



THE UNIVERSITY OF  
**TENNESSEE**  
KNOXVILLE

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OFFICE OF RESEARCH &  
ENGAGEMENT

# **ANNUAL REPORT** 2016

## LETTER FROM THE INTERIM VICE CHANCELLOR FOR RESEARCH AND ENGAGEMENT



The Office of Research and Engagement's fiscal year 2016 data reveals an increasingly competitive world for federal funding. Despite this, our work with the National Science Foundation and the Department of Energy remains strong, and we continue to grow our National Institutes of Health and Department of Defense portfolios. There are many efforts under way to expand our funding base, some

of which are highlighted in the "What We Do Well" section of this report.

At the heart of all we do are the students. At the University of Tennessee, Knoxville, we have an active community of undergraduate researchers that has shown exponential growth since FY2014. This year, we celebrated the 20th anniversary of the Exhibition of Undergraduate Research and Creative Achievement (EURēCA) with 247 poster presentations from departments across campus.

More eyes are turning to UT and East Tennessee for innovations in advanced manufacturing and materials research. Appointments made through the UT-Oak Ridge National Laboratory Governor's Chairs program in the areas of advanced manufacturing and advanced materials indicate the university's commitment to becoming a powerhouse in these fields.

Our faculty and staff competed successfully for \$154 million in externally sponsored research awards in FY2016, up 3.1 percent from FY2015. This \$4.8 million increase continues a three-year growth pattern that we foresee extending into FY2017. Also continuing to trend upward was the average total amount received per award, which increased from \$165,000 in FY2015 to \$169,000 in FY2016.

Looking ahead, we continue to contemplate strategic opportunities and diversify our sources of funding. We look forward to the exciting research discoveries that lie ahead.

**Robert Nobles II, DrPH, MPH, CIP**  
Interim Vice Chancellor for Research and Engagement

## FY16 AT A GLANCE

### FACTS & FIGURES

TOTAL RESEARCH EXPENDITURES

**\$154,428,220**

SPONSORED PROJECT EXPENDITURES

■ NONFEDERAL

**\$56,551,119**

■ FEDERAL

**\$97,877,101**



## NEWS OF NOTE

**Robert Grzywacz**, director of the **UT-ORNL Joint Institute for Nuclear Physics and Applications** and a physics professor at UT, helped develop a process that measures the decay of nuclear materials down to one millionth of a second, which was vital in proving the existence of four new super-heavy elements.

UT hosted the **Southeast Regional Energy Innovation Workshop**, a gathering of representatives from universities, industry, and federal agencies, along with elected officials, with a goal to advance clean energy technology innovation in the region.

The **College of Engineering** developed a graduate-level automotive engineering concentration that will begin in fall 2016. The coursework will span several departments. It is a move toward workforce preparation and is in response to the major role that the automotive industry is playing in Tennessee.

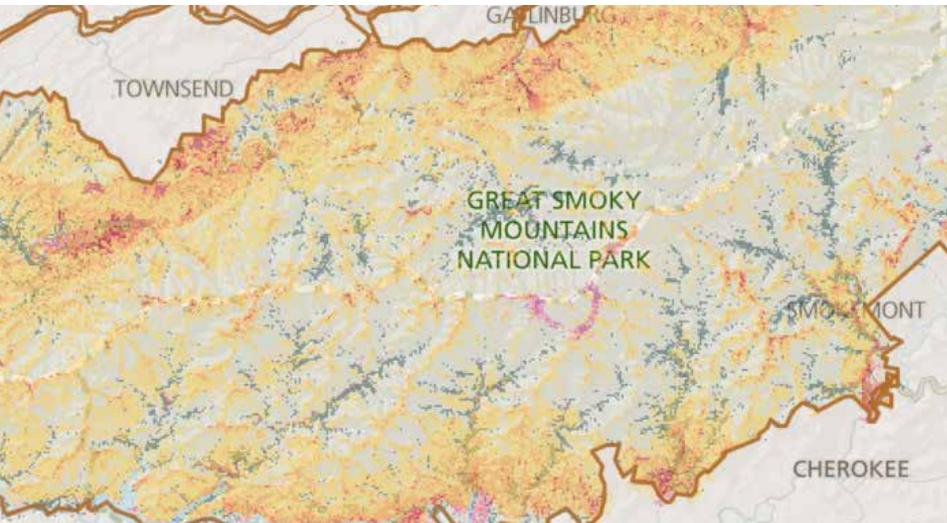
A study from UT's **Forensic Anthropology Center** has called into question forensic results based on animal models. The study shows that decomposition rates, insect activity, and scavenger activity vary greatly between human and nonhuman subjects.

A study led by the **UT Goodrich Chair of Excellence Thanos Papanicolaou** shed new light on theories surrounding the 1940s-era Dust Bowl. The study showed that soil quality actually continued to decline until the 1980s and even now isn't back to the level it was in the mid-1930s.

## WHERE WE EXCEL

### THE FUSION OF BIG DATA AND LARGE-SCALE COMPUTING

The amount of data and the rate at which it is generated by both humans and machines are unprecedented. Challenges in storage, management, and analysis of large-scale data have critical impact on business intelligence, scientific discovery, social, and environmental challenges.



This fiscal year, the **Department of Electrical Engineering and Computer Science** and the **School of Art** created a web application called Species Mapper for the Great Smoky Mountains National Park Inventory and Monitoring Branch.

Species Mapper uses locations where species have been found to help predict additional places they may occur in the park. These predictions, or models, are based on observations made during ongoing resource monitoring as well as research studies conducted by scientists from all over the world.

This project utilizes supercomputers at the **UT-ORNL Joint Institute for Computational Sciences** to analyze the location of observations as well as the characteristics of the environment such as slope, forest type, geology, elevation, temperature, and sun exposure. UT's **National Institute for Mathematical and Biological Synthesis** also helped to guide the team on the ecological analysis of the data and the models. The result of the model is a reliable distribution of where each species lives in the park.

## ALL EYES ON UT FOR MATERIALS SCIENCE AND ADVANCED MANUFACTURING RESEARCH

UT and East Tennessee are receiving recognition for excellence in advanced manufacturing research. Not only are our faculty and students leading the industry with advances in the field, but our collaborations with Oak Ridge National Laboratory have brought worldwide attention to the innovative techniques developed here.

In addition to the seven **UT-ORNL Governor's Chairs** focused specifically in the areas of advanced manufacturing and advanced materials, the university leads the Institute for Advanced Composites Manufacturing Innovation (IACMI), a National Network for Manufacturing Innovation (NNMI), and plays a role in three others.

In August 2015, Secretary of Commerce Penny Pritzker visited the Department of Energy's Manufacturing Demonstration Facility as part of a tour of IACMI and other institutes that make up the NNMI. Chancellor Jimmy G. Cheek, UT scientists, and industry and government leaders discussed the importance of sharing knowledge so breakthroughs can happen.

As our scientists develop the building blocks for tomorrow's devices and technologies, their discoveries will transform fields as wide ranging as energy production, computing and information technologies, and transportation systems.

## ENERGY SCIENCE AND ENGINEERING WORKING ON EFFICIENT AND CLEAN SOLAR POWER

The field of energy science focuses on developing or refining technologies for efficient and clean energy conversion and utilization, facing the challenge of rising energy demands and prices while simultaneously addressing the accompanying environmental impact.

The **College of Engineering** was awarded a \$2.3 million, 36-month project through the SunShot Initiative, which aims to reduce the total costs of photovoltaic solar energy systems by about 75 percent before the end of the decade. Doing so would make the cost of photovoltaic power competitive at large scale with other forms of energy without subsidies.

**Yong Liu**, research assistant professor of electrical engineering and computer science, said UT's study will look at problems inherent to current photovoltaic power generation, its effect on the US power grid frequency stability, and how to mitigate its effect in order to avoid large blackouts.

The **Bredesen Center for Interdisciplinary Research and Graduate Education**, UT's fastest-growing doctoral program, draws some of the nation's leading scholars to study energy science and engineering. Key to this interdisciplinary program are the diverse research disciplines represented by UT faculty and researchers from ORNL.



**Mallory Ladd**, doctoral candidate and National Science Foundation (NSF) Graduate Research Fellow in Energy Science and Engineering at the Bredesen Center, is focusing her doctoral dissertation work on carbon storage in arctic ecosystems.

## AT THE INTERSECTION BIOLOGY AND MATHEMATICS IS A SOLUTION

The **National Institute for Mathematical and Biological Synthesis (NIMBioS)**, an NSF Synthesis Center at UT, fosters new collaborative efforts to investigate biological questions using mathematical and computational methods. Since the program began in 2009, more than 6,000 scientists and experts from more than 50 countries have participated in scientific collaborative activities. The institute has contributed to investigating questions of direct public policy concern,



particularly the analysis of the potential spread, impact, and control of infectious diseases of zoonotic origin, including West Nile virus, anthrax, swine flu, and mad cow disease.

This year, researchers at NIMBioS published a study finding that developing shale gas wells that have less impact on the environment, at least at the surface, is not as costly as presumed.

The institute also uses this unique approach to study aspects of human culture and society. Last fall, researchers examined patterns in small-scale mammalian societies, including humans and other social mammals, to learn what qualities make a good leader. They found that there were more similarities than previously thought in the leadership methods between humans and nonhumans.

## THE ROLE OF SOCIAL SCIENCE IN THE 2016 ELECTION

As the nation approaches the 2016 presidential election, social scientists have taken center stage. Researchers in anthropology, sociology, communications, political science, history, and law work to explain issues such as the reasoning behind why we vote the way we do, how social media (or media in general) impacts how we think about candidates, and what the rest of the world thinks about the presidential candidates and election process.

**Dan Feller**, a professor in the **Department of History**, was interviewed by National Public Radio's *On the Media* podcast regarding how the

election of 1824 and the alleged corrupt bargain that decided it laid the groundwork for our modern two-party system and the notion that the people, not the politicians, should get to pick the president.

**Richard Pacelle**, head of the **Department of Political Science**, discussed the divergent voting populations that the Democratic and Republican candidates will rely upon in the coming election. Analyzing which voters the candidates will pursue and what tactics they will use to engage with these populations lends greater insight into the personalities of each. In this election, Pacelle said, citizens know more about the candidates' personalities than they do the issues.

## INVENTORS AND ENTREPRENEURS

**Peroxygen Systems Inc.** won the 2016 Tennessee Venture Challenge, a business plan competition hosted by the University of Tennessee Research Foundation (UTRF) and geared specifically toward start-up companies commercializing intellectual property created at a UT campus or institute.



Ming Qi of Peroxygen Systems received \$20,000 from UTRF.

Peroxygen Systems is changing the cumbersome hydrogen peroxide production and delivery process, making it not only energy efficient but cost effective. Hydrogen peroxide is used for its oxidizing properties, working as a bleaching agent and as a disinfectant against bacteria, viruses, spores, and yeasts.

**Yilu Liu**, the UT-ORNL Governor's Chair for Power Electronics, was named a member of the National Academy of Engineering in February 2016.



Being elected to the academy is among the highest professional distinctions accorded to an engineer. Lui serves as deputy director of the NSF-backed Center for Ultra-wide-area Resilient Electric Energy Transmission Networks (CURENT), which is housed in UT's College of Engineering. She was elected "for her innovations in electric power grid monitoring, situational awareness, and dynamic modeling," according to the NAE.

In December, Liu was also inducted to the National Academy of Inventors (NAI), which noted that she was selected for demonstrating a spirit of innovation and for the impact her efforts have made on everyday life.

Through her role with CURENT, as a researcher, and as a professor of electrical engineering and computer science at UT, Liu has helped pioneer many of the advancements in the safeguarding of the nation's power grid.



**Doug Birdwell**, professor emeritus of electrical engineering and computer science, was named a fellow of the NAI in December 2015.

Birdwell's research into computing and information systems has spanned the era from their initial surge in the 1970s through their universal adoption today.

Birdwell said he suspects the award comes for his work on high-performance databases.

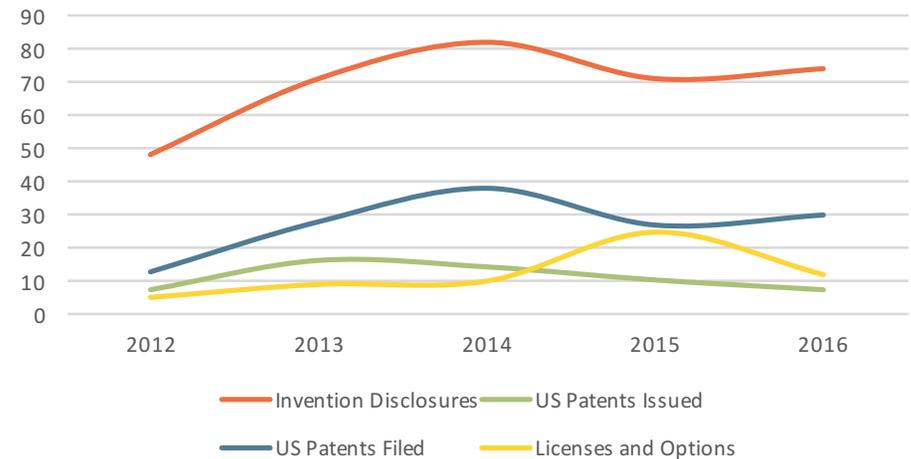
"Those resources are for data derived from DNA and their utility in human identification, both using direct search and search via family relationships," he said.

Because of that work Birdwell has become a well-known figure in the field, having published more than 100 papers and led millions of dollars of research.

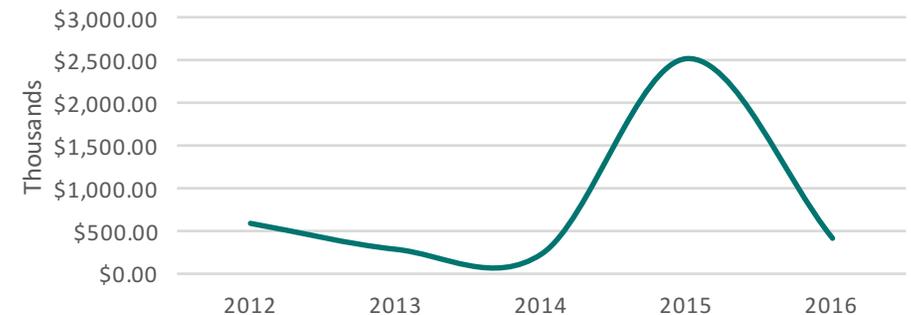
## DATA SUMMARY

Data for this report includes research expenditures from UT Knoxville and the UT Space Institute during fiscal year 2016 as reported to the National Science Foundation. The research expenditures listed in Vol Vision 2020 reflect the Knoxville area, to include the UT Institute of Agriculture. This data is based on data published by NSF, typically from two years prior. The data for this report was run on April 10, 2016.

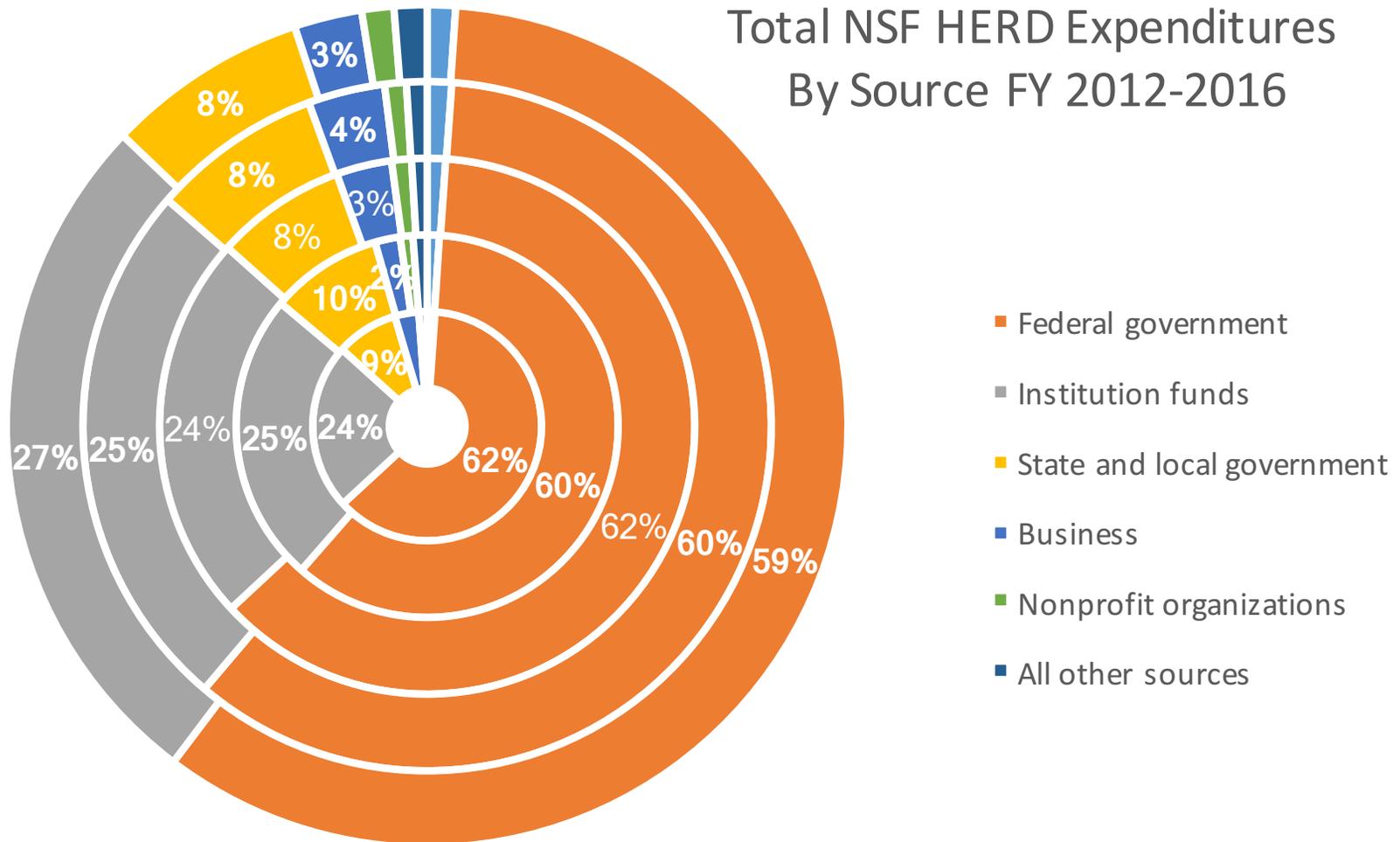
### Technology Transfer



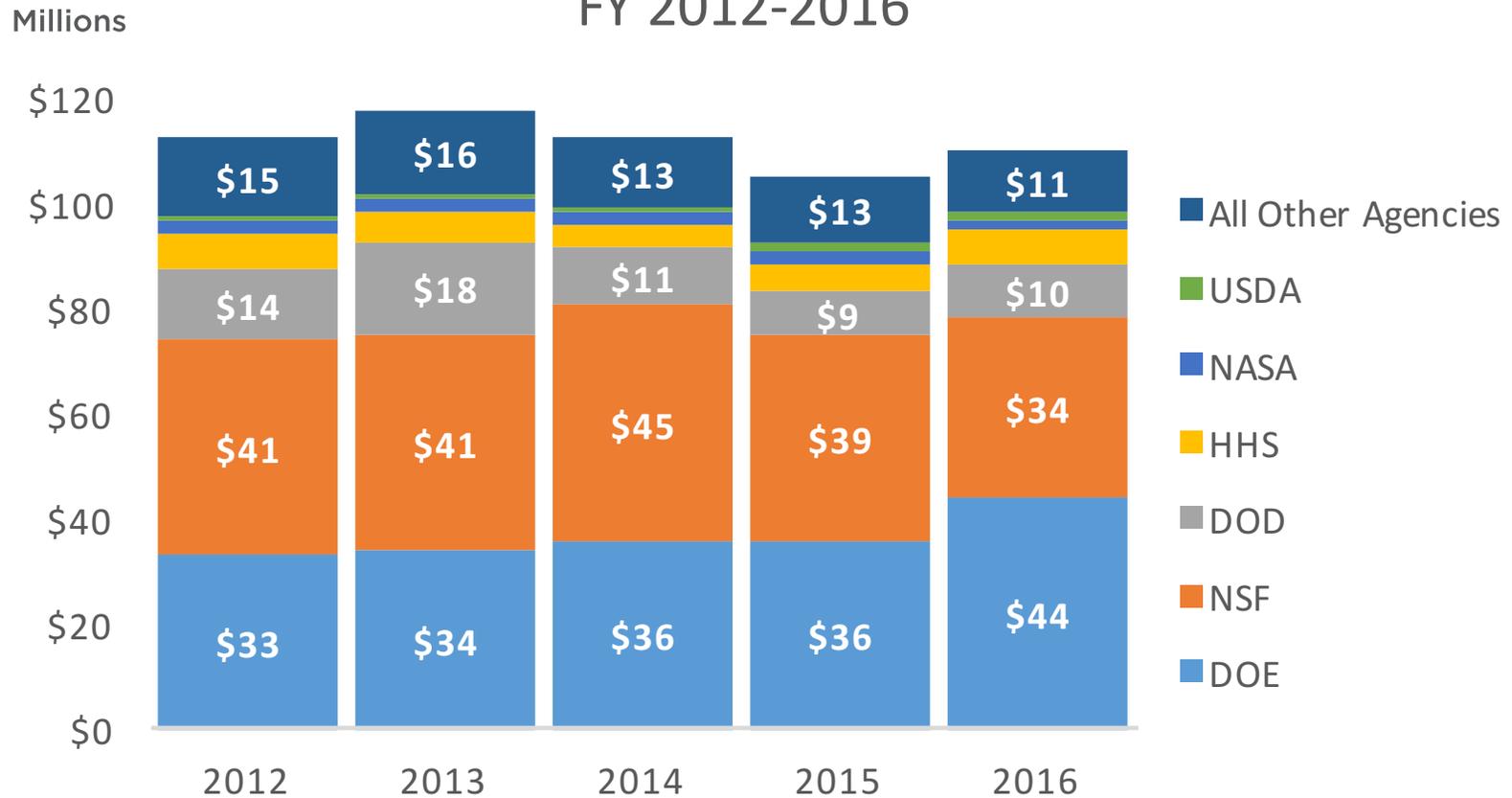
### Revenue



Total NSF HERD Expenditures  
By Source FY 2012-2016

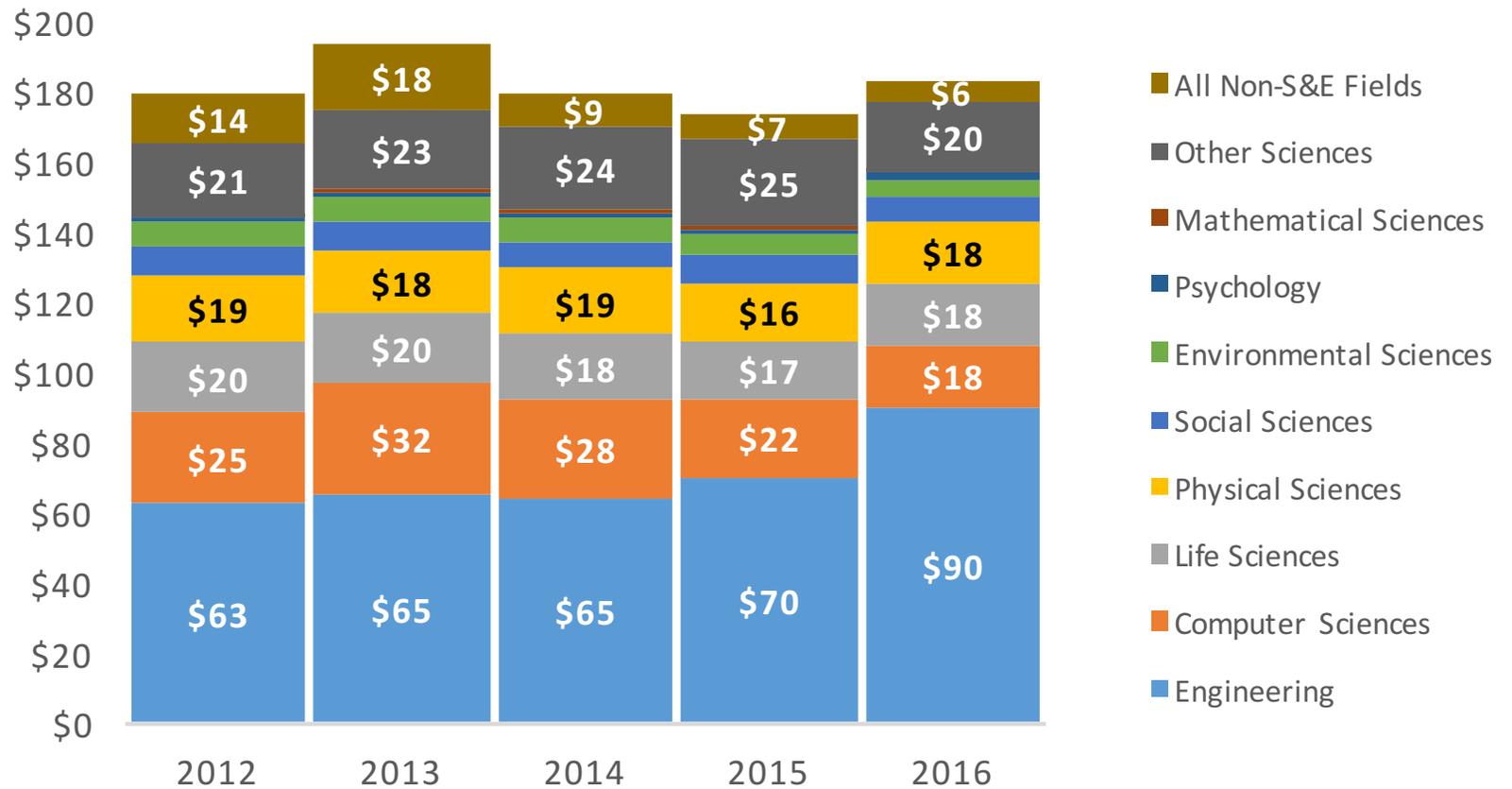


## Federal Research Expenditures by Agency FY 2012-2016



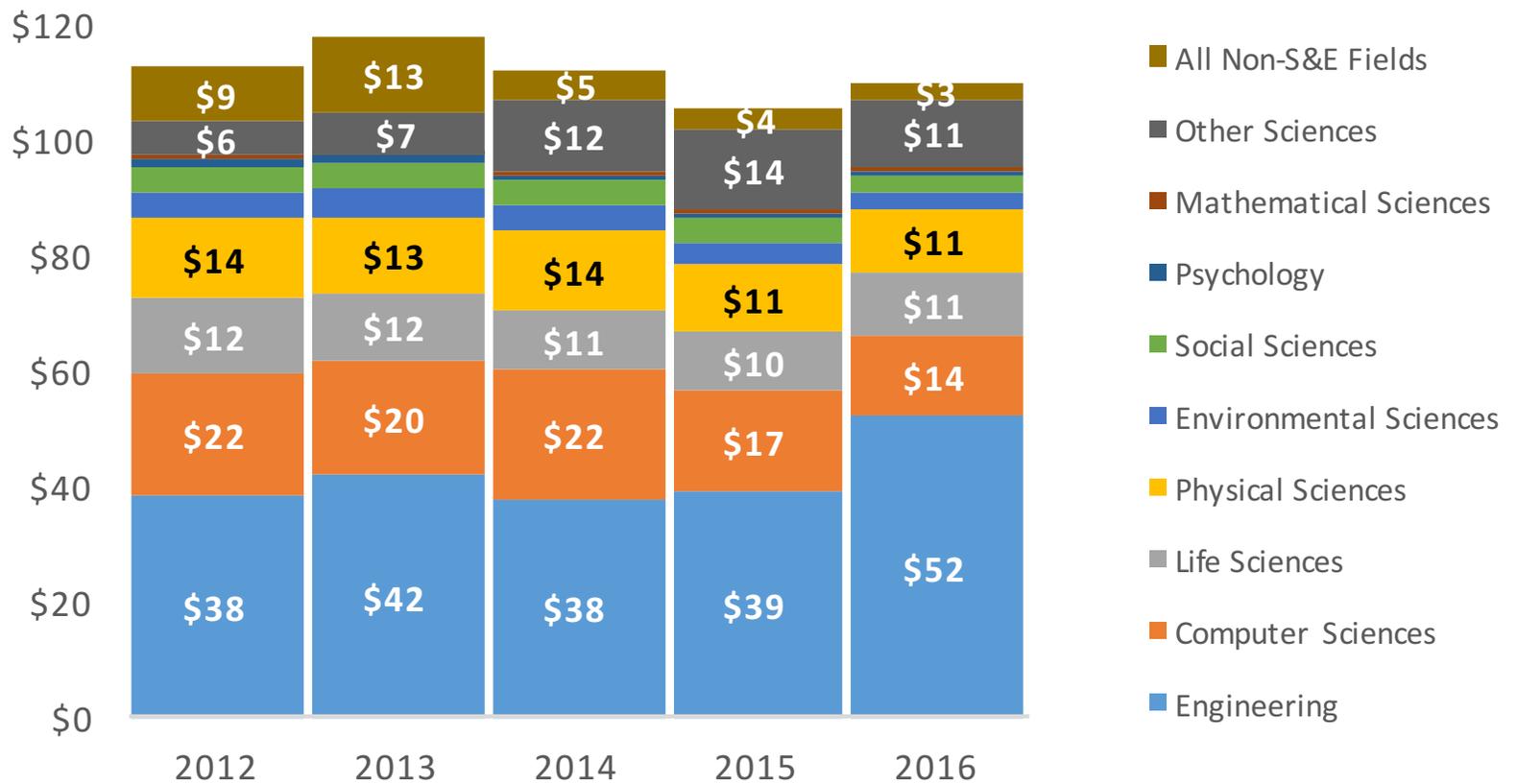
### Total NSF HERD Expenditures By R&D Field FY 2012-2016

Millions



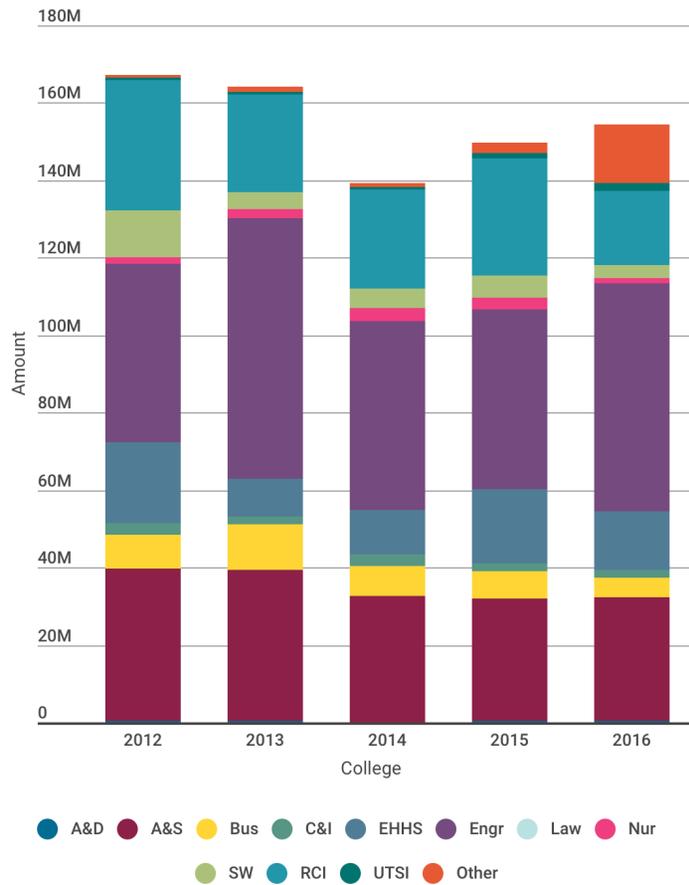
### Federal NSF HERD Expenditures By R&D Field FY 2012-2016

Millions

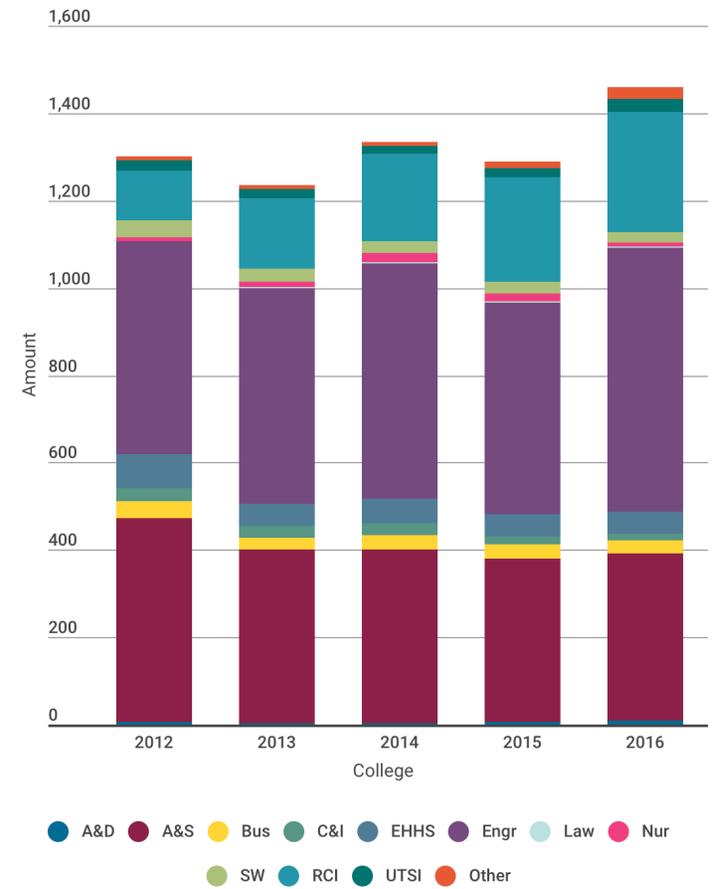


## AWARD DATA BY COLLEGE

### Award Amount Received by College

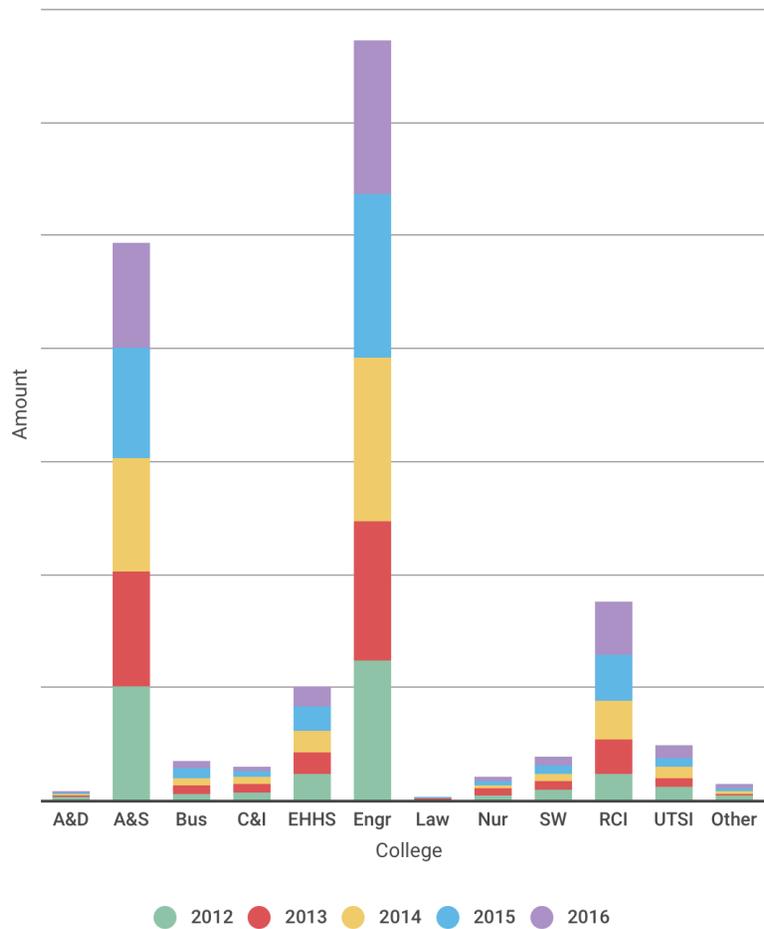


### Number of Awards Received by College

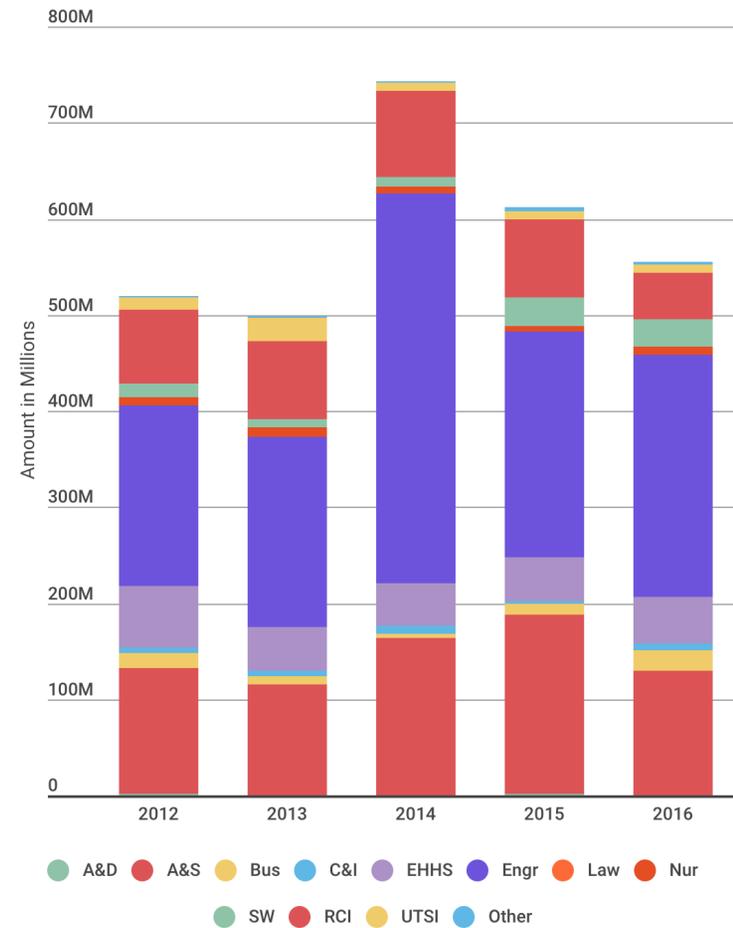


**PROPOSAL DATA BY COLLEGE**

Proposals Submitted by College



Proposal Amount Requested by College



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Job 437453