Benchmarks 2019

# Second Place America?

## Increasing Challenges to U.S. Scientific Leadership

## Report Highlights

A Report by the Task Force on American Innovation

May 2019

## ABOUT THE TASK FORCE ON AMERICAN INNOVATION

The Task Force on American Innovation (TFAI) is a non-partisan alliance of leading American companies and business associations, research university associations, and scientific societies. Established in 2004, TFAI supports federally-funded scientific research and promotes its benefits to America's economy and national security. TFAI is particularly concerned with research and educational funding in the physical sciences and engineering at the Department of Defense, the National Science Foundation, the Department of Energy's Office of Science, the National Institute of Standards and Technology, and NASA.

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# Introduction

The United States has a rich history of global leadership in science and technology. Much of this success is due to the unique partnership between the federal government, universities, and private industry. This innovation ecosystem has allowed for the generation of new knowledge and foundational ideas helping make the U.S. the world leader in many scientific and technological fields. It has also helped to attract the best and brightest students and scholars from around the world to come to the U.S. to study, work, and contribute to advancing U.S. scientific research and our economy.

***America's global leadership in science, technology and innovation is now threatened, as China and other countries are rapidly increasing investments in research and growing their STEM workforce.***

In this document are highlights from a report released by the Task Force on American Innovation: *Second Place America? Increasing Challenges to U.S. Scientific Leadership*. This report benchmarks the U.S. against other nations in R&D investment, knowledge production, education, workforce, and high-tech sectors of the economy. These benchmarks illustrate that while the U.S. continues to lead the world, other countries are on track to catch up and soon surpass the United States.

# Research & Development Investment Benchmarks

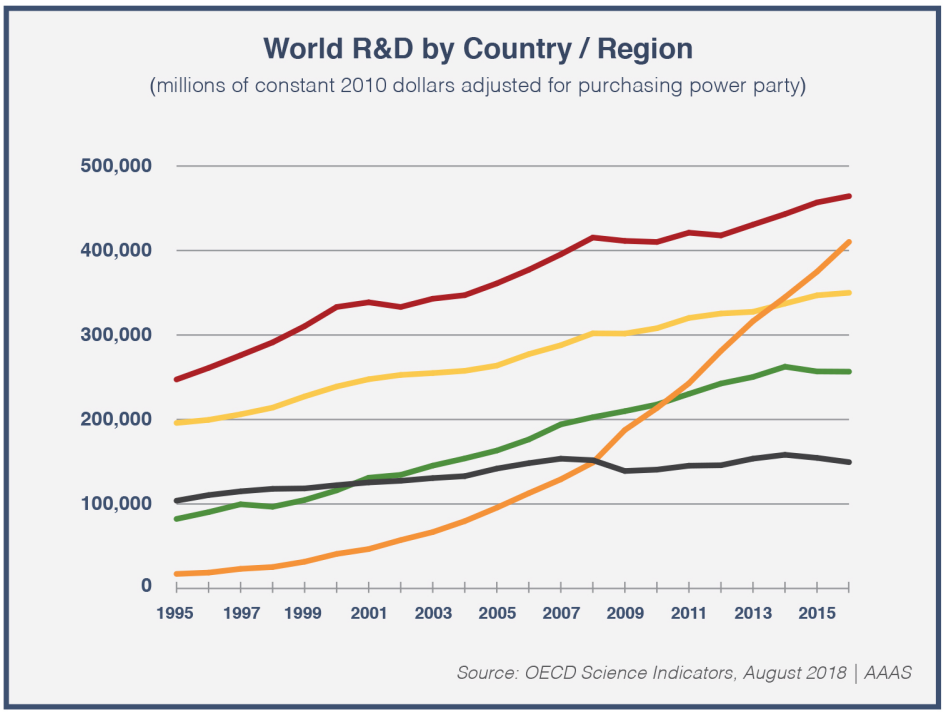
Maintaining America's global leadership status is critical to national security as well as to future economic growth and prosperity. This will require a renewed national commitment to invest in the key federal science agencies that undergird the U.S. research and development enterprise and spur American innovation, including the National Science Foundation, Department of Energy, Department of Defense, National Institutes of Health, National Aeronautics and Space Administration, and National Institute of Standards and Technology.

To put this problem into perspective, the U.S. share of global R&D is diminishing, while competitor nations have surged ahead. For example, China is on track to surpass the United States in total R&D expenditures, according to OECD estimates. Additionally, other nations are formulating targeted strategies and investments for their R&D portfolios, recognizing the importance role it plays in their country's economic prosperity and national security.

**GRAPH 1.2**

**World R&D by Country/Region**

(millions of constant 2010 dollars adjusted for purchasing power party)



## International R&D Investment Targets and Strategies

**Korea:** Following the establishment of multiple government research institutes and the Ministry of Science and Technology in the 1960s, and the introduction of R&D tax credits in the 1970s, Korea has become an international R&D powerhouse. Last summer, the Korean government reached an agreement to double funding for basic science by 2022.

**Germany:** Last year, Germany pledged to increase the country's research intensity from 2.9 percent to 3.5 percent – which would rank the country third in the world. Some German officials have also considered establishing an R&D tax credit for the first time.

**United Kingdom:** After years of high scientific achievement but surprisingly low investment in R&D, the UK's latest industrial strategy, released in late 2017, aims to increase total investment from 1.7 percent of GDP to 2.4 percent by 2027, which would put the UK on par with other major economies and begin to approach current U.S. research intensity.

**China:** China's most recent five-year-plan for science and technology, issued in 2016 and extending through 2020, pledges continued spending growth and establishes a research intensity target of 2.5 percent of GDP by 2020. This target came on the heels of China's much-noted Made in China 2025 strategy issued in 2015, which seeks to establish Chinese dominance in high-tech manufacturing areas such as robotics, aerospace, and energy-saving vehicles.

# Knowledge Creation & New Ideas Benchmarks

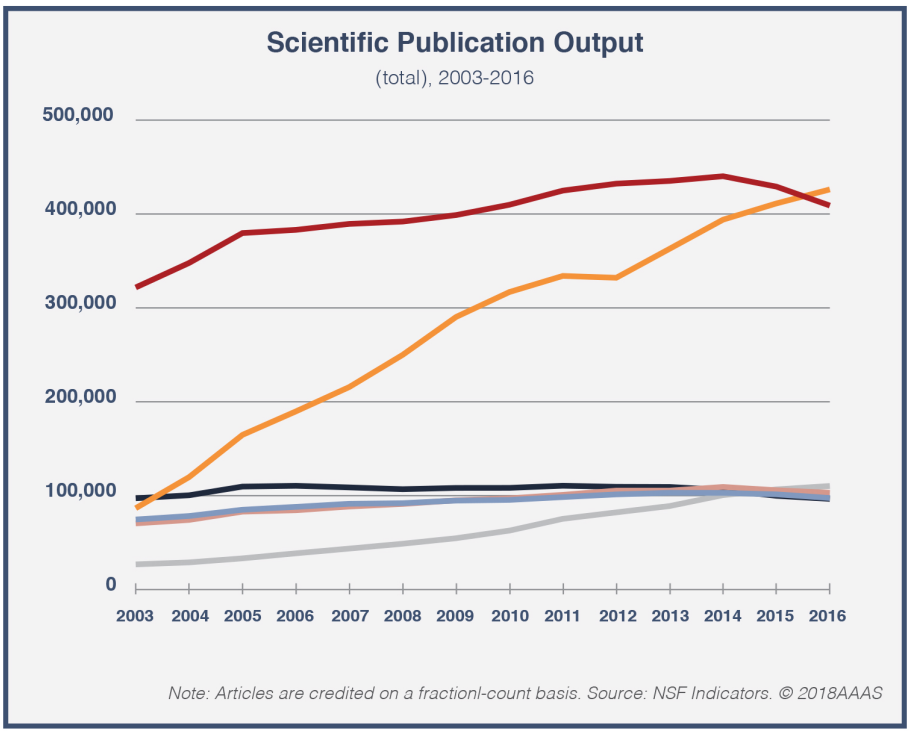
Emerging economies, particularly China, are playing a greater role in scientific discovery and innovation, and challenging U.S. leadership in critical research fields.

China has overtaken the United States in total research publication output as of 2016. China is now the dominant research producer in key areas including engineering, physics, chemistry, geosciences, and mathematics.

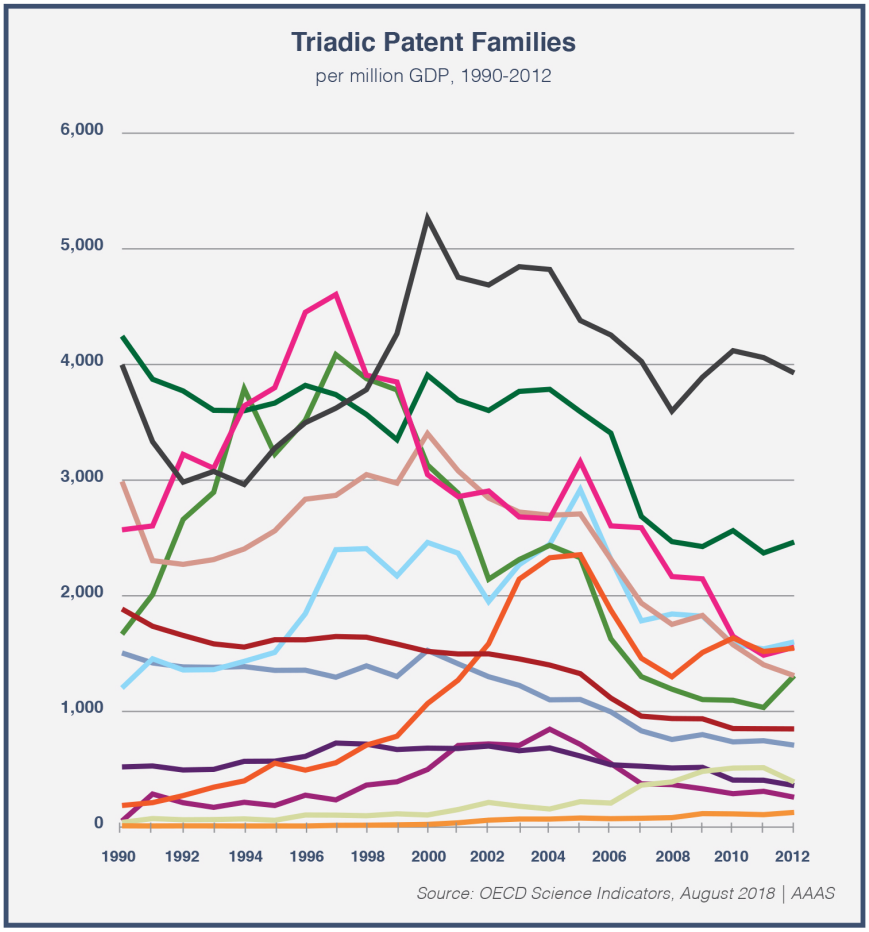
**GRAPH 2.5**

**Scientific Publication Output**

(total), 2003-2016



U.S. patent productivity has declined in recent years, while East Asian economies such as South Korea, Taiwan, and Singapore have accelerated their patent output.




**GRAPH 2.13**

**Triadic Patent Families**

per million GDP, 1990-2012

- USA
- Japan
- China
- Korea
- Taiwan
- Sweden
- Canada
- Germany
- Switzerland
- Finland
- Israel

# Education Benchmarks

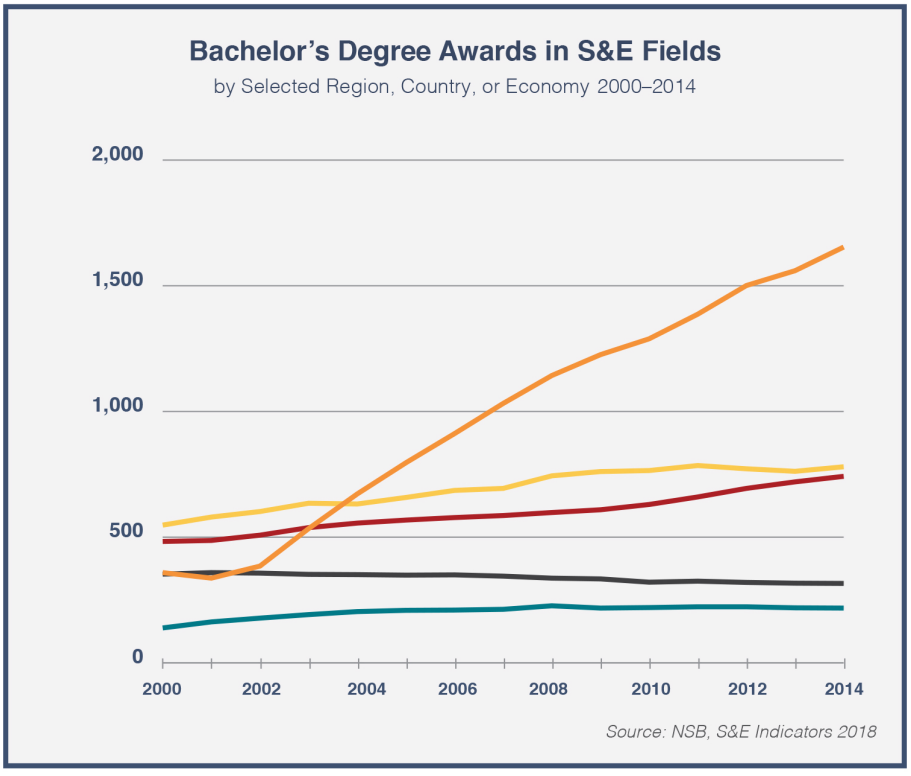
Other countries invest heavily in their higher education systems, in turn producing and increasing their numbers of science and technology degrees.

The U.S. continues to trail the top eight countries in the E.U., as measured by the total number of bachelor's degrees in science and engineering awarded since 2000. The U.S. has been eclipsed by China, whose output of science and engineering degrees increased by over 360 percent during this time.

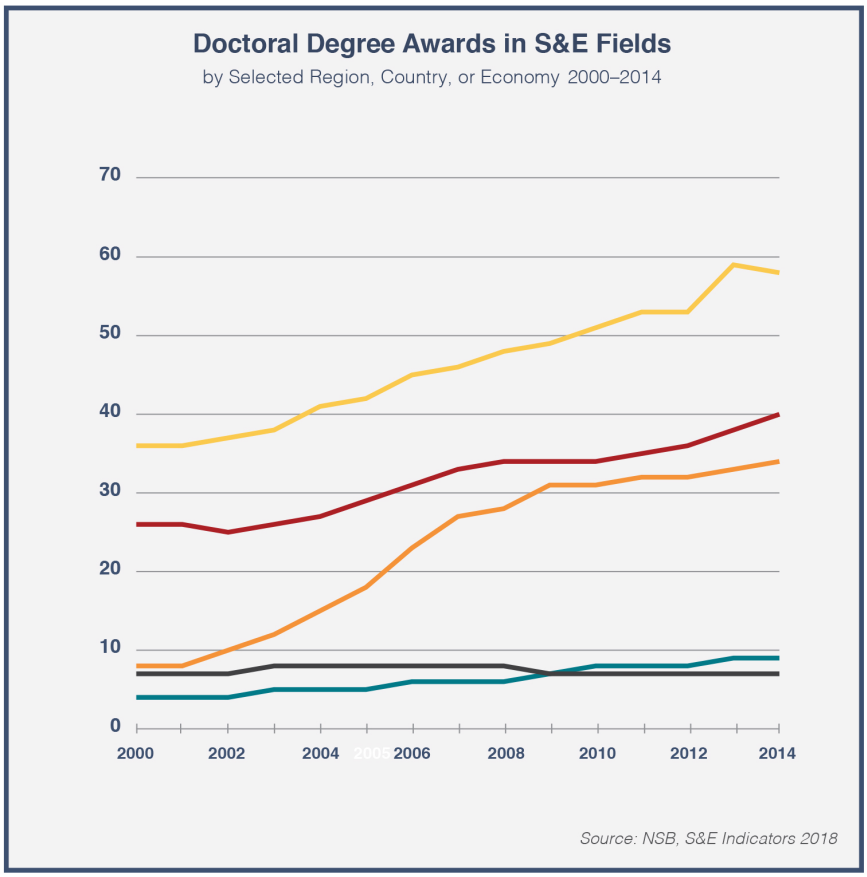
**GRAPH 3.15**

**Bachelor's Degree Awards in S&E Fields**

by Selected Region, Country, or Economy 2000–2014



China now awards nearly as many science and engineering doctorates as the United States. In the 15-year period between 2000 and 2014, China increased its doctoral degree output in science and engineering by over 53 percent.




**GRAPH 3.16**

**Doctoral Degree Awards in S&E Fields**

by Selected Region, Country, or Economy 2000–2014

- China
- EU - Top 8
- Japan
- South Korea and Taiwan
- USA

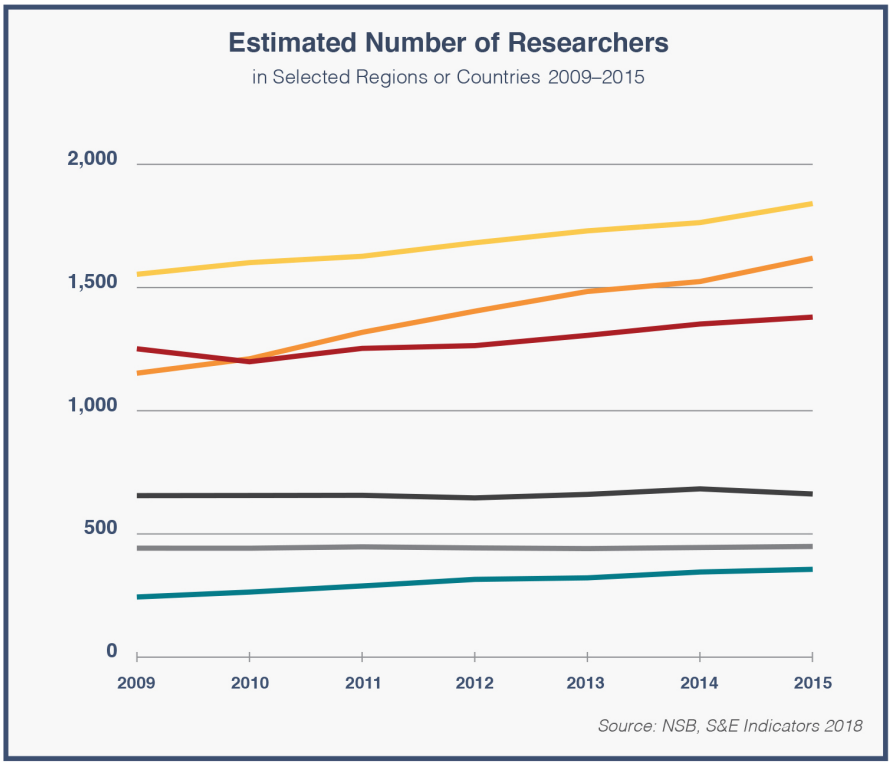
# Workforce Benchmarks

To maintain U.S. scientific leadership and economic competitiveness, it is critical that the U.S. workforce be adequately trained in science, technology, engineering, and math (STEM) fields and that we attract, grow and retain the best and brightest scientific researchers to support and cultivate our innovation ecosystem. Compared to other countries, however, the U.S. appears to be lagging in this area.

As of 2010, China has surpassed the number of researchers in the United States. In 2015, the estimated number of total researchers in China was more than 1.6 million compared to 1.3 million in the United States.

The U.S. still leads in the amount of funds spent per researcher but faces competition from countries like China, which continues to increase both its number of researchers and R&D expenditures. Between 2009 and 2015, China reported an increase of almost 43 percent for its gross domestic expenditures on R&D per researcher (in constant prices and purchasing power parity).[1]

**GRAPH 4.19**
**Estimated Number of Researchers**
in Selected Regions or Countries 2009–2015



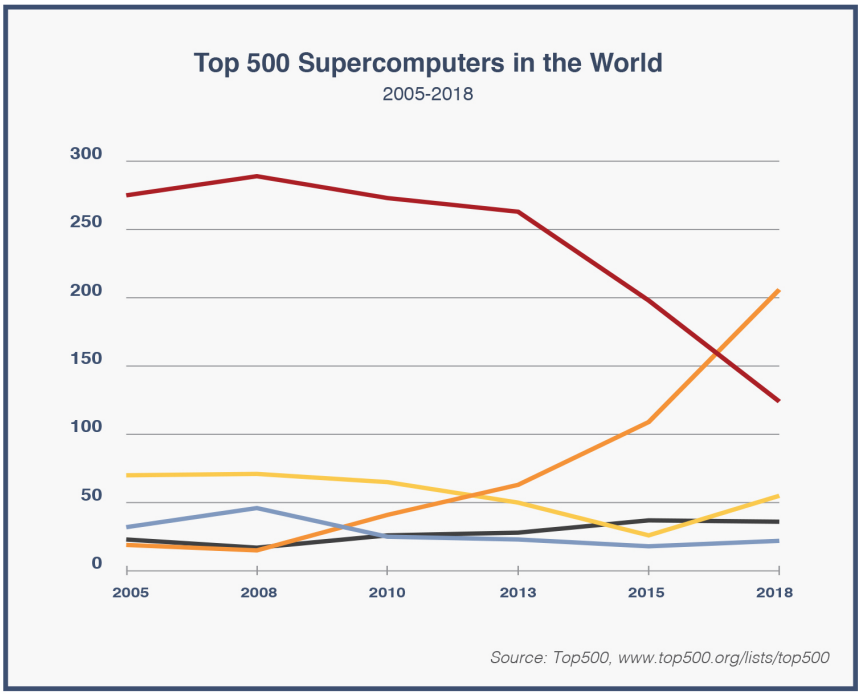

1 - National Science Board. 2018. *Science and Engineering Indicators 2018 Digest*. NSB-2018-2. Alexandria, VA: National Science Foundation.

# High-Tech Sectors Benchmarks

Across many sectors of the economy, signs of trouble for the U.S. are emerging in areas important to national security, economic competitiveness, technological leadership, and industrial capacity. These warning signs show the ripple effects of lapses in support for research and education.

The full Benchmarks report has multiple vignettes and data points on **Aerospace**, **Artificial Intelligence**, **Biomedical**, **Nanotechnology**, and **Telecommunications**, that show the U.S. is not investing enough in the physical sciences and engineering and is in danger of losing its competitive edge, with potential economic and national security implications.

Perhaps the best example is in **Supercomputing**, where the U.S. has surrendered its once commanding lead. On the Top 500 list of the world's fastest supercomputers, the U.S. controlled almost half the world's top machines in 2005; today it now controls less than a quarter, with China now boasting the largest number of supercomputers.[2]




**GRAPH 5.21**
**Top 500 Supercomputers in the World**
2005-2018

- USA
- UK
- China
- EU
- Japan

2 - "Top 500 List, 26th Edition, 32nd Edition, 36th Edition, 42nd Edition, 46th Edition, and 52nd Edition." Top 500. Nov 2005, Nov 2008, Nov 2010, 2013, 2015, 2018. Available at www.top500.org/lists/.

**By numerous measures, America's leadership among its global competitors is not being sustained. The Task Force on American Innovation calls for strong and sustained commitments to increasing federal investments in scientific research and human capital that drives the U.S. economy forward and fuels American innovation.**

To read the full report:
www.innovationtaskforce.org/Benchmarks2019

# Task Force on American Innovation

*Securing the future through research in the physical sciences and engineering*

IBM

SIA SEMICONDUCTOR INDUSTRY ASSOCIATION

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CRA Computing Research Association

Crop Science SOCIETY OF AMERICA

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