ASU IRA A. FULTON SCHOOLS OF
engineering
ARIZONA STATE UNIVERSITY

make. code. fly. build. design.
engineer.

**People**

83,301 students
   15,794 graduate students
   67,507 undergraduate students
≈12,000 faculty and staff
   ≈3,000 faculty

**Programs**

> 150 undergraduate majors
> 75 doctoral programs
$2+ billion total revenue,
$350M state support (<20%)

**Research**

$426.7M research expenditures in
FY2014; looking to grow to
$700M by 2020

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$350M state support (<20%)

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FY2014; looking to grow to
$700M by 2020

# engineering@asu

land ... systems
...te ...en...
integrated circuits
semiconductor devices and materials
sensors and control systems
communications and networks
wireless and mixed-signal circuits
electomagnetic fields and

flex...
...d di...
power grid management and stability
personalized learning
engineering education
K-12 STEM
electrical energy storage
thermal energy storage and conversion

si...la...ns
...at...sp...c... ...s
biof...
waste conversion to energy
public health–technology–environment interactions

connections between human health and micro-organisms

SM...
...t...
transportation materials and systems
project performance
underground infrastructure
medical devices and diagnostics
biosensors
molecular, cell and tissue

motor control
biomaterials and therapeutics delivery

synthetic and systems biology
imaging
nano/micro biodevices
lab-on-a-chip
predictive health analytics
computational biological

systems
personalized learning
educational gaming
energy-efficient data storage and computing
health informatics
haptic interfaces
assistive devices
healthcare system logistics
information assurance

## IRA A. FULTON SCHOOLS OF ENGINEERING

| School of Biological and Health Systems Engineering | School of Computing, Informatics, and Decision Systems Engineering | School of Electrical, Computer and Energy Engineering | School for Engineering of Matter, Transport and Energy | School of Sustainable Engineering and the Built Environment | The Polytechnic School |
|---|---|---|---|---|---|

### ENERGY | SECURITY | HEALTH | SUSTAINABILITY | EDUCATION

waves
signal and image processing
photovoltaics and solar energy
biosensors and bioelectronics
biosignatures discovery
automation

energy production separations
therapeutics and bioseparations
rehabilitation and robotics
adaptive and intelligent materials
high-performance computing

infrastructure and product life cycle analysis
earth systems engineering
water purification
resource-climate interactions
indoor air quality

engineering
regenerative medicine
human-machine interfaces
neuroscience
assistive and rehabilitative devices

engineering
bioengineering education research
bioinspired complex adaptive systems
nonlinear dynamics of biological

production logistics
artificial intelligence
transportation
production logistics
data mining

## affiliations with shared faculty/programs

Biomedical Informatics (College of Health Solutions)

Mary Lou Fulton Teachers College

School of Arts, Media and Engineering (Herberger Institute for Design and the Arts)

School of Earth and Space Exploration (College of Liberal Arts and Sciences)

School of Sustainability

W.P. Carey School of Buisness

## connections to pan-university transdisciplinary initiatives

Biodesign Institute

Center for Science and the Imagination

Consortium for Science, Policy and Outcomes

Edson Student Entrepreneur Initiative

Global Institute of Sustainability

Global Security Initiative

Learning Sciences Institute
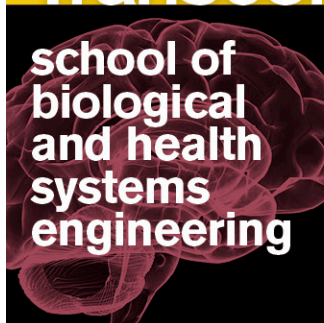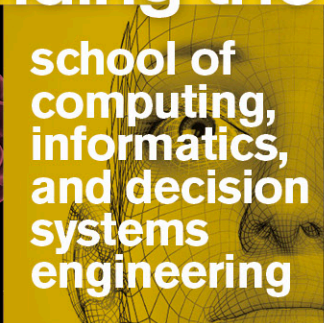
LightWorks

Lincoln Center for Applied Ethics

# IRA A. FULTON SCHOOLS OF
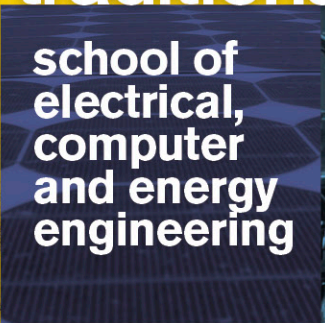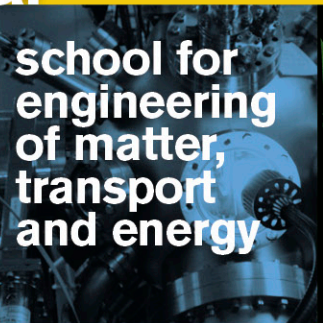# engineering
## ARIZONA STATE UNIVERSITY

**SCHOOL OF ARTS, MEDIA AND ENGINEERING** in *association with Herberger Institute for Design and the Arts*

**SCHOOL OF EARTH AND SPACE EXPLORATION** *in association with the College of Liberal Arts and Sciences*

**SCHOOL OF SUSTAINABILITY**

**TRANSDISCIPLINARY PARTNERS**

THE BIODESIGN INSTITUTE

GLOBAL INSTITUTE OF SUSTAINABILITY

GLOBAL SECURITY INITIATIVE

# Transcending the traditional

| school of biological and health systems engineering | school of computing, informatics, and decision systems engineering | school of electrical, computer and energy engineering | school for engineering of matter, transport and energy | school of sustainable engineering and the built environment | the polytechnic school |
|---|---|---|---|---|---|
| **1,065 students** 878 undergraduate 187 graduate | **4,328 students** 3,108 undergraduate 1,218 graduate | **2,490 students** 1,395 undergraduate 1,083 graduate | **3,532 students** 2,806 undergraduate 726 graduate | **1,391 students** 1,054 undergraduate 337 graduate | **3,412 students** 3,157 undergraduate 255 graduate |
| biomedical engineering<br><br>biological design | computer engineering<br>computer science<br>computer systems engineering<br>engineering management<br>industrial engineering<br>informatics<br>software engineering | electrical engineering<br>computer engineering | aerospace engineering<br>chemical engineering<br>materials science and engineering<br>mechanical engineering<br>solar energy engineering and commercialization | civil, environmental and sustainable engineering<br>construction engineering<br>construction management<br>sustainable engineering | aviation<br>human systems engineering<br>manufacturing engineering<br>environmental and resource management<br>graphic information technology<br>information technology<br>technological entrepreneurship and management |

**24 undergraduate programs ▪ 30 graduate programs ▪ two campuses**

## engineering.asu.edu

# new faculty, new ideas, more capacity

## 2012

Spring Berman, Ph.D., University of Pennsylvania
Mariana Bertoni, Ph.D., Northwestern University
Dan Bliss, Ph.D., University of California, San Diego
Srabanti Chowdhury, Ph.D., University of California, Santa Barbara
Scotty Craig, Ph.D., University of Memphis
Mounir El Asmar, Ph.D., University of Wisconsin-Madison
Ashraf Gaffar, Ph.D., Concordia University
David Grau, Ph.D., University of Texas–Austin
Zachary Holman, Ph.D., University of Minnesota
Yang Jiao, Ph.D., Princeton University
Jennifer Kitchen, Ph.D., Arizona State University
Oliver Kosut, Ph.D., Cornell University
Jeffrey La Belle, Ph.D., Arizona State University
Micah Lande, Ph.D., Stanford University
Amy Landis, Ph.D., University of Illinois-Chicago
Yongming Liu, Ph.D., Vanderbilt University
Abdel Mayyas, Ph.D., Clemson University
Kristen Parrish, Ph.D., University of California-Berkeley
Matthew Peet, Ph.D., Stanford University
Yulia Peet, Ph.D., Stanford University
Yueming Qiu, Ph.D., Stanford University
T. Agami Reddy, PhD, University of Perpignan, France
Soroush Saghafian, Ph.D., University of Michigan
Lalitha Sankar, Ph.D., Rutgers University
Angela Sodemann, Ph.D., Georgia Institute of Technology
Sohun Sohoni, Ph.D., University of Cincinnati
Hyunjin Song, Ph.D., University of Michigan
Pingbo Tang, Ph.D., Carnegie Mellon University
Shane Underwood, Ph.D., North Carolina State University
Erin Walker, Ph.D., Carnegie Mellon University
Liping Wang, Ph.D., Georgia Institute of Technology
Carole-Jean Wu, Ph.D., Princeton University
Lei Ying, Ph.D., University of Illinois at Urbana-Champaign

## 2013

Visar Berisha, Ph.D., Arizona State University
Wai "Oswald" Chong, Ph.D., University of Texas–Austin
Bradley Greger, Ph.D., Washington University, St. Louis
Ximin He, Ph.D., University of Cambridge
Keng Hao Hsu, Ph.D., University of Illinois
Nathan Johnson, Ph.D., Iowa State University
Yingyan Lou, Ph.D., University of Florida
Bin Mu, Ph.D., Georgia Institute of Technology
Mehdi Nikkhah, Ph.D., Virginia Polytechnic Institute and State University
Umit Ogras, Ph.D., Carnegie Mellon University
Greg Raupp, Ph.D., University of Wisconsin, Madison
Rod Roscoe, Ph.D., University of Pittsburgh
Konrad Rykaczewski, Ph.D., Georgia Institute of Technology
Rosalind Sadleir, Ph.D., University of Western Australia
Jae-sun Seo, Ph.D., University of Michigan
Shimeng Yu, Ph.D., Stanford University
Xuesong Zhou, Ph.D., University of Maryland

## we will hire 300 new faculty over the next 10 years

## 2014

Steven Ayer, Ph.D., Penn State
David Brafman, Ph.D., University of California-San Diego
John Brunhaver II, Ph.D., Stanford University
Samantha Brunhaver, Ph.D., Stanford University
Adam Doupé, Ph.D., University of California, Santa Barbara
Heather Emady, Ph.D., Purdue University
Emma Frow, Ph.D., Cambridge University
Robert David Gray, Ph.D., York University, Toronto
Matthew Green, Ph.D., Virginia Polytechnic Institute and State University
Jingrui He, Ph.D., Carnegie Mellon University
Owen Hildreth, Ph.D., Georgia Institute of Technology
Claire Honeycutt, Ph.D., Georgia Institute of Technology
Sharon Hsiao, Ph.D., University of Pittsburgh
Jaewon Jang, Ph.D., Georgia Institute of Technology
Nadia Kellam, Ph.D., University of South Carolina
Richard Kiehl, Ph.D., Purdue University
Klaus S. Lackner, PhD, Heidelberg University, Germany
Thurmon Lockhart, Ph.D., Texas Tech
Fengbo Ren, Ph.D., UCLA
Yi Ren, Ph.D., University of Michigan
Mohamed Sarwat, Ph.D., University of Minnesota
Anna Scaglione, Ph.D., Sapienza–Università di Roma
Paulo Shakarian, Ph.D.., University of Maryland, College Park
Barbara Smith, Ph.D., Colorado State University
William "Jamie" Tyler, Ph.D., University of Alabama-Birmingham
Hanghang Tong, Ph.D., Carnegie Mellon University
Sefaattin Tongay, Ph.D., University of Florida
Qing Hua Wang, Ph.D., Northwestern University
Yu Yao, Ph.D., Princeton University
Yuji Zhao, Ph.D., University of California, Santa Barbara

# focused on student success



## 16,799 +24%
fall 2014 enrollment

## 2,542
first-time freshmen +17%

## 90% retention at the university

### engineering freshmen and retention
**freshmen**



Bar chart with y-axis values: 325, 650, 975, 1300, 1625, 1950, 2275, 2600

Bar labels: 83%, 87%, 85%, 87%, 88%, 85%, 86%, 89%, 90%
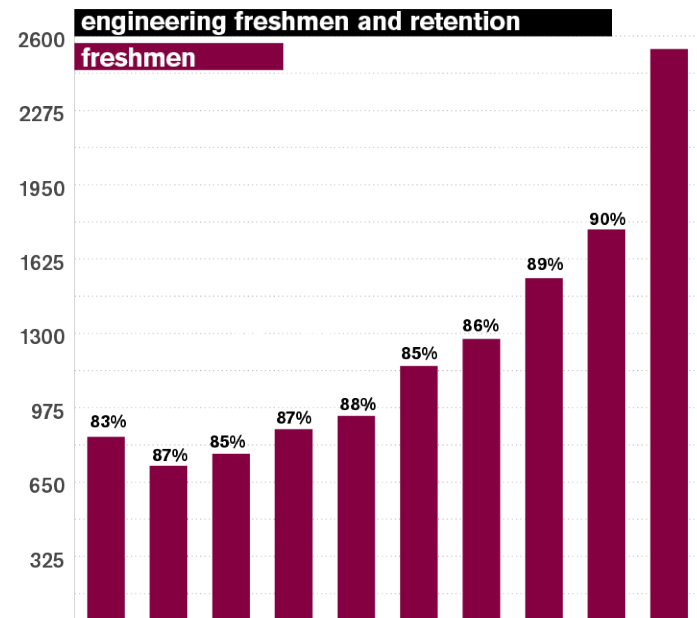
# use-inspired research



**$96M** FY2014
research awards

**$85.3M** FY2014
research expenditures

**304** faculty

**1,000+**
students
conducting
research

**152** invention
disclosures

### invention disclosures



| FY | Value |
|---|---|
| FY2010 | 59 |
| FY2011 | 71 |
| FY2012 | 101 |
| FY2013 | 118 |
| FY2014 | 152 |

# successfully competing for national research awards

**QESST ERC NSF/DOE Engineering Research Center (MIT, CalTech, others)**

**Flexible Display Center U.S. Army University Center**

**Five I/UCRCs: PSERC, Center for Embedded Systems, WET, Connection One, SenSIP**

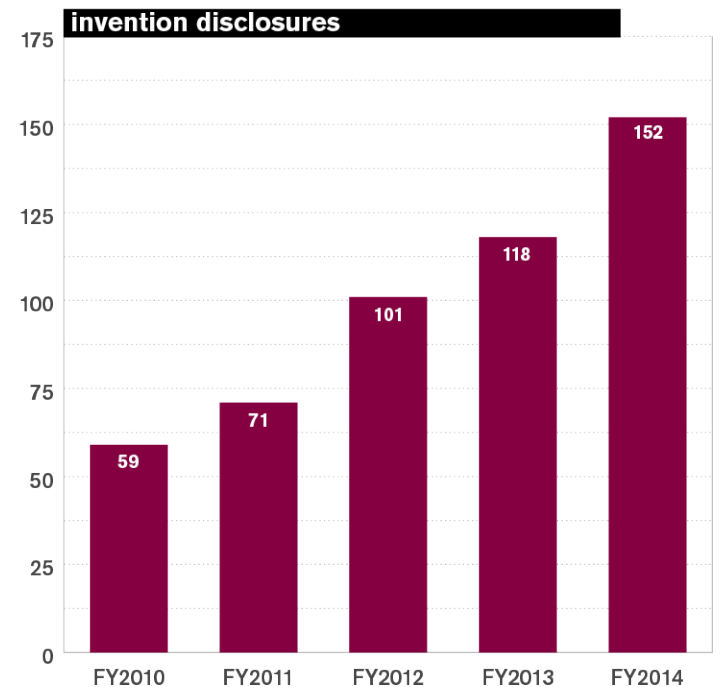**IGERTs:** Person Centered Technologies and Practices for Individuals with Disabilities and Solar Utilization Network

**Four current MURI awards; eight total since FY2005**

**Higher Engineering Education Alliance Program (Intel, Siemens)** $20M cash and more than $50M in-kind donations by academic-government-industry alliance partners

**68** NSF CAREER Award Recipients

**Quantum Energy and Sustainable Solar Technologies**
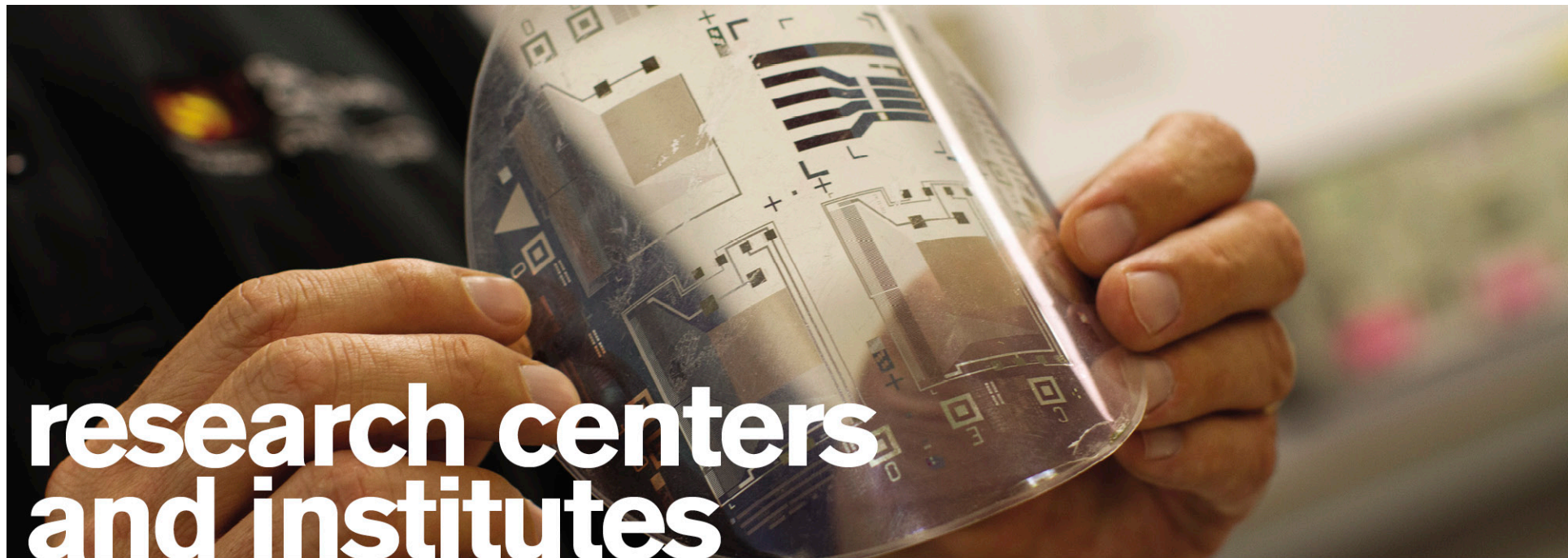
QESST

# research centers and institutes

**NSF-DOE Engineering Research Center (ERC)**

Quantum Energy and Sustainable Solar Technologies (QESST)

**NSF Industry/University Cooperative Research Centers (I/UCRCs)**

Center for Embedded Systems

Connection One

Power Systems Engineering Research Center

Sensor, Signal and Information Processing Center

Water and Environmental Technology Center

Adaptive, Intelligent, Materials and Systems (AIMS)

Advanced Technology Innovation Center

Algae Testbed Public-Private Partnership (ATP3)

Arizona Center for Algae Technology and Innovation (AzCATI)

Arizona Initiative for Renewable Energy

Arizona Institute for Nano-Electronics

ASU Advanced Photovoltaics Center

Center for Adaptive Neural Systems

Center for Applied Nanoionics

Center for Biolelectronics and Biosensors

Center for Biosignature Discovery Automation

Center for Cognitive Ubiquitous Computing (CUbiC)

Center for Computational Nanoscience

Center for Earth Systems Engineering and Management

Center for Environmental Fluid Dynamics

Center for Environmental Security

Center for Negative Carbon Emissions

Center for Photonics Innovation

Center for Renewable Energy Electrochemistry

Center for Research on Education in Science, Mathematics, Engineering and Technology

Center for Science and the Imagination

Center for Solid State Electronics Research

Center for Sustainable Health

Construction Research and Education for Advanced Technology Environments

Decision Theater

Flexible Display Center

Global Security Initiative

Information Assurance Center

LeRoy Eyring Center for Solid State Science

Lincoln Center for Applied Ethics

National Center of Excellence on SMART innovations

Partnership for Research in Spatial Modeling

Swette Center for Environmental Biotechnology

# school of
# **biological** and **health systems engineering**

neural engineering and
    neurorehabilitation
molecular, cellular and tissue
    bioengineering
synthetic biology
biosensors and biomarkers
medical diagnostics

# school of
# **computing, informatics,** and **decision systems engineering**

personalized learning systems:
intelligent tutors, educational games,
natural language processing

new computing paradigms (beyond
CMOS)

data analytics (logistics, healthcare)

fully networked existence: social
computing, cyberphysical and
embedded systems, ubiquitous
computing

school of **electrical, computer** and **energy engineering**

**Quantum Energy and Sustainable Solar Technologies**

$18.5M grant from NSF and DoE

An eight-university consortium

The only Engineering Research Center focused on photovoltaics

# school of
# **sustainable engineering** and the
# **built environment**

constructional management and engineering

transportation systems
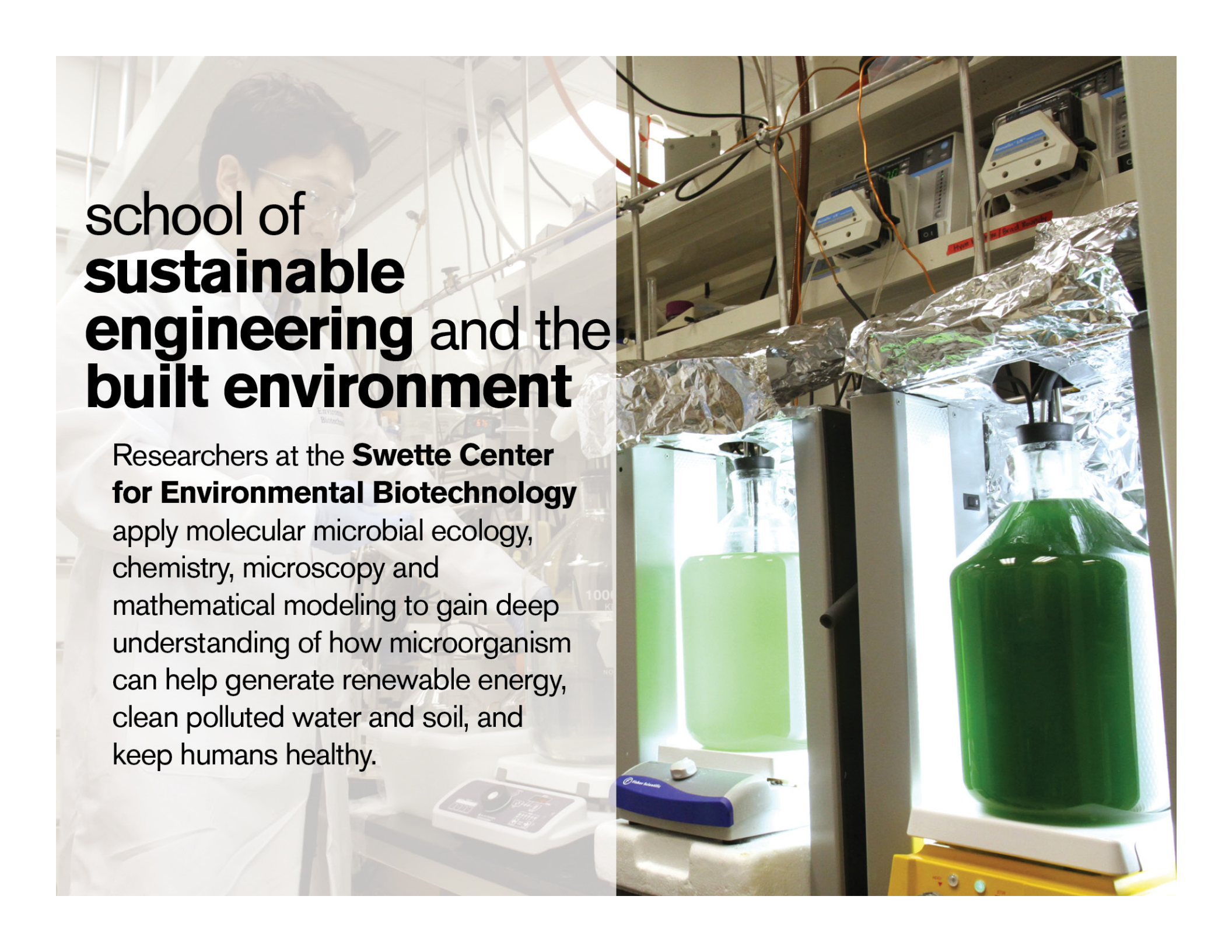
energy systems

sustainable engineering

sustainable materials and structural systems

sustainable systems

# school of
# **sustainable**
# **engineering** and the
# **built environment**

Researchers at the **Swette Center for Environmental Biotechnology** apply molecular microbial ecology, chemistry, microscopy and mathematical modeling to gain deep understanding of how microorganism can help generate renewable energy, clean polluted water and soil, and keep humans healthy.

school for
**engineering of matter, transport** and **energy**

adaptive materials and structures
integrated energy storage systems
flexible systems and sensors
new materials design and mechanics
membranes for energy and water
   applications
robotics
solar/thermal energy systems
therapeutics and diagnostics

# the polytechnic school

## Growth

### Proposals
In 2010, 64% of faculty submitted research proposals

In 2013, 86% of faculty submitted research proposals

### Total research awards
In 2010, research awards totaled $7.8M

In 2013, research awards totaled $10.1M

## Featured project
The Vocational Training and Education for Clean Energy (VOCTEC) program is lead by the Polytechnic School and funded by a $10.1M research grant from the United States Agency for International Development (USAID). VOCTEC helps improve the sustainability of renewable energy investments and infrastructure in the Pacific region by increasing local awareness, knowledge and capacity in clean energy.
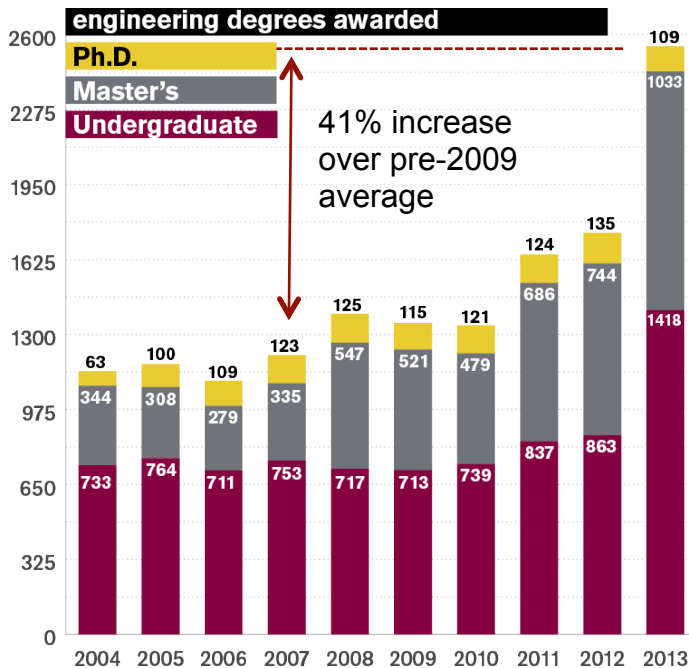
# assignment: more engineers + increase student success

## total fulton schools enrollment

- ph.d.
- master's
- undergraduate
- other

77% increase (2008-14)

| Year | ph.d. | master's | undergraduate | other |
|------|-------|----------|---------------|-------|
| 2007 | 138 | 1,662 | 5,063 | 763 |
| 2008 | 170 | 1,728 | 5,350 | 758 |
| 2009 | 204 | 1,633 | 5,714 | 812 |
| 2010 | 196 | 1,801 | 6,447 | 808 |
| 2011 | 193 | 2,079 | 7,203 | 835 |
| 2012 | 182 | 2,255 | 8,345 | 854 |
| 2013 | 264 | 2,701 | 9,886 | 918 |
| 2014 | 196 | 3,003 | 12,398 | 999 |

## engineering freshmen and retention

freshmen

100% increase in FTFT freshman (2008-13)

Retention increased from average of 85% (pre-2009) to 90% in 2014

*Note: 2020 goal is 15,000 total students in the Fulton Schools of Engineering*

| Year | Retention |
|------|-----------|
| 2005 | 83% |
| 2006 | 87% |
| 2007 | 85% |
| 2008 | 87% |
| 2009 | 88% |
| 2010 | 85% |
| 2011 | 86% |
| 2012 | 89% |
| 2013 | 90% |
| 2014 | |

## engineering degrees awarded

- Ph.D.
- Master's
- Undergraduate

41% increase over pre-2009 average

| Year | Ph.D. | Master's | Undergraduate |
|------|-------|----------|---------------|
| 2004 | 63 | 344 | 733 |
| 2005 | 100 | 308 | 764 |
| 2006 | 109 | 279 | 711 |
| 2007 | 123 | 335 | 753 |
| 2008 | 125 | 547 | 717 |
| 2009 | 115 | 521 | 713 |
| 2010 | 121 | 479 | 739 |
| 2011 | 124 | 686 | 837 |
| 2012 | 135 | 744 | 863 |
| 2013 | 109 | 1033 | 1418 |

## Graduation Rates

| FTFT Freshmen | Fall 2003 | Fall 2004 | Fall 2005 | Fall 2006 | Fall 2007 | Fall 2008 | Fall 2009 | |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---|
| Total entering class | 794 | 765 | 806 | 684 | 720 | 825 | 890 | |
| 4-year graduation rate in Engineering | 12% | 18% | 16% | 25% | 26% | 31% | 32% | +167% |
| 4-year graduation rate at university | 20% | 24% | 23% | 37% | 37% | 40% | 43% | +115% |
| 5-year graduation rate in Engineering | 29% | 34% | 33% | 39% | 39% | 42% | 45% | |
| 5-year graduation rate at university | 47% | 48% | 49% | 58% | 58% | 60% | 62% | |
| 6-year graduation rate in Engineering | 34% | 38% | 38% | 42% | 42% | 46% | | |
| 6-year graduation rate at university | 56% | 56% | 58% | 65% | 64% | 66% | | |

# assignment: increase research impact

## 152 FY2014 invention disclosures

**29%** increase over FY 2013
5-year growth: 158%

## 56%* of
Fulton Engineering faculty filed invention disclosures in FY13

## 42% filed
multiple invention disclosuresin FY13

*Benchmark: In a study of 3,000+ scientists and engineers spanning 17 years, 35.8% disclosed an invention (Thursby and Thursby, 2003)

## 26 issued U.S. patents
FY2014
**266%** increase over FY2010

## 83 patents 23 startups
FY2010-2014

## 20 young investigator awards
FY 2014 and 2015 to date

Note: 2020 research expenditure goal is $150M
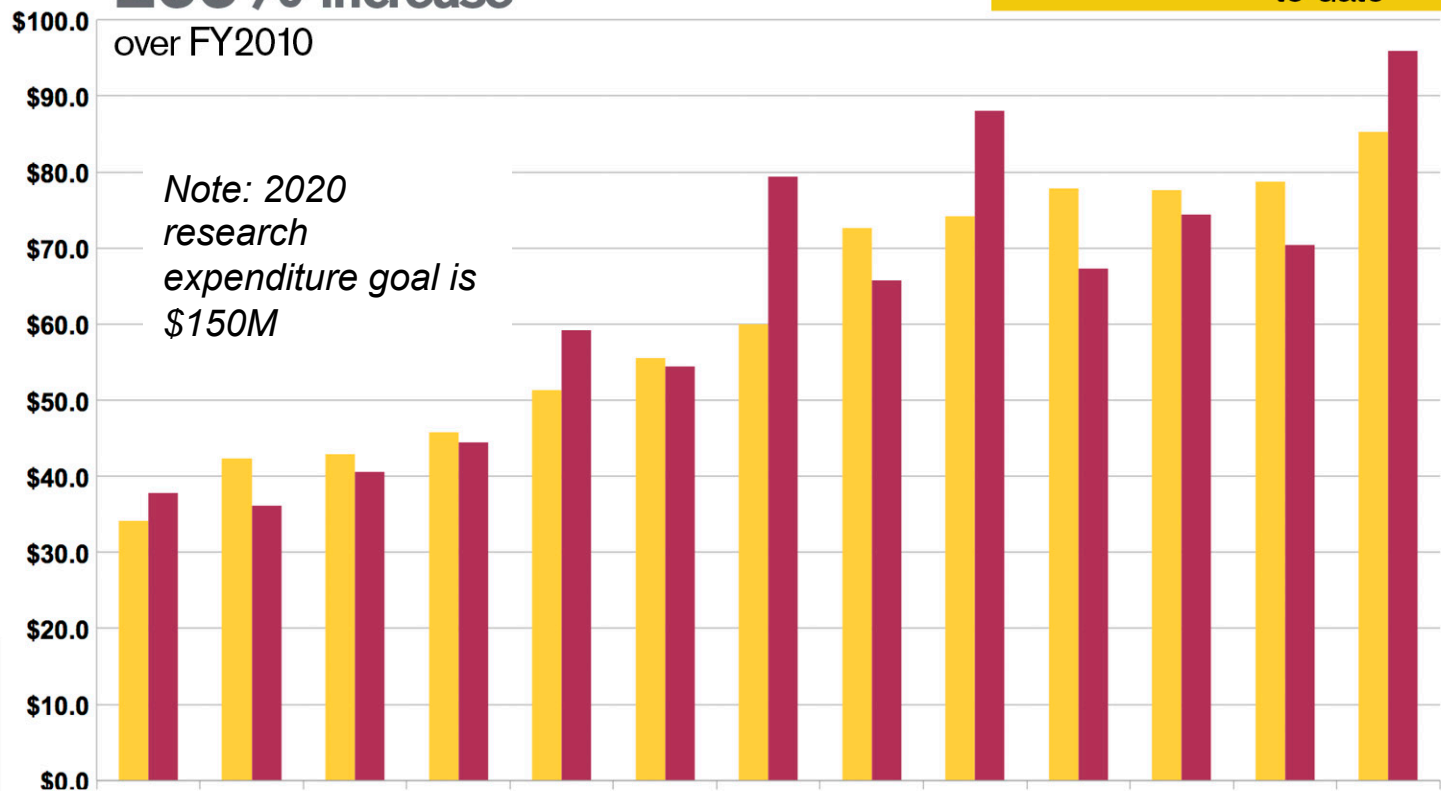


| | $34.2 | $42.3 | $42.9 | $45.8 | $51.3 | $55.5 | $60.0 | $72.6 | $74.2 | $77.9 | $77.6 | $79.7 | $85.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Research Expenditures in millions | $34.2 | $42.3 | $42.9 | $45.8 | $51.3 | $55.5 | $60.0 | $72.6 | $74.2 | $77.9 | $77.6 | $79.7 | $85.3 |
| Research Awards in millions | $37.8 | $36.1 | $40.6 | $44.5 | $59.2 | $54.4 | $79.4 | $65.8 | $88.0 | $67.3 | $74.4 | $70.4 | $95.9 |
| Tenured/Tenure-Track Faculty | 203 | 196 | 192 | 199 | 196 | 208 | 207 | 207 | 212 | 209 | 220 | 231 | 304 |
| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |

**Kyle Squires**
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**School Director and Professor**
School for Engineering of Matter,
Transport and Energy
**squires@asu.edu**
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# Yong-Hang Zhang

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Ira A. Fulton Schools of Engineering
**Professor,** School of Electrical,
Computer and Energy Engineering

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