

New ENG Advisory Committee Members

Leah Jamieson
Purdue University



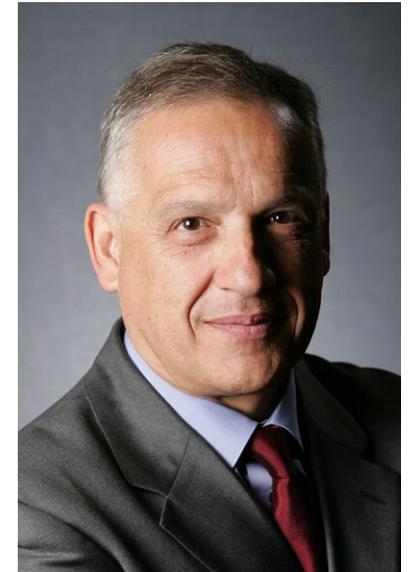
Maxine Savitz
Honeywell (ret.)



Gregory Washington
University of California,
Irvine



Yannis Yortsos
University of
Southern California



Agenda

Day 1

Directorate for Engineering Report

NSF Budget Update

Reports from Advisory Committee Liaisons

Intelligent Cognitive Assistants

Discussion: Intelligent Cognitive Assistants

Preparation for Discussion with the NSF Office of the Director

Day 2

Fostering Convergent Research to Address Grand Challenges

Future of Multidisciplinary Engineering Research Centers

Perspectives from the NSF Office of the Director

Breakouts, Reporting and Discussion: Future of Multidisciplinary Engineering Research Centers

Roundtable on Strategic Recommendations for ENG

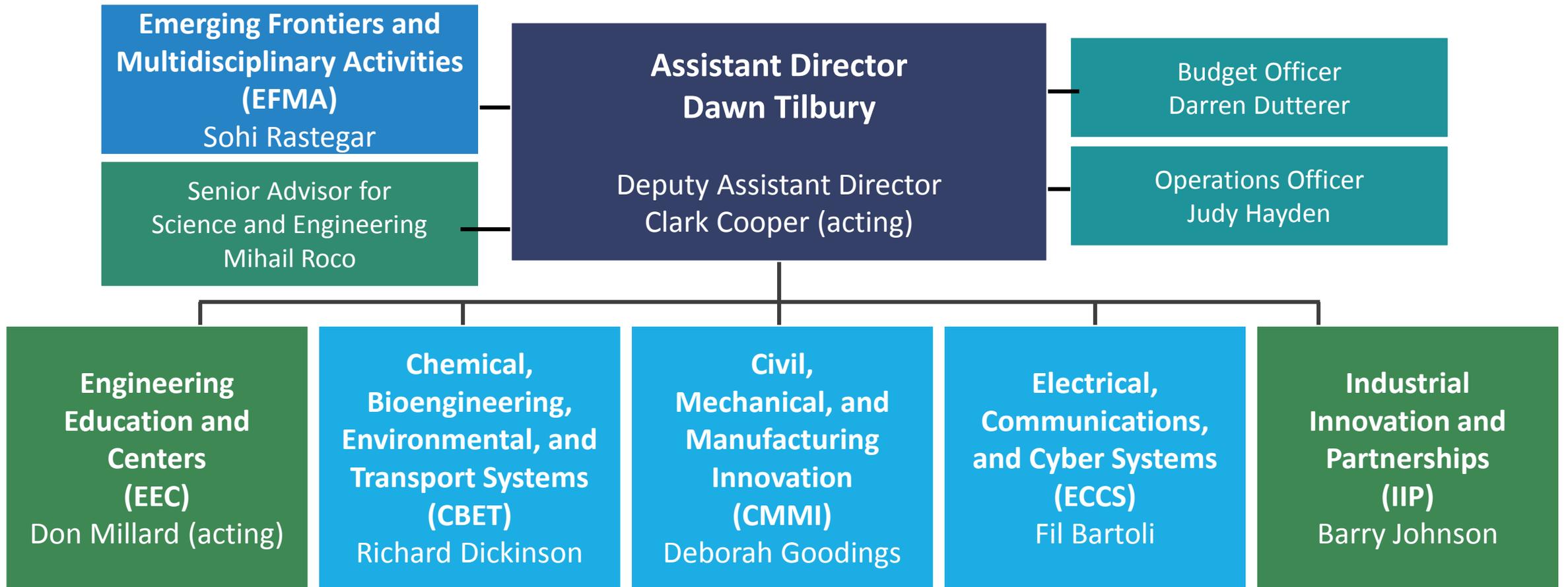
Recognition of Departing Advisory Committee Members

Directorate for Engineering Report

DAWN TILBURY, NSF ASSISTANT DIRECTOR FOR ENGINEERING
DIRECTORATE FOR ENGINEERING ADVISORY COMMITTEE MEETING
OCTOBER 24, 2017

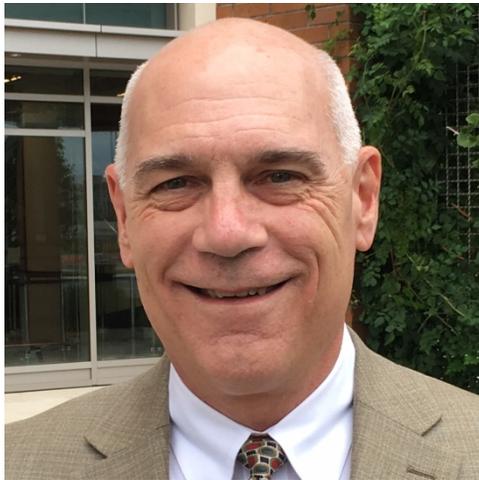
ENG People

NSF Directorate for Engineering



New ENG Leaders

Clark Cooper
ENG Deputy
Assistant Director
(acting)



**Richard
Dickinson**
CBET Division
Director



**Carmiña
Londoño**
EEC Deputy Division
Director (on detail)



Mary Toney
CMMI Deputy
Division Director



New ENG Colleagues

CBET

Gregory Meyer, AAAS Fellow (East Carolina University)

Chenzhong Li, Program Director for Nano-Biosensing (Florida International University)

Susan Muller, Program Director for Particulate and Multiphase Processes (University of California, Berkeley)

Christina Payne, Associate Program Director for Engineering, Biology, and Health Cluster (University of Kentucky)

Karl Rockne, Program Director for Environmental Engineering (University of Illinois at Chicago)

Brandi Schottel, Associate Program Director for Environmental Engineering and Sustainability Cluster (Texas A&M University)

CMMI

Robin Dillon-Merrill, Program Director for Humans, Disasters and the Built Environment (Georgetown University)

Ololade Fatunmbi, AAAS Fellow (University of Pennsylvania)

Robert Scheidt, Program Director for Mind, Machines and Motor Nexus (Marquette University)

Michael Rawlings, AAAS Fellow (Northwestern University)

New ENG Colleagues

ECCS

Turquoise Bowen, Administrative Support Assistant

Chanel Kemp, Operations Specialist

Stephanie Woods, Pathways Program Assistant

EEC

Jesus Alvelo, AAAS Fellow (MIT)

Jennifer Beierlein, AAAS Fellow (Bentley University)

Junhong Chen, Program Director for Engineering Research Centers (University of Wisconsin-Milwaukee)

Erick Jones, Program Director for Engineering Research Centers (University of Texas at Arlington)

Julie Martin, Program Director for Engineering Education Research (Clemson University)

Eileen Oni, AAAS Fellow (Rutgers University)

Paige Smith, Program Director for Broadening Participation in Engineering (University of Maryland, College Park)

New ENG Colleagues

EFMA

Brian Gray, AAAS Fellow (University of California, Riverside)

OAD

Maria (Mary) Loera, Intern (George Mason University)

IIP

Andre Marshall, Program Director for IUCRC (University of Maryland, College Park)

Cindy WalkerPeach, Program Director for I-Corps (UT Austin)

Current Searches

Leadership – interviewed

ENG Deputy Assistant Director

CBET Deputy Division Director

ECCS Deputy Division Director

Leadership – reviewing applications

EEC Division Director

Program Directors (PDs)

CMMI

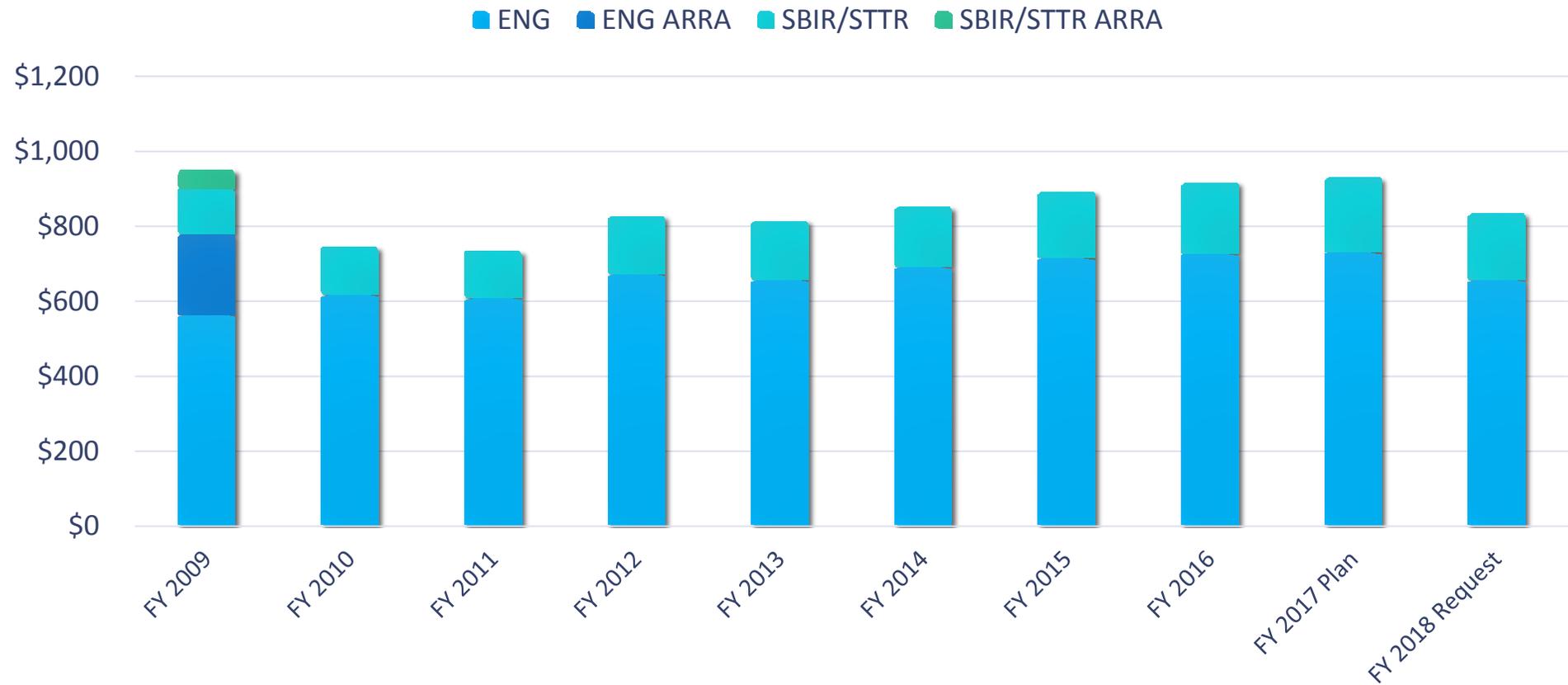
- PD for Biomechanics and Mechanobiology
- PD for Mechanics of Materials and Structures
- PD for Dynamics, Control and Systems Diagnostics
- PD for Operations Engineering
- Associate PD for Operations, Design, and Dynamic Systems Cluster

ECCS

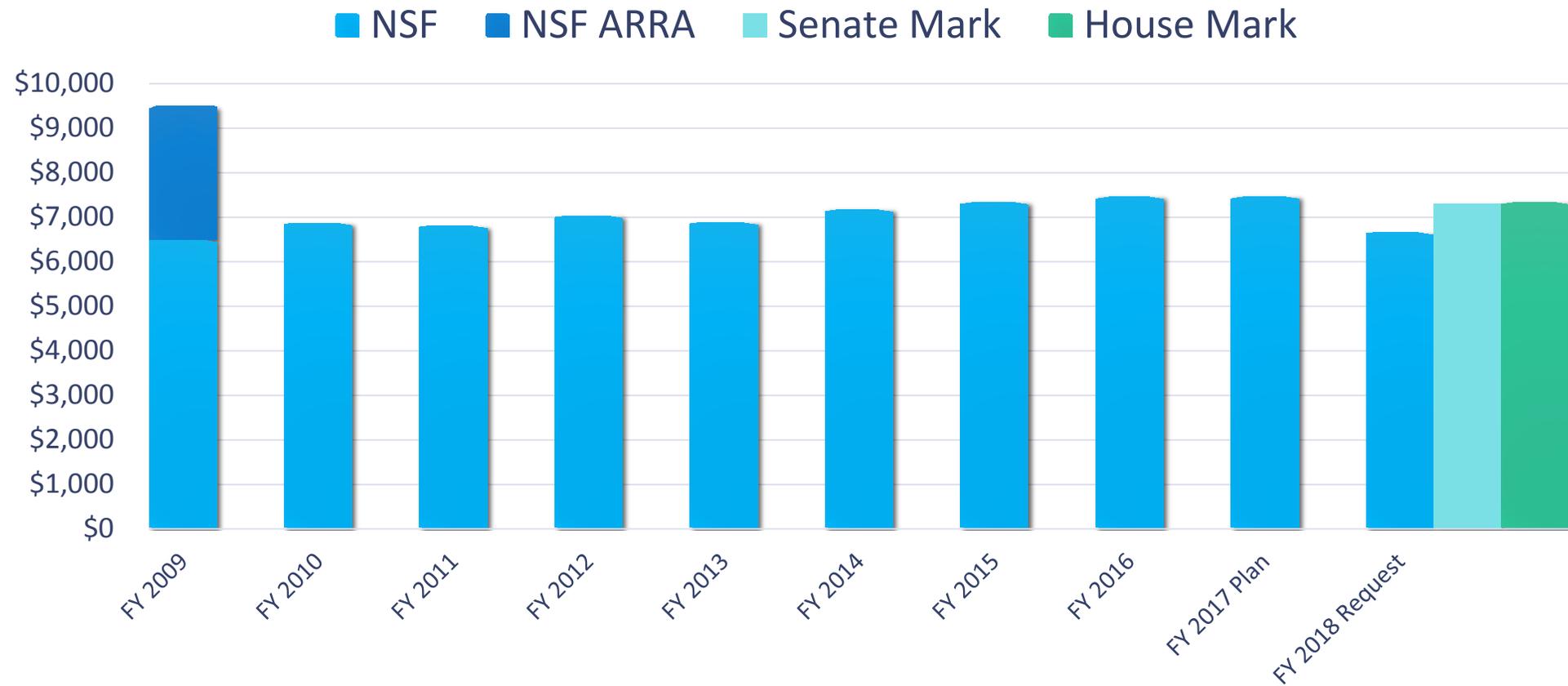
- PD for Communications, Circuits, and Sensing Systems
- PD for Energy, Power, Control, and Networks

ENG Budget

ENG and SBIR/STTR R&RA Budgets (\$M)



NSF Budgets (\$M)



ENG Research

NSF Responds to Hurricanes Harvey, Irma, and Maria

- Deadline extensions
- Mobilization of Geotechnical Extreme Events Reconnaissance (GEER) Association and Natural Hazards Engineering Research Infrastructure (NHERI) teams
- Funding of Rapid Response Research (RAPID), Early-concept Grants for Exploratory Research (EAGER) and supplements
- <https://nsf.gov/naturaldisasters/>



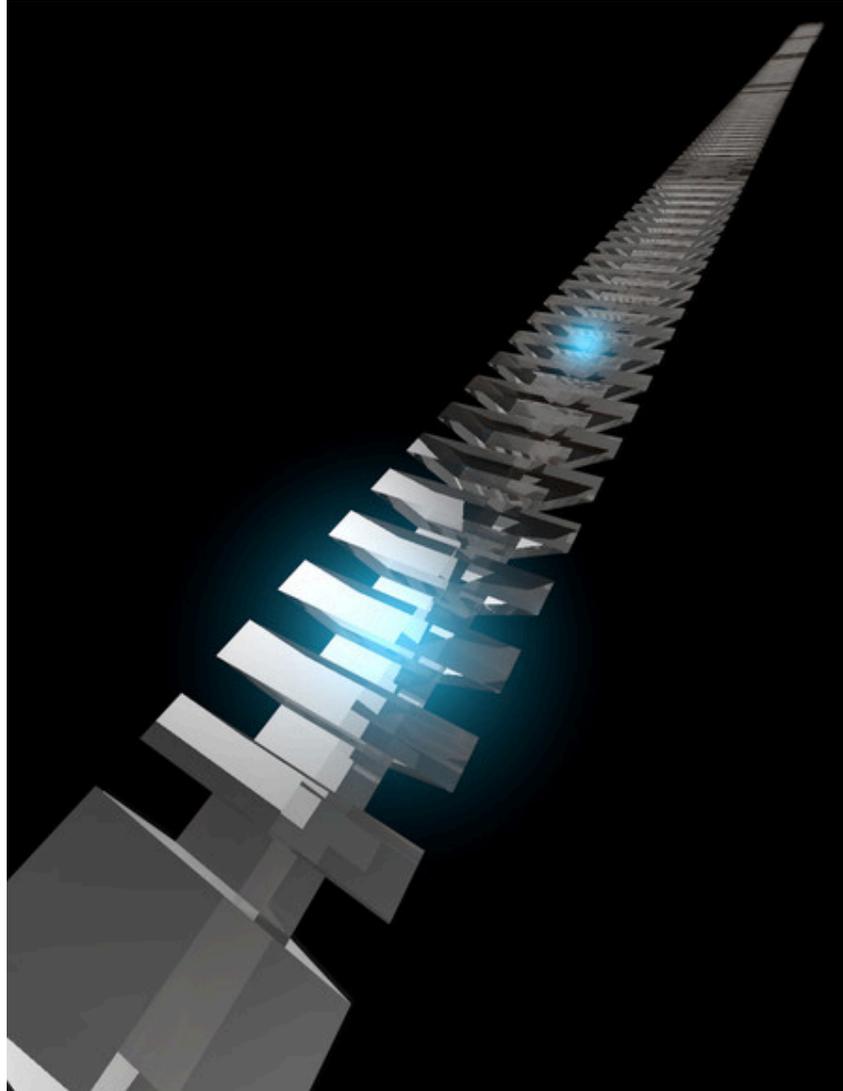


Earthquake Shake Tests Help Engineers Design Safe Wooden Buildings Up to 20 Stories

A two-story wooden structure endured four different earthquake simulations on July 14, 2017 on the world's largest outdoor shake table, a component of the NSF Natural Hazards Engineering Research Infrastructure.

The goal of the tests is to gather enough data to design wood buildings as tall as 20 stories that do not suffer significant damage during large earthquakes. The designs will allow occupants to leave the building unharmed and resume living in the building shortly afterwards.

CMMI 1520904

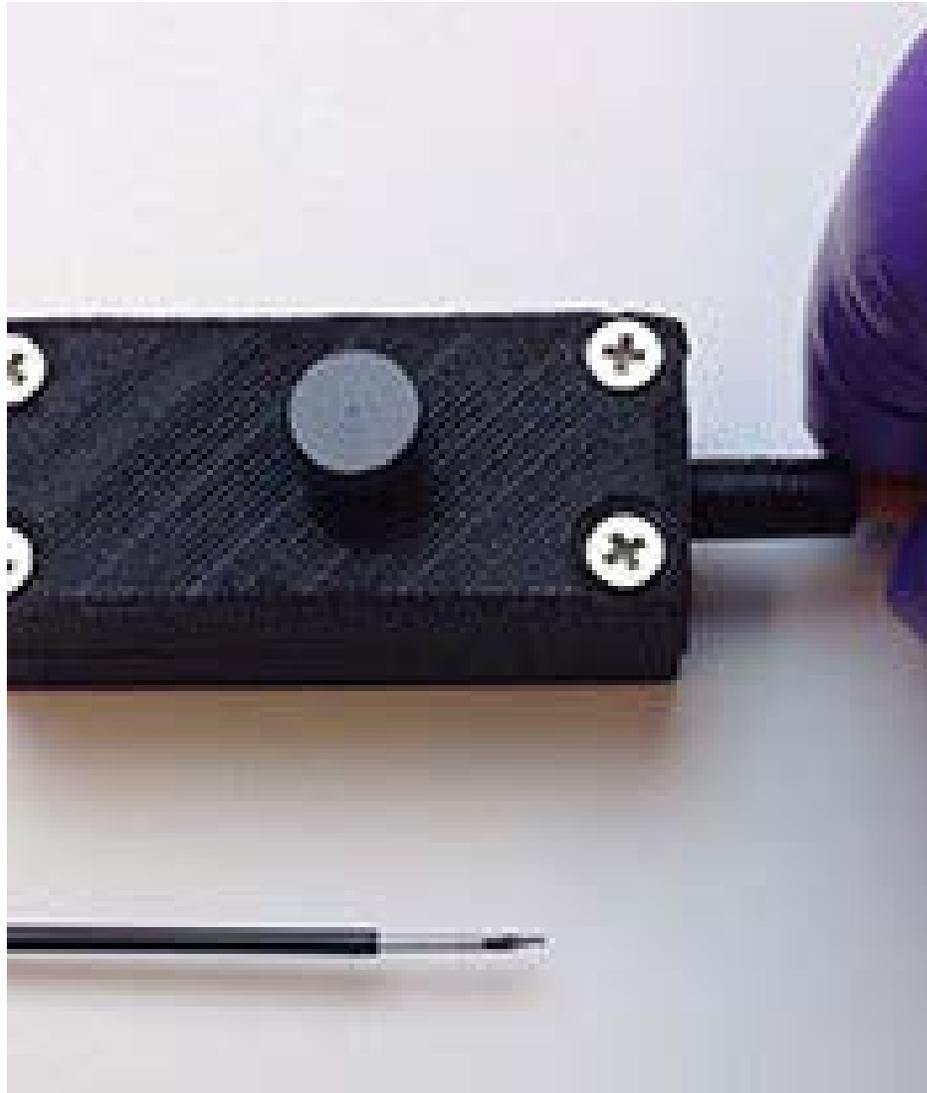


First On-chip Quantum Memory

In a breakthrough for optical quantum memory, Caltech researchers have created a new chip-scale technology that stores quantum states of light at the single-photon level.

Its extremely small size – carefully engineered at the nanoscale level – allows for integration with traditional hardware components, and for its future use in secure quantum communication networks.

ECCS 1454607 and EFMA 1741707



Light-scattering tool peers into pancreas to find cancer

Pancreatic cancer is difficult to detect early because the pancreas is deep inside the abdomen, making potentially cancerous cells hard to reach and identify without surgery.

Researchers funded by NSF developed a new light-based technique that can identify precancerous and cancerous cysts — small, fluid-filled cavities in the body — by piggybacking on a standard diagnostic procedure.

CBET 1402926 and 1605116



Waste methane and bacteria produce biodegradable polyester fibers

Small business Mango Materials announced a novel, energy efficient method to produce a biodegradable, bio-based polyester fibers.

Their closed-loop method uses waste methane gas as a feedstock to produce polyhydroxyalkanoate (PHA) at a price competitive with petrochemical-based polymers.

They piloted their method at a California wastewater treatment plant, and clothing and textile companies are now testing the product.

IIP SBIR 1256623 and 1142566



AP in Engineering

Prepare students for four-year undergraduate engineering programs and two-year Career and Technical Education (CTE) programs

Promote inclusion, help level the 'playing field,' and increase diversity

Respond to support from deans, teachers, and students

Act on College Board commitment

Integrate with K-12 standards

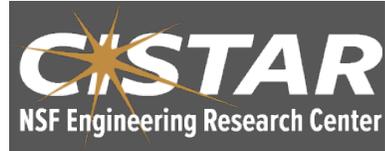
Support National priorities

"It is clearly a good idea if for no other reason than to give engineering a place among other serious academic subjects at the secondary school level that is not at the technician standard... It positions engineering to be fundamental to all highly educated people."

Dan Mote, President of National Academy, October 2013

FY 2017 Engineering Research Centers to advance health, manufacturing and energy

Fuel derived from shale gas



- NSF Engineering Research Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR)
- Purdue University, University of New Mexico, Northwestern University, the University of Notre Dame and the University of Texas at Austin

Personalized heart tissue



- NSF Nanosystems Engineering Research Center for Cellular Metamaterials (CELL-MET)
- Boston University, the University of Michigan and Florida International University

Therapies based on living cells



- NSF Engineering Research Center for Cell Manufacturing Technologies (CMaT)
- Georgia Institute of Technology, the University of Georgia, the University of Wisconsin-Madison and the University of Puerto Rico



Health systems for underserved populations

- NSF Engineering Research Center for Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP)
- Texas A&M University, the University of California at Los Angeles, Rice University and Florida International University.

ENG Opportunities

NSF Big Ideas for Future NSF Investments

RESEARCH IDEAS

MATHEMATICAL, STATISTICAL, COMPUTATIONAL FOUNDATIONS
ANALYTICS
DATA SCIENCE
HARNESSING THE DATA REVOLUTION
FUNDAMENTAL RESEARCH
MACHINE LEARNING
RESEARCH DATA
CYBERINFRASTRUCTURE
MODELING
DATA MINING

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future



Navigating the New Arctic

Windows on the Universe: The Era of Multi-messenger Astrophysics



The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype



NSF Big Ideas for Future NSF Investments

RESEARCH IDEAS



Harnessing the DATA REVOLUTION

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Understanding the Rules of Life: Predicting Phenotype



NSF Big Ideas for Future NSF Investments

PROCESS IDEAS

Mid-scale Research Infrastructure



NSF 2026



**Growing
Convergent
Research at NSF**



**NSF INCLUDES:
Enhancing STEM
through Diversity and
Inclusion**

NSF Big Ideas for Future NSF Investments

PROCESS IDEAS

Mid-scale Research Infrastructure



NSF 2026



**Growing
Convergent
Research at NSF**



**NSF INCLUDES:
Enhancing STEM
through Diversity and
Inclusion**



Growing Convergent Research at NSF

April 2017 — DCL to address grand challenges in NSF's 10 Big Ideas

August 2017 — 23 new projects include 4 with ENG support

- Quantum Elements of Secure Communication (workshop)
- Convergence Research about Multimodal Human Learning Data during Human Machine Interactions (workshop)
- From Making to Micro-Manufacture: Reimagining Work Beyond Mass Production
- Enhancing small and mid-level farm viability through a systems-based research network: Linking technology and sustainable development and practice (research coordination network)

August 2017 — Ideas Lab: Practical Fully-Connected Quantum Computer Challenge



NSF INCLUDES



JULY 2017

DCL for NSF INCLUDES EAGERS,
supplements and conferences



JAN. 2018

Workshop for NSF INCLUDES grantees
and NSF centers



Awards for 27 Design and Development
Launch Pilots

SEP. 2017





Strategic Challenges and Opportunities

Increasing enrollment and interest in engineering while struggling with diversity and inclusion; uneven distribution across engineering disciplines

- AP Engineering pilot with support from Deans
- NSF INCLUDES

Flat or decreasing budgets

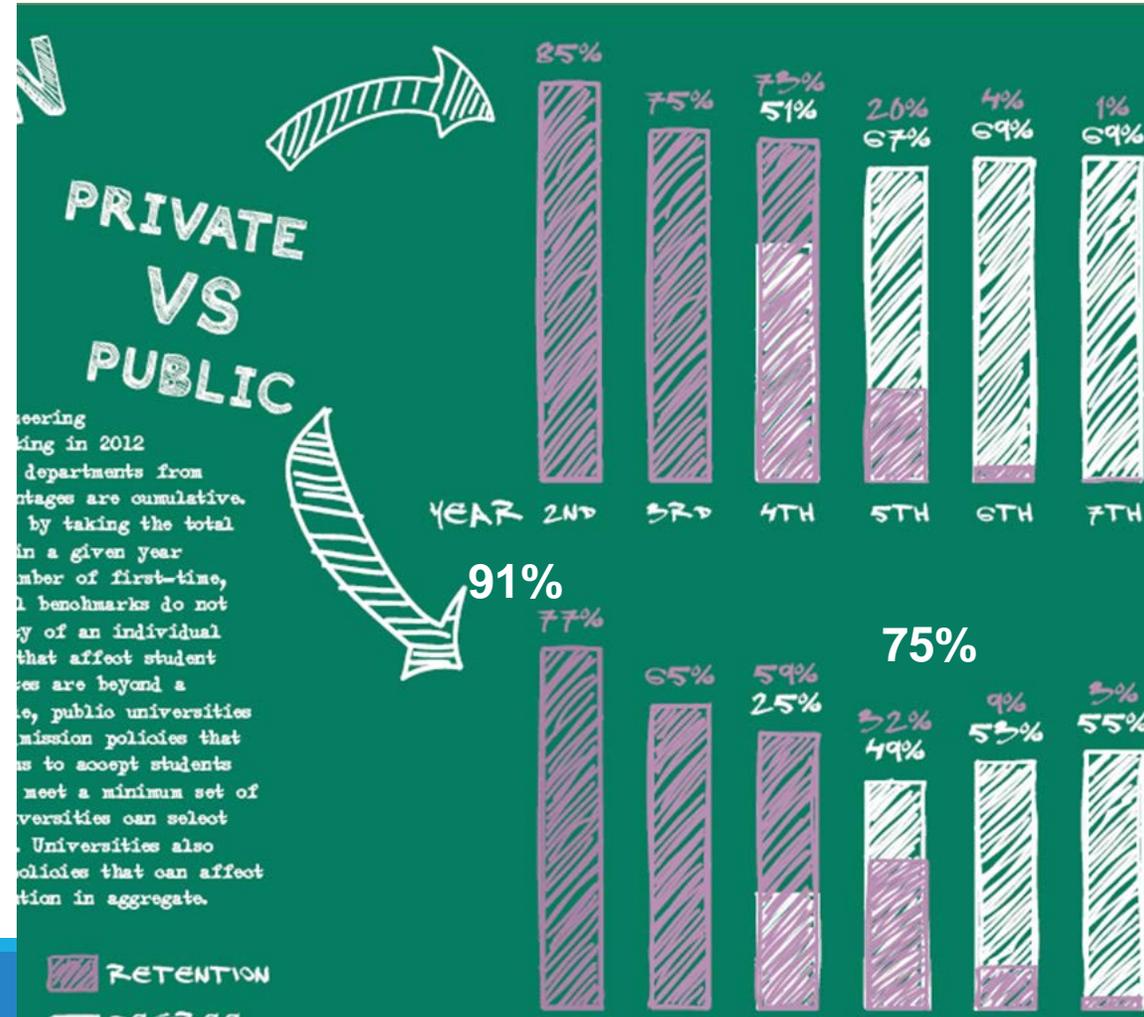
- Leading Engineering for America's Prosperity, Health, and Infrastructure (LEAP HI)
- Partnerships
 - Industry (SRC, I/UCRC and other IIP programs)
 - Government (INFEWS USDA/NIFA, AFOSR, I-Corps)
 - International (Ireland, UK, China, Israel; CASIS)

ENG and SBIR/STTR R&RA Budget (\$M)

	FY 2016 Actuals	FY 2017 Current Plan	FY 2018 Request	FY 2018 Request change over FY 2016 Actuals	
				Amount	Percent
CBET	\$183.76	\$183.60	\$168.20	-\$15.56	-8.5%
CMMI	216.27	221.14	202.20	-\$14.07	-6.5%
ECCS	113.89	113.82	102.85	-\$11.04	-9.7%
EEC	107.51	108.75	100.28	-\$7.23	-6.7%
IIP	239.87	249.88	223.21	-\$16.66	-6.9%
<i>SBIR/STTR</i>	<i>188.52</i>	<i>198.57</i>	<i>176.21</i>	<i>-\$12.31</i>	<i>-6.5%</i>
EFMA	54.37	52.33	36.75	-\$17.62	-32.4%
ENG TOTAL	\$915.68	\$929.52	\$833.49	-\$82.19	-9.0%

Public and Private Undergraduate Engineering Retention and Graduation Rate

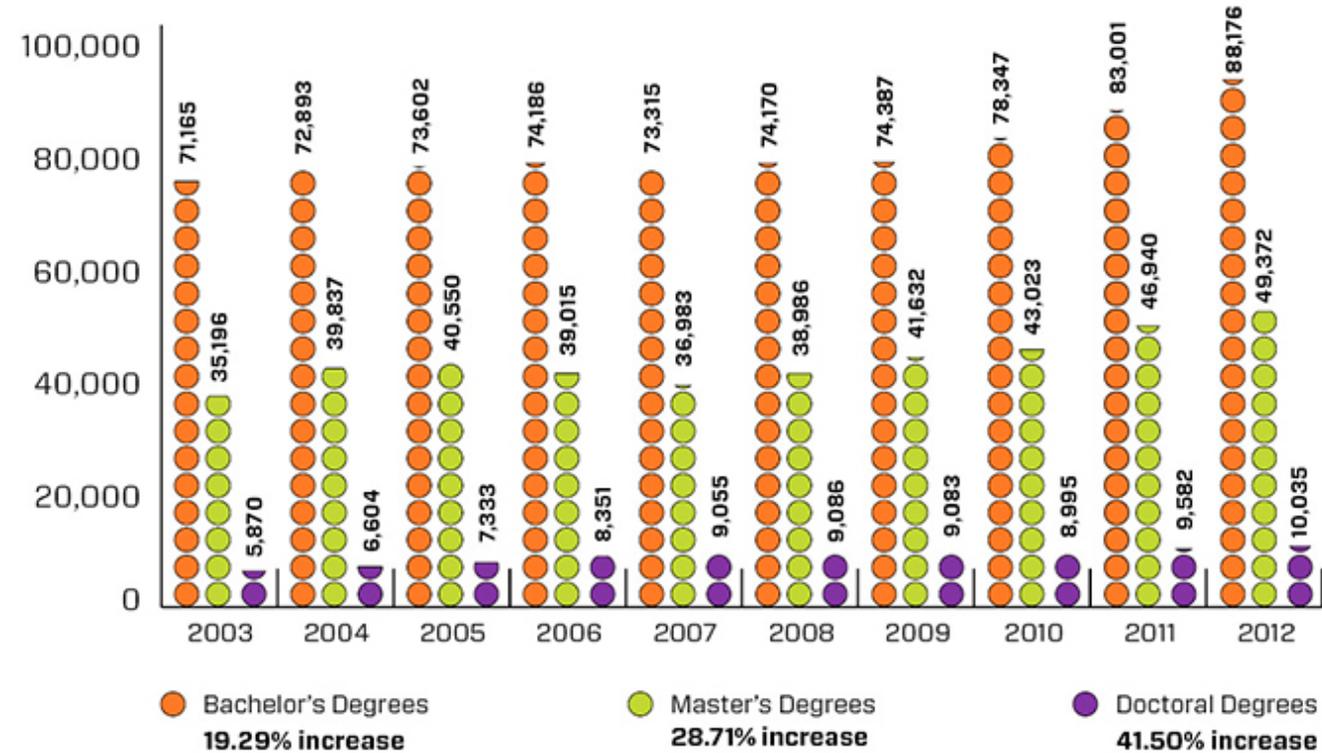
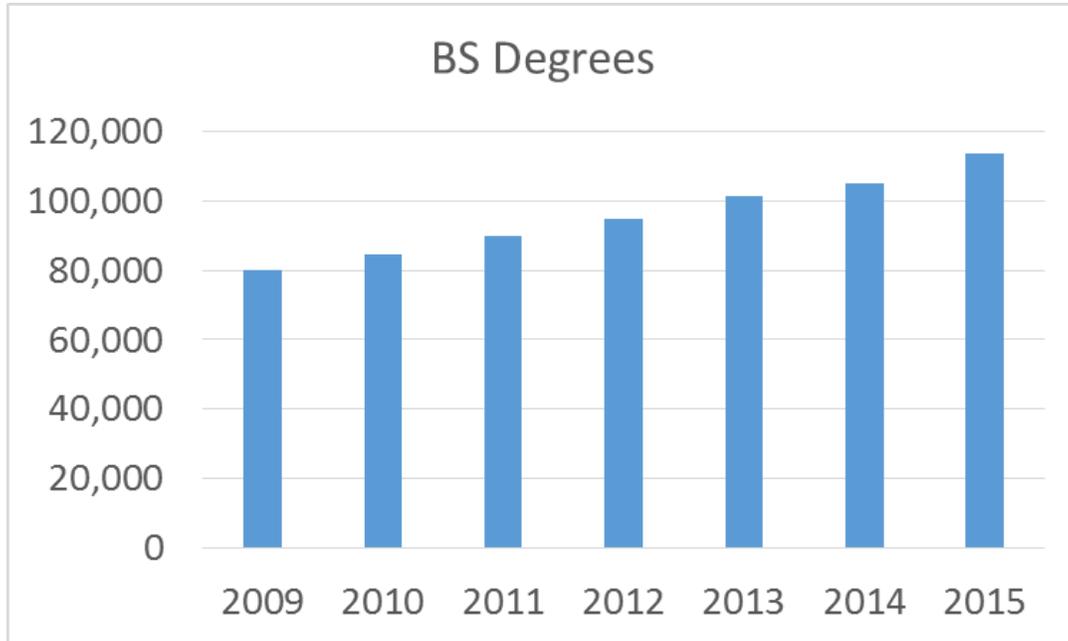
ASEE Data (January issue of Prism)



Retention: Purple

Graduation: White

US Engineering Enrollment/Graduates



Towards 150,000 BS Degrees
by 2025

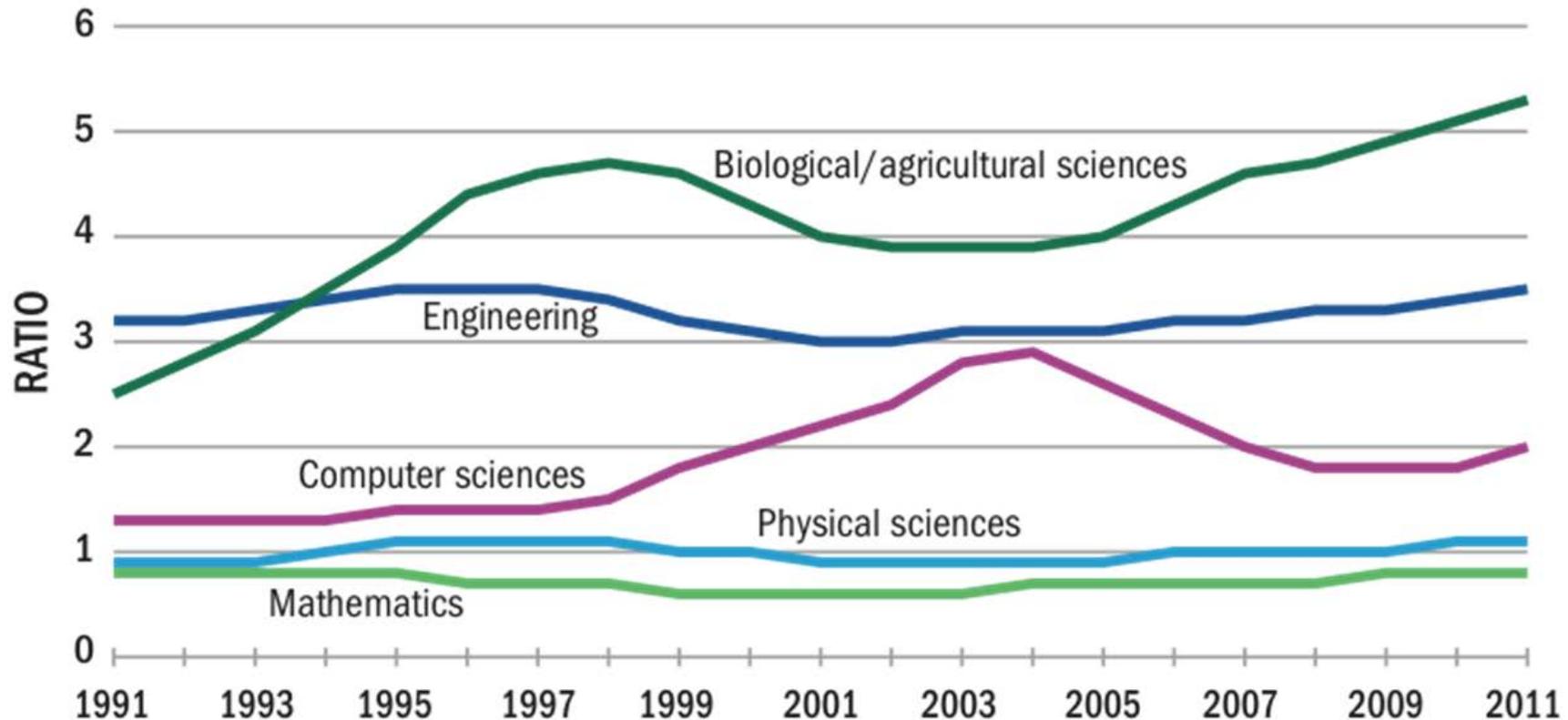
140,000 Degrees in US

Timeline of ASEE Engagement With College Board on AP in Engineering

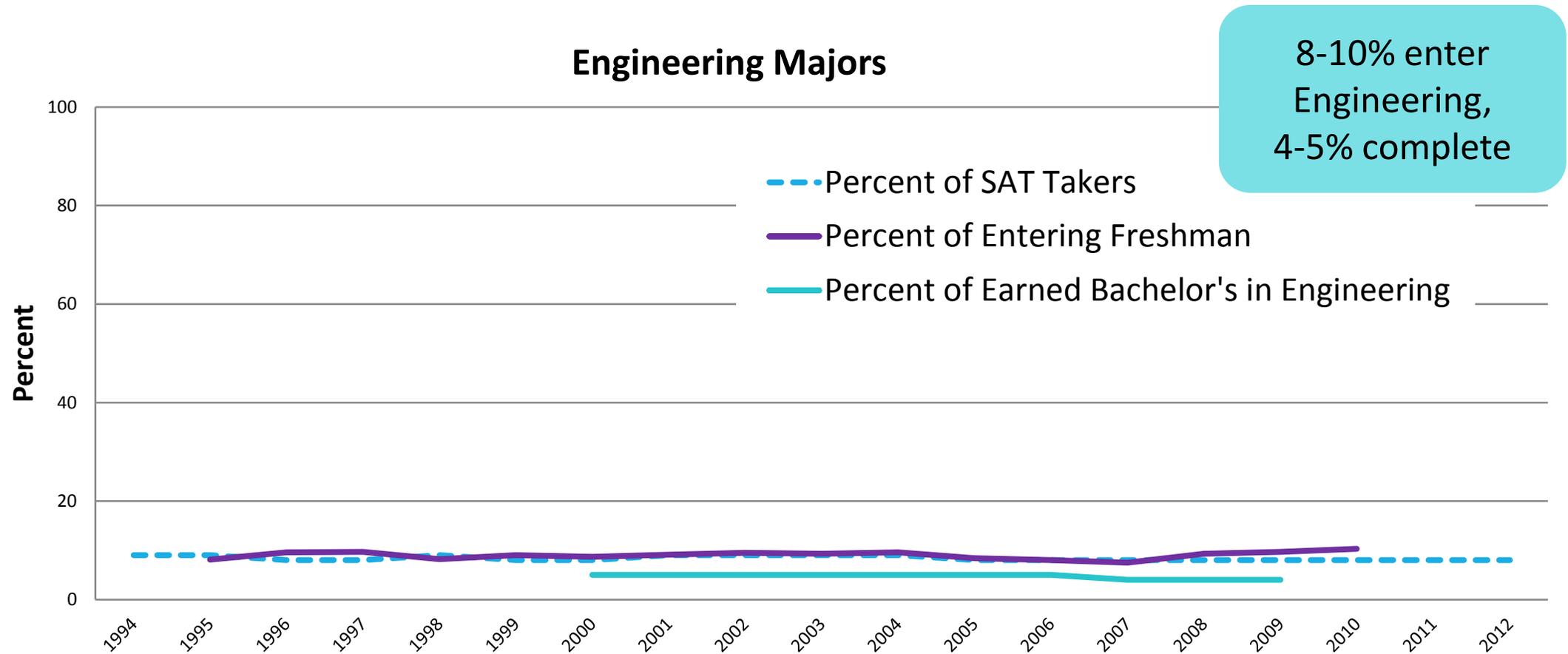
- ✓ 2010 Update to College Board on Engineering Design Project Portfolio Scoring Rubric **EDPPSR** Progress
- ✓ 2011 NSF PRIME Program Award on EDPPSR (UMD/UVA/PLTW)
- ✓ 2013 Meeting at College Board to discuss status of AP in Engineering (2/14)
- ✓ 2013 Session: **“NGSS and Engineering”** a EDI at Grand Hyatt in NYC (4/14-4/16)
 - 7 Questions asked with Clicker Responses-Auditi Chakravarty/Maureen Reyes
 - ✓ • What additional support would students need to get them to engineering?
 - ✓ • What would attract women and other underrepresented groups to engineering?
 - ✓ • What additional support would schools need to get them to engineering
 - ✓ • Percentage of schools with capacity for engineering (teachers, resources, etc.)
 - ✓ • What training would an engineering teacher need? (either existing teacher or practitioner)
 - ✓ • What alternative certification pathways exist for practitioners to teach engineering?
 - ✓ • What percentage of existing teachers would be interested in teaching engineering?
- ✓ 2013 Interest by White House OSTP on an AP in Engineering
- ✓ 2013 **Survey of Engineering Deans**, AP Teachers, Students-(10/16)
- ✓ 2014 Approval by Engineering Deans Council to Develop Curriculum (4/12)
- ✓ 2014 Commitment by College Board to fund Curriculum Development-6/14
- ✓ 2015 Appointment of Ms. LaTanya Sharpe to lead AP in Engineering under Mr. J. Williamson
- ✓ 2015 Survey of Engineering Deans about Course Details, Credit/Placement (6/15)

Interest in Science and Engineering

U.S. bachelor's degrees in selected S&E fields per 1,000 20–24-year olds
1991–2011



Post-Secondary Engineering Pipeline





Broader Impacts

- 2011 National Science Board Report
- 2015 Start of NSF empirical study of Broader Impacts (Office of Integrative Activities)
- 2016 Workshop on Defining Broader Impact Activities (ECCS) – Final Report
- 2016 2017 NSF Proposal and Award Policies and Procedures Guide
- 2017 American Innovation and Competitiveness Act update to NSF Broader Impacts
- 2018 Workshop on Setting a Broader Impacts Innovation Roadmap (CMMI) – Final Report
- 2018 Definitive steps and guidance based on NSF study of Broader Impacts

New 3D printing method creates shape-shifting objects

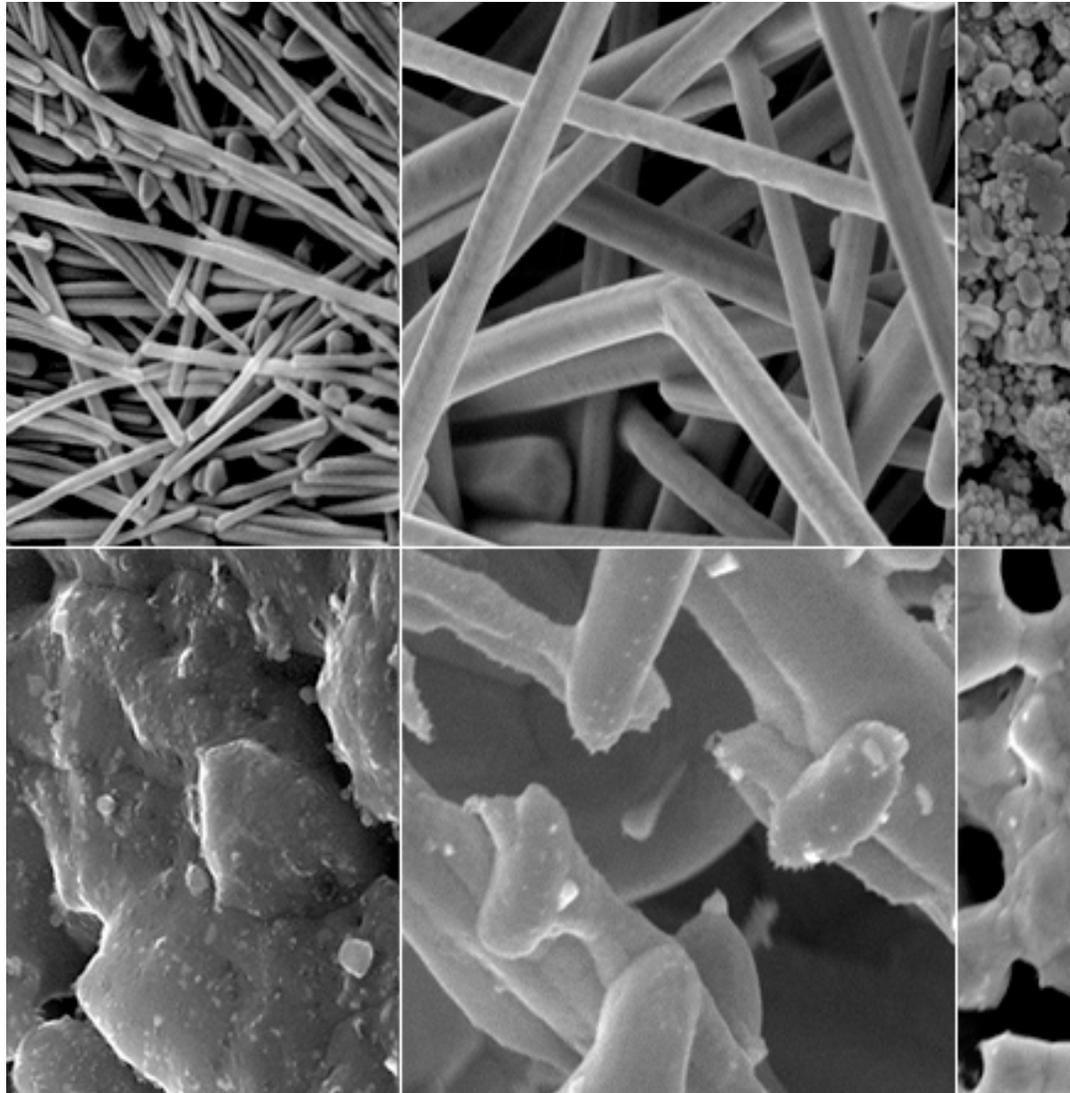
Researchers 3D printed objects of shape memory polymers that can permanently transform into different shapes in response to heat.

Their approach could enable a range of new product features, such as allowing products that could be stacked flat or rolled for shipping and then expanded once in use.

CMMI 1462894 and 1462895;
EFRI 1435452

Image Credit: Georgia Tech





Nanowire 'inks' enable paper-based printable electronics

Conductive "inks" made from silver nanowires may create functioning electronic circuits, without the high temperatures needed for conventional printed electronics.

This discovery enables customizable, inexpensive electronics on heat-sensitive materials like paper or plastic.

ECCS 1344745 and DMR 1253534



Wind data collected from Hurricanes Harvey and Irma

NSF Natural Hazards Engineering Research Infrastructure (NHERI) researchers mobilized ahead of Hurricanes Harvey and Irma to learn which building materials and designs best resist extreme winds.

Two 50-foot weather stations in Texas and other instruments in southern Florida were deployed to collect synchronized, high-fidelity measurements of wind gusts and turbulence.

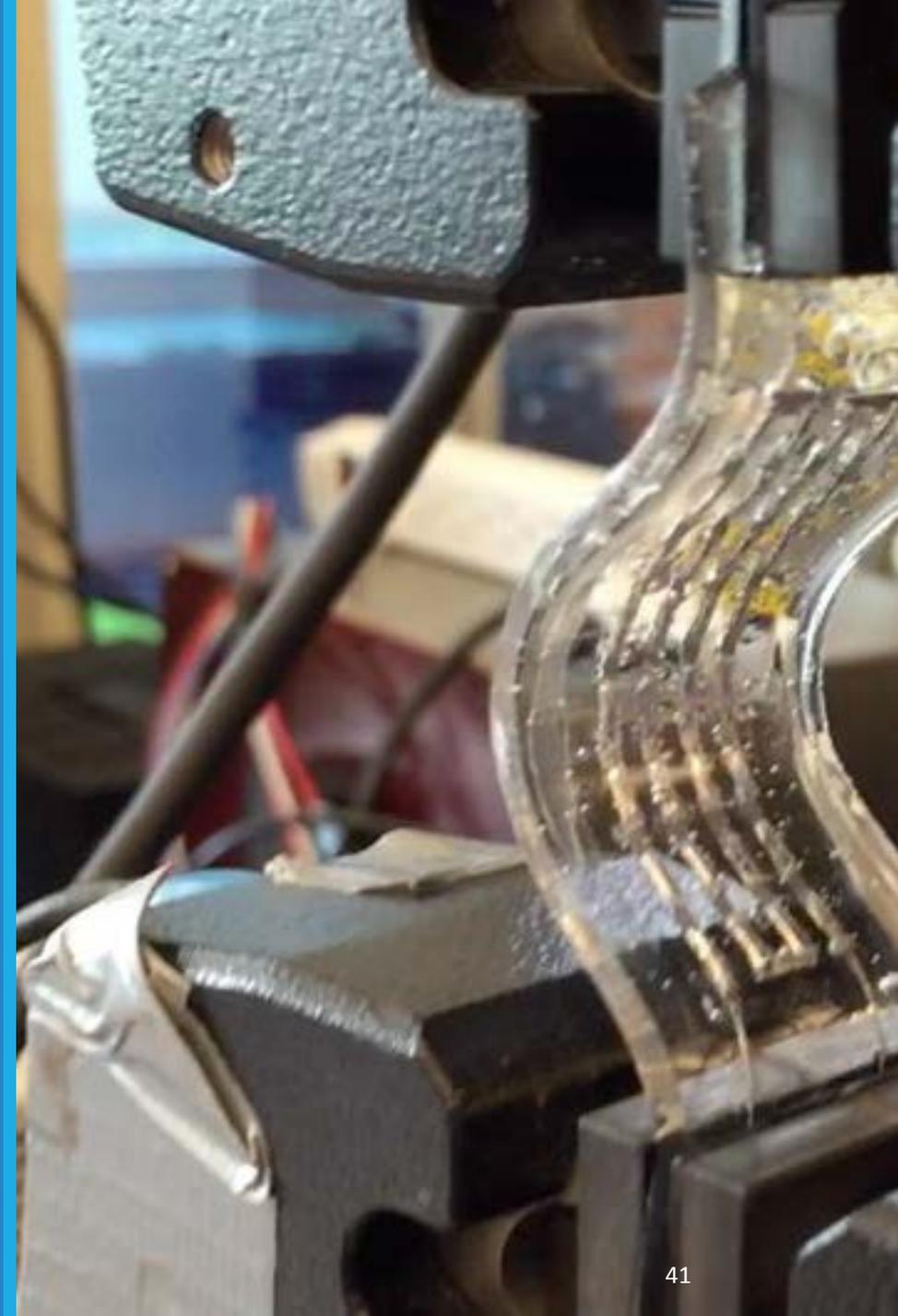
The data will be shared with the research community through the NHERI DesignSafe cyberinfrastructure.

CMMI 1520817 and 1520843

New energy harvester design improves performance of flexible wearable electronics

Advances in flexible thermoelectric generators, made with liquid metal for self-healing, open a path to wearable electronic devices powered by body heat.

CMMI 1363485, ECCS 1351533, and EEC 1160483





Brain signals deliver first targeted treatment for world's most common movement disorder

Essential tremor, affecting an estimated 7 million people in the U.S. alone, can be treated with deep brain stimulation.

To deliver stimulation only when it's needed, researchers combined the deep brain electrode with others that sense movement in parts of the body that experience essential tremor.

The new approach uses half the power, which would allow patients more time between surgeries to replace the battery.

EEC 1028725