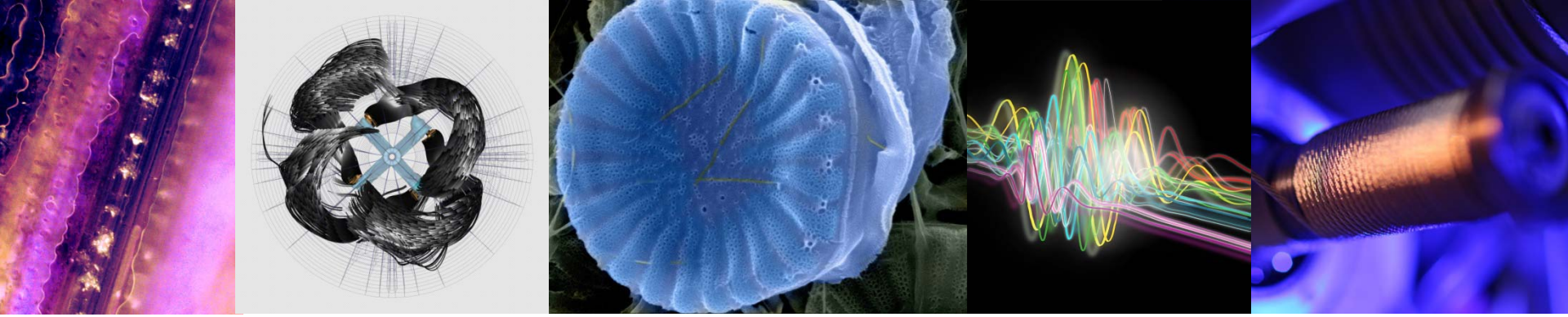
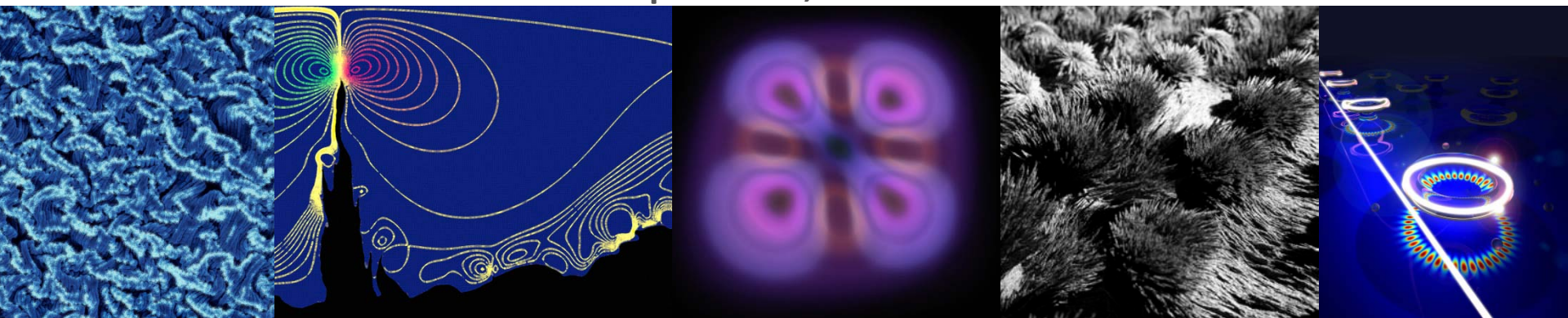


Directorate for Engineering Update

Thomas W. Peterson
Assistant Director for Engineering

April 11, 2012

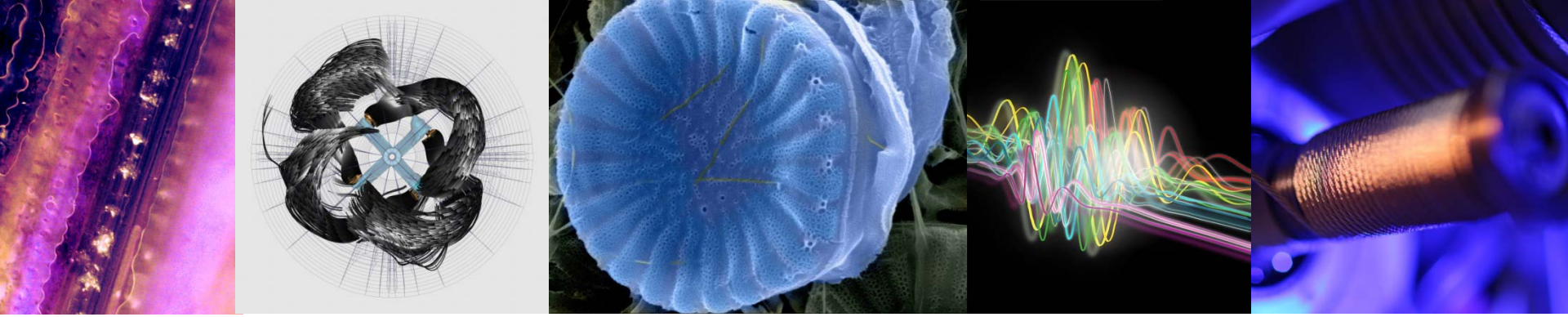


Spring 2012 Meeting Agenda

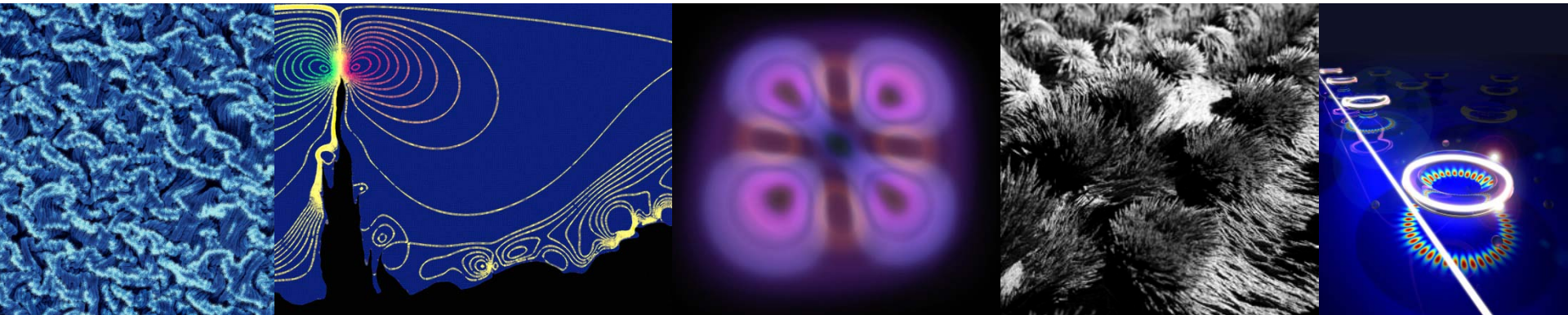
- Directorate Update
- Remarks from the Office of the Director
- Building Next-generation Engineers (NSF and ENG Strategic Activities)
- Evaluation and Assessment

ENG Directorate Update

- AdCom business
- New ENG staff
- ENG FY 2013 Budget Request
- EFRI Update
- ENG Outreach
- ENG Responses to Strategic Planning
  - Flagship Activities
  - Beacon Activities



AdCom Business



Future Meeting Dates

- 2012
  - October 17–18
- 2013
  - April 17–18 or April 24–25
  - October 16–17 or October 23–24

NSF Communications

- NSF Task Force activities
  - surveyed Advisory Committee members and NSF panelists
  - developed recommendations with input from focus groups
  - recommendations under review by OD
- Judith Gan, Head, OLPA, began Jan. 15
- New NSF Homepage in the works
- New NSF informational video created

Global Summit on Merit Review

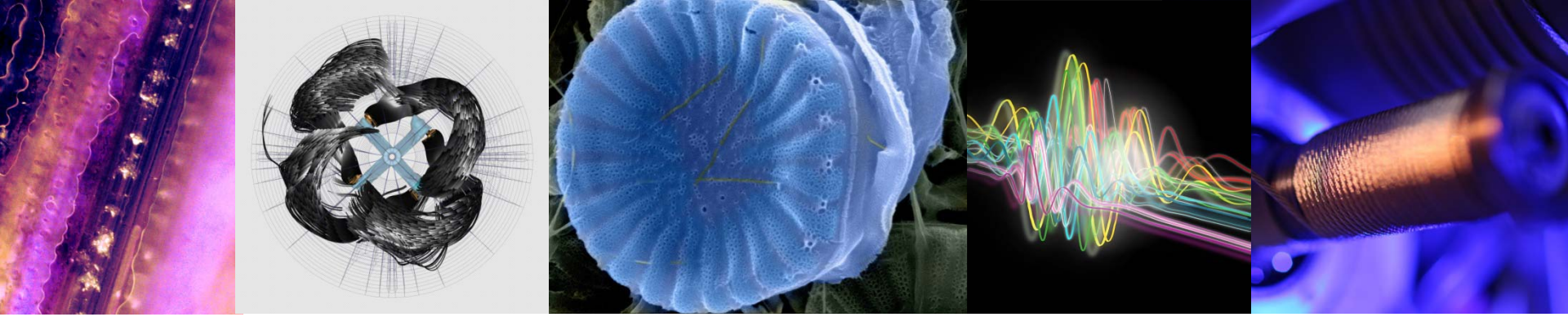
- On May 14–15, 2012, heads of research councils from G-20 and OECD countries will gather at NSF to identify common principles and facilitate collaboration.

NSF Merit Review Process

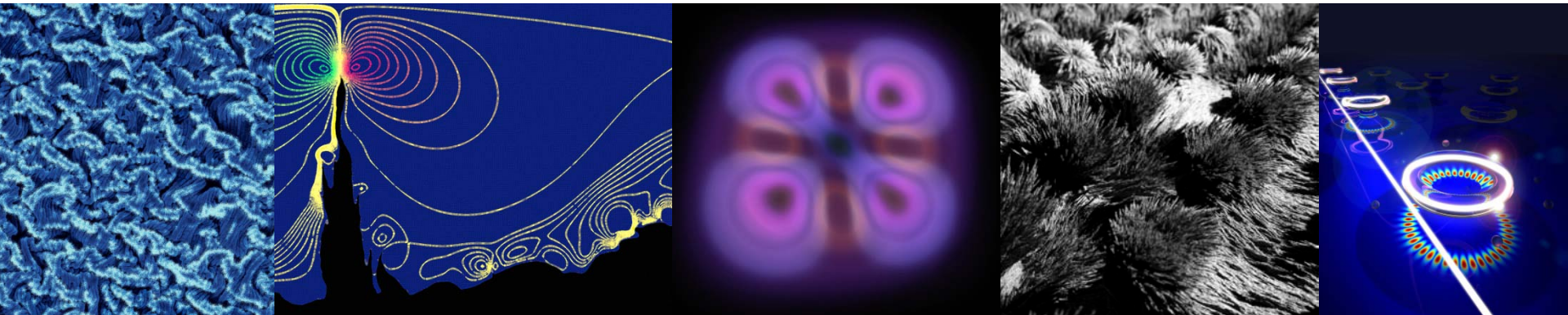
- NSF expects to make greater use of virtual panels in FY 2013
- NSF will embark on a series of pilots in 2013 designed to see how effective some of the other potential approaches to merit review actually are

NSB Policy Recommendations

- Task Force on Merit Review
  - “National Science Foundation's Merit Review Criteria: Review and Revisions” released January 10, 2012
- Task Force on Unsolicited Mid-Scale Research
  - Final Report in preparation



New ENG Staff



NSF Directorate for Engineering (ENG)

Emerging Frontiers in Research and Innovation (EFRI)
Sohi Rastegar

Program Director for Diversity
Omnia El-Hakim

Office of the Assistant Director
Thomas Peterson, Assistant Director
Kesh Narayanan, Deputy Assistant Director

Senior Advisor for Nanotechnology
Mihail Roco

Program Director for Evaluation & Assessment
Alexandra Medina-Borja

Engineering Education and Centers (EEC)
Theresa Maldonado

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)
Grace Wang

OAD

- **Alexandra Medina-Borja**, Program Director for Evaluation and Assessment (University of Puerto Rico at Mayagüez)
- **Evette Rollins**, DAD Secretary

CBET

- **Luke Achenie**, Program Director, Process and Reaction Engineering (Virginia Tech)
- **Lucinda Lazaro**, Program Support Manager

CMMI

- **Nia Owens**, STEP Program Assistant
- **Elliott Tibor**, Science Assistant

ECCS

- **George Haddad**, Program Director, Communications, Circuits, and Sensing-Systems (Univ. of Michigan)
- **Shanell Kemp**, STEP Program Assistant

EEC

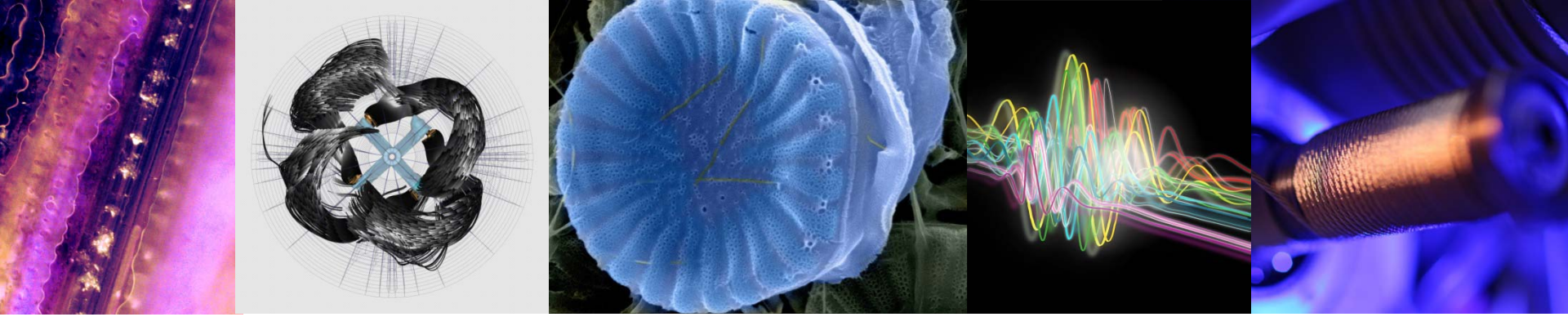
- **Brooke Coley**, AAAS Fellow (CISE)

IIP

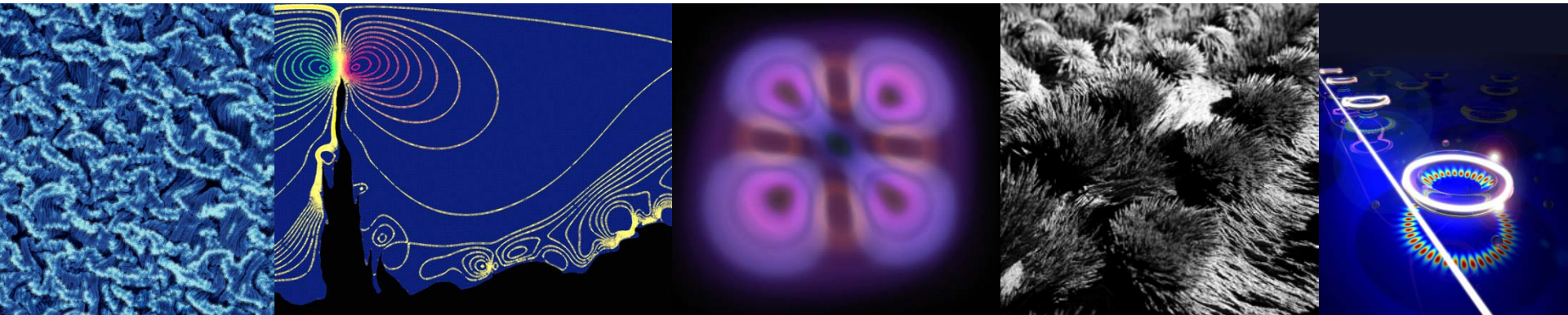
- **Grace Wang**, Division Director
- **Mary Konjevoda**, Program Specialist (OAD)
- **Jesus Soriano**, Program Director, SBIR/STTR Biological and Chemical Technologies (Puerto Rico Science & Technology Trust)

Open Recruitments

- CBET Division Director
- CBET Program Directors
  - Biosensing
  - Biotechnology, Biochemical, and Biomass Engineering
  - Combustion, Fire, and Plasma Systems
- CMMI Program Directors
  - Engineering Design and Innovation
  - Manufacturing Machines and Equipment
  - NanoManufacturing
  - Operations Research
  - Service Enterprise Systems and Manufacturing Enterprise Systems
- ECCS Program Director
  - Communications, Circuits, and Sensing Systems
- EEC Program Director
  - Engineering Research Centers

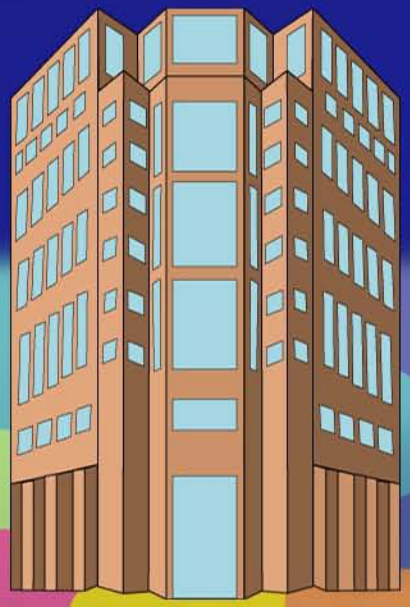


FY 2013 ENG Budget Request



OneNSF

catalyze human capital development



create networks and infrastructure for the nation

improve organizational efficiency

spark greater innovation and opportunity for scientific discoveries

address multidisciplinary challenges of national/global significance

support fundamental research in all disciplines

Engineering will prioritize research critical to the nation's challenges

- National Priorities
  - National Nanotechnology Initiative
  - National Robotics Initiative
- OneNSF Initiatives
  - Interdisciplinary Research
  - Advanced Manufacturing
  - Communications and Cyberinfrastructure
  - Sustainability and Clean Energy
  - Education and Workforce
  - Innovation Ecosystem

ENG will continue major support for Nanotechnology

$174 M

- **National Nanotechnology Initiative**
  The Directorate will sustain funding for
  - nanomaterials and nanodevices; nanosystems; nanomanufacturing; and environment, health, and safety

  ENG will provide additional funds towards three Signature Initiatives:
  - Nanoelectronics for 2020 and Beyond
  - Sustainable Nanomanufacturing
  - Nanotechnology for Solar Energy Collection and Conversion

ENG will increase its Robotics investment

$10 M

- **National Robotics Initiative**
  ENG support will enable
  - Assistive mechanisms for those with physical disabilities and/or cognitive impairments
  - Systems integration that enables ubiquitous, advanced robotics to be realized
  - Next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and transportation

Credit: Yoky Matsuoka, University of Washington

One NSF

- Interdisciplinary Research
- Advanced Manufacturing
- Communications and Cyberinfrastructure
- Sustainability and Clean Energy
- Education and Workforce
- Innovation Ecosystem

ENG will continue its long-standing support for Interdisciplinary Research

- **INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education)** ENG will support creative, significant research collaborations between disciplines that may lead to new opportunities

$6 M for INSPIRE

ENG will continue its long-standing support for Interdisciplinary Research

- **Emerging Frontiers of Research and Innovation (EFRI)**
  ENG will provide strategic support for fundamental research that may overcome scientific and/or national challenges and lead to breakthrough technologies

$32 M for EFRI

Credit: Gary Alpert, Harvard University, Bugwood.org

Research Centers will lead our Collaborative Efforts

$69 M for ERCs

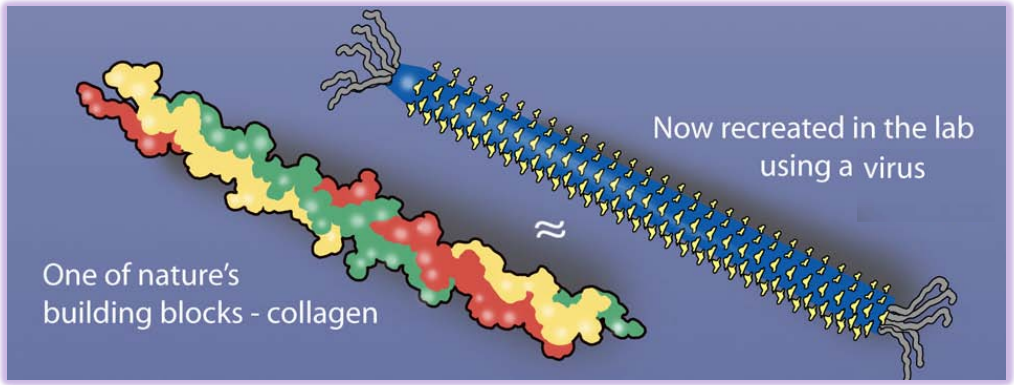
- Engineering Research Centers (ERCs)
  - EEC will continue support for the first class of Nanosystems ERCs from FY 2012 and 17 others
- Science and Technology Centers (STCs)
  - CBET will continue supporting the Center on Emergent Behaviors of Integrated Cellular Systems
  - ECCS will continue supporting the Center for Energy Efficient Electronics Science

$10 M for STCs

ENG will be a major contributor to Advanced Manufacturing

- **Cyber-Enabled Materials, Manufacturing, and Smart-Systems (CEMMSS)**
  ENG will invest in breakthrough materials and design, advanced techniques and processes, and smart systems

$110 M for CEMMSS



Credit: Zina Deretsky, National Science Foundation

ENG will be a major contributor to Advanced Manufacturing

- **Advanced Manufacturing**
  ENG will support multi-scale modeling, nanomanufacturing, and complex engineering systems design

$68 M for Adv. Manu.

ENG will be a major contributor to Advanced Manufacturing

- **Research at the Interface of the Biological, Mathematical, and Physical Sciences, and Engineering (BioMaPS)**
  ENG will focus on nanoscale biosensing, neuro-engineering, cellular biomechanics, metabolic engineering, and engineering aspects of synthetic biology

$5 M for BioMaPS

ENG will strategically support better Communications and Cyberinfrastructure

- **Cyberinfrastructure for the 21st Century (CIF21)**
  The ENG investment will focus on cyber–physical systems, engineering modeling and simulation, smart networks, and sensors

$11 M for CIF21

ENG will strategically support better Communications and Cyberinfrastructure

- **Enhancing Access to the Radio Spectrum (EARS)**
  ENG will prioritize research on more efficient radio spectrum use and energy-conserving device technologies

$14 M for EARS

Credit:
Nicolle Rager Fuller, NSF

ENG will strategically support better Communications and Cyberinfrastructure

- **Secure and Trustworthy Cyberspace (SaTC)**
  ENG support will focus on the engineering aspects of the Networking and Information Technology Research and Development (NITRD) strategic plan

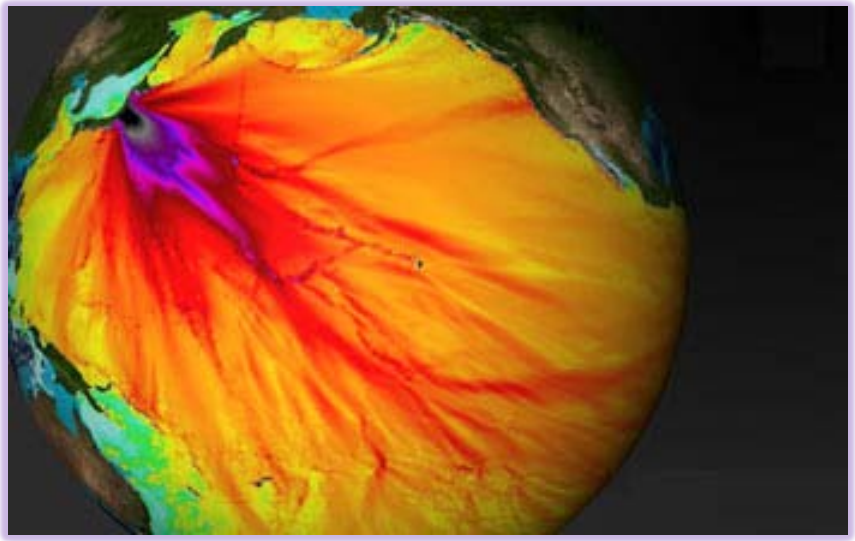
$4 M for SaTC

Credit: ThinkStock

ENG will invest substantially in Sustainability and Clean Energy

- **Science, Engineering, and Education for Sustainability (SEES)**
  ENG's investment will focus on sustainable research networks, sustainable materials, and human dimensions

$20 M for SEES

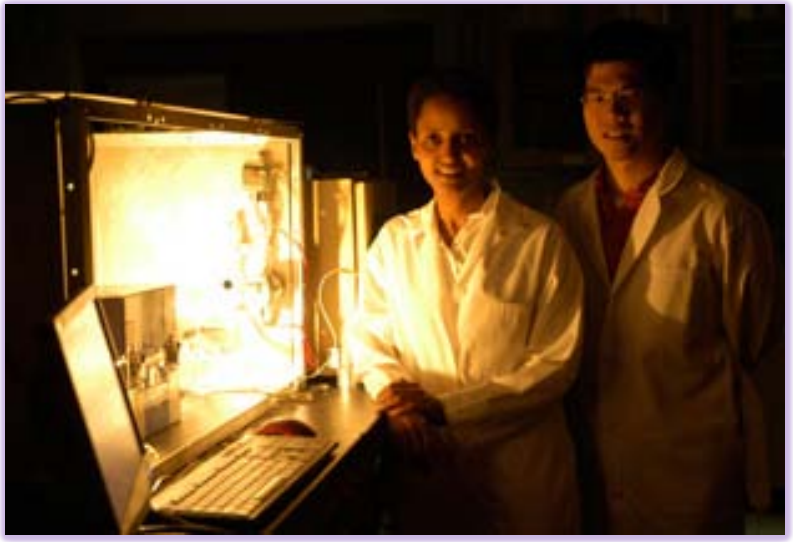


Credit: NOAA

ENG will invest substantially in Sustainability and Clean Energy

- **Clean Energy Technologies**
  ENG will support novel research for smart grid technologies, solar energy technologies, biofuels and bioenergy, wind energy generation, and renewable energy storage

$128 M for Clean Energy



Credit: Sossina M. Haile, California Institute of Technology

The Directorate will invest in preparing the Future Engineering Workforce.

- **CAREER awards**
  ENG will support young investigators who exemplify the role of teacher–scholar through outstanding research, excellent education, and the integration of education and research.
- **Expeditions in Education (E^2)**
- **Non-traditional Students**
  ENG will invest in activities that promote the entry and retention of veterans and other non-traditional students in engineering programs

$53 M for CAREER

ENG will invest strategically in the Innovation Ecosystem

- **Innovation Corps (I-Corps)**
  The ENG investment will provide mentoring and resources to help determine the commercial readiness of technology built on NSF-funded basic research

$6 M for I-Corps

NSF I-CORPS NSF Innovation Corps

One NSF

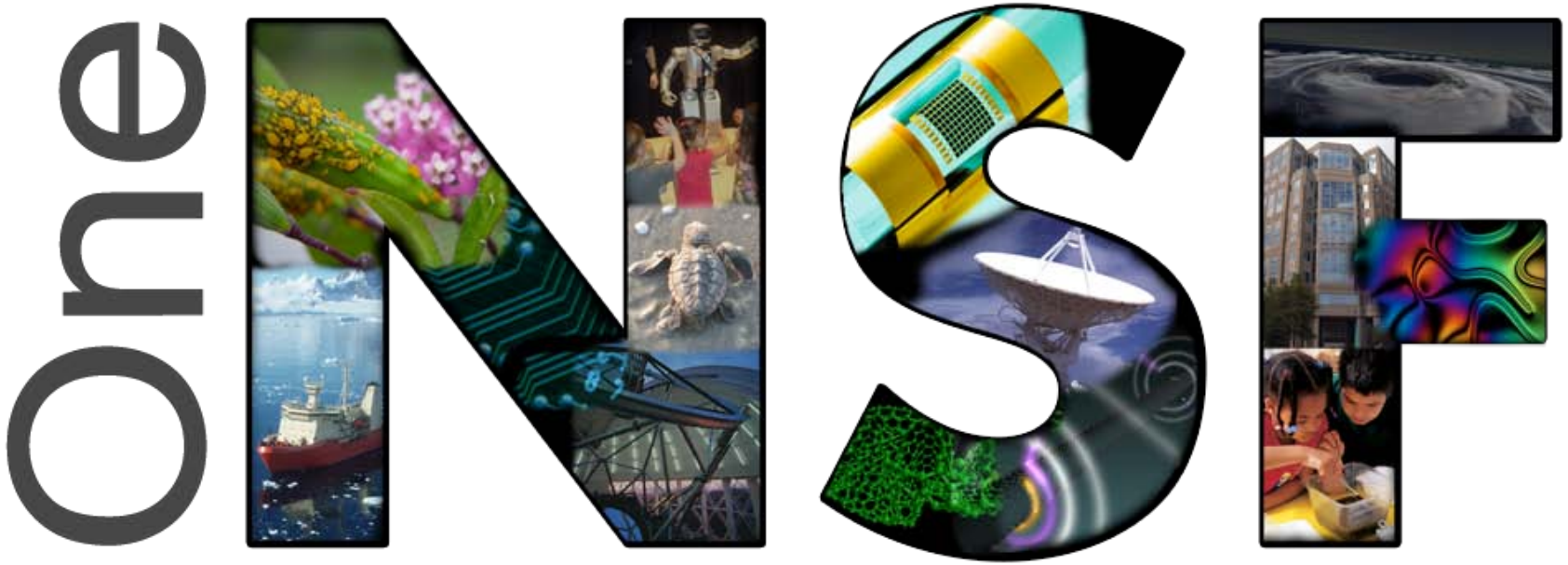
ENG will invest strategically in the Innovation Ecosystem

$22 M for PFI

- **Partnerships for Innovation**
  - Accelerating Innovation Research (AIR) will foster connections with existing NSF innovation research alliances
  - Building Innovation Capacity (BIC) will enable collaboration between academia and business to advance basic research for market-accepted innovations

ENG Budget ($M)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change over FY 2012 Estimate	
				Amount	Percent
CBET	$158.82	$171.45	$179.40	$7.95	4.6%
CMMI	189.62	203.58	217.06	13.48	6.6%
ECCS	97.54	106.73	114.30	7.57	7.1%
EEC	125.76	120.00	123.27	3.27	2.7%
IIP	162.65	193.41	210.30	16.89	8.7%
SBIR/STTR	*126.47*	*152.76*	*165.20*	*12.44*	*8.1%*
EFRI	28.95	31.00	32.00	1.00	3.2%
ENG TOTAL	$763.33	$826.17	$876.33	$50.16	6.1%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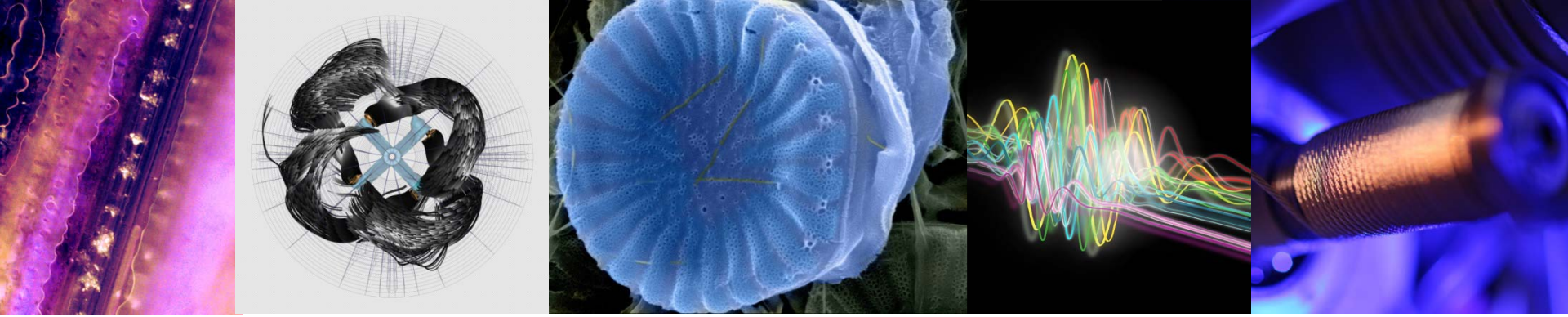
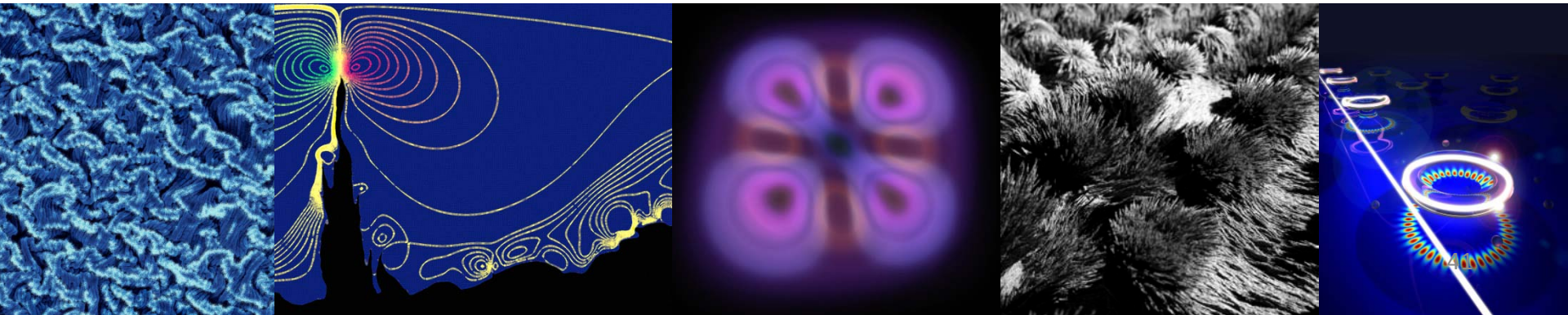
NSF



EFRI Update



EFRI Update

- **TOPIC SELECTION FREQUENCY –** Based on recommendation of EFRI Committee of Visitors (COV), Topic Selection Frequency has changed to ***every other year***.
- **EFRI TOPICS**

FY 2007	Auto-Reconfigurable Engineered Systems (**ARES**)
	Cellular and Biomolecular Engineering (**CBE**)
FY 2008	Cognitive Optimization (**COPN**)
	Resilient and Sustainable Infrastructures (**RESIN**)
FY 2009	Biosensing and Bioactuation (**BSBA**)
	Hydrocarbon from Biomass (**HyBi**)
FY 2010	Science in Energy and Environmental Design: Engineering Sustainable Buildings (**SEED**)
	Renewable Energy Storage (**RESTOR**)
FY 2011	Engineering Multicellular and Interkingdom Signaling (**MIKS**)
	Mind, Machines, and Motor Control (**M3C**)
FY 2012, 2013	Flexible Bioelectronics Systems (**BioFlex)**
	Origami Design for Integration of Self-assembling Systems for Engineering Innovation (**ODISSEI)**
	Photosynthetic Biorefineries (**PSBR**)

FY 2012 Competition in Progress

- Selected EFRI topics
  - Flexible Bioelectronics Systems (BioFlex)
  - Origami Design for Integration of Self-assembling Systems for Engineering Innovation (ODISSEI)
  - Photosynthetic Biorefineries (PSBR)
- Received 200 preliminary proposals
- Invited 71 full proposals
- Planning 14 awards by fall 2012

EFRI for FY 2013

- Decision to repeat FY 2012 topics
- Topics for FY 2013 EFRI Solicitation
  - Flexible Bioelectronics Systems (BioFlex)
  - Origami Design for Integration of Self-assembling Systems for Engineering Innovation (ODISSEI)
  - Photosynthetic Biorefineries (PSBR)

Topic Selection Process for FY 2014

- Continuous Community Input (workshops, publications, panels, conferences, advisory committees, committees of visitors, …)
- Explicit Community Input through Website (DCL)
- Presentations by selected DCL submissions
  - **INCLUDES INPUT FROM EXTERNAL EXPERTS**
- Program Directors Frontier Ideas meeting
- ENG Leadership Retreat
  - **TOPICS ARE FINALIZED**
- Spring Advisory Committee
  - **TOPICS ARE ANNOUNCED AND MADE PUBLIC**

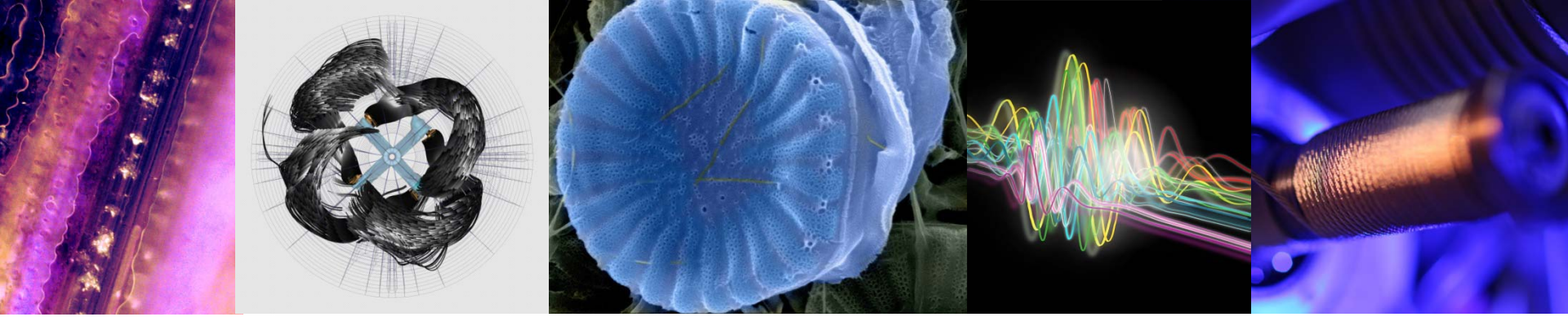
Program Directors are the Kernel of Integration and Leaders for EFRI Topics

EFRI-REM:
Research Experience and Mentoring

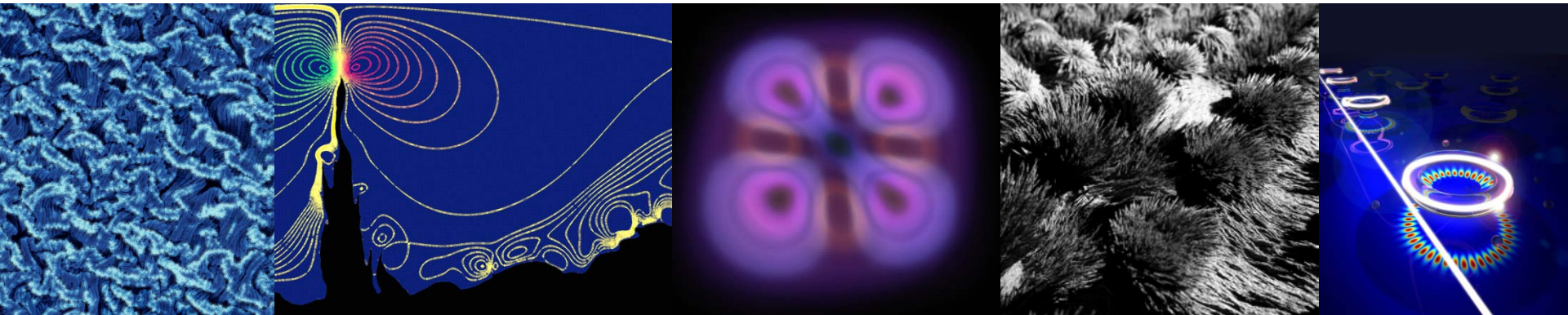
- GOAL: Enhance EFRI Projects by broadening participation of underrepresented groups in current EFRI projects
- Key Features:
  - Mentored research experience
  - Include didactic training in research
  - Engage cohorts as appropriate to each project
    - Not just REU or RET. May Include: High School Students, Teachers, Undergraduates, Graduates, Post-doc, Faculty from Minority Serving Institutions, Verterans.
- Seven Supplement Awards are expected

EFRI Activities

- Formative Evaluation: external evaluation of EFRI processes is underway.
- Broadening Participation Plan: AAAS Fellow is developing a plan with COV report in mind.
- For more information:
  - EFRI website: www.nsf.gov/eng/efri
  - Grantee meetings: www.abecker.com



ENG Outreach



Science Means Innovation

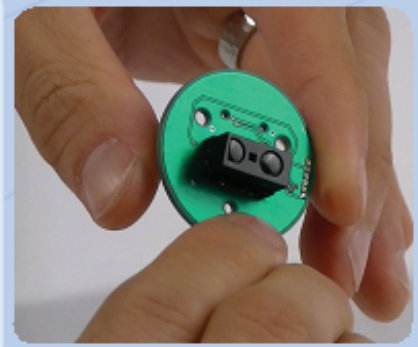
The **National Science Foundation** and the **Coalition for National Science Funding** cordially invite you to attend a Congressional Luncheon Briefing

Science Means Innovation

How Basic Research Discoveries Underpin Technological Advances in the Marketplace

Presented in conjunction with the Congressional Research and Development Caucus
Co-Chairs Judy Biggert (R-IL) and Rush Holt (D-NJ), House R&D Caucus

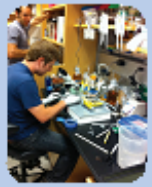
The National Science Foundation's (NSF) support for fundamental science and engineering research and workforce education underpins its long-standing efforts to stimulate technological advances. This briefing will highlight how NSF leverages fundamental science and engineering innovation with private-sector partnerships to strengthen our national innovation ecosystem. NSF funding transforms basic research into science and engineering knowledge, which feeds industrially relevant research, technological commercialization, economic growth, and the creation of high-quality jobs.



Thursday, March 29, 2012
12:00 to 1:30 pm
2325 Rayburn House Office Building

Lunch will be provided first come, first served
There is no fee for attending this widely attended public event

RSVP by emailing amsdc@ams.org
Or call 202-588-1100 by March 27



WELCOME
- **Sam Rankin**
  Associate Executive Director
  American Mathematical Society

FEATURING
- **Subra Suresh**
  Director
  National Science Foundation

MODERATOR
- **Thomas Peterson**
  Assistant Director
  Directorate for Engineering
  National Science Foundation

SPEAKERS
- **Charles Wessner**
  Director
  Technology, Innovation & Entrepreneurship
  National Academy of Sciences
- **Richard Haber**
  Director
  Ceramics, Composites, and Optical Materials Center
  Rutgers University
- **Neil Kane**
  President
  Illinois Partners Executive Services
- **Steve Spoonamore**
  President
  ABSMaterials, Inc.

CNSF
COALITION FOR NATIONAL SCIENCE FUNDING

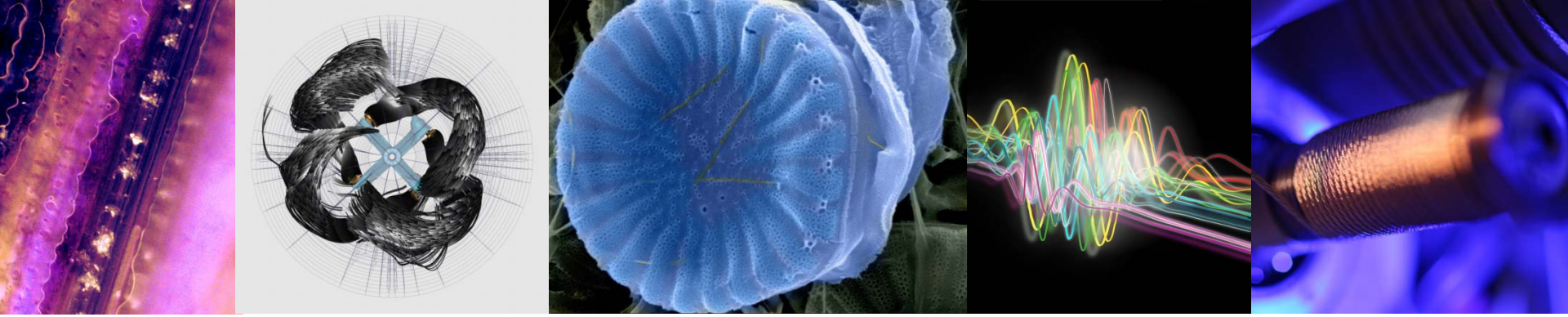
The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230

Engagement in Administration Priorities

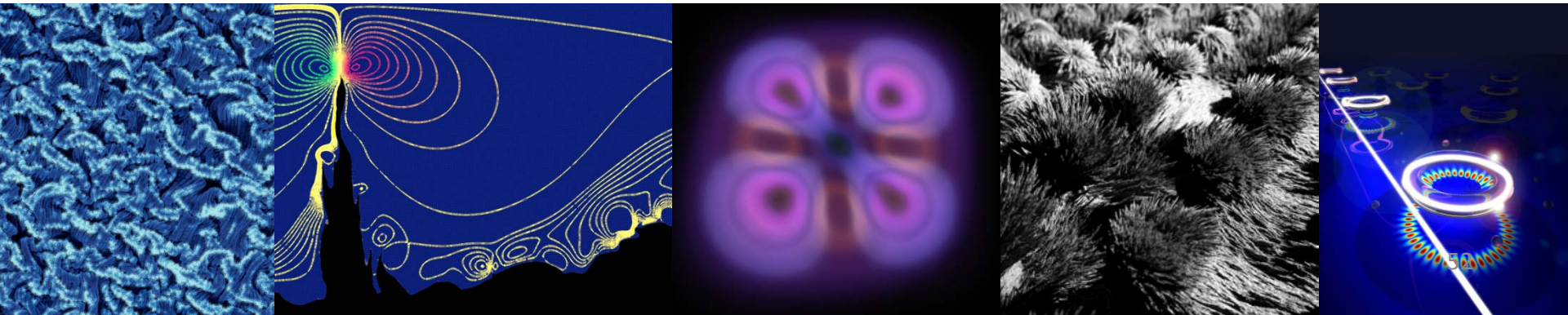
- Advanced Manufacturing Partnership (AMP)
  - CMU, GaTech, MIT, Berkeley, Michigan
- Manufacturing Institutes
  - Presidential Announcement in Petersburg VA
- Advanced Robotics Initiative
- EARS
- Materials Genome
- NNI Signature Initiatives
- Smart Health Systems
- Innovation
  - Duke, Florida, Ga Tech, Michigan, AAU, APLU

Building Partnerships

- Interagency collaborations
- International activities



ENG Strategic Planning and Response



Strategic Planning 2009-10
Five Working Groups

- Strategic Thinking Group
  - *Considered ENG Directorate Organization*
  - *Coordinated with NSF Strategic Plan*
- Awards and Solicitations
- Assessment and Evaluation
- Public Understanding of Engineering
- Engineering Education and Workforce

Recap of Recent AdCom Meetings

Fall 2010

- Summary of Strategic Planning Activities

Spring 2011

- Discussion of CIF21 and SEES Initiatives

Fall 2011

- NSF and ENG Initiatives in Response to Strategic Directions, with a focus on Innovation

Flagship Activities

Research that is:

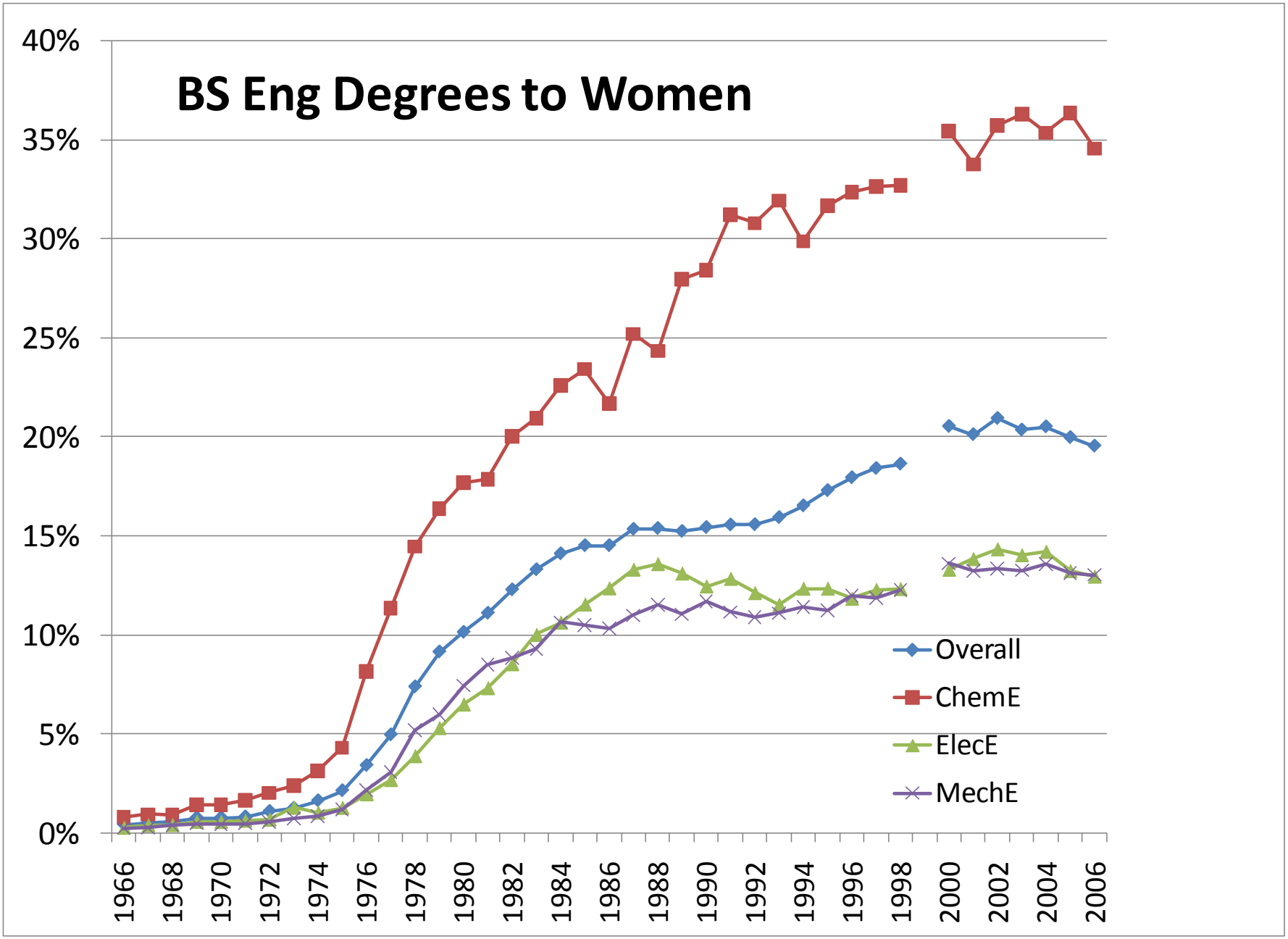
- Fundamental – supported by core programs
- Frontier – integrated with education, addressing grand challenges
- Potentially Transformative – high risk, high reward

Research *Teams* that are:

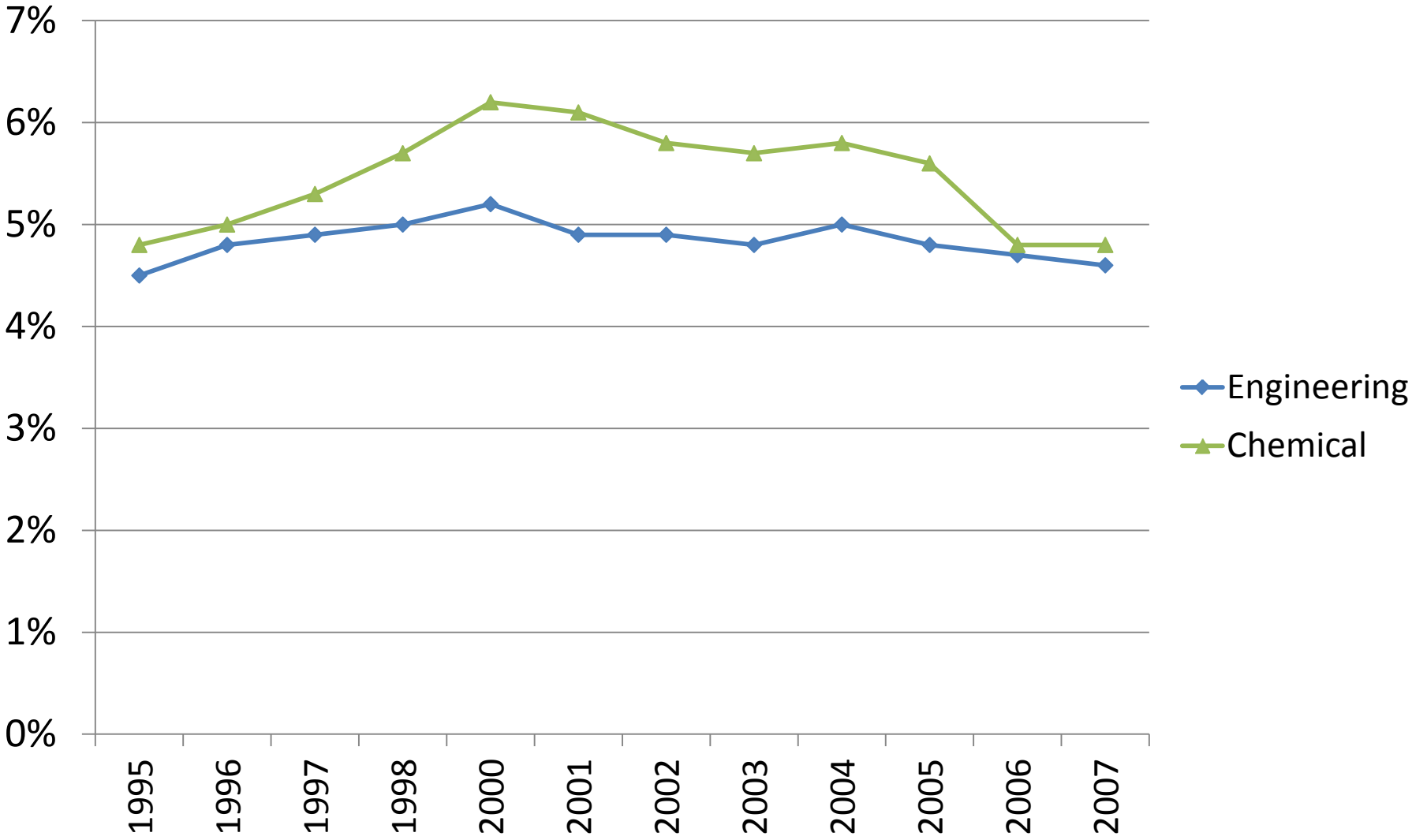
- Interdisciplinary
- International

Beacon Activities

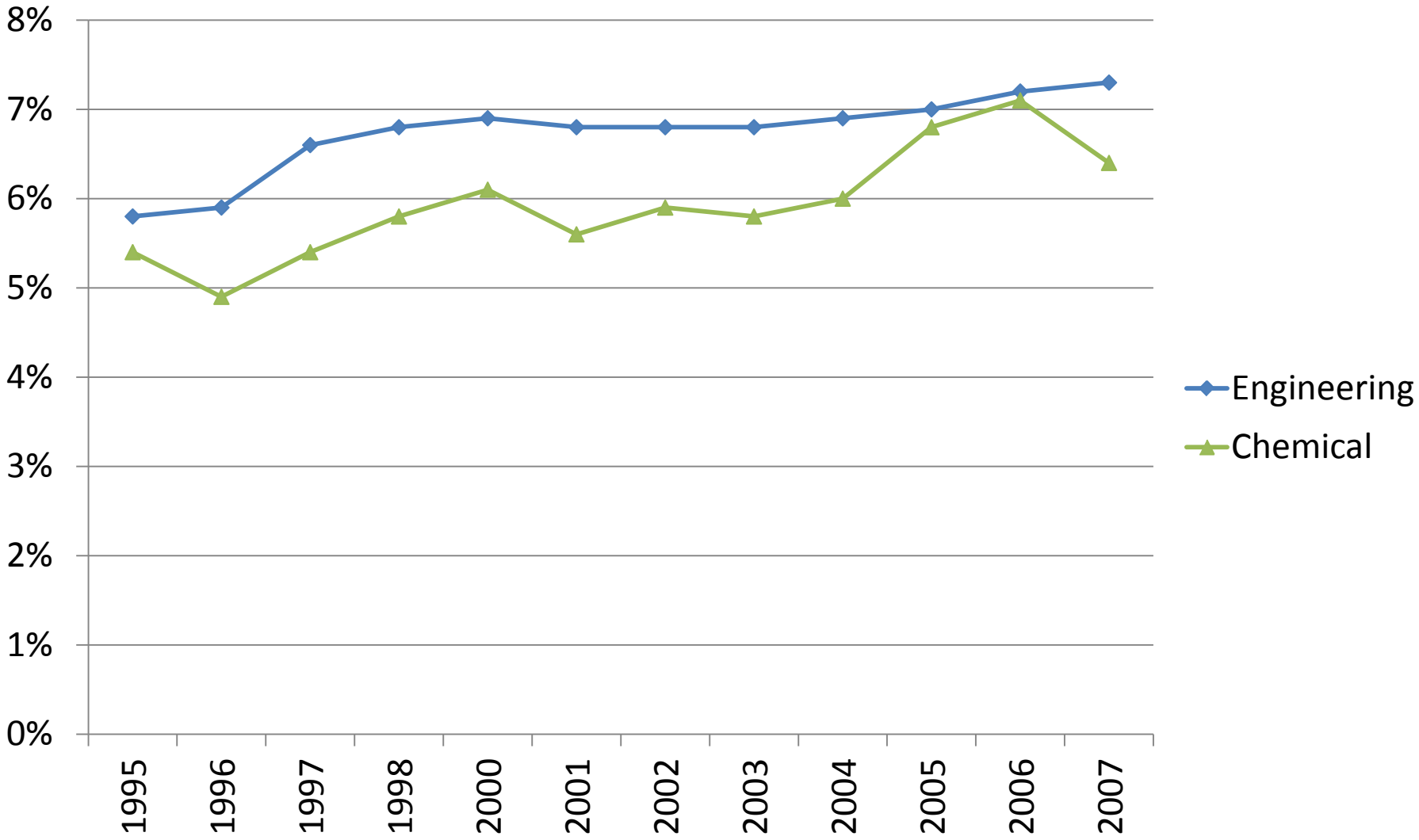
- Innovation
  - Cultivate an ecosystem
  - Accelerate the process
  - Support translational activities
- **Next-generation Engineers**
  - Are innovative, entrepreneurial, globally aware
  - Represent a diverse country
  - Support alternative pathways
- Public understanding of engineering


BS Eng Degrees to Women
40%
35%
30%
25%
20%
15%
10%
5%
0%
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
Overall
ChemE
ElecE
MechE

Percentage ENG BS Degrees to African Americans



Percentage ENG BS Degrees to Hispanics



Graduate Research Diversity Supplements

- To broaden the participation of underrepresented students in engineering Ph.D. programs through supplements to current research grants funded by ENG divisions
- FY 2012: planning ~58 supplements
  - Diversity office planning to co-fund ~45
- FY 2011: 52 supplements
  - Diversity office co-funded all
- FY 2010: 61 supplements
  - Diversity office co-funded 35

BRIGE Program

- Holding third grantee conference in August 2012
- Receiving significant co-funding support from the EPSCoR Office
- FY 2012
  - 137 proposals in panel
  - Planning ~30 awards (~22% success rate)
- FY 2011
  - 126 proposals
  - 30 awards (24% success rate)
- FY 2010
  - 116 proposals
  - 31 awards (27% success rate)

AdCom Meeting Focus

- Discussion and feedback on ENG alignment with NSF and ENG strategic goals
- Developing the Next Generation Engineer
- Systematic Evaluation and Assessment

STEM Education Program Analysis

THE FEDERAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION PORTFOLIO

A Report from the
Federal Inventory of STEM Education Fast-Track Action Committee
Committee on STEM Education
National Science and Technology Council

DECEMBER 2011

COORDINATING FEDERAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION INVESTMENTS: PROGRESS REPORT

A Report from the
Federal Coordination in STEM Education Task Force
Committee on STEM Education
National Science and Technology Council

In Response to the Requirements of the America COMPETES Reauthorization Act of 2010

FEBRUARY 2012

GAO

United States Government Accountability Office
Report to Congressional Requesters

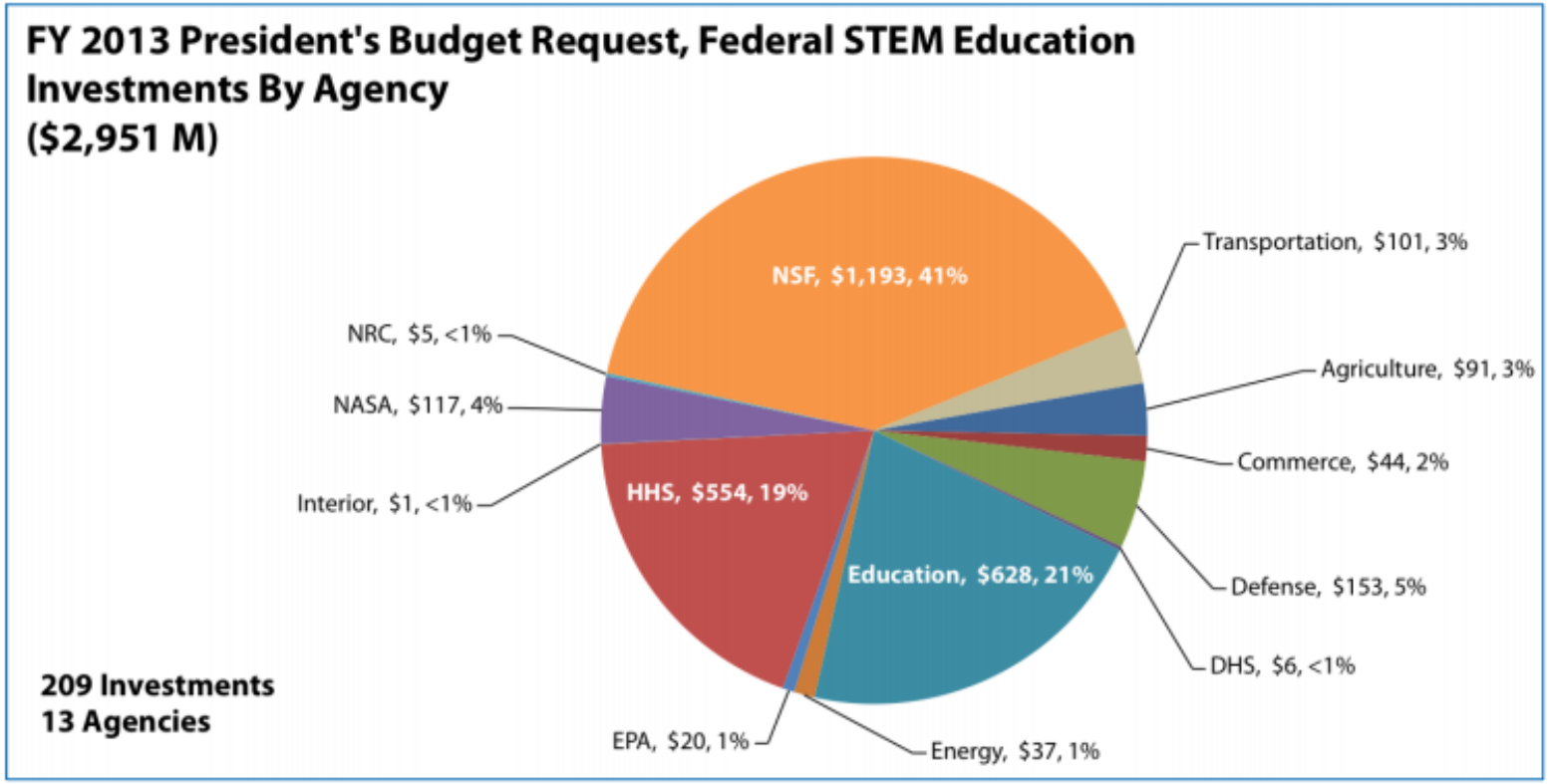
January 2012

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS EDUCATION

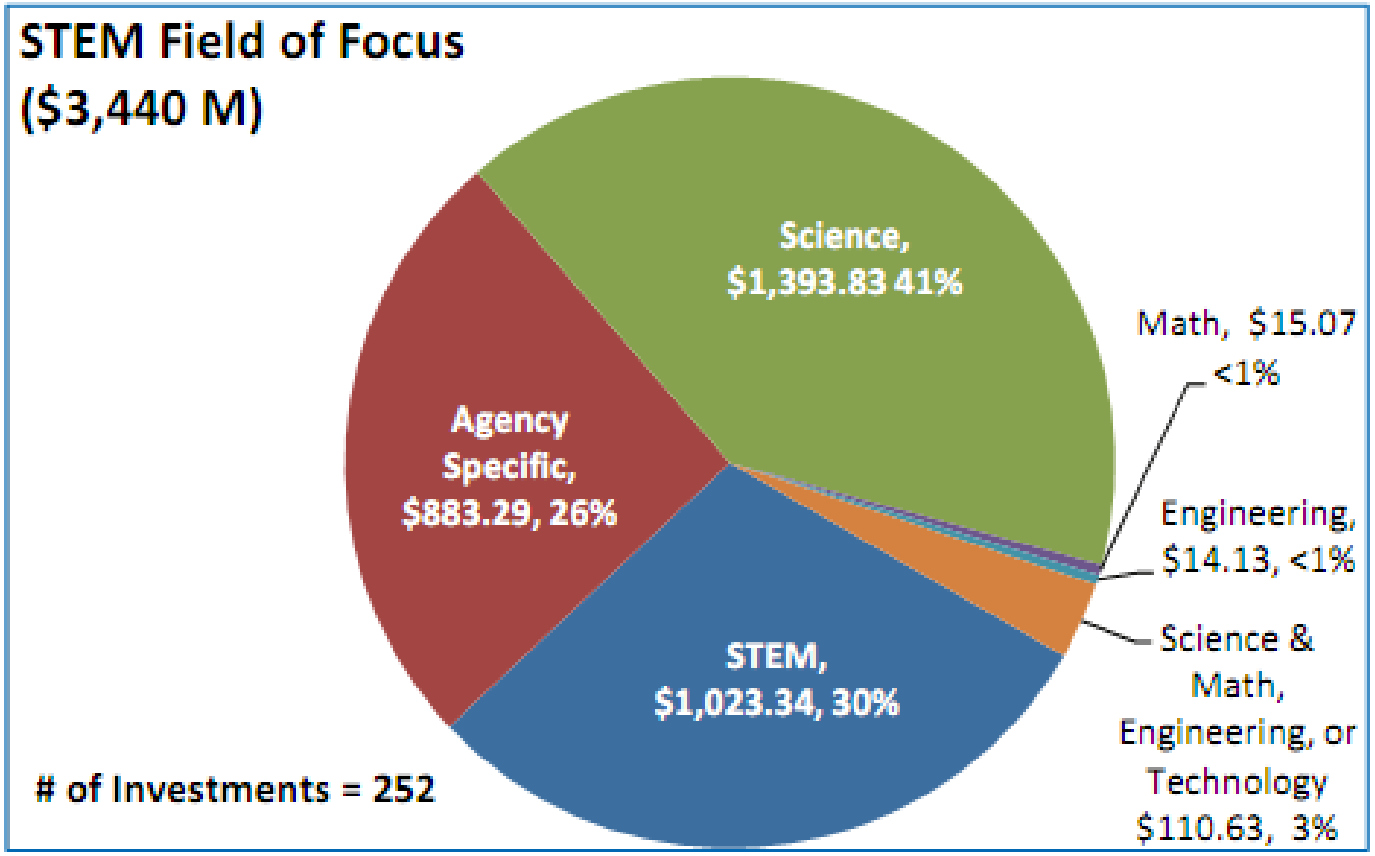
Strategic Planning Needed to Better Manage Overlapping Programs across Multiple Agencies

GAO
Accountability * Integrity * Reliability

NSF is the BIG DOG in STEM ED

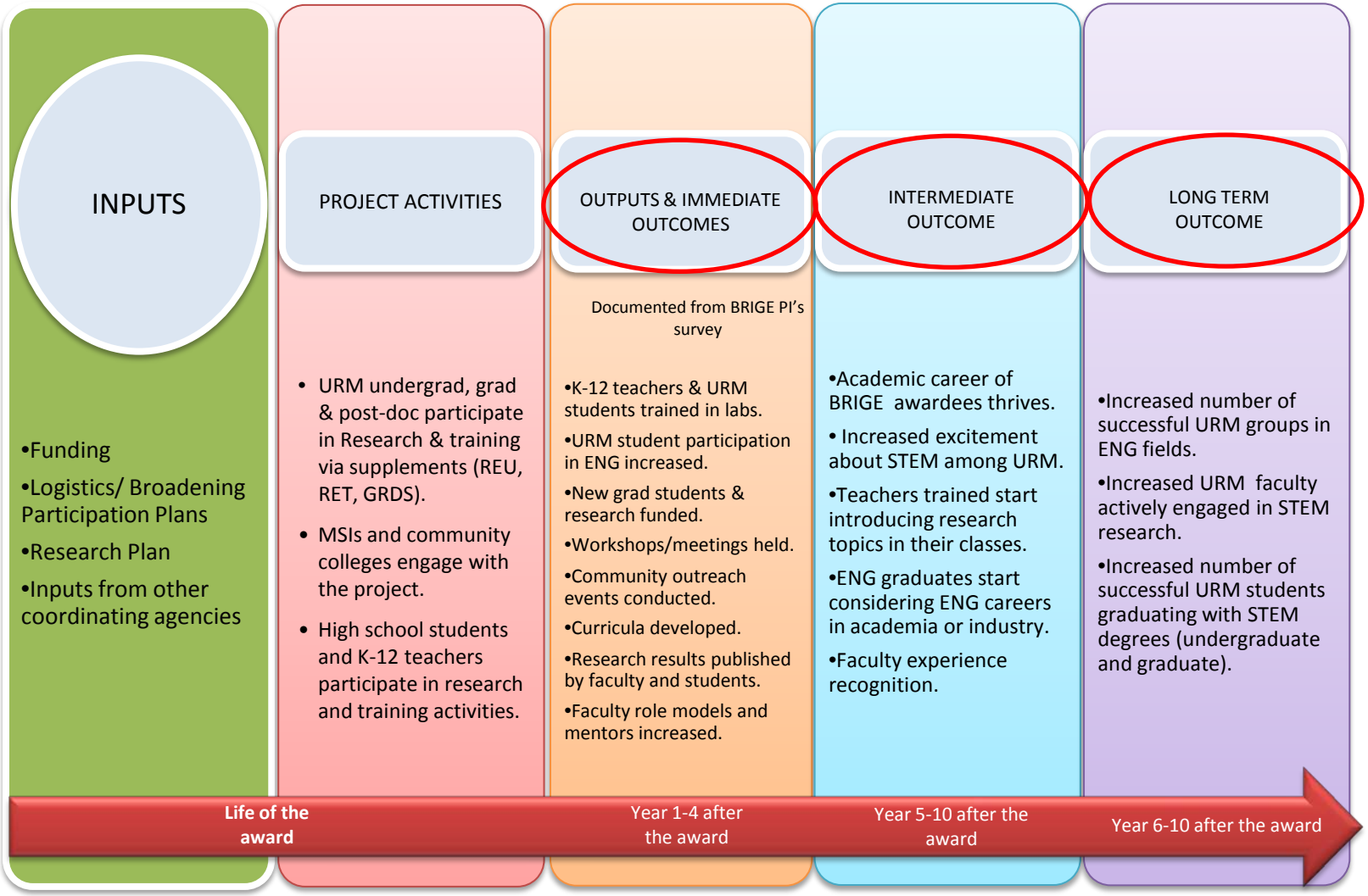


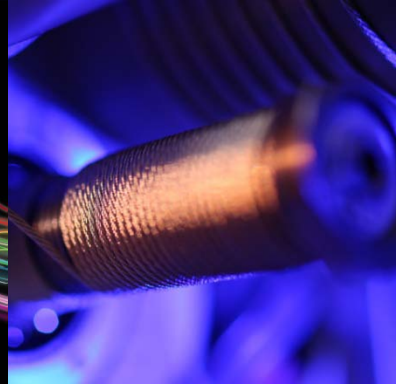
Engineering Education Investment is VERY SMALL



"The Federal Science, Engineering, and Mathematics (STEM) Education Portfolio," National Science and Technology Council, 2011.

Assessment & Evaluation: BRIGE Logic Model





Questions

Image Credits (top, from left): Sijie Lin, Pu-Chun Ke, Clemson Univ.; Sumanta Acharya, Louisiana State Univ.; Gregory L. Rorrer, School of Chemical, Biological, and Environmental Engineering, Oregon State Univ.; Tenio Popmintchev, JILA and Univ. of Colorado at Boulder; Barrett Technology, Inc. www.barrett.com
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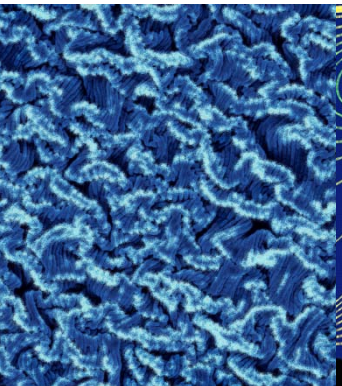
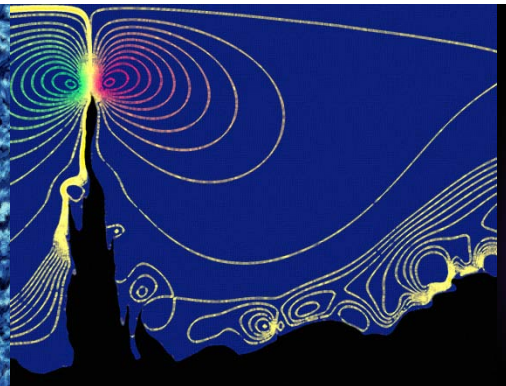
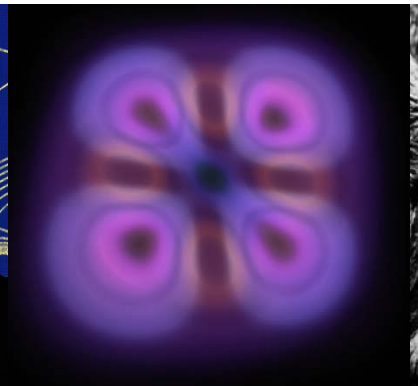
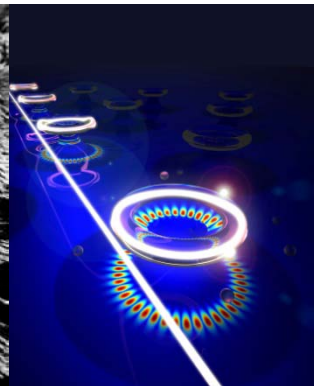
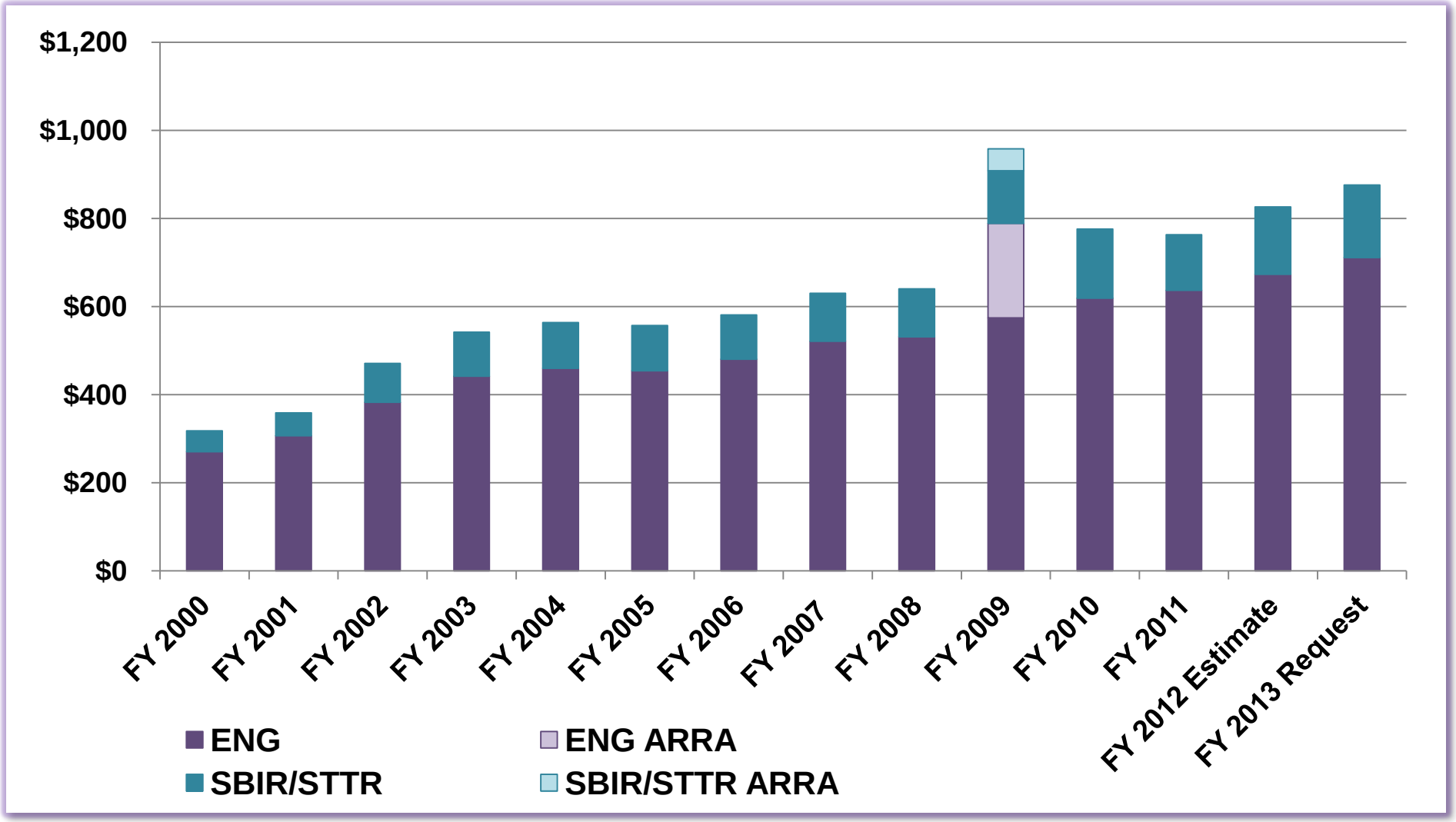
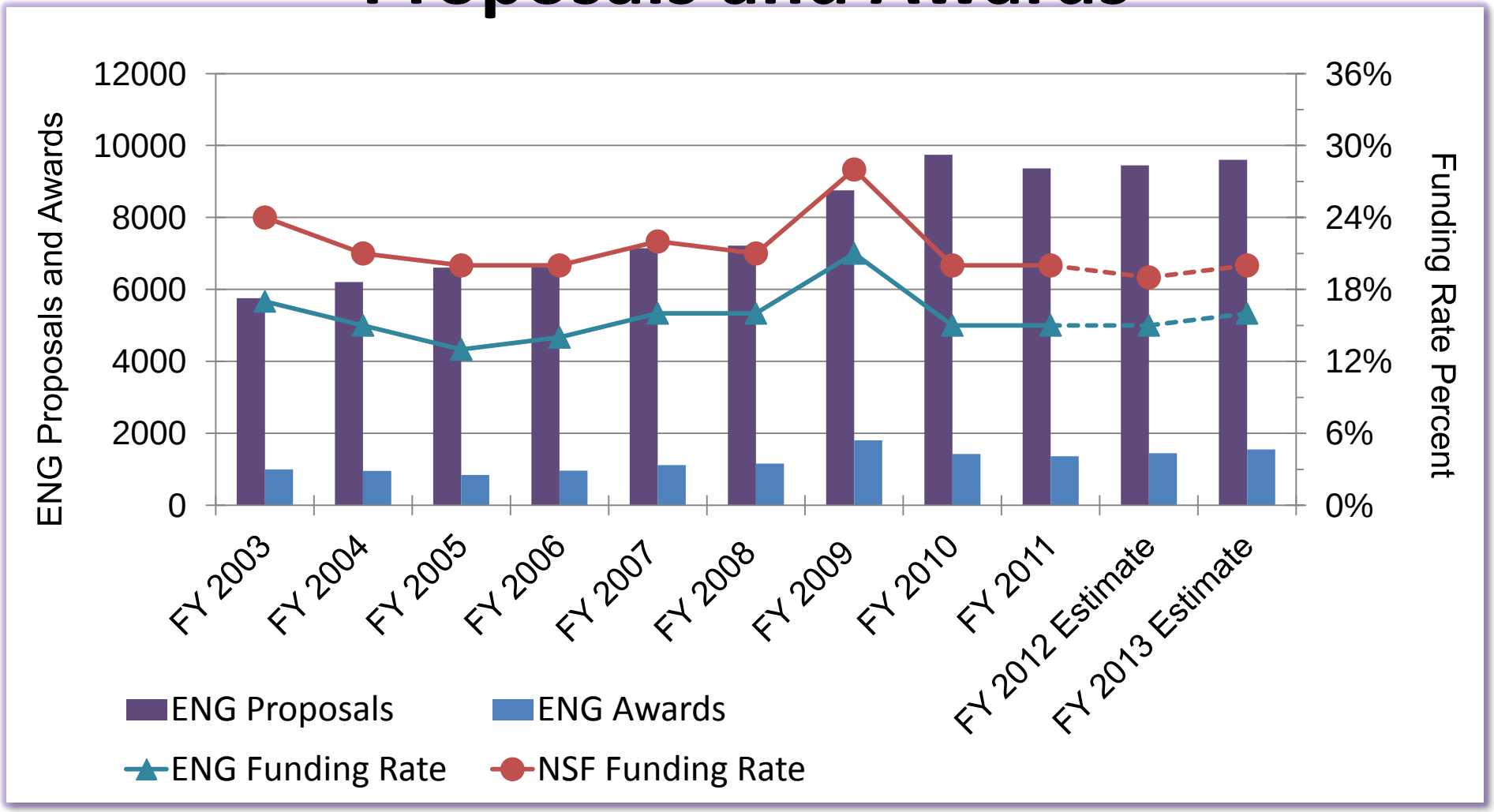






ENG and SBIR/STTR Budgets ($M)



ENG and NSF Research Grant Proposals and Awards



NSF R&RA Budget ($M)

Directorate	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	FY 2013 Request Over:			
				FY 2011 Actual		FY 2012 Estimate	
				Amt	%	Amt	%
BIO	$712.27	$712.38	$733.86	$21.59	3%	$21.48	3.0%
CISE	636.06	653.59	709.72	73.66	12%	56.13	8.6%
ENG	763.33	826.17	876.33	113.00	15%	50.16	6.1%
ENG Programs	*636.86*	*673.41*	*711.13*	*74.27*	*12%*	*37.72*	*5.6%*
SBIR/STTR	*126.47*	*152.76*	*165.20*	*38.73*	*31%*	*12.44*	*8.1%*
GEO	885.32	885.27	906.44	21.12	2%	21.17	2.4%
MPS	1,312.42	1,308.94	1,345.18	32.76	2%	36.24	2.8%
SBE	247.33	254.25	259.55	12.22	5%	5.30	2.1%
OCI	300.75	211.64	218.27	-82.48	-27%	6.63	3.1%
OISE	49.03	49.85	51.28	2.25	5%	1.43	2.9%
OPP	440.70	435.87	449.74	9.04	2%	13.87	3.2%
IA	259.60	349.59	431.52	171.92	66%	81.93	23.4%
U.S. Arctic Res. Comm.	1.58	1.45	1.39	-0.19	-12%	-0.06	-4.1%
Research & Related Activities	$5,608.38	$5,689.00	$5,983.28	$374.90	6.7%	$294.28	5.2%

Wireless Innovation

Advancing wireless capabilities via research and testbeds

- Funded by spectrum auction revenues
  - $1B over 5 years for NSF
- Components
  - Basic wireless research
  - Wireless testbeds
- Obama's promise to the Nation
  - High-speed wireless coverage to 98% of Americans in 5 years

Enhancing Access to the Radio Spectrum (EARS)

- The ENG investment will support research on
  - more efficient radio spectrum use
  - energy-conserving device technologies

$14 M for EARS

U.S. radio frequency allocations.
Credit: U.S. Department of Commerce

Enhancing Access to the Radio Spectrum

Enhancing access to wireless service and/or efficiency with which radio spectrum is used

Credit: Nicolle Rager Fuller, National Science Foundation

- Partnership among CISE, ENG, MPS, and SBE to strengthen U.S. leadership in the global wireless technology marketplace.
- Support for research in wireless communication, spectrum sharing, and mobile computing, as well as development of wireless and spectrum testbeds.
- Advance spectrum sensing techniques, explore machine learning and game theory for dynamic spectrum management, and understand incentive mechanisms.

INSPIRE Awards Activities

FY 2013 Budget—NSF Total (not just IA): $63 Million

- **CREATIV**—Second year of the CREATIV ***pilot*** grant award mechanism
  - Proposals ***must*** be interdisciplinary and potentially transformative
  - Generally merit-reviewed internally by program directors
  - Open to all NSF-supported fields—no favored topics
  - Substantial funding (maximum award size -- $1.0 million); not limited to exploratory stage
  - Maximum award duration: 5 years
  - Typically for an individual PI or a small team

- **New open pilot** mechanism under INSPIRE to begin in FY 2013
  - Larger **"mid-scale"** interdisciplinary awards up to $2.5-$3.0M
  - Utilize novel internal & external merit review approaches

Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

OneNSF investment: $110.25 M

- Cross-foundation partnership includes CISE, EHR, ENG, MPS, OCI, and SBE to build a cybersecure society and provide a strong competitive edge in the Nation's ability to produce high-quality digital systems and a well-trained cybersecurity workforce.
- Supports the Comprehensive National Cybersecurity Initiative (CNCI).
- Aligns with the President's *Strategic Plan for the Federal Cybersecurity Research and Development Program* (released December 2011).

Image Credit: *ThinkStock*

Secure and Trustworthy Cyberspace (SaTC)

Image Credit: *ThinkStock*

- SaTC addresses cybersecurity from one or more of three perspectives:
  - Trustworthy Computing Systems
  - Social, Behavioral and Economics
  - Transition to Practice
- Scholarship for Service (SFS) will increase the number of qualified students entering the fields of information assurance and cybersecurity.
  - Of over 1500 funded through the program, over 1100 have been placed in Federal agencies.

Science Engineering and Education for Sustainability (SEES)

To advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being.

Goals

- Build the knowledge base.
- Grow workforce of the future.
- Forge critical partnerships.

FY13 Investment Highlights

- Resilience to natural and technological disasters
- Coastal and Arctic systems
- Sustainable Chemistry, Engineering and Materials
- Improvements in IT energy efficiency

FY13 Request: $202.50M

GEO FY13 Investments in SEES

- GEO FY13 SEES Request: $70.75M
- *Hazards and Resilience*
  - Atmospheric and space weather hazards, severe storms, earthquakes, tsunamis, storm surge
- *Coastal Systems*
  - Interactions among natural and human-driven processes
  - Pathways to enhance coastal resilience
- Ongoing support for Water Sustainability and Climate, Networks, Ocean Acidification, Energy activities

E^2: Expeditions in Education

engage, empower, and energize

Transform STEM learning for the Nation through cognitive research and frontier science.

Focus Topics for 2013:

- Transforming Learning for STEM Undergraduates
- People and the Planet
- Cyberlearning and Big Data

FY 2013 Budget—NSF Total:	**$49 Million**

E^2 Investments will:

- Make frontier science central
- Use theory and research on STEM learning
- Aim for bold learning outcomes
- Commit to common metrics
- Involve all NSF directorates and offices

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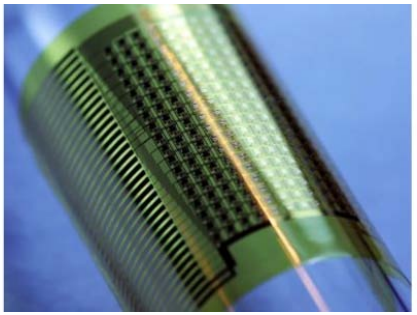
EFRI

BACK-UP

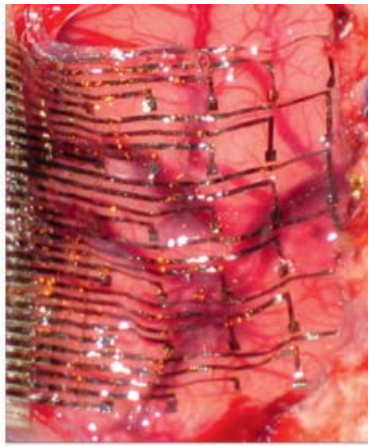
Topic 1: BioFLEX – Flexible BioElectronic Systems

Flexible electronics

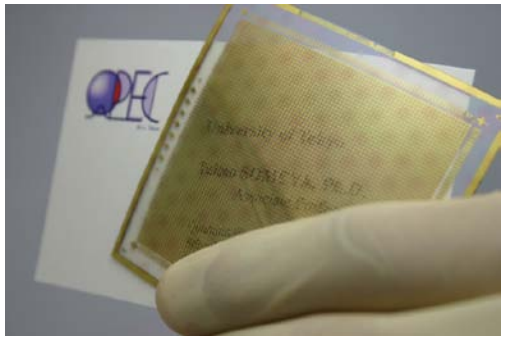


Wrap around cylindrical surface

Stretchable electronics



Flexible Scanner



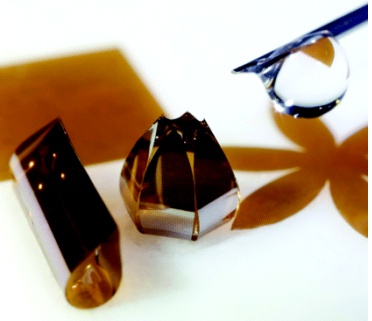
Rogers et al., "Materials and Mechanics for Stretchable Electronics", Science 327, 1603 (2010)

Expected Transformative Impact:

Advances in basic science and engineering, including materials, devices, circuit design, novel sensors, biomedical applications

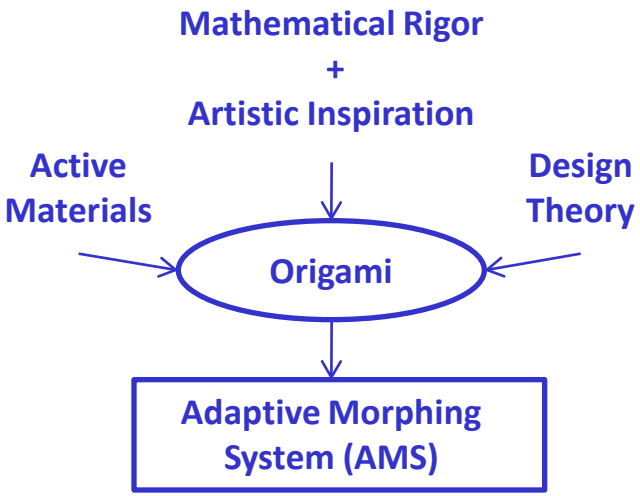
Develop/focus enabling technologies that allow enhancing quality of life and patient care while lowering total healthcare costs

New collaborations between different communities (materials, electrical, biomedical, chemical, manufacturing etc.)



TOPIC 2:
ODISSEI: Origami Design For The Integration Of Self-assembling Systems For Engineering Innovation

Objective: Use origami to enable self-assembling, multifunctional, compliant structures (Adaptive Morphing Systems) through the integration of active materials, design theory and compliant mechanisms, mathematics, and artistic inspiration.

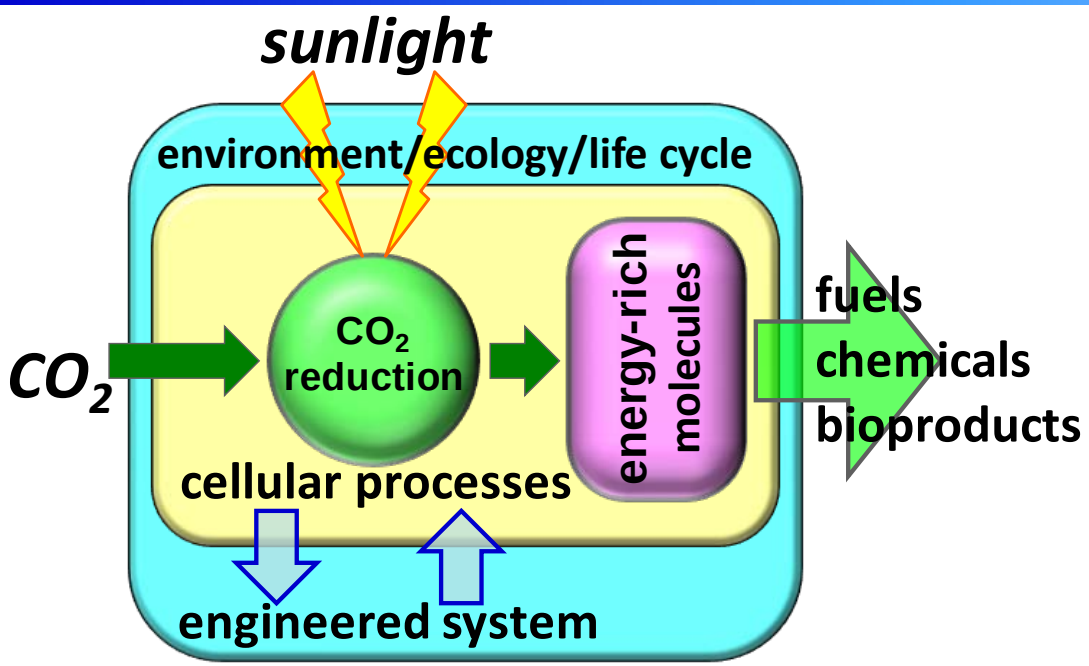


Expected Transformative Impact:

- Foster advances in fundamental understanding of folding and unfolding mechanisms in active materials, design theory, and mathematics
- Underpin design of foldable products at all scales and across scales
- Promote new collaborations between different communities
- Enable novel engineered adaptive morphing systems for breadth of national priorities, including energy, complex design, and manufacturing

Image from PNAS Cover, December 1, 2009, Courtesy of Xiaoying Guo, Zachery Johnson, and Alex Jerez (University of Illinois at Urbana Champaign, Urbana, IL), "Two- and three-dimensional folding of thin film single-crystalline silicon for photovoltaic power applications"

Topic 3:
PSBR: Photosynthetic Biorefineries



Objective: Establish the fundamental principles which efficiently deliver light and CO_2 to photosynthetic micro-organisms in scalable platforms for the sustainable & flexible production of fuels, chemicals, and bio-products

Expected Transformative Impact

- New paradigms for the rational/sustainable design and upscaling of photosynthesis-based, bio-manufacturing platforms that use sunlight and atmospheric CO_2 as inputs
- Advances in the basic science of flexibly transforming atmospheric CO_2 to complex and/or energy-rich molecules through metabolic processes
- Novel engineered systems for the emerging bio-economy

New Web resource

efri.org

Emerging Frontiers in Research and Innovation

Discoveries at the creative edge of engineering research

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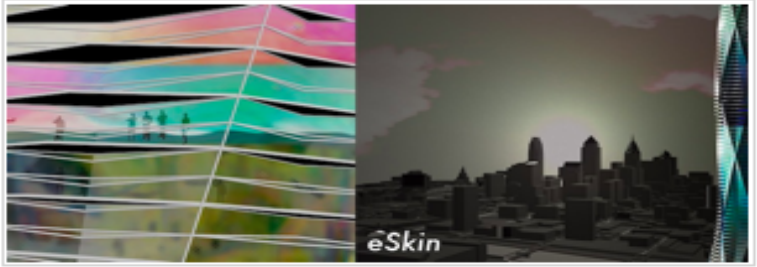
FEATURED EFRI ACHIEVEMENTS

Play

WELCOME TO EFRI

The Office of Emerging Frontiers in Research and Innovation (EFRI) strives to keep the nation at the forefront of engineering discoveries. A part of the Engineering Directorate of the National Science Foundation (NSF), EFRI serves a critical role in pursuing timely investments in creative ideas that can push engineering research beyond its apparent limits.



IN THE MEDIA

The work of EFRI researcher Seth DeBolt of the University of Kentucky was featured in a Voice of America story on how energy could be generated from agricultural products in Indonesia: "Mango Pits, Coconut Shells Could Generate Electricity."

more In the Media items...

HONORS

EFRI researcher Rakesh Agrawal of Purdue University was honored as a National Medal of Technology and Innovation laureate by President Obama.

more Honors...

RELATED ITEMS

The University of Illinois Urbana-Champaign hosted the November 2011 workshop, "Modeling Sustainable, Resilient, and Robust Infrastructure Systems"

more Related Items...

TAG CLOUD

airports bioprinter blood Cancer Cells Cooling diseases Fuel Heart Nanoscale Nerve Organs Power Regenerate Software therapies tissue Vascular wastewater Water