decentralize water monitoring, quality control, and operation and maintenance for a low-energy water reuse system.
- Water treatment will be designed to effectively destroy contaminants common to homes and workplaces (such as endocrine-disrupting pharmaceuticals).
- The system will involve real-time risk assessment and reflect architectural and socio-cultural acceptability of reused potable water.



The goal is to develop systems that turn wastewater into drinking water.
Credit: James Englehardt, University of Miami

EFRI 2011 Topics

- **MIKS**: Engineering New Technologies Based on Multicellular and Inter-Kingdom Signaling
- **M3C**: Mind, Machines, and Motor Control
- Developed in collaboration with BIO and CISE
- Preliminary proposals due Nov. 8, 2010; full proposals due April 1, 2011

EFRI Topic Selection

- Continuous Community Input (publications, conferences, advisory committee, committees of visitors, panels, workshops, …)
- Explicit Community Input through Website (Dear Colleague Letter; Sept deadline) **90 RECEIVED**
- Fall Advisory Committee (October)
- EFRI Community Series (Nov/Dec) **10 PRESENTATIONS at NSF**
- Program Directors' Retreat (Jan)
- ENG Leadership Retreat (March)
  - **TOPICS ARE FINALIZED**
- Spring Advisory Committee (April)
  - **TOPICS ARE ANNOUNCED AND MADE PUBLIC**

Program Directors are the Kernel of Integration and Leaders for EFRI Topics

EFRI 2012 Topic Selection

- Requested emerging transformational areas of research and innovation from the community
- 120 ideas received by Sept. 30 deadline (90 last year)
- Up to 10 ideas will be presented at NSF in January

Review and Evaluation of EFRI

- Committee of Visitors: review planned for January 2011, with report at Spring 2011 AdCom meeting.
- Formative Evaluation: external evaluation of EFRI processes is underway.
- For more information:
  - EFRI Website: www.nsf.gov/eng/efri
  - Grantee Meetings: www.abecker.com

ENG RAPIDs

Haiti and Chile Earthquakes

- $2.3M awarded across NSF for RAPIDs and other awards
- $1.9M awarded by ENG for 26 awards
- For study and assessment of structural performance, geotechnical, sustainable recovery, displacement patterns, housing, and an interdisciplinary grantee workshop

Structural engineer Reginald DesRoches of Georgia Tech speaks with CNN newscaster Christianne Amanpour about the future of Haiti following the Jan. 12, 2010, earthquake. *Credit: Reginald DesRoches, Georgia Institute of Technology*

Gulf Oil Spill

- $18.8M awarded across NSF for RAPIDs
- $3.2M awarded by ENG for 26 awards
- For instruments and study of oil absorbents, dispersants, deposition, flow, persistence, remediation, environmental impacts, and public understanding

Researchers are studying the impact of the oil spill in Gulf waters and sediments. *Credit: Samantha Joye*

ENG Strategic Thinking

ENG in FY 2010

Office of the Assistant Director
Thomas Peterson, Assistant Director
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Charge to ENG WGs

- Take stock of the progress made towards addressing recommendations from 2005
- Evaluate strengths and weaknesses of new Directorate organizational structure
- Determine other issues deserving the attention and focus of the Directorate
- Coordinate our planning with current NSF Strategic Planning

2009-10: Five Working Groups

- Strategic Thinking Group
- Awards and Solicitations
- Assessment and Evaluation
- Engineering Education and Workforce
- Public Understanding of Engineering
- Organization - Considered by STWG

ENG Strategic Goals

- Focus break-out groups on goals
  - Frontier Research
  - Innovation Ecosystem
  - Engineer of the Future
  - Organizational Excellence

Strategy for ENG

- Reports from ENG Working Groups – complete
- Input from ENG all-hands meeting – complete
- Response from AdCom – in progress
- Implementation – next

Breakout Groups

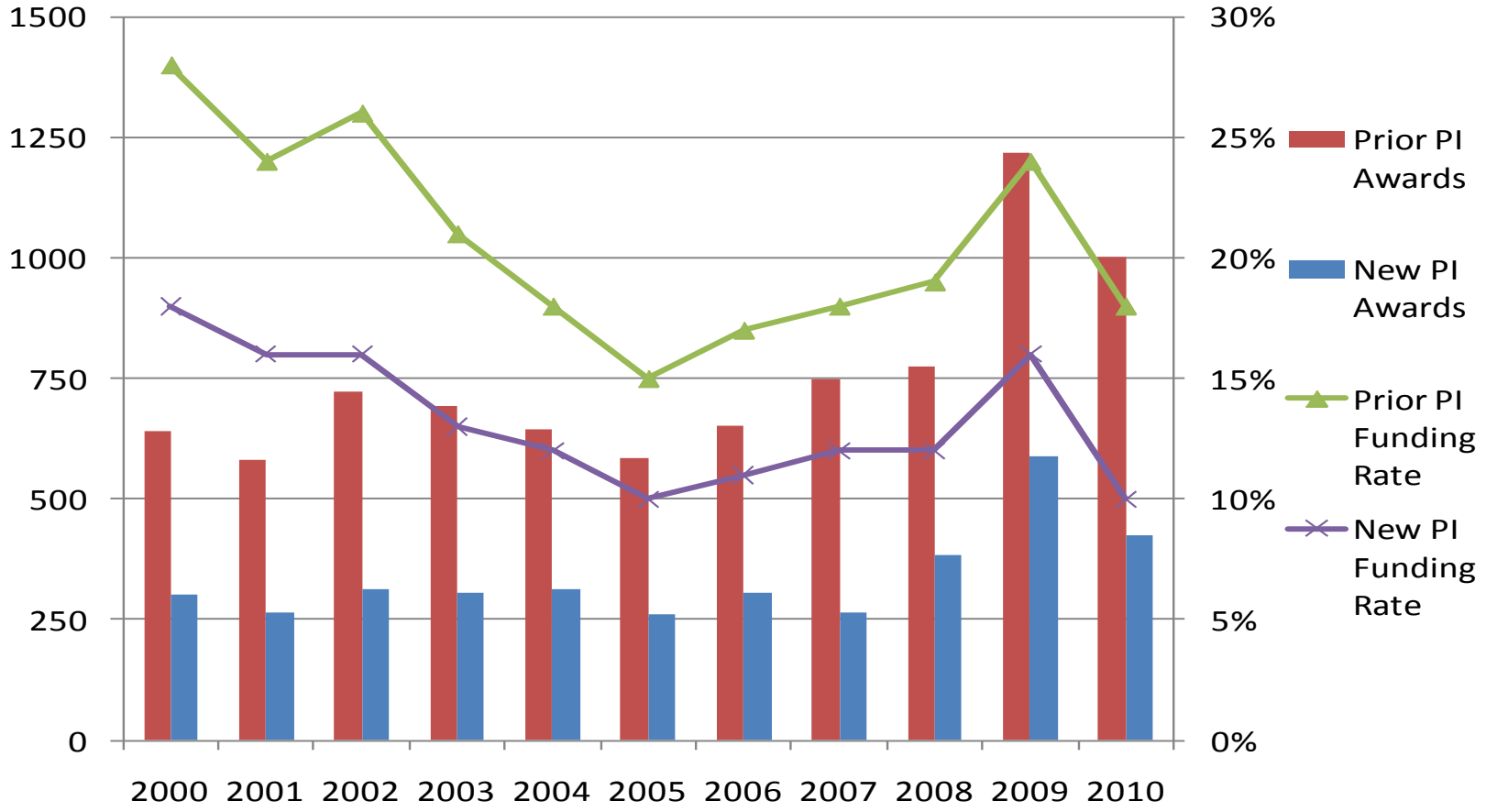
- Goal 1 (room 1235)
  - **Murnane**
  - Khargonekar
  - Logan
  - Pollock
- Goal 2 (room 1235)
  - **Knight**
  - Silevitch
  - Toner
- Goal 3 (room 546)
  - **Farrell**
  - Castillo
  - Paulus
- Goal 4 (room 505)
  - **Flatau**
  - Abriola
  - Adesida

Suggested Questions to Consider

- Do you see any **gaps** in the Goals?
- Do you have suggested **changes** to the goals or recommendations?
- How should we **prioritize** the Goals and Recommendations?
- What **outcomes** should we target for each Goal?

Questions

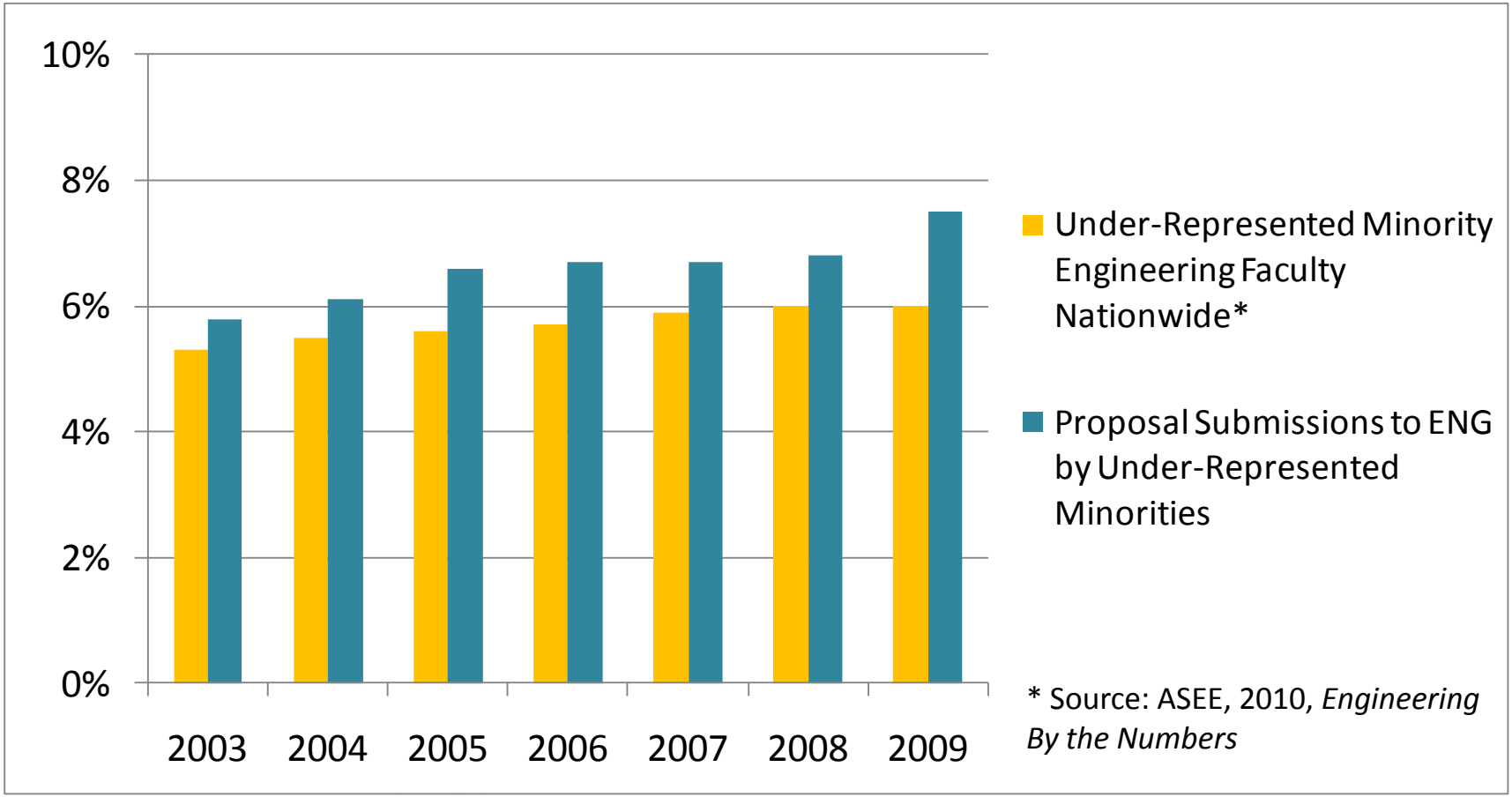
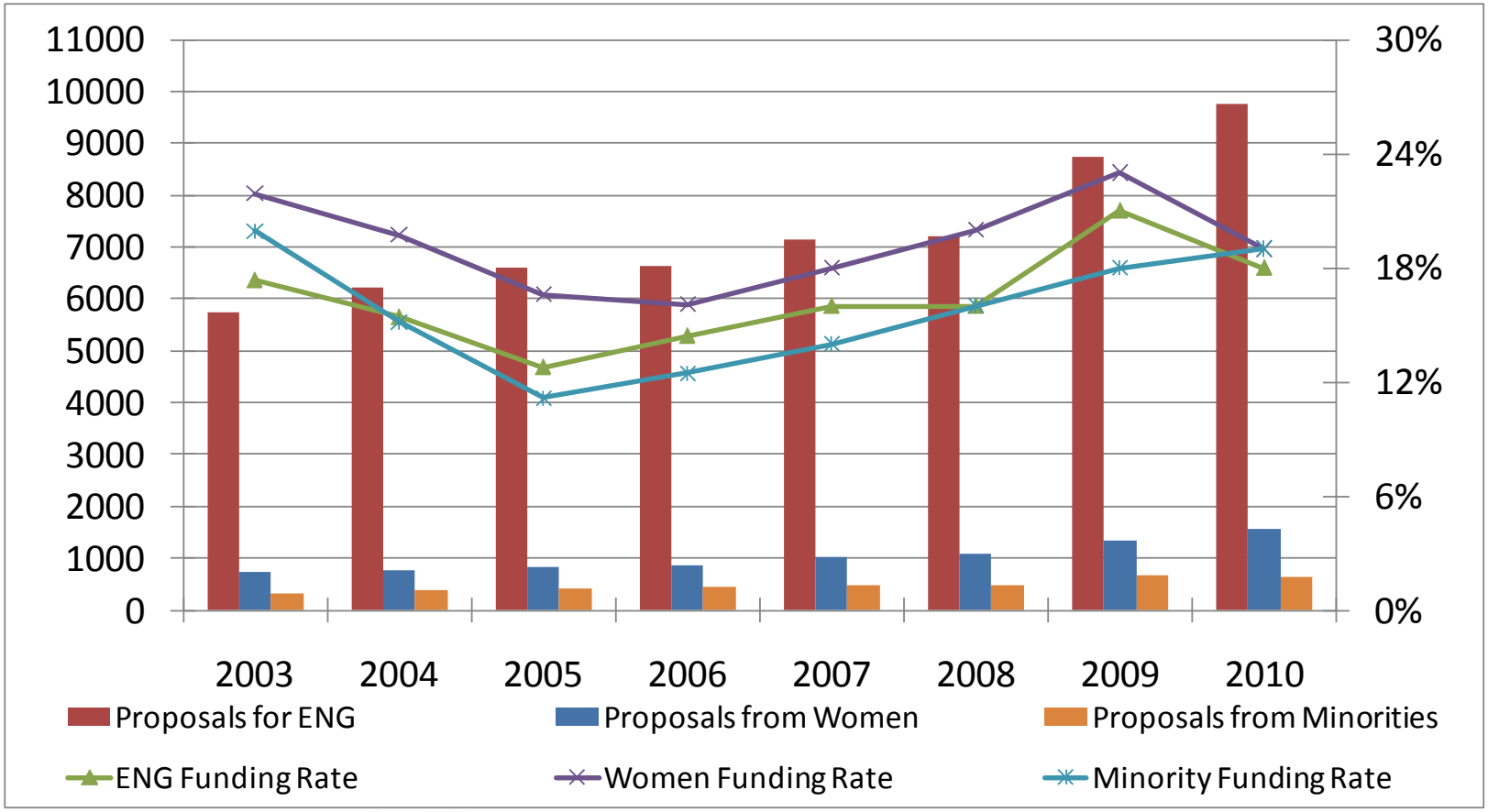
ENG Awards and Funding Rates for Prior and New PIs



Proposal Submissions to ENG by Women

* Source: ASEE, 2010, *Engineering By the Numbers*

Proposal Submissions to ENG by Under-Represented Minorities



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