Directorate for Engineering Report

DAWN TILBURY, NSF ASSISTANT DIRECTOR FOR ENGINEERING

NATIONAL SCIENCE BOARD MEETING

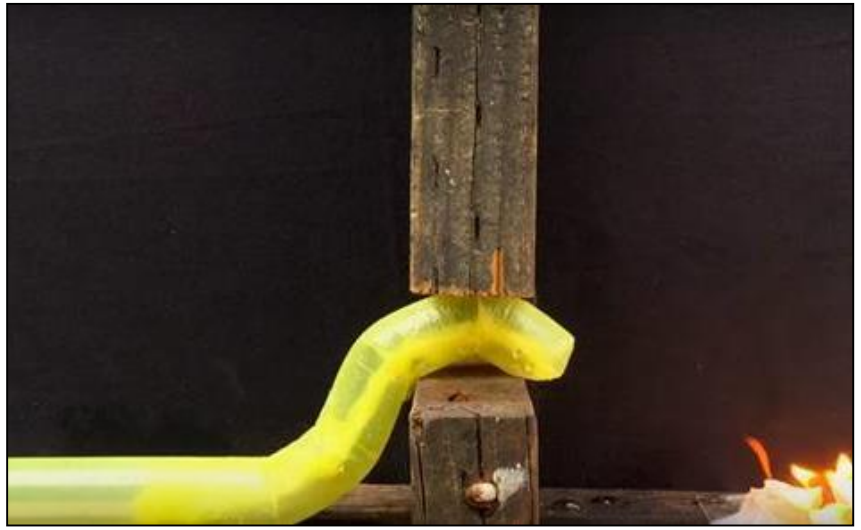
NOVEMBER 8, 2017

Image credit: *Rob Felt*

Create the future

NSF supports engineering discovery and education to create a future where people thrive.

Engineers are making this future a reality through research in areas such as advanced manufacturing, health care, sustainability, infrastructure and more.



Innovate for prosperity

NSF-funded engineering researchers create new knowledge, concepts and designs that become technological breakthroughs and solve real-world problems. They create innovations for clean water, the electric grid, agriculture and other national challenges.

To speed innovations to the market, NSF also spurs entrepreneurship, small business growth and industry collaboration.

Image credits: *Jonathan Coe, Prescient Surgical, Inc.; Kurt Hickman and Aaron Kehoe*

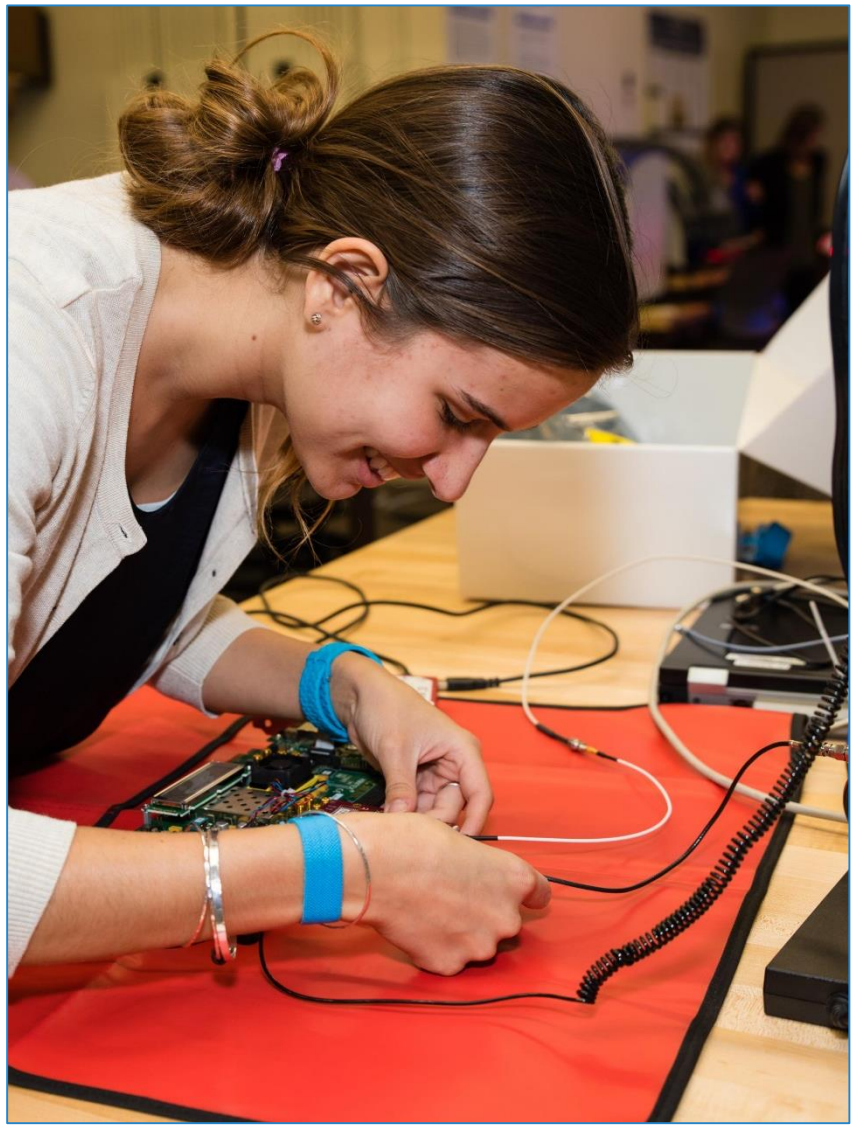
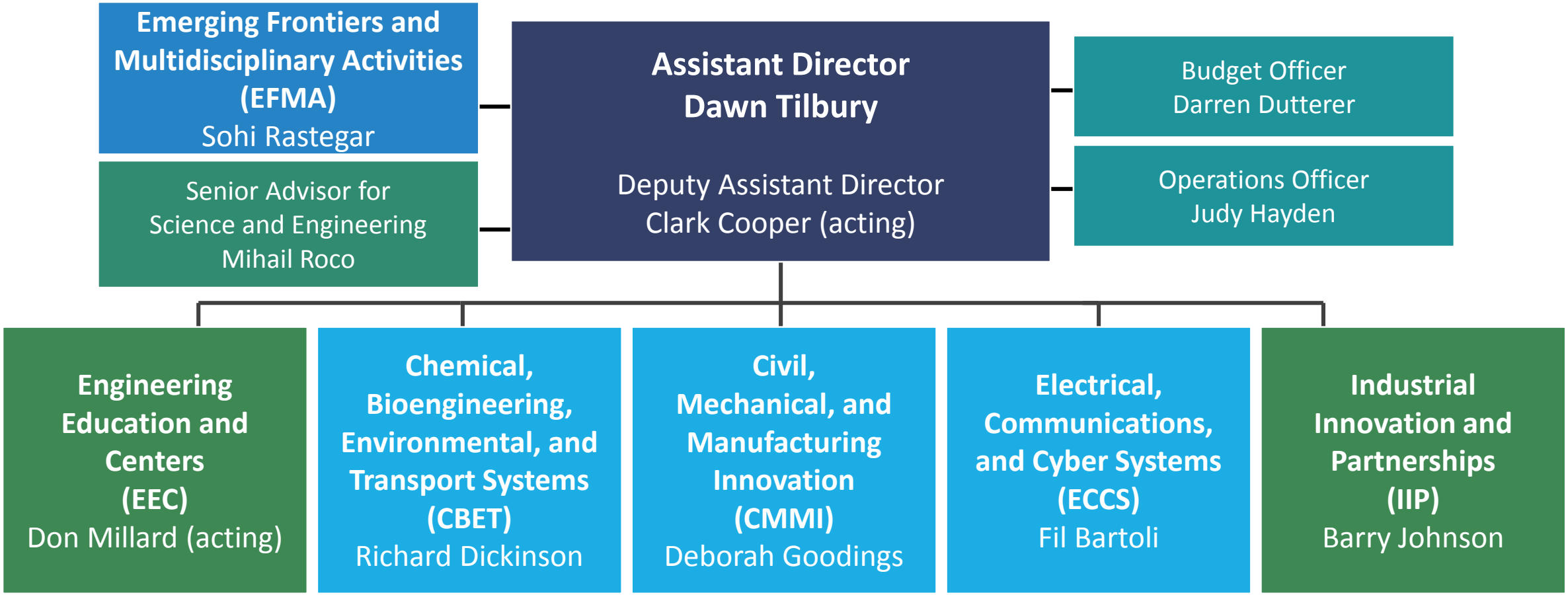


Image credit: *University of San Diego*

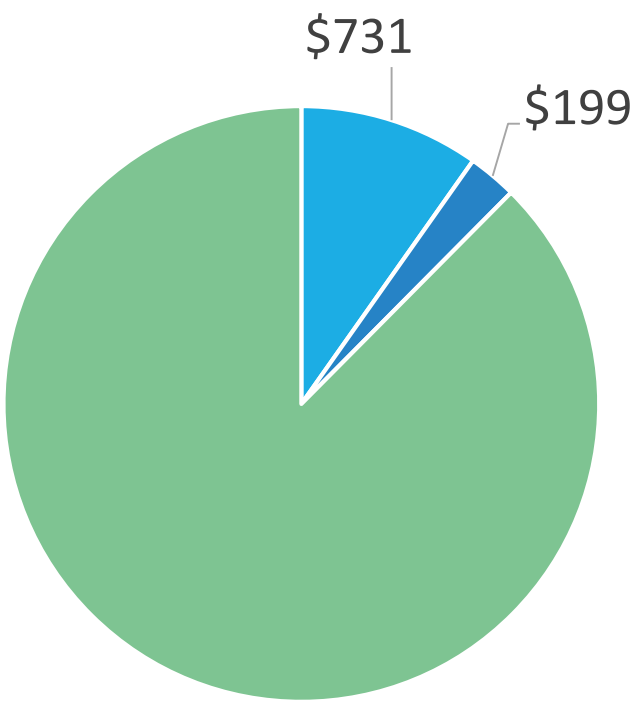
Educate the future workforce

To prepare an inclusive, innovative engineering workforce that can meet the changing needs of the American economy, NSF supports advances in engineering education and introduces the exciting possibilities of engineering to the next generation.

NSF Directorate for Engineering



NSF FY 2017 Current Plan ($M)



NSF Total $7,472
ENG Total $930

- ENG - other than SBIR
- ENG - SBIR
- NSF - other than ENG

NSF Big Ideas for Future NSF Investments

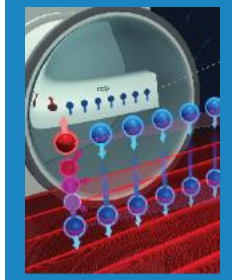
RESEARCH IDEAS

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

PROCESS IDEAS

Mid-scale Research Infrastructure

NSF 2026

Growing Convergent Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

NSF INCLUDES

SEPT. 2016

Awards for 37 Design and Development Launch Pilots

JULY 2017

DCL for NSF INCLUDES EAGERs, supplements and conferences

SEPT. 2017

Awards for 27 Design and Development Launch Pilots

JAN. 2018

Workshop for NSF INCLUDES grantees and NSF centers

ENG strengthens the future engineering workforce

Diversity and inclusion

Research on the formation of engineers

Research experiences for undergraduates, teachers, veterans

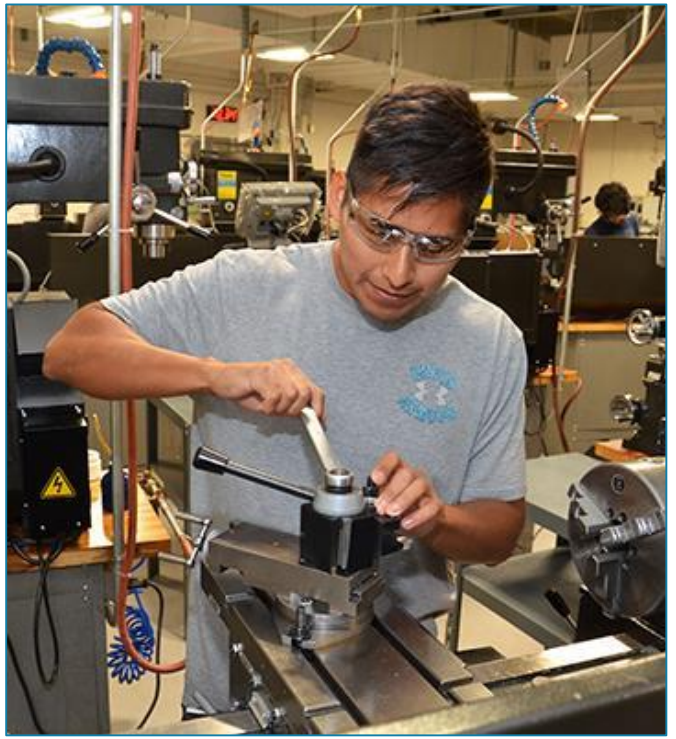
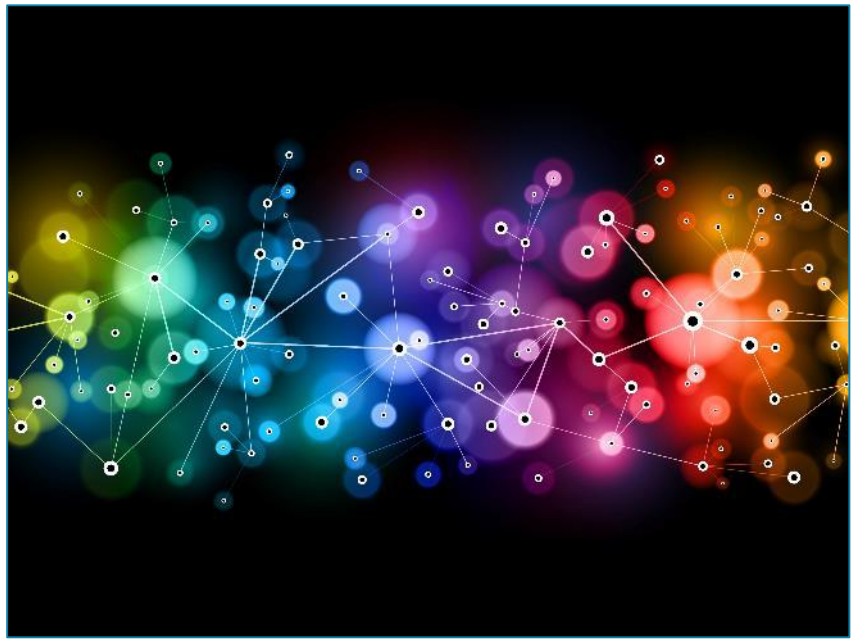


Image credit: *UNC Charlotte*



Engineering Research Centers take on complex research challenges

ERCs focus cutting-edge researchers from multiple fields to discover and launch ubiquitous future technologies

- Translate discoveries into innovations
- Strengthen U.S. competitiveness
- Prepare next generation of technological leaders

14 Generation-3 ERCs in FY 2018

4 new ERCs awarded in FY17

- Innovative and Strategic Transformation of Alkane Resources, *Purdue University*
- Cell Manufacturing Technologies, *Georgia Tech*
- Cellular Metamaterials, *Boston University*
- Precise Advanced Technologies and Health Systems for Underserved Populations, *Texas A&M University*

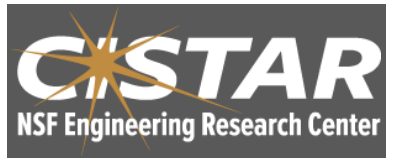


Image: *National Academies Press, Copyright 2017, National Academy of Sciences*

A New Vision for Center-Based Engineering Research

May 2017: National Academies report

Summer 2017: Working group

October 2017: ENG AdCom discussion

November 3, 2017: Workshop

Spring 2018: Solicitation for GEN-4 ERC

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

Synthetic biosystems for advanced biomanufacturing

Computation and data-enabled science and engineering to understand and control chemical, bioengineering, environmental, and transport systems

Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

Civil, Mechanical and Manufacturing Innovation (CMMI)

Advanced manufacturing and new materials for improved productivity

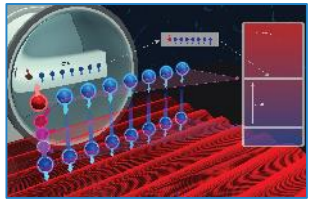
Robotics, sensing, and behavioral sciences to improve human-technology interaction

Resilient infrastructures in changing environments

Electrical, Communications and Cyber Systems (ECCS)

Dynamic data-enabled engineered systems

Networked mobile processors in connected engineering systems



Quantum information, memory, sensing and communication

Partnerships catalyze innovations

NSF supports industry-relevant research and knowledge transfer

- Grant Opportunities for Academic Liaison with Industry (GOALI)
- Industry–University Cooperative Research Centers (IUCRC)
- Partnerships for Innovation (PFI)

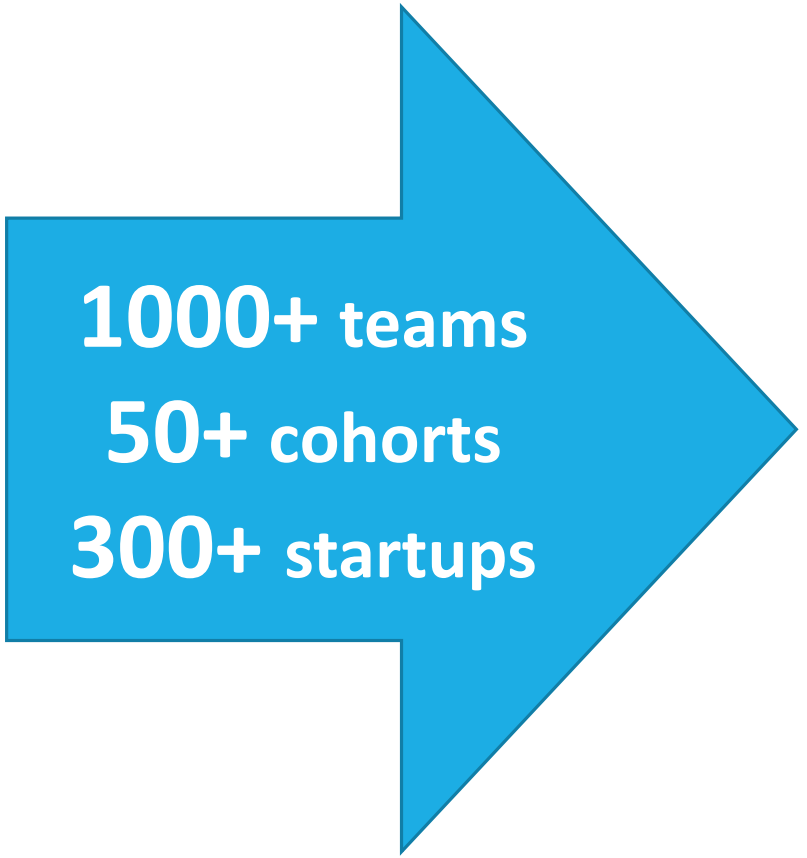
76 active IUCRCs
876 unique members
7:1 match of NSF $

Innovation Corps spurs entrepreneurship

Trains teams of faculty, students/postdocs, and business mentors

Translates NSF discoveries into new technologies

Involves people across NSF



Small business programs transform discoveries into societal benefits

Small Business Innovation Research (SBIR) + Small Business Technology Transfer (STTR) support high-tech small businesses in almost all areas of science and technology

- stimulate technological innovation in the private sector
- strengthen the role of small business in meeting federal R&D needs
- increase commercial applications of research results
- foster and encourage participation by socially and economically disadvantaged and women-owned small businesses

Congressionally mandated

TC

After scrapping Monsanto deal, Deere agrees to bu precision farming startup Blue River for $305M

BY CATHERINE SHU
Sep 6, 2017

MASS DEVICE

FORTUNE

TECH • CYBERSECU

Google Capital Leads $75 Million Inves

MENU

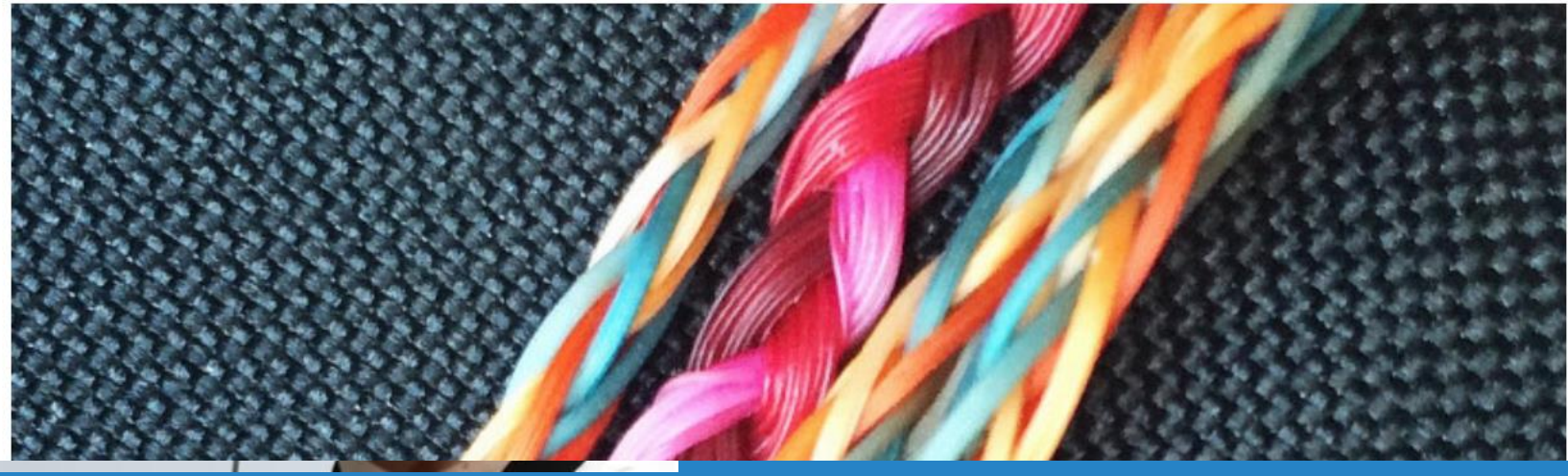
FAST COMPANY

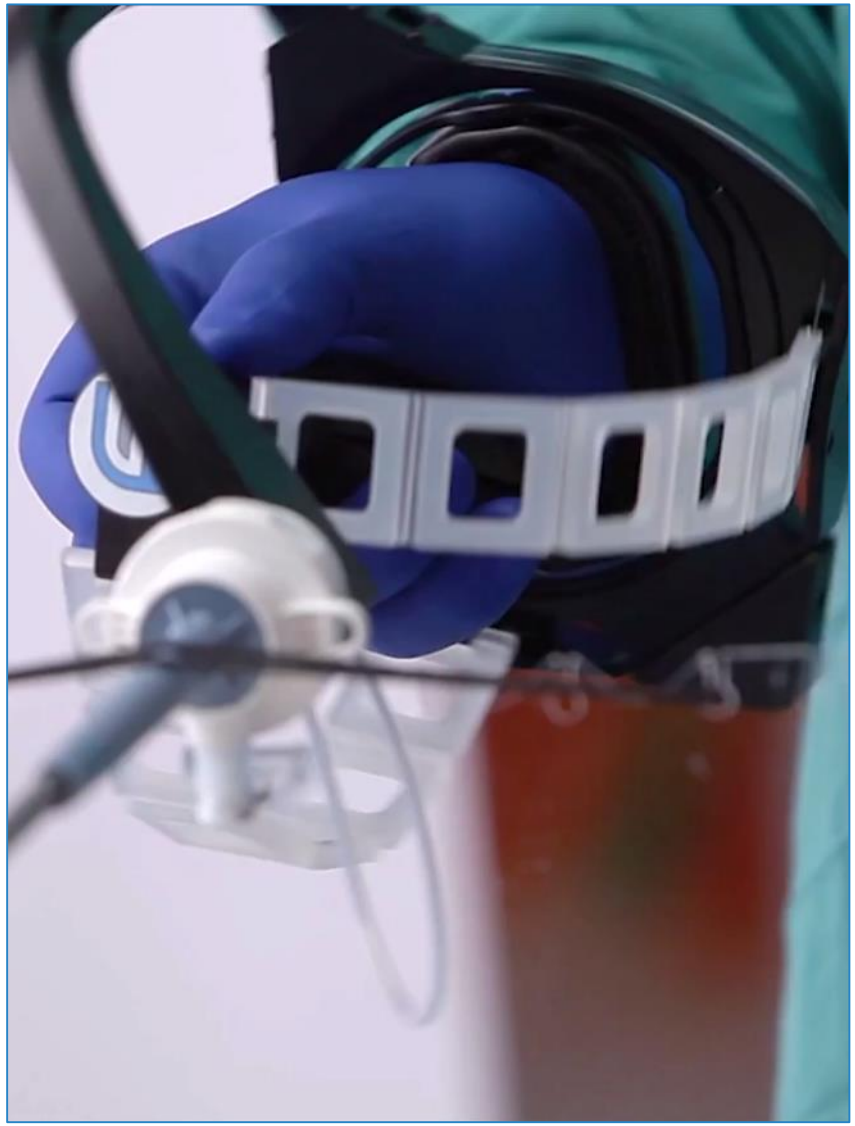
TECHNOLOGY | LEADERSHIP | ENTERTAINMENT | IDEAS | VIDEO | NEWS

10.03.17 | WORLD CHANGING IDEAS

The Shirt Of The Future Will Be Made By Methane-Eating Bacteria

By using a greenhouse gas as the basis for a new material, Mango Materials wants to create a new model of garment production that cleans up the atmosphere as it makes us new clothes.





Low-cost mechanical device for minimally invasive surgery

A new type of mechanical instrument allows surgeons to perform complex, minimally invasive procedures and reduce patient recovery times.

The handheld instrument provides many of the benefits of robot-assisted surgery at a much lower cost.

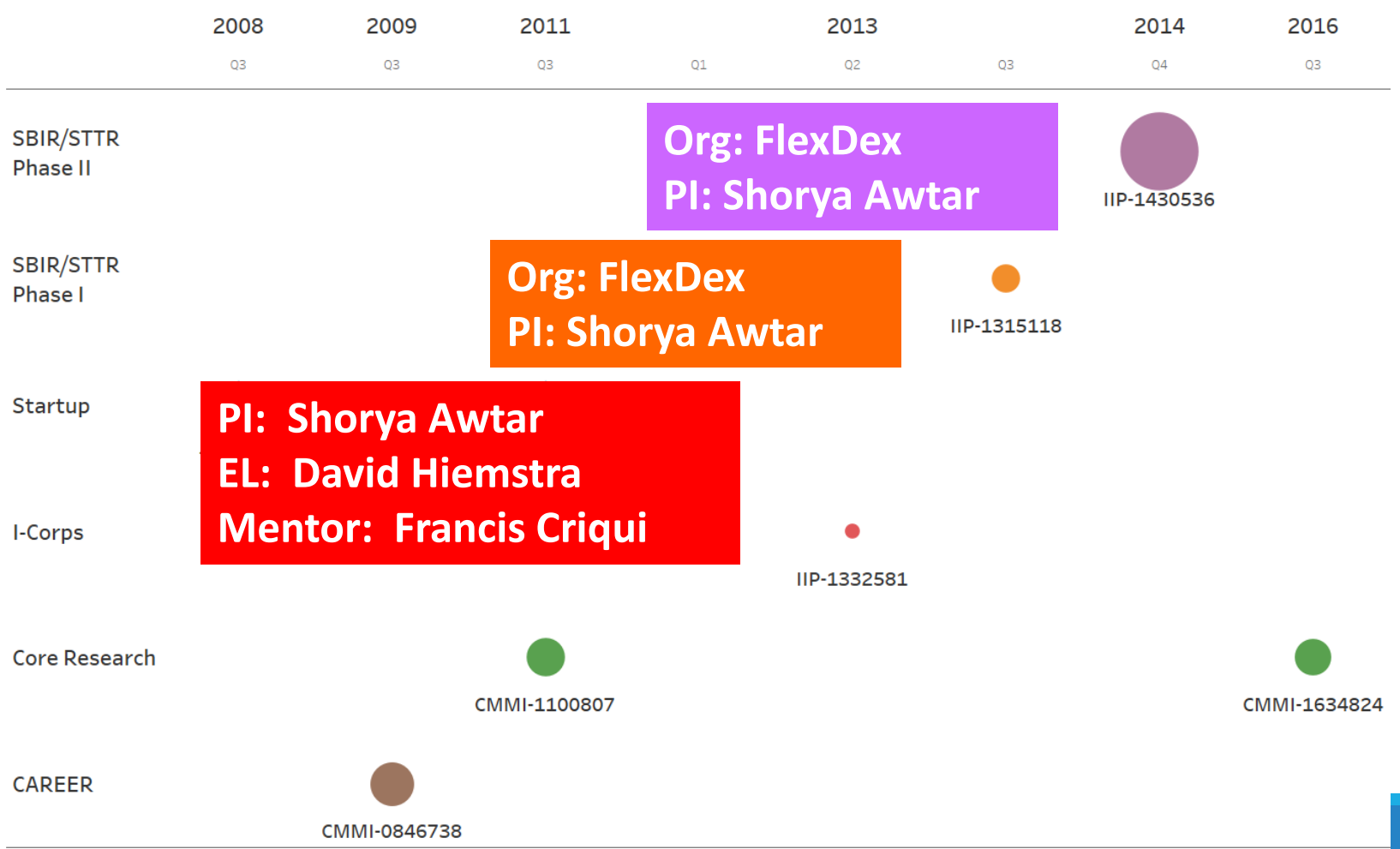
The technology, based on NSF-funded research, is being commercialized by small business FlexDex Surgical.

Image credit: FlexDex Surgical

NSF Lineage: Basic research to commercialization

Dr. Shorya Awtar
University of Michigan
Ann Arbor

FlexDex SURGICAL™



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/

ENG Challenges and Opportunities

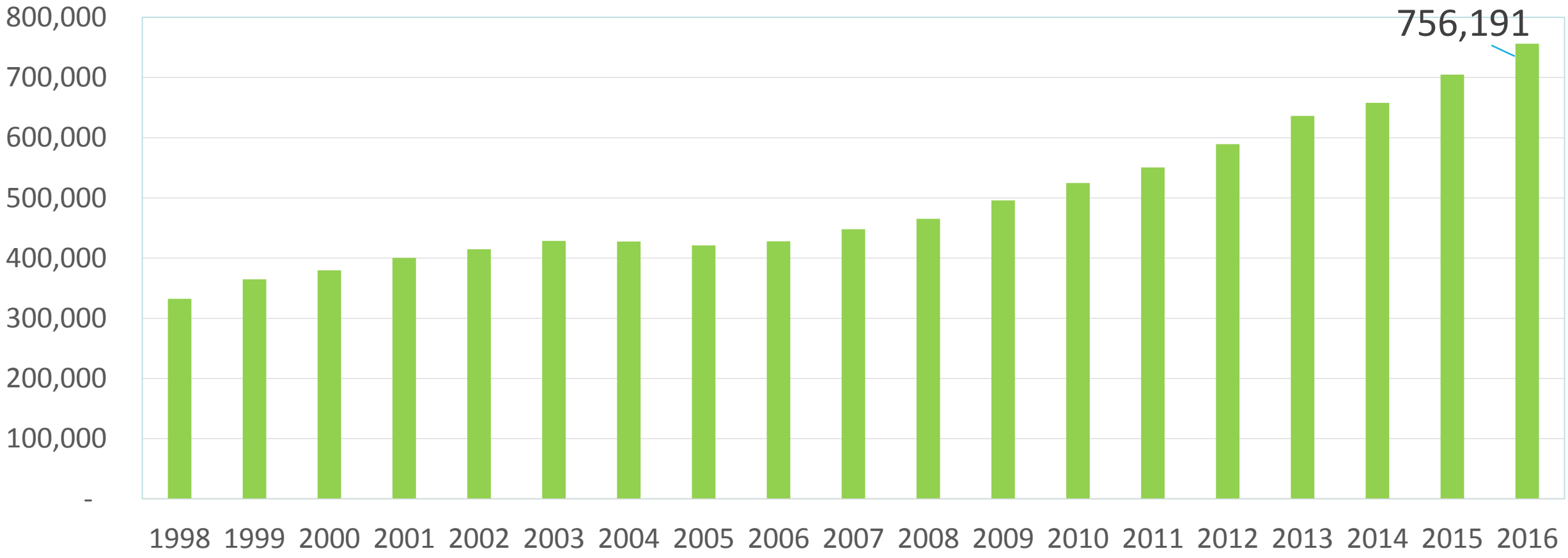
Strategic Challenges and Opportunities

Struggling with diversity and inclusion despite increasing enrollment; uneven distribution across engineering disciplines

- AP Engineering pilot
- NSF INCLUDES

Flat or decreasing budgets

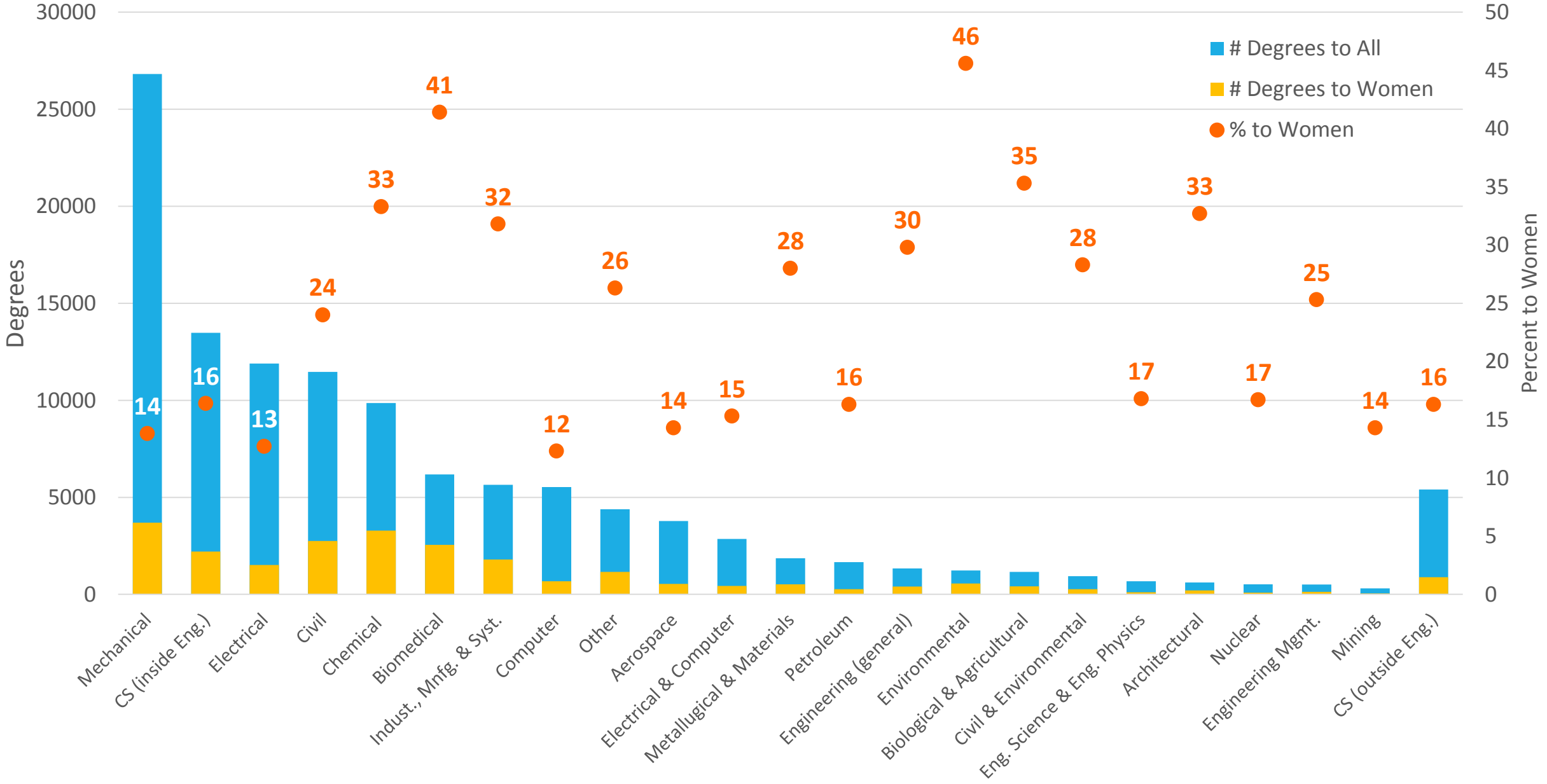
US Undergraduate Enrollment in Engineering



Data courtesy ASEE

Nearly 77% growth in 10 years!

Bachelor's Degrees by Engineering Discipline, 2015-2016



Data courtesy ASEE

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, National Academy of Engineering president, October 2013

Strategic Challenges and Opportunities

Struggling with diversity and inclusion despite increasing enrollment; uneven distribution across engineering disciplines

Flat or decreasing budgets

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