



# Update to the ENG Advisory Committee

*Thomas W. Peterson*

*Assistant Director for Engineering*

*April 14, 2010*





# ENG Update

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







# AdCom Business





# New AdCom Members

- Linda Abriola, Tufts University
- Alison Flatau, University of Maryland
- Pramod Khargonekar, University of Florida
- Bruce Logan, Pennsylvania State University
- Eugenia Paulus, North Hennepin Community College (CEOSE Liaison)
- Michael Silevitch, Northeastern University
- Mehmet Toner, Harvard Medical School, Massachusetts General Hospital







# Future Meeting Dates

- October 21–22, 2010
- April 20–21 (April 13–14), 2011
- October 19–20 (October 26–27), 2011
- To be finalized once we have NSB meeting schedule
- Provide Feedback to Shirah asap





# Spring Meeting Agenda

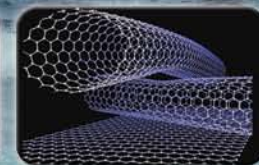
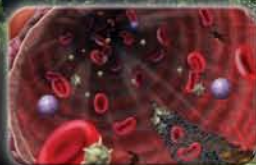
- ENG Update
- Plans for FY11
  - Science, Engineering, and Education for Sustainable Well-Being (SEES)
  - Innovation Ecosystem
  - Advanced Manufacturing, NNI, SEBML, Re-ENERGYSE, CPS
- NSF and ENG Strategic Planning
- EEC COV





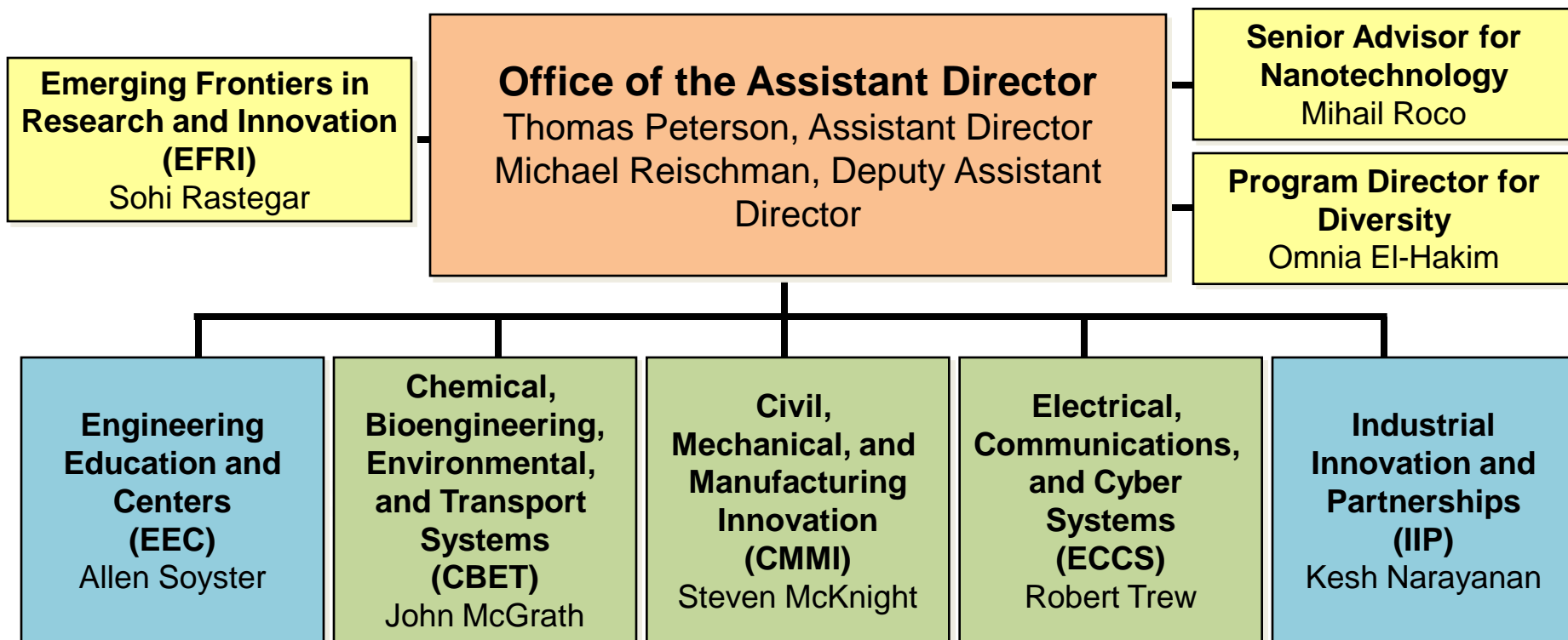


# New ENG Staff





# Directorate for Engineering (ENG)







# CBET

- **Arvind Atreya**, Program Director for Combustion, Fire, and Plasma Systems (University of Michigan)
- **Theresa Good**, Program Director for Biotechnology (University of Maryland)
- **Barbara Thomas**, Administrative Support Assistant





# ECCS

- **George Maracas**, Program Director for Power, Controls and Adaptive Networks (Arizona State University)







IIP

- **Kelli Parker, SCEP Program Specialist**





# Open Recruitments

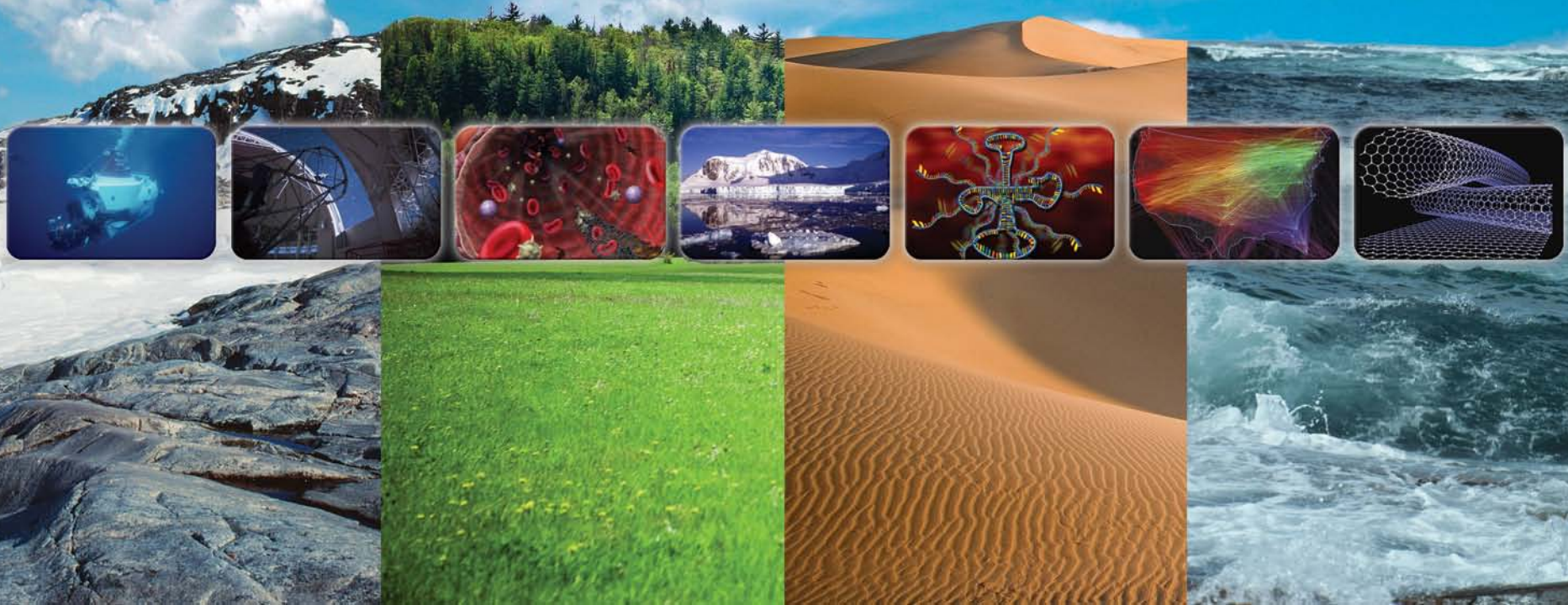
- EEC – Division Director
- CBET – Program Director for Particulate and Multiphase Processes
- CBET – Program Director for Thermal and Transport Processes
- CMMI – Program Director for Civil Infrastructure Systems
- CMMI – Program Director for NanoBio Mechanics
- ECCS – Program Director for Photonics
- IIP – Program Director for I/UCRCs







# ENG Budget and Trends





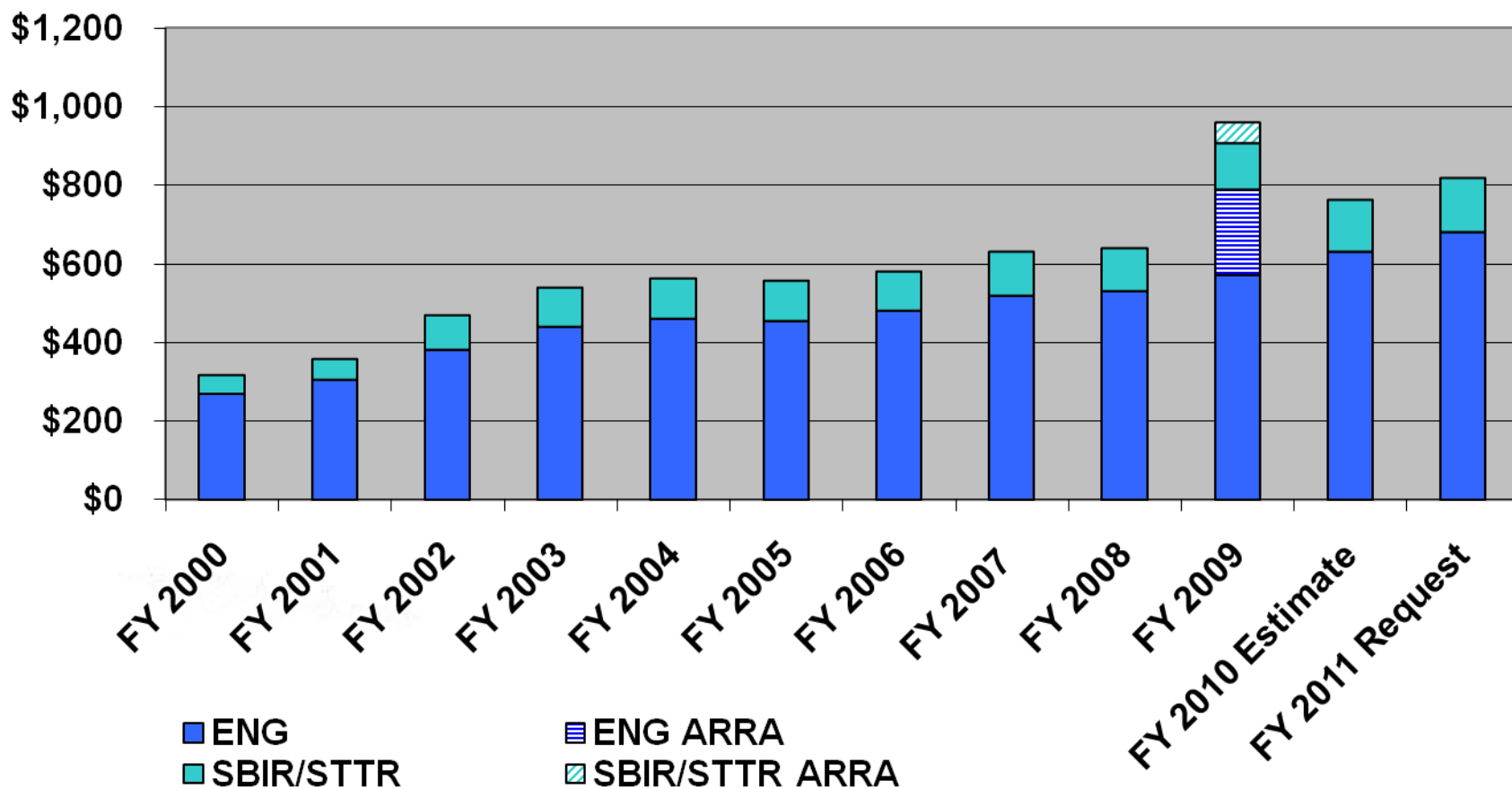
# NSF R&RA Budget (\$M)

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 ( <i>less SBIR/STTR</i> )	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)





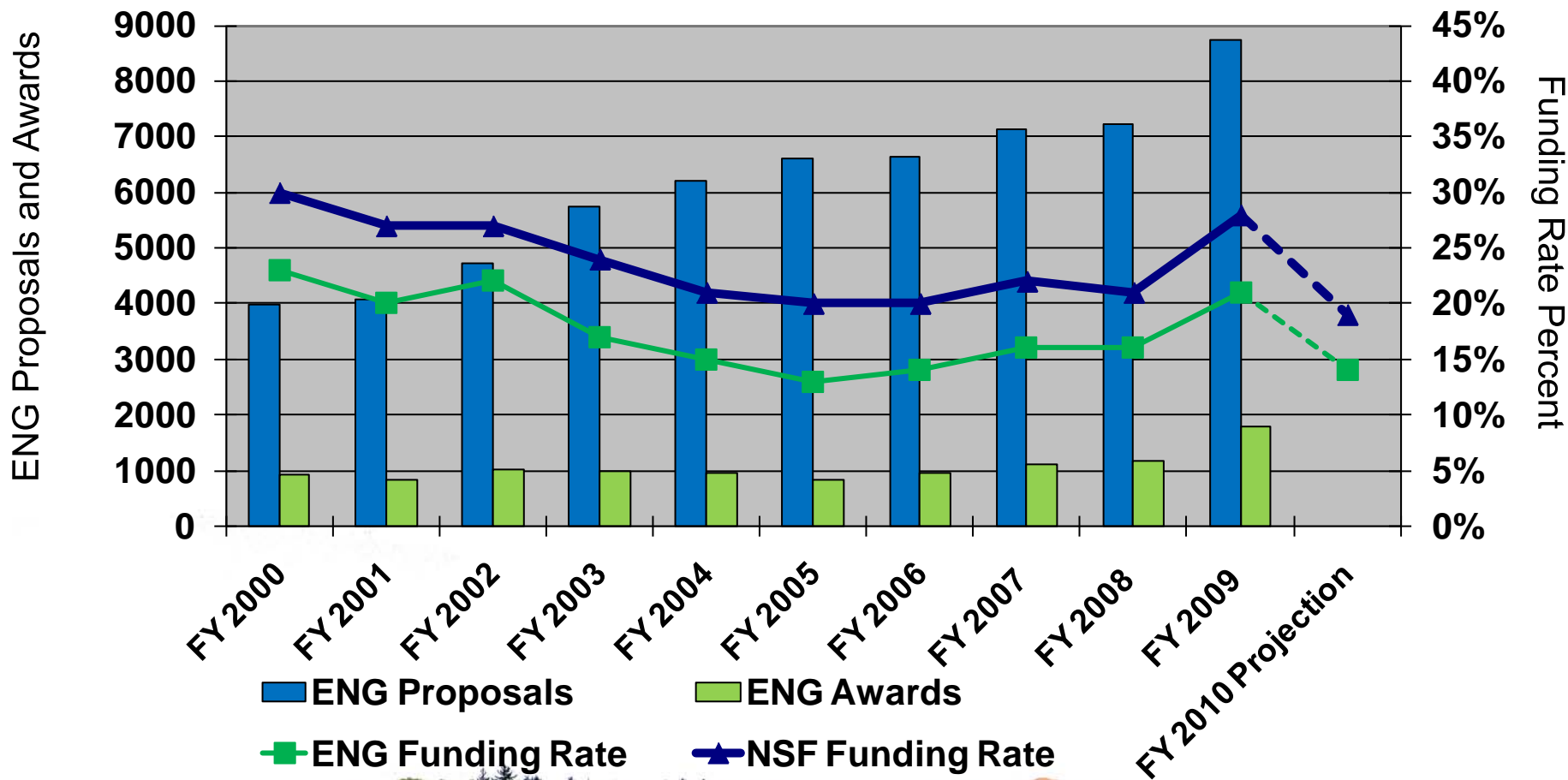
# ENG Budget (\$M)

	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
<i>SBIR/STTR</i>	<i>90.39</i>	<i>49.91</i>	<i>125.77</i>	<i>142.86</i>	<i>52.47</i>	<i>58.0</i>	<i>17.09</i>	<i>13.6</i>
EFRI	26.50	14.00	29.00	31.00	4.50	17.0	2.00	6.9
<b>ENG TOTAL</b>	<b>\$664.99</b>	<b>\$264.99</b>	<b>\$743.93</b>	<b>\$825.67</b>	<b>\$160.68</b>	<b>24.2%</b>	<b>\$81.74</b>	<b>11.0%</b>





# ENG and NSF Research Grant Proposals and Awards





# 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**

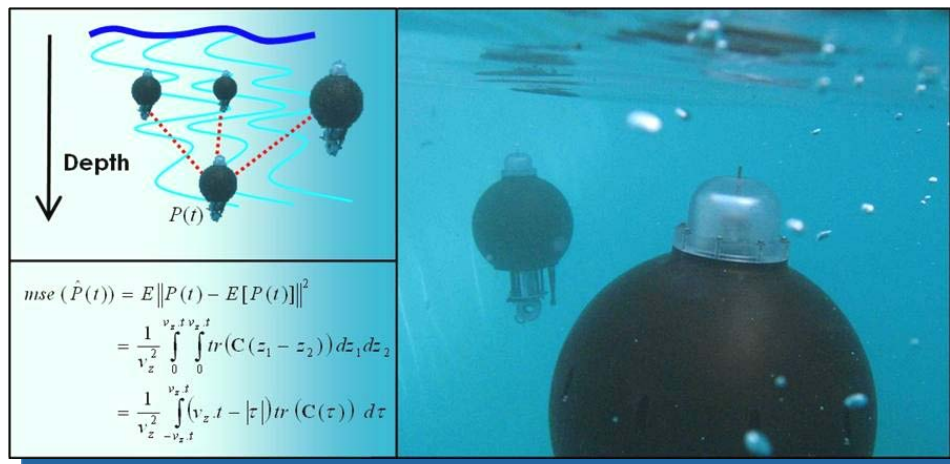






# Cyber–Physical Systems

- 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



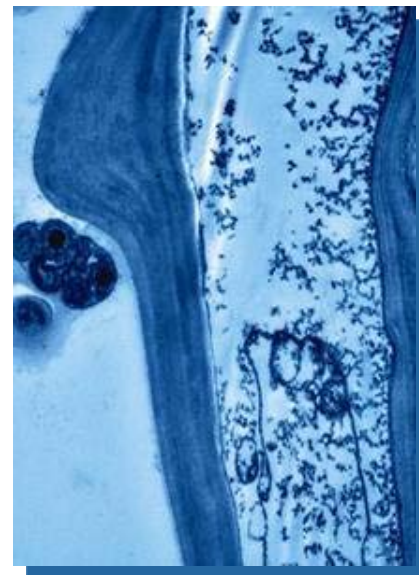
Sensor-equipped underwater drifters self-localize through networked underwater communications and smart formation selection. *Credit: UCSD*





# 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

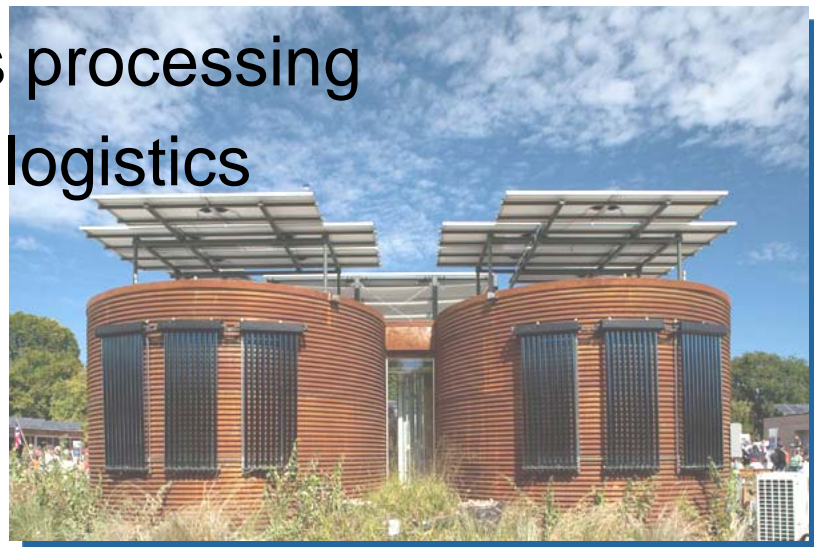




# RE-ENERGYSE

- Collaboration with DOE to support undergraduate and graduate research in sustainable energy, including the areas of:
  - Manufacturing for energy
  - Energy-efficient materials processing
  - Energy supply chain and logistics

Cornell University home  
for Solar Decathlon 2009.  
*Credit: Jim Tetro, U.S. Department of  
Energy Solar Decathlon*





# Innovation Ecosystem

- Partnerships for Innovation will provide research grants to universities in partnership with other institutions to increase the economic and social impacts of university research 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.



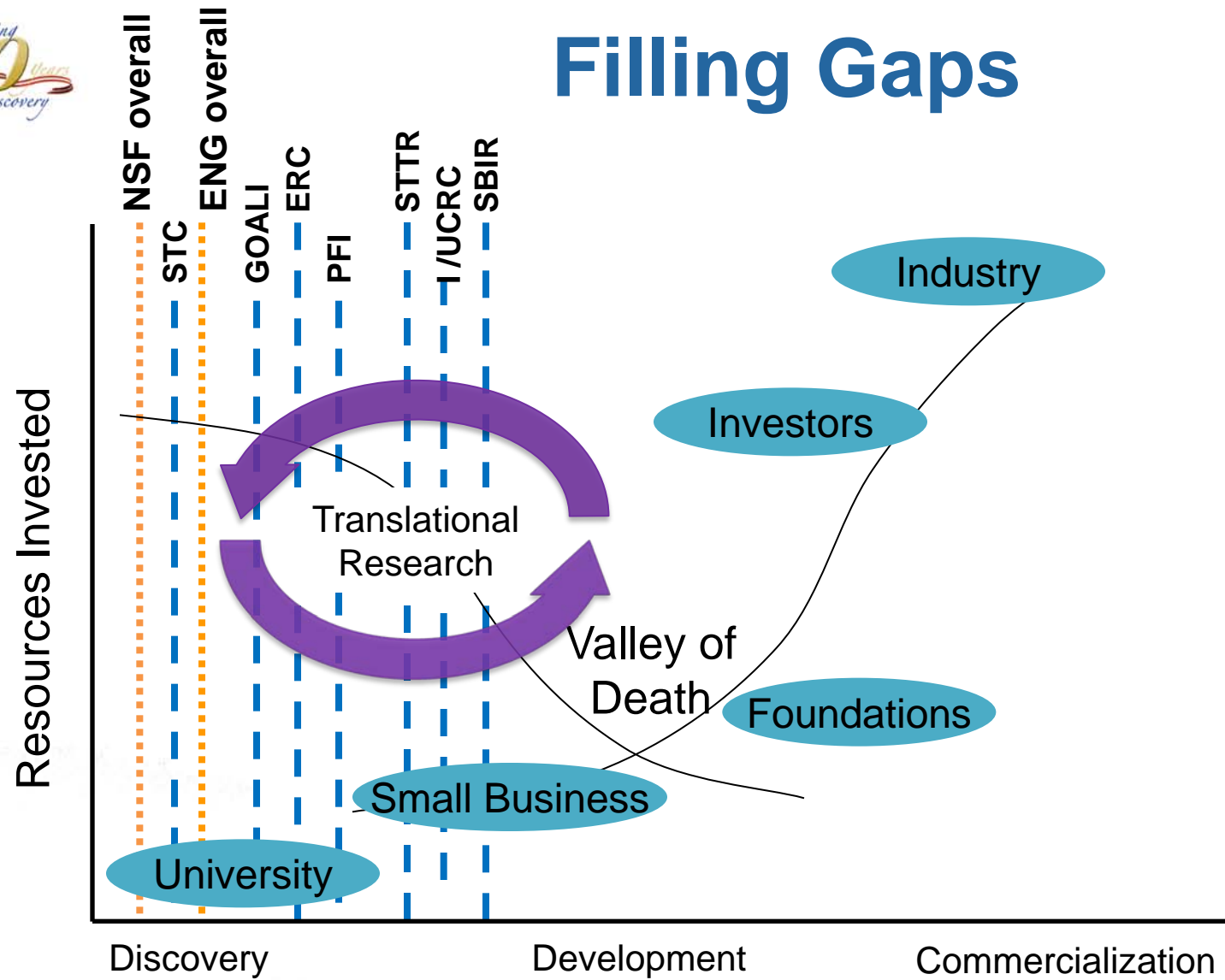




# Innovation Ecosystem



# Filling Gaps







# NSF ENG Interactions with OSTP and Commerce

- NSTC Committee on Technology
  - Nanoscale SET Subcomm.
  - Innovations and Entrepreneurship Subcomm.
  - Aeronautics S&T Subcomm.
  - Advanced Manufacturing interactions
- Interagency Working Groups
  - Simulation and Modeling WG
  - Regional Innovation Cluster WG
  - SBIR WG
  - Cyber–Physical Systems WG







# NSF ENG Interactions with OSTP

- Resonance on importance of innovation
- Appreciation for role ENG at NSF can play
  - Basic research
  - Translational research
  - Catalyst for innovation





## 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





# Postdoctoral Fellows in Industry

- Goal: foster innovation in future engineers at universities and in industry
- Match 40 recent engineering PhDs with:
  - Industry giants (Alcatel-Lucent Bell Labs, Bentley Systems, Hewlett Packard, et al.)
  - Innovative start-ups (BioCee, Inc., Ginkgo Bioworks, Kyma Technologies, et al.)
- \$75K from NSF and \$25K from company for one year
- 26 contracts finalized and 12 more pending, involving 27 companies
- 45 companies, 117 jobs, 92 applicants (309 more in progress) remain for last 2 fellowships







# Innovation Fellows

- Goal: encourage cohorts of engineering undergraduates to pursue an innovation-focused Ph.D. graduate program
- Provide direct grants to participating engineering colleges to support the fellows over 5 years
- Prepare fellows for innovation through:
  - Courses on innovation
  - Research collaborations
  - Summer internships in industry





# 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 is a FY 2010 PILOT that will provide targeted resources to academic researchers (active GOALI awardees) to translate results from fundamental research into potential commercial applications





# Innovation Ecosystem

- Tie to the President's *Innovation for Sustainable Growth* concept
- Investigate various models to accelerate innovations to commercialization
  - ENG working group with representation from all five divisions
- Collect community inputs
  - ENG Advisory Committee
  - PFI workshop (April 25–27, 2010)
- Plan to release a solicitation by September 30, 2010







# 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







# BRIGE Program

- Engaging support from across ENG
- Increasing geographic diversity of grantees
- Planning grantee conference for August 2010
- FY 2010
  - 129 proposals
  - Planning 27 awards (21% 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

- Up to \$2.7M investment in FY 2010
  - Proposals due May 14, 2010
  - Funding for 30 to 60 supplements anticipated
  - Support from across ENG
- \$1.2M investment in FY 2009
  - Funding for 29 supplements (12 CBET, 9 CMMI, 5 ECCS, 2 EEC, and 1 EFRI)





# Professional Development and Mentoring Workshops

- Transitioning community college students into undergraduate engineering by Univ. of Alabama (Oct. 2009) \*
- Mentoring underrepresented minority engineering undergraduates by Quality Education for Minorities Network (Nov. 2009)
- “Problem-solvers” AAAS workshop for engineers and scientists with disabilities (Dec. 2009) \*
- Mentoring and networking for Big 10 junior women faculty by Univ. of Michigan (April 2010)
- “Effective Negotiation Skills” workshop for ASME women and underrepresented minorities (Aug. 2010)

\* Co-funded





# Broadening Participation in Research Conferences

- Student travel to SHPE annual meeting (Oct. 2009) \*
- Graduate student travel to International Congress on Applications of Lasers & Electro-optics (Nov. 2009) \*
- International wind energy conference (March 2010) \*
- International sustainable building conference (March 2010)
- Univ. of Arkansas workshop on advances in breast cancer detection and treatment (Fall 2010)

\* Co-funded







# 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
- 2–3 awards for up to \$1M per year (\$250K/institution) for up to five years





# 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)
  - Cognitive Optimization (COPN)
  - Resilient and Sustainable Infrastructures (RESIN)
  - Biosensing and Bioactuation (BSBA)
  - Hydrocarbon from Biomass (HyBi)
  - Science in Energy and Environmental Design (SEED)
  - Renewable Energy Storage (RESTOR)
- 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](http://nsf.gov/staff/staff_list.jsp?org=EFRI&from_org=EFRI)

FY 2007

FY 2008

FY 2009

FY 2010







# Quick 'Nuggets'

- **EFRI PI to lead STC**
  - Roger Kamm (CBE), MIT, to direct STC on Emergent Behaviors of Integrated Cellular Systems
- **EFRI PI elected to NAE**
  - Cynthia Barnhart (ARES), MIT, elected to NAE in 2010 for her research on airline transportation.
- **EFRI algorithm adopted by power company**
  - David Allen (RESIN), Univ. of Texas, and his colleagues developed an algorithm that has been adopted by utility company and minimizes ozone-producing emissions.





# 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 2011 TOPICS

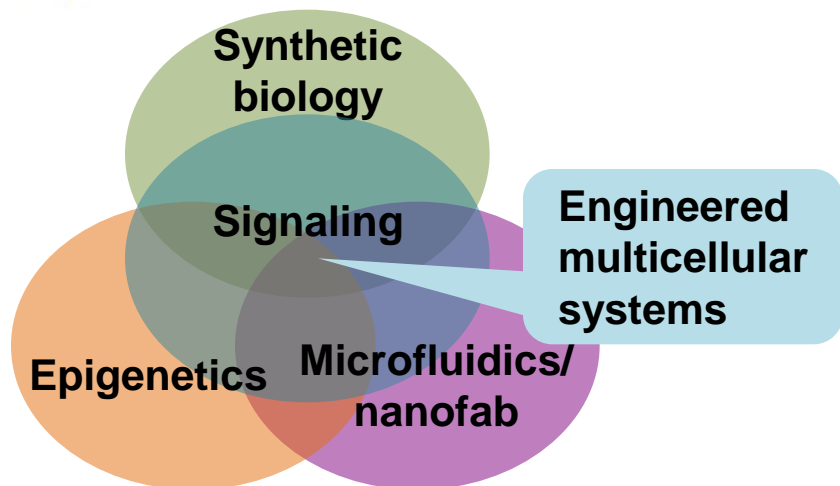
- **MIKS:** Engineering New Technologies Based on Multicellular and Inter-Kingdom Signaling
- **M3C:** Mind, Machines, and Motor Control







# MIKS: Engineering new technologies based on Multicellular and Inter-Kingdom Signaling



**Goal:** Use molecular tools to understand multicellular and inter-kingdom signaling and engineer new multicellular systems to solve problems in energy, health, food safety and environment.

## Expected Transformative Impacts:

- Fundamental knowledge in multi-cellular systems and bacteria–eukaryote interactions
- Basic sciences, including developmental biology, stem cells, bacteria–eukaryote interactions
- Enabling technologies including synthetic biology, high-throughput tools
- Novel engineered multicellular systems
- New collaborations between different research communities





# EFRI-M3C: Mind, Machines and Motor Control

**Goal:** To establish experimentally verified, mathematical theories of M3C that can serve as predictive tools for the design of machines that involve forceful, physical interaction with humans.

## **Expected Transformative Impacts:**

- Mathematical foundations and principles of optimality that govern M3C
- Dynamics of learning and skill acquisition
- Benchmarking systematic biomechanical function & rehabilitation
- Reverse-engineering sensory motor neuroscience
- Superior machines that work with humans





# EFRI Plans

- 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](http://www.nsf.gov/eng/efri)
  - Grantee Meetings: [www.abecker.com](http://www.abecker.com)







# Strategic Planning 2010

- On behalf of the Foundation
- On behalf of the Engineering Directorate
  - 2005
  - 2010





# 2005: Six Working Groups

- Strategic Thinking Group
- Awards and Solicitation
- Awards Impact and Assessment
- Making the Case for Engineering
- Engineering Workforce
- Engineering Organization and Structure





# 2009-10: Five Working Groups

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



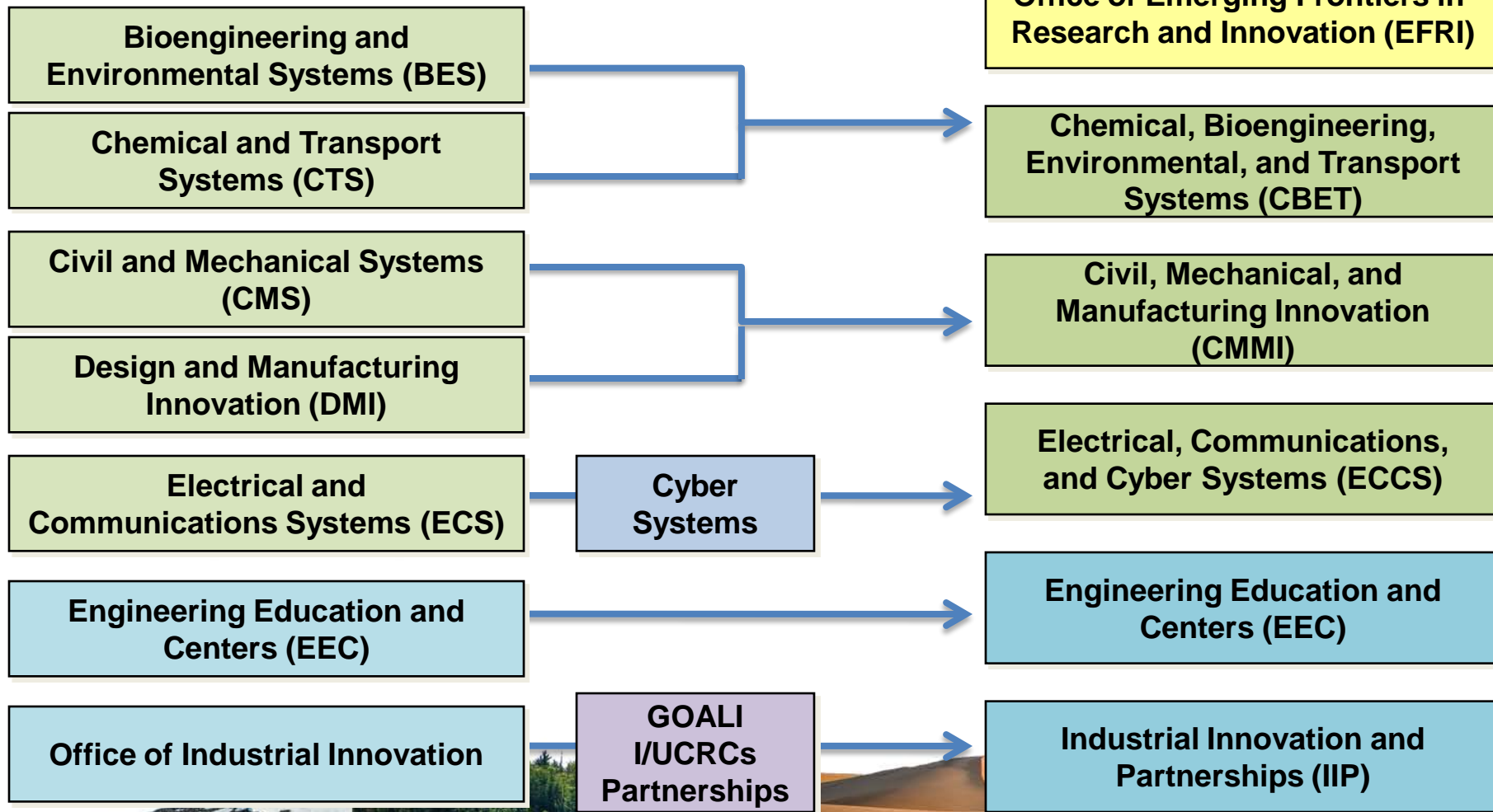




# ENG Reorganization

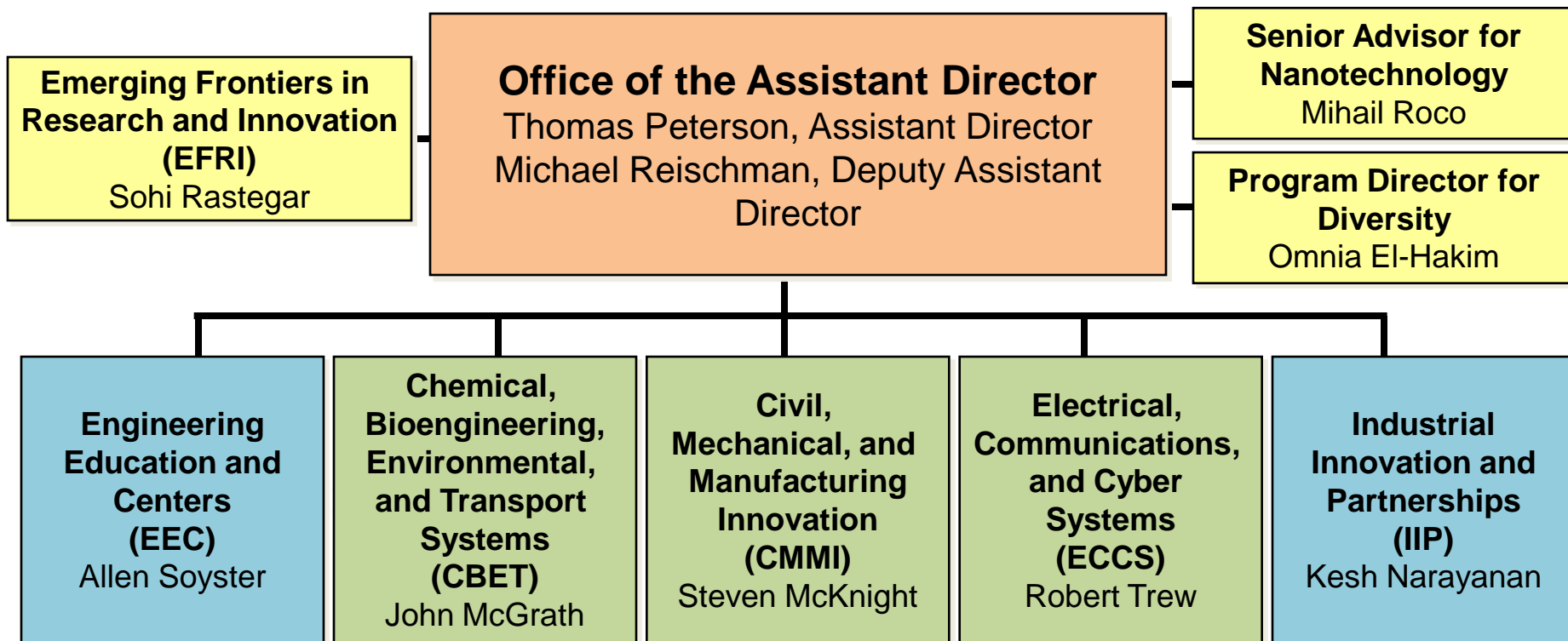
FY 2007

FY 2006





# ENG in FY 2010





# Awards and Solicitations

- Reduce the number of topics and solicitations
- Hold annual planning retreat
- No more than 50% of annual funding going to continuing grants
- Impose proposal submission limitations
- Improve proposal management process







# Evaluation and Assessment

- Require annual reports from grants
- Modify FastLane to include 'Highlights'
- Make annual reports public documents





# Education and Workforce

- Expand Research Experiences for Teachers
- Establish AP engineering course
- Support research in engineering education, including graduate education
- Restructure engineering education pedagogy and culture
- Expand Research Experiences for Undergraduates
- Improve support networks for women and minority faculty





# Public Understanding of ENG

- Conduct message research on PUE
- Build a unified voice for outreach
- Communicate Grand Challenges
- Increase emphasis on our contributions to Innovation
- Build prestige for engineering through national/international prize







# Strategic Thinking WG

- Identify Engineering Grand Challenges and emerging frontier research areas
- Increase support for exploratory research
- Increase support for multi-disciplinary, small group research (mid-scale)
- Increase support for industry research collaborations
- Increase support for K–12 outreach





## Strategic Thinking WG (cont'd)

- Increase support for research in engineering education
- Encourage professional organizations to develop programs supporting diversity in the engineering workforce
- Develop a marketing strategy for engineering
- Restructure directorate to better respond to demands of global engineering community





# Primary Charge to 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







# AdCom Meeting Focus

- Interim Reports on
  - NSF Strategic Planning – Foundation-wide WG
  - ENG Strategic Planning – 4 topical working groups and the Strategic Thinking WG
- Directed discussion and AdCom feedback
  - At this meeting
  - As members of WGs going forward





# Questions









# ENG Use of ARRA Funding

- Young Investigators
  - 80 additional CAREER awards
  - 15 additional BRIGE awards
  - 16 additional GRF in addition to the 80 Women in Engineering (WENG) GRF Fellows funded annually by ENG
  - 1 additional IGERT in the area of energy
- Education and Workforce Development
  - 40 Postdocs in Industry
  - 17 additional REU/RET awards
  - 76 additional Education awards, including 4 for veterans/GI Bill activities
- High Risk / High Reward
  - 7 additional EFRI awards
- Translational Research
  - 257 additional small business awards (50% increase)
  - 9 additional I/UCRC awards
  - 2 additional PFI awards
  - 21 additional GOALI awards

