U.S.-funded R&D projects drive innovation and science forward.

PHOTO: CHARLES A. SMITH/JSU

AAAS NEWS & NOTES

Increases in U.S. federal R&D needed in a global crisis

Support can boost the U.S. economy, innovation, and global standing

By **Anne Q. Hoy**

Imagine a world without the internet, a Google search engine, magnetic-resonance imaging, or the Human Genome Project—a sampling of American innovations that, like many scientific tools and research efforts, evolved from U.S. R&D investments.

Until Congress recently boosted federal R&D funding as a share of the U.S. economy, such investments had been on the decline—sliding from a high just shy of 1.9% of the gross domestic product in 1964 to 0.62% of the nation's gross domestic product (GDP) in 2018—impeding scientific advances, slowing innovation, and clipping the nation's share of global R&D funding at a time when the country faces challenges, economic and human, triggered by coronavirus disease 2019 (COVID-19).

The American Association for the Advancement of Science presented recommendations on how to advance scientific discovery, expand innovation, drive economic advancement, and ensure the scientific community supports opportunities for all at the "Fueling American Innovation and Recovery" hearing held by the U.S. House of Representatives Budget Committee on 8 July.

Sudip Parikh, AAAS CEO and executive publisher of the *Science* family of journals, was among the expert witnesses at the hearing that examined ways to reinvigorate U.S. economic competitiveness, renew federal investment in scientific R&D, and address the global pandemic.

Since 1995, the global ranking of U.S. R&D investment as a percentage of its GDP slipped from 4th to 10th place, said House Budget Committee Chairman John Yarmuth during the hearing.

The United States now lags behind competitors such as South Korea, Taiwan, Japan, and Germany in R&D investments, said Deborah L. Wince-Smith, president and CEO of the Council on Competitiveness, during her testimony at the House Budget Committee hearing.

Yarmuth warned that delays in scientific research projects as well as other economic challenges triggered by COVID-19 could diminish the U.S. position as a leader of global R&D funding.

Updating a long-standing framework that guides federal investment in scientific research, ensuring effective coordination of federal responses to the crises facing the nation, and committing to provide scientific evidence to propel racial equity in science and national policy-making formed the core of Parikh's recommendations to the panel.

Parikh pointed to research that found U.S. R&D as a share of GDP is well below its historic peak and below the current investment levels of nine other countries.

U.S. funded R&D projects drive innovation forward. The crises at hand require a federal investment of 1.9% of GDP, a level that represents an annual funding increase of 11% in scientific R&D, said Parikh.

Support for the full spectrum of innovation is needed, including "fundamental science, mission-driven technology, useful knowledge programs to meet local, national and international needs with the federal government as a key partner," said Parikh. New approaches to R&D funding models and networks should be explored, including "project grants, people-centered grants, teams and hubs, and prizes."

"Broadly, federal research is effective in producing discoveries that lead to high-impact, novel inventions, often in technology areas that have not yet received much industry attention," said Parikh.

AAAS tracks administration and congressional appropriations through the R&D Budget and Policy program, an outreach effort that keeps scientists and policy-makers informed through regular analyses, reports and media outreach. AAAS also engages in advocacy efforts to address executive branch and congressional actions that pose negative consequences for U.S. scientific research activities.

AAAS has issued, for instance, statements on the U.S. withdrawal from the World Health Organization, which collaborates across borders to support human health, and an administration proposal to limit the participation of international students at U.S. academic institutions despite a long history of important scientific contributions that foreign national students have made to the U.S. scientific enterprise.

"From the beginning, the Trump administration has taken a hard-fiscal line on most research and development programs, favoring Department of Defense technology development and acquisition at the expense of basic and applied research, even Defense research activities," noted Matthew Hourihan, director of the AAAS R&D Budget and Policy Program.

In fiscal year 2017, Congress rejected steep spending cuts outlined in the administration's budget proposal and instead adopted significant spending increases, particularly for the Department of Energy's Office of Science for basic science and R&D programs.

By fiscal year 2020, congressional R&D increases stood as a rebuttal to the president's consistent budget reduction proposals that sought more than $12 billion in spending to be shed from federal basic and applied research programs, according to a 2019 analysis by the AAAS R&D Budget and Policy Program.

Federal R&D investment supports government laboratories, research activities at federal agencies, academic institutions, and private-sector facilities to drive U.S. scientific advances.

AAAS NEWS & NOTES

The 2020 fiscal year spending package Congress approved dedicated the largest funding increases to the life sciences, particularly for the National Institutes of Health's basic research on human health and related topics, and made low-carbon energy and space exploration programs the second-largest funding recipients, as documented by the AAAS R&D Budget and Policy dashboard that tracks congressional appropriations trends across the scientific enterprise.

Despite the rise in the levels of federal R&D funding from 2000 to 2017, "the share of total U.S. R&D funded by the federal government declined from 25% to 22%," according to "The State of U.S. Science and Engineering," which highlights the 2020 "Science and Engineering Indicators," a suite of reports that provide findings on thematic scientific topics. The National Science Board is required to deliver the findings to Congress and the president every 2 years.

The business sector and U.S. academic institutions of higher education have stepped up financial support for R&D programs and activities, aware that R&D investments often spark novel scientific knowledge that, in turn, opens new research avenues, contributes to the training of young scientists, and helps fuel the U.S. economy. The business sector plays the most prominent role, having outpaced federal R&D funding to become primarily responsible for the rise in R&D support since 2000.

Universities and colleges are the second-largest contributors to R&D and play an important role in the progress of the nation's overall R&D activities by funding more than half of both U.S. basic research and the training of incoming scientists and engineers, according to the 2020 "Science and Engineering Indicators."

Yet, the combination of an overall decline in state support for public universities and colleges, and a leveling off of federal R&D funding for academic institutions at an annual $30 billion, risks a weakening of the United States' standing in innovation, reports suggest.

More encouraging, federal science and engineering support for historically black colleges and universities delivered HBCUs a 5.4% R&D funding increase for research and experimental development, according to the National Center for Science and Engineering Statistics.

Joining Parikh and Wince-Smith at the House hearing were two other expert witnesses, including Paul Romer, a Nobel-Prize winning economist and professor at New York University. Romer called on U.S. universities to give talented science and technology students a larger voice and leeway to pursue their own innovative ideas, not just those of professors. He said science and engineering degree fellowships should be granted to highly talented undergraduates to help expand U.S. innovation.

Economist Willy Shih, a professor at Harvard Business School, said the COVID-19 pandemic has exposed U.S. reliance on other nations for equipment, devices, and pharmaceuticals, a reality that requires expanded federal investment in basic scientific research and direct stimulus spending for technology investments.

"If the United States does not make needed investments in its future, increase its scope and rate of innovation, its fundamental capacity to grow its economy, create jobs, maintain national security, solve societal challenges and provide a social safety net, it will continue to erode—and its geopolitical leadership will be at increasing risk," said Wince-Smith.

Increases in U.S. federal R&D needed in a global crisis

Anne Q. Hoy

Science **369** (6507), 1067-1068.
DOI: 10.1126/science.369.6507.1067