Quadrennial Science and Technology Review Report

September 2024

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976 to provide the President and others within the Executive Office of the President with advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget with an annual review and analysis of federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the federal government. More information is available at http://www.whitehouse.gov/ostp.

About this Document

This Quadrennial Science and Technology Review (QSTR) was developed in response to Section 10613 of the CHIPS and Science Act (Act), which requires OSTP to complete a review of the science and technology enterprise of the U.S. every four years and submit to Congress a report on the results of the review.

Section 10611 of the Act further calls upon OSTP, in coordination with the National Science and Technology Council, to develop and submit a U.S. National Science and Technology Strategy to meet national research and development objectives one year after the submission of the QSTR. Specifically, Section 10611 calls for "*a comprehensive national science and technology strategy of the U.S. to meet national research and development objectives for the following 4-year period."* This inaugural QSTR is one of many resources that will inform the development of the forthcoming U.S. National Science and Technology Strategy.

As required by Section 10613, this inaugural QSTR was developed in consultation with the National Science and Technology Council (NSTC), the President's Council of Advisors on Science and Technology (PCAST), the National Science Board (NSB), the National Security Council (NSC), and the following federal departments and agencies:

- Department of Commerce
- Department of Defense
- Department of Energy
- Environmental Protection Agency
- Department of Health and Human Services
- Department of Homeland Security
- Department of the Interior
- National Aeronautics and Space Administration
- National Science Foundation
- Department of Agriculture
- Department of Transportation
- Department of Veterans Affairs

The content herein reflects a thematic representation of the myriad science and technology (S&T) efforts ongoing across the federal government. This report reflects themes which the Office of Management and Budget (OMB) and OSTP have articulated in recent multi-agency research and development priorities memoranda.[1]

The department and agency highlights include select examples of their efforts, and are neither an exhaustive list of all departments and agencies conducting work across each thematic area nor an all-encompassing list of relevant projects or programs at those agencies. The areas of focus herein include basic and applied research, as well as thematic goals, such as improving health outcomes, meeting the climate crisis, and supporting the national and economic security of the U.S.

Copyright Information

[1] The White House. "Multi-Agency Research and Development Priorities for the FY2025 Budget." August 17, 2023. https://www.whitehouse.gov/ostp/news-updates/2023/08/17/multi-agency-research-and-development-priorities-for-the-fy-2025-budget/

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Abbreviations and Acronyms

AI	artificial intelligence
ARPA	Advanced Research Projects Agency
ARPA-E	Advanced Research Projects Agency-Energy
ARPA-H	Advanced Research Projects Agency-Health
ARPA-I	Advanced Research Projects Agency-Infrastructure
ASPR	Administration for Strategic Preparedness and Response
CDC	Centers for Disease Control and Prevention
CHIPS	Creating Helpful Incentives to Produce Semiconductors
CTSA	Clinical and Translational Science Awards
DARPA	Defense Advanced Research Projects Agency
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOT	Department of Transportation
EPSCoR	Established Program to Stimulate Competitive Research
FDA	Food and Drug Administration
FY	fiscal year
GHG	greenhouse gas
HBCU	Historically Black College and University
HHS	Department of Health and Human Services
HSI	Hispanic serving institution
IT	information technology
MSI	minority-serving institution
NASA	National Aeronautics and Space Administration
NCI	National Cancer Institute
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
OTT	Office of Technology Transitions

PRC	People's Republic of China
QSTR	Quadrennial Science and Technology Review
R&D	research and development
RDT&E	research, development, test, and evaluation
STEM	science, technology, engineering, and mathematics
TCU	Tribal college and university
TIP	Directorate for Technology, Innovation, and Partnerships
TTP	Technology Transfer Program
USDA	U.S. Department of Agriculture
VA	Department of Veterans Affairs

Message from the Director of the White House Office of Science and Technology Policy

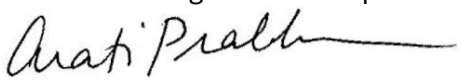
The purpose of science and technology (S&T) is to make it possible to achieve our nation's aspirations. Today, those aspirations are greater than they have ever been. We reach for a future with robust health and plentiful opportunity for every person in America. We aim to confront the climate crisis through mitigation and resilience. We work to attain a competitive economy with good-paying jobs. We seek a world that is more free, open, equitable, secure, and prosperous. We strive to use technological advances like artificial intelligence (AI) to overcome our challenges and strengthen our values. We aspire to expand the boundaries of human knowledge in every domain. Realizing these aspirations is how we will, as President Biden says, "build the future together."

The research and development (R&D) capability in the U.S. today is the most powerful engine for innovation in history. The largest and fastest growing portion of America's R&D spending comes from industry, with the information technology and pharmaceutical industries driving the biggest increases. These innovation-intensive sectors have deep roots in the federally funded R&D of earlier years, and they and other sectors continue to rely on today's publicly funded foundation of research. The federally funded portion of our Nation's R&D today is roughly half research and half development. Almost all of federally funded development is for specific military and space systems, primarily in the Department of Defense. Federally funded research—which includes both basic and applied research—provides a vitally important foundation for multiple public missions as well as for industry. Federally funded research provides 55% of the dollars for research in universities, and it supports the Nation's network of federal labs and 42 Federally Funded R&D Centers. The interactions and relationships among these many R&D actors, including companies, universities, nonprofits, government labs, and funding agencies, are rich and complex. Together they create the R&D ecosystem that our Nation counts on to create pathways to a better future.

The essential, foundational role that federally funded research plays in this ecosystem is the focus of this Quadrennial Science and Technology Review (QSTR). Today, federally funded research must step up to meet the challenges of our times. It must sustain America's leadership position in S&T and take aim at bold goals. It must translate into new products and services, new industries and jobs, new policies and regulations, and new standards and practices. And it must bring the power of innovation to important national missions that have not fully benefitted from research advances.

The Biden-Harris Administration has called for increases in federally funded R&D and has proposed budgets with the largest ever total funding for R&D. However, budget caps created constraints for federally funded R&D appropriated in fiscal year (FY) 2024 that have impacted the full breadth of R&D-supporting agencies. As departments and agencies work to manage current funds, the President will continue advocating for robust federally funded R&D.

Science, technology, and innovation have been integral to our Nation's great accomplishments in the past, and they remain integral to achieving our current aspirations. They allow us to step beyond the limitations of today into a better tomorrow. This QSTR describes current federally funded research efforts and identifies the need for further action to keep our S&T enterprise healthy, so it can fulfill its role in achieving America's aspirations.



Arati Prabhakar
Assistant to the President and Director of OSTP

I. FEDERALLY FUNDED RESEARCH: THE FOUNDATION OF U.S. SCIENCE AND TECHNOLOGY

How Americans live and work, our health and opportunities, the security of our nation and the stability of our world, and the expanding scope of human knowledge all depend on continued U.S. leadership in S&T. That leadership is the result of a richly complex, constantly evolving ecosystem, academic institutions, government labs, companies, and nonprofits.

Most of the R&D conducted in the U.S. is funded and performed by companies to create future products and services. The federal government funds R&D for public purposes, and that work is performed in government, academic, corporate, and other facilities.

Figure 1 shows how federally funded research and development funding varies across many agencies serving different missions: national security, health, energy, space exploration, the environment, agriculture, transportation, and more. Federal *research* dollars create the foundation for the full set of public missions—including the important role of expanding knowledge and understanding in all fields—and the foundation on which current and new industries build our economic prosperity. Federal *development* dollars build experimental prototypes of systems for missions such as defense and space.

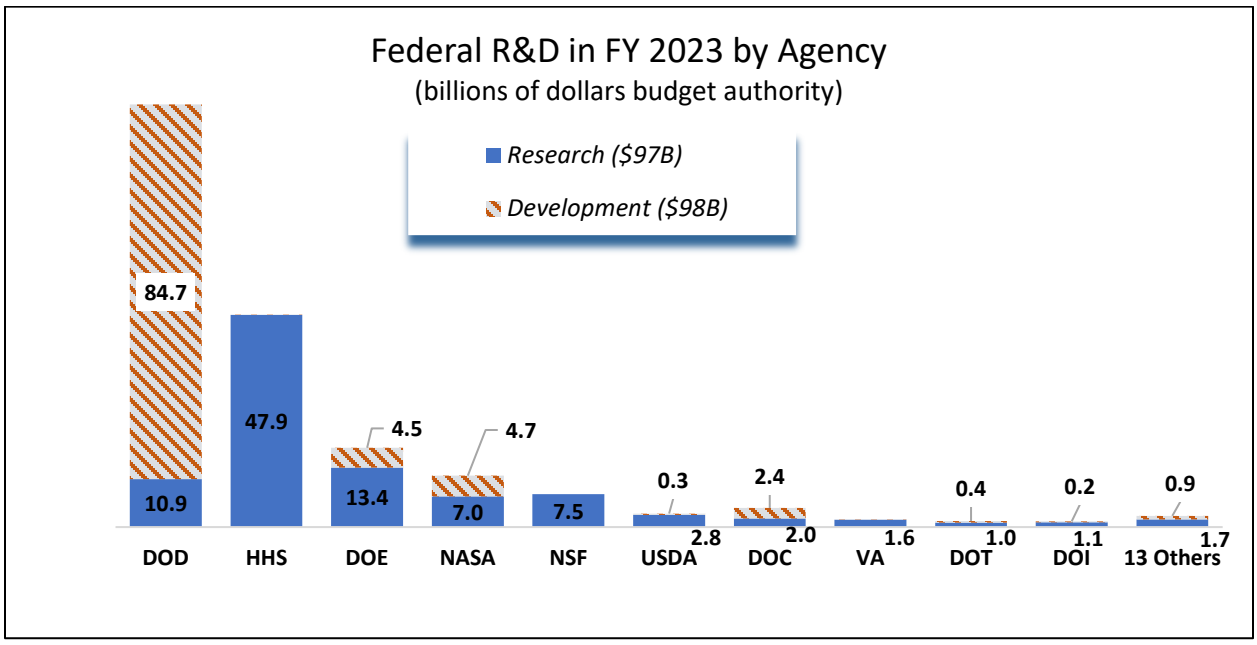


Figure 1. Actual federally funded R&D by agency in FY2023. Research = basic research + applied research. Excludes R&D facilities construction and major capital equipment for R&D ($5 billion). Includes one-time appropriations from the Bipartisan Infrastructure Law, CHIPS and Science Act, Inflation Reduction Act, and other one-time legislation.2

Because federally funded research (basic and applied together) plays such a fundamental role in the success of American science, technology, and innovation, it is the focus of this report. Sustaining

[2] Office of Management and Budget. "Analytical Perspectives: Budget of the U.S. Government, Fiscal Year 2025". Chapter 6: Research and Development. https://www.whitehouse.gov/omb/budget/analytical-perspectives/

federally funded research, refreshing it for the challenges of our times, and renewing its vibrancy are critical to maintaining the nation's global leadership.

Under President Biden and Vice President Harris's leadership, the U.S. has reinvigorated American S&T through transformative investments in both R&D. This Administration has successfully worked with Congress to achieve multiple strong budgets; pass landmark bills that include R&D investments, such as the Bipartisan Infrastructure Law, the CHIPS and Science Act, and the Inflation Reduction Act; and support the Biden Cancer Moonshot and establish the new Advanced Research Projects Agency for Health (ARPA-H). For federally funded research to continue its vital contributions as America's economy and ambitions grow, it will be essential to maintain strong growth despite budget pressures.

a. A Flourishing Research Ecosystem

Federally funded research can make it possible to achieve better health outcomes, create new products and services, generate new industries and good jobs, improve policies and regulations, and develop new standards and practices, all to address the greatest challenges of our time. The U.S. has the world's strongest research enterprise, including our universities and federal and national labs. Global industrial bases have been born out of and built on U.S.-led advances in S&T. Public investment is critical in realizing and applying foundational research for broad national benefits in the longer term.

The federal investment in research (basic and applied) totaled $97 billion in FY2023, as shown in Figure 1 and Table 1. Research investments are supported by nearly two dozen federal agencies; selected agency examples of research investments are below.

Table 1. Federally funded research by agency (FY2023; millions of $ budget authority) [3]

Agency	FY2023 Budget Authority: Research (millions of $)
Department of Health and Human Services	47,916
Department of Energy	13,418
Department of Defense (Military)	10,860
National Science Foundation	7,468
National Aeronautics and Space Administration	6,958
Department of Agriculture	2,763
Department of Commerce	1,953
Department of Veterans Affairs	1,648
Department of the Interior	1,091
12 others	2,673
Total	**96,748**

Notes: Research = basic research + applied research. Excludes experimental development, R&D facilities construction, and major capital equipment for R&D.

[3] Office of Management and Budget. "Analytical Perspectives: Budget of the U.S. Government, Fiscal Year 2025". https://www.whitehouse.gov/omb/budget/analytical-perspectives/

A Flourishing Research Ecosystem – *Select Department and Agency Examples*

Department of Health and Human Services (HHS)
HHS seeks to enhance the health and well-being of all Americans by providing for effective health and human services and fostering sound, sustained advances in the sciences underlying health, including medicine, public health, and social services. The National Institutes of Health (NIH) is the world's largest public funder of biomedical and behavioral research to advance knowledge of health and disease in order to transform scientific discovery into positive health outcomes. The NIH awards 83% of its funding to over 300,000 researchers at thousands of universities, medical schools, and research institutions in every state. Also, 11% of NIH's budget funds its researchers at internal laboratories. A new major agency is the Advanced Research Projects Agency for Health (ARPA-H), established by President Biden with bipartisan Congressional support in March 2022 to drive the development of transformative solutions for society's greatest health challenges. The Food and Drug Administration (FDA) conducts regulatory science research to assess the safety, efficacy, quality, and performance of products used or consumed by patients and consumers. The Centers for Disease Control and Prevention (CDC) conducts scientific research on current and emerging threats with over 200 specialized laboratories across the nation.

Department of Energy (DOE)
The DOE, through its Office of Science, sponsors basic research related to energy and supports scientific discoveries to transform our understanding of nature and advance the energy, economic, and national security of the U.S. It is also the nation's largest federal sponsor of basic research in the physical sciences, with programs in chemistry, computing and applied mathematics, materials science, and physics conducted at hundreds of universities and at its 17 national laboratories. DOE also supports fundamental research in biological and Earth system science. Together, these programs address some of the world's most pressing challenges in energy and climate and advance our understanding of elementary constituents of matter and energy in the universe. The close coupling of basic to applied scientific research to accelerate innovation has long been a priority for DOE and has helped to create new industries and jobs in energy efficiency, renewable energy, sustainable transportation, and other areas. This is exemplified through DOE's Advanced Research Projects Agency-Energy (ARPA-E), which funds high-impact research in clean energy technologies and fosters collaboration among industry, academia, and government to create a vibrant S&T ecosystem.

Department of Defense (DOD)
DOD's S&T program focuses on developing technology capabilities and fostering a vibrant defense innovation ecosystem. Each military service invests in S&T across hundreds of research partners in universities, research institutions, DOD laboratories, national laboratories, and industry. The Defense Advanced Research Projects Agency (DARPA) pursues high-risk, high-payoff projects through contracted partnerships for research and development with companies and universities in order to transform revolutionary concepts into practical capabilities. DOD's model of working with innovators both inside and outside of government has made it possible for the U.S. to have the most capable military systems in the world, and has led to a wide variety of breakthrough commercial technologies, such as the internet, global positioning systems (GPS), and advanced structural materials.

National Science Foundation (NSF)
NSF is an independent federal agency created by Congress in 1950 "to promote the progress of science; advance the national health, prosperity, and welfare; and secure national defense."[4] Each year, NSF supports an estimated 318,000 researchers, entrepreneurs, students, and teachers across 2,000 colleges, universities, and other institutions through 12,000 competitive awards for research, education, and training.[5] NSF is the only federal agency that supports all fields of science and engineering disciplines—including mathematics, engineering, geosciences, biological, behavioral, and computer sciences. It also supports science, technology, engineering, and mathematics (STEM) education, workforce development, and research infrastructure. NSF investments account for about 25% of federal support to America's colleges and universities for fundamental research.[6]

NSF invests in researchers as they probe the unknown and seek to understand nature's great mysteries. These investments support foundational research across all fields of science and engineering, except the medical sciences, as well as use-inspired research with the potential to create products and solutions that improve people's lives. NSF also supports research partnerships among colleges and universities, industry, nonprofits, government and other organizations within the U.S. and across the globe. These investments focus on sparking new ideas and creative approaches that can accelerate discovery and transform knowledge into tangible benefits to society.

National Aeronautics and Space Administration (NASA)
NASA's enduring purpose is scientific discovery and exploration for the benefit of the U.S. and all of humanity, across science, aeronautics research, space technology, exploration systems development, and space operations. To achieve these goals, NASA conducts basic scientific exploration enabled by observatories that view Earth from space, observe and visit other bodies in the solar system, and gaze out into the galaxy and beyond. NASA's science programs focus on three interdisciplinary objectives: discovering the secrets of the universe, searching for life in the solar system and beyond, and safeguarding and improving life on Earth.

Department of Commerce: National Institute of Standards and Technology (NIST)
NIST promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. As one of the nation's oldest physical science laboratories, NIST supports the advancement of foundational, critical, and emerging technologies at all scales through the development of robust measurements, testing, and standards which are needed for basic and applied research. Today, NIST also houses important new initiatives for semiconductors from the CHIPS and Science Act and for testing and evaluation of AI systems.

Department of Veterans Affairs: Office of Research and Development (ORD)
Since 1925, the ORD has focused on bio-medical research to better diagnose, treat, and cure our nation's Veterans. In doing so, it takes advantage of a robust research ecosystem that is integrated

[4] National Science Foundation. "About NSF". https://new.nsf.gov/about.

[5] National Science Foundation. "About NSF". https://new.nsf.gov/about.

[6] National Science Foundation. "NSF BY THE NUMBERS." https://www.nsf.gov/news/factsheets/Factsheet_By%20the%20Numbers_05_21_V02.pdf.

into the nation's largest health system, providing physicians an effective means to translate laboratory discoveries to superior health care. ORD combines VA appropriations with Medical Care Support, Extramural Funding, and Reimbursement Activity for a sum budgetary source of approximately $2.3 billion in FY2023, which supported 105 research sites nationwide and funded 7,431 research projects. ORD supports groundbreaking research in key areas of veteran needs such as military exposures, traumatic brain injury, pain and opioid abuse, veteran suicide, women's health issues, precision oncology. ORD has set up numerous health information databases to assist current and future generations of researchers, the largest of which is the Million Veterans Program, which surpassed a million veteran participants in 2023 to become one of the world's largest and most diverse genomic repositories.

b. Robust Technology Translation

Federally funded research achieves its impact in many ways, from simply increasing knowledge to providing a start for major practical advances. To increase the effectiveness and impact of federally funded research, agencies have established and continue to improve a variety of efforts aimed at technology translation. Select agency examples are below.

Robust Technology Translation – *Select Department and Agency Examples*

Department of Health and Human Services (HHS)
HHS supports a number of efforts to translate biomedical discoveries into new ways to prevent, diagnose, and treat diseases and disorders. Through its Designated Cancer Centers Program, the National Cancer Institute of the NIH recognizes centers that meet rigorous standards for research focused on developing new and better approaches to preventing, diagnosing, and treating cancer and delivering cutting-edge cancer treatments to patients in communities across the U.S. NIH's Clinical and Translational Science Awards (CTSA) Program supports a national network of medical research hubs that work together to improve the translational research process to bring more treatments to all people more quickly. The NIH Proof of Concept Network supports academic innovators across more than 100 universities in translation and training a diverse biomedical workforce that is globally competitive in technology development and entrepreneurship. ARPA-H has started a nationwide health innovation network that will reach all 50 states and several territories so ARPA-H programs can reach all geographies and diverse populations. The NIH Common Fund's Community Partnerships to Advance Science for Society (ComPASS) Program works to develop, share, and evaluate community-led health equity structural interventions to reduce health disparities with strong partnerships.

Department of Energy (DOE)
DOE's Office of Technology Transitions (OTT) provides programming, resources, and tools to increase commercialization impacts from the Department's technology investments. OTT's programs integrate private sector and market-oriented perspectives into DOE investment planning and help to accelerate commercialization of laboratory discoveries to the marketplace, enhancing technology transfer at DOE's plants, sites, and 17 National Laboratories. The recently launched Energy Earthshots Initiative[7]

[7] DOE. "Energy Earthshots Initiative." https://www.energy.gov/energy-earthshots-initiative

also builds on these long-standing collaborative efforts, setting ambitious technical goals in key areas critical to addressing the climate crisis. DOE's approach has transitioned scientific discoveries to development of new technologies and then to new products in the marketplace, such as fuels derived from biomass, energy-efficient building materials, batteries, and solar cells.

Department of Defense (DOD)
DOD champions several efforts designed to accelerate applied R&D transitions for expanding military capabilities and, in certain cases, commercializing technologies to the broader market. Working directly with service program offices to develop and test prototype systems, DARPA continues to successfully turn revolutionary concepts and even seeming impossibilities into practical capabilities. Rapid Defense Experimentation Reserve prioritizes rapid modernization by focusing on prototyping and experimentation efforts for multi-component missions for technologies relevant to warfighting such as intelligence, surveillance, and contested logistics. Accelerate the Procurement and Fielding of Innovative Technologies is a pilot program to rapidly transition technologies such as mixed-reality training simulations and unmanned aerial vehicles, while prioritizing small business and non-traditional contractors. The office of Congressionally Directed Medical Research Programs funds high-impact, high-risk projects for the purposes of transforming health care for service members and the American public for areas such as diagnostics, therapeutics, prevention, and clinical care.

National Science Foundation (NSF)
The CHIPS and Science Act established the NSF's Directorate for Technology, Innovation and Partnerships (TIP) in 2022 with an explicit focus on advancing U.S. competitiveness and societal impact. TIP provides pathways for researchers, startups, small businesses, and aspiring entrepreneurs to move their ideas from the lab to society at each stage of maturity. The TIP directorate has initiated the NSF Regional Innovation Engines (NSF Engines) program to catalyze regional innovation ecosystems throughout the U.S. by bringing together the S&T research enterprise with regional-level resources, experts, and communities. In addition, TIP supports use-inspired technology research and development, such as Breaking Low, which is investing $10 million to accelerate breakthroughs in low-latency wireless technologies, as well as new pathways for technology transfer, such as the Pathways to Enable Open-Source Ecosystems program, which invests about $30 million annually to transition open-source technologies to further advance key technologies. In addition to the TIP directorate, NSF provides experiential training to help researchers become entrepreneurs through its Innovation Corps program. In partnership with NSF's Established Program to Stimulate Competitive Research (EPSCoR), TIP is strengthening STEM capacity and capabilities across underserved regions of the country, including by supporting opportunities for Minority Serving Institutions (MSIs) and Historically Black Colleges and Universities (HBCUs) to transition technologies into the marketplace.

Department of Agriculture (USDA)
USDA coordinates technology transfer through Cooperative Extension System partnerships among land-grant universities and state and local governments, reaching all ~3,000 counties in the U.S.. USDA originated out of the U.S. Patent Office's Agriculture Division, reflecting the agency's foundational focus on translating research into practice. Today, USDA's Rural Partners Network is an alliance of federal agencies and civic partners working to expand rural prosperity and spur inclusive, sustainable economic growth. Rural Partners introduces a new approach to improve rural community access to resources and tools, with hubs that launch regionally-based technical assistance networks through USDA investment and partnerships with foundations and other private capital sources. USDA Regional

Food Business Centers support producers by providing localized assistance to access local and regional supply chains, including linking producers to wholesalers and distributors, and assist small- and mid-sized producers in overcoming barriers to market access, with a focus on underserved farmers, ranchers, and food businesses.

Department of Veterans Affairs (VA)
The VA invests focused resources to expediently transfer VA-developed technologies from the laboratory to the bedside of our nation's veterans. The VA Technology Transfer Program (TTP) supports two groundbreaking initiatives, TTAP (Technology Transfer Assistance Program) and BRAVE (Bringing Research Advancements for Veterans to Everyone) to fund development projects to bridge the gap from research to commercialization. Moreover, because most of VA's 8,000 researchers hold academic appointments, TTP also manages Invention Management Agreements with hundreds of U.S. universities to facilitate the coordinated commercialization of joint inventions.

II. CORE INFRASTRUCTURE FOR FEDERALLY FUNDED R&D

Federal investments in world-class R&D infrastructure after World War II paved the way for a new era of scientific and technological innovation and leadership in the U.S. Over the past 75 years, our nation's investments in R&D infrastructure have led to capabilities that have significantly increased human lifespans and helped to mitigate widespread diseases, enabled the revolution in personal electronics, catalyzed the development of exascale[8] computing and AI, and enabled exploration of our universe. Our R&D infrastructure has also historically bolstered America's global leadership in S&T and enabled collaborative partnerships.

However, much of our federally funded R&D infrastructure now faces multibillion-dollar deferred maintenance backlogs, and numerous facilities are nearing the end of or exceeding their designed lifespans. Many buildings were not designed for the strict environmental controls required to keep our researchers safe, and older heating, ventilation, and air conditioning systems are inefficient and costly to operate. Many facilities do not have sufficient clean, reliable, and secure electrical power to support today's instrumentation and high-performance computers. Deficiencies in aging and inadequate research infrastructure leads to cascading impacts on local economies, loss of global leadership on S&T outcomes, and challenges in recruiting and retaining top talent.[9] Our nation's continued leadership in S&T depends on the maintenance and modernization of existing infrastructure as well as investments in new facilities and systems that can support cutting-edge 21st century research.

a. Physical Infrastructure

Federally funded research facilities include national laboratories, large-scale scientific user facilities, high-performance computing centers, polar facilities, agricultural and food sciences research facilities, and other specialized technical facilities. University-based laboratories and user facilities, cooperative institutes, clinical trials networks, research networks, and centers of excellence are additional forms of physical research infrastructure supported by U.S. efforts. Physical infrastructure that is inadequate to meet the needs of modern scientific experiments is reducing the efficiency of research. Inadequate attention to deferred maintenance, building codes, and safety concerns is creating risks for laboratory workers and local communities and is hindering scientific progress.

b. Knowledge and Digital Infrastructure

Federal information repositories range from biomedical data to major social science surveys to scientific collections, such as those curated by the Smithsonian Institution. These datasets play a key role in research and applications from determining drug therapies for COVID-19 to predicting weather patterns sooner. These resources have also taken on newfound importance, as the rise in analytics and AI applications depends on large volumes of high-quality, wide-ranging, easily accessible, and

[8] DOE. "DOE Explains…Exascale Computing." https://www.energy.gov/science/doe-explainsexascale-computing.

[9] NSTC. "U.S. Federal Research and Development Infrastructure." May 2024. https://www.whitehouse.gov/wp-content/uploads/2024/05/NSTC-Report-on-RDI-Global-Competition-and-Modernization.pdf

secure data. Agencies' open science practices, such as programs and policies[10] enabling equitable access to datasets and best practices for data sharing,[11] can help make this knowledge more freely accessible to all. For example, the Smithsonian Institution, DOI, USDA, and other federal collections acquired over a century or more are used today to address climate change, the spread of invasive species, the loss of biological and cultural diversity, and other pressing contemporary challenges.[12] While knowledge infrastructure can be relatively inexpensive to maintain compared with other forms of infrastructure, it is often overlooked, placing the sustainability and future accessibility of many critical datasets in doubt.

Information technology and data infrastructure play an increasingly important role in advancing federally funded research and providing critical information to the public.[13] These resources include facilities for high-performance computing, tools for enterprise analytics, and cybersecurity controls for data and facilities. The nation will need to increase its high-performance computing capabilities to harness the full potential of AI, data, and technology for endless possibilities. Additionally, the government will need to strengthen digital accessibility with expanded access to technical infrastructure, including broadband, data, and computing resources, across the nation.

R&D Infrastructure – *Select Department and Agency Examples*

Department of Health and Human Services (HHS)
HHS invests in infrastructure for R&D through a number of component agencies including primarily NIH, FDA, and the Administration for Strategic Preparedness and Response (ASPR). The NIH Clinical Center is the world's largest hospital devoted exclusively to clinical research and is designed to rapidly transition scientific observations and laboratory discoveries into clinical studies and treatments for patients. FDA core facilities allow researchers access to state-of-the-art technology, equipment, facilities, experts, resources and information. ASPR partners with academia and private sector companies to develop medical advances more effectively and efficiently and to generate medical countermeasures against threats such as pandemic influenza, multi-drug resistant bacteria, chemical agents, Ebola, and COVID-19. These efforts are enabled by a robust infrastructural capacity developed through internal investment and partnerships.

Despite these capabilities, the deferred maintenance backlogs for some HHS agencies are substantial. In its committee report on the Consolidated Appropriations Act of 2017, the Appropriations Committees noted that "Over time, only the most essential maintenance and repairs for health and

[10] OSTP. "Memorandum for the Heads of Executive Departments and Agencies: Ensuring Free, Immediate, and Equitable Access to Federally Funded Research." August 25, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-access-Memo.pdf

[11] OSTP. "Desirable Characteristics of Data Repositories for Federally Funded Research." April 2022. https://doi.org/10.5479/10088/113528

[12] Smithsonian. "National Collections: An Overview of Collections, Research, and Public Engagement." https://www.si.edu/dashboard/national-collections

[13] NSTC. "National Strategic Overview for Research and Development Infrastructure." October 2021. https://www.whitehouse.gov/wp-content/uploads/2021/10/NSTC-NSO-RDI-_REV_FINAL-10-2021.pdf

safety have been addressed, leaving an increasing backlog of projects requiring attention."[14] Even at the higher FY2023 investment amount, the backlog continues to increase in all NIH sites in Maryland, Montana, and North Carolina.

Department of Energy (DOE)
DOE builds and maintains world-class large-scale scientific facilities, including x-ray and neutron sources, high performance computing centers, nanoscale science centers, accelerators, and biological characterization facilities, which are used by tens of thousands of researchers every year. DOE is stewarding the development of two megascience projects in the U.S.: the Long Baseline Neutrino Facility and the Electron-Ion Collider. Both projects will unlock the mysteries of matter and the universe and will drive technological breakthroughs in science and industry. In addition, DOE supports the development of new instruments and capabilities at its scientific user facilities. The Science Laboratories Infrastructure Program supports scientific and technological innovation at the 10 Office of Science laboratories by funding and sustaining mission-ready infrastructure and fostering safe and environmentally responsible operations, including modernization of existing infrastructure and construction of new facilities, such as the Grid Storage Launchpad at the Pacific Northwest National Laboratory. By supporting state-of-the-art R&D capabilities, DOE aims to design and construct the next generation of facilities and infrastructure to advance all departmental priorities while maintaining a safe and healthy work environment.

DOE is committed to improving the state and sustainability of its infrastructure at its 17 national laboratories and is investing in the renovation and modernization of existing facilities and utility systems, many of which are over 40 years old. As global R&D funding increases to record levels, the spending gaps between the U.S. and other countries, including the People's Republic of China (PRC), is narrowing, [15] placing even more emphasis on the need of state-of-the-art scientific facilities in the U.S.

Department of Defense (DOD)
DOD's S&T infrastructure is a critical asset to generate ideas, innovate new technologies, and sustain existing technologies. DOD laboratories and research facilities drive capabilities for military operations, allowing the Department to maintain a technological edge over current and future adversaries. However, DOD's unfunded research, development, test, and evaluation (RDT&E) infrastructure requirements have grown significantly, putting the military at risk of losing its technological superiority.[16] In addition to these concerns, the cost to maintain DOD facilities, even without bringing them up to modern standards, continues to grow.

[14] Senate Report 114-274. "Departments of Labor, Health and Human Services, and Education, and Related Agencies Appropriation Bill, 2017". June 9, 2016. https://www.congress.gov/congressional-report/114th-congress/senate-report/274/1

[15] DOE Office of Science. "U.S. Scientific Leadership Addressing Energy, Ecosystems, Climate, and Sustainable Prosperity." December 2022. https://genomicscience.energy.gov/wp-content/uploads/2024/01/BERAC_International_Report-2024.pdf

[16] DOD. "FY25 Budget Request." April 4, 2024. https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2025/FY2025_Budget_Request_Overview_Book.pdf

Department of Commerce: National Institute of Standards and Technology (NIST)
NIST's infrastructure consists of facilities in Maryland, Colorado, and Hawaii to produce advancements in measurement science, standards, and technology to promote innovation and industrial competitiveness of the nation. These facilities were built in the 1950s and 1960s when the U.S. government recognized the need to invest in S&T and build state-of-the-art scientific facilities to support the research mission of NIST. However, today, 73% of NIST facilities are between 60 to 70 years old, and over 60% of the square footage is classified as in "poor to critical condition." Failing systems at NIST have resulted in productivity losses between 10% and 40%.[17] Issues endemic to NIST's facilities create major concerns for workforce retention as existing staff are strained beyond their limits as they work in these difficult environments. A 2022 utility failure caused the shutdown of nearly all Gaithersburg, Maryland facilities for 14 days, creating significant delays for research and also for private sector, university, and federal customers who rely on NIST standards and traceable measurements. Without sustained and sufficient investment, NIST faces an increased probability of catastrophic infrastructure failure, which will increase operational costs, decrease productivity of the laboratories, and put the safety and health of staff at risk.

III. PEOPLE AT THE HEART OF U.S. INNOVATION

Today, the U.S. S&T ecosystem is unparalleled in size, scope, and impact, powered by unprecedented connections between people, places, organizations, and networks. This robust ecosystem contributes to American leadership on the world's greatest discoveries and solutions and advances economic growth and social progress.

Cultivating a robust S&T workforce is core to continued progress. As Vice President Harris stated, "when we invest in innovation, when we invest in people who have really great, smart ideas born out of an understanding and a belief that we can create things that have never been done before…it will forever change the world."[18] This approach emphasizes providing inspiration and opportunity for Americans of all backgrounds to discover, invent, and create in science, technology, engineering, math, and medicine. People of color and women, who are often underrepresented in these fields, and people from all communities whether rural, urban, Tribal, or elsewhere, must have access to develop the skills to participate in the future economy. At the same time, immigrants play an immense role in bolstering our nation's S&T competitiveness. Foreign-born workers are approximately 19% of the overall U.S. STEM workforce.[19] Attracting talent from across the globe to explore research frontiers and develop new ideas and industries in the U.S. has been a hallmark of our leadership in science, technology, and innovation for generations.

[17] National Academies. "Technical Assessment of the Capital Facility Needs of the National Institute of Standards and Technology." 2023. https://doi.org/10.17226/26684

[18] The White House. "Remarks by Vice President Harris on Building a Clean Energy Future." April 18, 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/04/18/remarks-by-vice-president-harris-on-building-a-clean-energy-future/

[19] NSF. "The State of U.S. Science and Engineering 2024." March 13, 2024. https://ncses.nsf.gov/pubs/nsb20243/talent-u-s-and-global-stem-education-and-labor-force

a. Developing Workforce Partnerships and Ecosystems

The federal government supports an array of STEM outreach and engagement efforts at all stages (pre-K-12, college/graduate school, and career-level) to promote the development of a STEM pipeline and workforce. [20] At the pre-K-12 level, engagement and education programs encourage early interest in STEM subjects and careers, and outreach programs at community-partnered research centers provide STEM enrichment. For undergraduates, graduate students, and post-doctoral researchers, federally funded research at academic institutions provides real-world experience, and several agencies offer research internships and fellowships (e.g., at national labs). At the post-secondary and career-level, research funding also provides opportunities for professional development and STEM workforce training. Departments and agencies have established grants and training programs that provide institutional, individual, and career support, as well as competitions, internships, fellowships, all to grow a more diverse and technically skilled STEM workforce.[21]

Following training, recruitment and retention of top STEM talent is a priority within and outside of the federal government. Within the federal government, departments and agencies have implemented efforts to improve hiring practices, such as competitive compensation packages and faster onboarding. Moreover, departments and agencies have increased opportunities for professional development training and promoted more equitable access to employment in the federal STEM workforce. For many departments and agencies that require specialized STEM talent in a wide range of fields, targeted outreach programs, direct hiring authorities, and other recruitment programs help bring in the top STEM talent into the federal workforce.

For example, the Pathways Program[22] allows current students, recent graduates, and individuals with advanced degrees to enter the federal government with the potential for permanent placement, and the Presidential Management Fellows Program[23] provides a two-year training and leadership development experience within a federal agency.

Other recruitment and outreach efforts focus on socially disadvantaged workers and veterans who may be overlooked by traditional STEM recruitment programs. Other efforts include work to retain talent by providing career mentorship; opportunities for upskilling; and access to resources such as Employee Resource Groups, which bring together employees of a common background and experience. The federal government has a number of scholarships-for-service programs. For example, DOD has the Science, Mathematics and Research for Transformation (SMART) Program, a scholarship-for-service program with a 1-for-1 payback through employment in a Defense laboratory.

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[20] OSTP. "2023 Progress Report on the Implementation of the Federal STEM Education Strategic Plan." April 16, 2024. https://www.whitehouse.gov/ostp/news-updates/2024/04/16/2023-progress-report-on-the-implementation-of-the-federal-science-technology-engineering-and-mathematics-stem-education-strategic-plan/

[21] NSF. "The STEM Labor Force of Today: Scientists, Engineers, and Skilled Technical Workers." August 31, 2021. https://ncses.nsf.gov/pubs/nsb20212

[22] OPM. "Students & Recent Graduates." https://www.opm.gov/policy-data-oversight/hiring-information/students-recent-graduates/

[23] OPM. "Presidential Management Fellows (PMF) Program Overview." July 8, 2024. https://www.pmf.gov/become-a-pmf/overview/

Developing Workforce Partnerships and Ecosystems – *Select Department and Agency Examples*

Department of Energy (DOE)
The DOE's STEM training and engagement efforts are critical to creating the diverse, skilled workforce that is needed to tackle some of the greatest scientific, technical, economic, and societal challenges of our time. Building on core research and training programs, DOE launched the Reaching a New Energy Sciences Workforce and Funding for Accelerated, Inclusive Research initiatives aimed at building foundations through student traineeships and increasing research capacity, respectively, at emerging research institutions and MSIs.

National Science Foundation (NSF)
NSF upholds America's competitive edge by training and preparing a 21st century STEM workforce. Each year, NSF invests an estimated $1.4 billion in STEM education and workforce development, including in bolstering partnerships for industry-led training. For example, NSF announced a new $45.6 million public-private partnership with Intel, Samsung, IBM, and Ericsson in FY2023 to train the next generation of talent necessary to grow a vibrant, domestic semiconductor industry. NSF also launched the Experiential Learning for Emerging and Novel Technologies to promote partnerships between organizations in emerging technology fields and organizations with expertise in workforce development. These partnerships expand access to practical learning opportunities in emerging and novel technology areas such as advanced manufacturing, AI, biotechnology, quantum information science, and semiconductors and microelectronics. NSF's Advanced Technological Education program supports partnerships between two-year institutions of higher education, other academic institutions, industry, and other entities to improve the education of technicians in science and engineering vital to the nation's economy and security.

Department of Commerce (DOC)
Building a diverse, skilled STEM workforce is a top priority for the DOC, and this mission is woven into a wide variety of DOC efforts. The Manufacturing USA network aims to secure U.S. global leadership in advanced manufacturing through large-scale, public-private collaboration on technology, supply chain, and education and workforce development. The network comprises 17 manufacturing innovation institutes sponsored by the DOC, DOD, and DOE, along with 6 other federal partners. Collectively, these institutes partnered with over 2,500 organizations in 142 education and workforce projects that touched more than 100,000 workers, students, and educators in 2022. Through these partnerships, the institutes engaged with community colleges, MSIs, HBCUs, and manufacturers to support new and upskilling workers. Additionally, NOAA's Cooperative Institute program supports 16 Cooperative Institutes across the country. These partnerships between NOAA and research universities or other research organizations expose students and early-career researchers to NOAA laboratories and programs, forming long-lasting collaborations.

b. Building an Equitable and Inclusive STEM Workforce

The U.S. continues to promote and invest in programs to develop a diverse STEM workforce through initiatives focused on undergraduate and graduate training opportunities and programs that increase

engagement with students attending HBCUs, MSIs, Hispanic-serving institutions (HSIs), and Tribal colleges and universities (TCUs). Effective practices for building an inclusive workforce include offering remote work opportunities; collaborating with institutions serving groups underrepresented in the STEM workforce, including women; and assistance programs supporting people from disadvantaged communities as well as support for specific groups, such as veterans, farmers, and ranchers.

Building an Equitable and Inclusive STEM Workforce – *Select Department and Agency Examples*

Department of Health and Human Services (HHS)
The NIH Common Fund Faculty Institutional Recruitment for Sustainable Transformation program aims to enhance and maintain cultures of inclusive excellence in the biomedical research community through recruitment, development, and support of a critical mass of early-career faculty who have a demonstrated commitment to inclusive excellence. The NIH Distinguished Scholars Program aims to build a more inclusive community within the NIH Intramural Research Program by facilitating the recruitment and career development of principal investigators who have a commitment to promoting diversity and inclusion in the biomedical, behavioral, and social sciences research workforce. The Cancer Moonshot Scholars program, created during the Biden-Harris Administration, is designed to improve cancer outcomes while also diversifying the pool of researchers and the approaches to cancer research that NIH funds.

National Science Foundation (NSF)
NSF is committed to bringing the "missing millions"—those from communities traditionally underrepresented in scientific and technical fields—into the STEM workforce. To do so, NSF is taking a comprehensive approach for inspiring, attracting, supporting, and advancing groups underrepresented in STEM. This strategy to "Create Opportunities Everywhere" aims to boost equity across the entire Agency portfolio. NSF is intentionally engaging MSIs and Emerging Research Institutions, especially those in EPSCoR jurisdictions.[24] Through the CHIPS and Science Act, NSF is authorized to support more pathways through scholarships, fellowships, traineeships, and project activities that enrich STEM education at all levels. NSF's commitment to finding talent provides opportunities that lead to a well-paid workforce and a vibrant U.S. economy. Complementing these efforts, NSF supports research to better understand and identify evidence-based approaches to addressing inequities. For example, the Science of Broadening Participation program employs the social, behavioral, economic, and learning sciences to understand levels of participation among underrepresented groups in education, workforce, and other social institutions. In addition, programs such as the HBCU Undergraduate Program, the TCU Program, and the Improving Undergraduate Education: HSI Program seek collectively to improve the quality of undergraduate STEM education and to increase the recruitment, retention, and graduation rates of students at MSIs pursuing post-secondary STEM degrees.

[24] NSF. "EPSCoR Funding Initiatives." https://new.nsf.gov/funding/initiatives/epscor

Department of Agriculture (USDA)
USDA conducts research to ensure that all Americans have access to healthy, safe, and affordable food. USDA supports research on environmental justice in agricultural and rural systems, supports R&D capacity for Tribal colleges, and makes major investments in education and skills development of our next generation. For example, USDA's NEXTGEN program provides training and support to more than 20,000 future food and agricultural leaders through 33 project partners. The 1890 National and Centers of Excellence Programs equip eligible minority-serving colleges and universities to educate and prepare citizens to benefit American agriculture, rural economies, and more. The 1890 Programs work collaboratively with local USDA agencies, 1890 Land-Grant Universities and the private sector to build capacity, support research, and award scholarships to students. The 1994 National Program builds the 35 Tribal schools' capacities in ways that benefit American agriculture, bolster rural Tribal economies, and strengthen U.S. nutrition security.

Department of Commerce: National Oceanic and Atmospheric Administration (NOAA)
NOAA is investing over $50 million in the new Climate-Ready Workforce initiative to meet emerging and existing needs of employers while helping workers find high-quality jobs. Efforts include workforce training investments focused on climate resilience ensuring direct hire or promotional pathways into jobs related to climate resilience with an emphasis on training and hiring in place, especially to benefit underserved communities. NOAA also provides research and experiential learning opportunities to prepare students from MSIs for careers in the STEM workforce. For example, NOAA's Educational Partnership Program with MSIs awards funding to MSIs and students attending MSIs through national competitions. Since its establishment in 2000, the program has worked collaboratively with MSI faculty and staff to increase the opportunities for education, training, and research in NOAA-mission disciplines, particularly for participants from historically underrepresented minority communities.

Department of Veterans Affairs: Office of Research and Development (ORD)
To meet the evolving healthcare needs of the nine million veterans that the VA cares for every day, ORD plays an essential role in the innovation of cutting-edge technologies and treatments. Its STEM workforce is pivotal to that effort. ORD has long been a proponent of the continuous learning needed to shape each generation of leaders in healthcare research and related fields through training programs, workshops, and access to cutting-edge tools that foster career growth. Furthermore, ORD employs several targeted recruitment strategies to identify and hire STEM experts, partnering with academic institutions, job boards, career fairs, and outreach programs that bring new opportunities to underprivileged areas so as to build a more diverse and inclusive workforce. These partnerships facilitate access to training, research opportunities, and internship programs for STEM students and interested professionals alike. For example, the VA ORD Summer Research Program gives students from high school to medical school the chance to gain valuable research experience, helping to shape the future careers of 170 students across 20 different VA medical centers in 2023.

IV. RESEARCH TO ACHIEVE AMERICA'S ASPIRATIONS

Today, our nation's aspirations are as great as they have ever been: to protect our national security, tackle the climate crisis, improve health outcomes, create opportunities for all, and govern and harness the power of AI and other emerging technologies. Doing this work well means building competitive 21st century industries that create good jobs, opening the door of opportunity for every American, and strengthening our values. The U.S. federal research ecosystem is essential to achieving all of these ambitions.

a. Protecting National Security

The U.S. remains the world's leading power. Our inherent national strengths remain unparalleled—the ingenuity, creativity, resilience, and determination of the American people; our values, diversity, and democratic institutions; our technological leadership and economic dynamism; and the strength of our national research, development, and engineering capabilities across the public and private sector.[25]

We are in a period in which the most pressing strategic challenge to our national security is from powers that layer authoritarian governance with a revisionist foreign policy. Many of their behaviors pose a challenge to international peace and stability—especially waging or preparing for wars of aggression, actively undermining the democratic political processes of other countries, leveraging technology and supply chains for coercion and repression, and exporting an illiberal model of international order.

The PRC is the only competitor to the U.S. with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power to advance that objective. The PRC continues to eliminate barriers between the civilian and military sectors, not just through R&D, but also by acquiring and diverting the world's cutting-edge technologies to achieve military dominance.[26]

Science and technology are central to today's geopolitical competition and to the future of our national security, economy, and democracy. U.S. and allied leadership in science, technology, and innovation has long underpinned our economic prosperity and military strength. In the next decade, critical and emerging technologies are poised to retool economies, transform militaries, and reshape the world. The U.S. is committed to a future where these technologies increase the security, prosperity, and values of the American people and like-minded democracies.

As we make investments to enhance U.S. R&D leadership and to advance U.S. competitiveness, we seek to accelerate the adoption of technical capabilities by U.S. forces, moving faster to extend and increase our advantage over competitors. We seek to maintain our advantage by ensuring appropriate safeguards to protect our technologies and programs against intellectual property theft and technology diversion and exploitation. We also seek to harness emerging technologies such as

[25] The White House. "National Security Strategy." October 12, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf

[26] The White House. "Executive Order on Addressing United States Investments in Certain National Security Technologies and Products in Countries of Concern" August 9, 2023. https://www.whitehouse.gov/briefing-room/presidential-actions/2023/08/09/executive-order-on-addressing-united-states-investments-in-certain-national-security-technologies-and-products-in-countries-of-concern/

quantum information science and AI capabilities for national security and to address the risks associated with nuclear proliferation and advanced biological threats. We continue to work to secure the American people and our critical infrastructure from cybersecurity threats and from foreign influence that seeks to manipulate our information environment.

b. Addressing the Climate Crisis

The world faces a profound climate crisis due to unabated greenhouse gas (GHG) emissions and further exacerbated by a loss of biodiversity and ecosystem disruptions. In the face of the mounting impacts, the need to mitigate, manage, and adapt to a changing climate is urgent. S&T play a key role in confronting this challenge, improving our understanding of how the climate and nature are changing, and developing mitigation strategies, new technologies and nature-based solutions that enable the transition to a clean and resilient economy. As the climate changes and natural buffers from healthy ecosystems are lost or degraded, extreme weather events are becoming more frequent and more dangerous. There is a clear need for innovative solutions both to mitigate the sources of greenhouse gas emissions and to improve the resilience of vulnerable communities and ecosystems.

The Biden-Harris Administration is leading a comprehensive and unprecedented approach, backed by science to understand, assess, anticipate, and respond to the climate crisis. This approach includes hundreds of new initiatives and efforts, particularly around the implementation of the Inflation Reduction Act, Bipartisan Infrastructure Law, and CHIPS and Science Act. These actions focus on research, development, demonstration, and deployment of new innovations and technologies that can reduce GHG emissions, as well as incentives and regulations to promote the adoption of clean energy technologies, such as electric vehicles, solar panels, wind turbines, and batteries. The projected effect of these efforts is to reduce U.S. emissions by up to 40% by 2030 from 2005 levels.[27] In order to reach net-zero emissions by 2050, additional development and deployment of new technologies will be needed, and it is estimated that 35% of reductions by 2050 will come from technologies still not developed.[28] Continued investment in the pipeline of these technologies and their deployment will enable U.S. global leadership on the road to net-zero emissions.

Alongside S&T development for mitigating emissions, the federal government is addressing climate resilience through coordinated approaches across agencies. These actions include investments in adaptation for the built and natural environment, advancing nature-based and ocean-based climate solutions, and supporting climate science and services to improve understanding and make information more actionable. Climate research programs are essential to informing a number of decisions, from stormwater management, to managing for shifts in species ranges, to the design of infrastructure to better withstand extreme events fueled by climate change. Throughout the federal government, these programs have diverse missions and goals, such as advancing research on nature to inform understanding of current and future food and water security, examining and addressing the environmental impacts of computing and electronics, anticipating and responding to the effects of climate change on human health, and supporting efforts to assess the impacts of climate change on

[27] Bistline et al., "Emissions and Energy Impacts of the Inflation Reduction Act," *Science*, June 29, 2023. https://doi.org/10.1126/science.adg3781

[28] International Energy Agency. "Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach." September 2023. https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach

biodiversity and nature. Given the disparate impacts of climate-related health and economic burdens across the nation, advancing environmental justice is a key priority underpinning all of these efforts, including that communities with environmental justice concerns are meaningfully involved across all stages of the science, data, and research life cycles and that longstanding barriers and gaps are identified and addressed.[29]

c. Improving Health Outcomes

Americans experience worse health outcomes than people in many other developed economies around the world. For example, with an estimated average life expectancy at birth of 77 years, the U.S. ranks 31st out of 38 Organization for Economic Co-operation and Development countries.[30] This is unacceptable for the world's wealthiest nation. America must achieve a future in which every person can live a long and healthy life, and science, technology, and innovation must drive progress to make that aspiration possible.

The federal government has long been a key funder of research in health and the biomedical and life sciences. Much of this investment is targeted at building the foundational knowledge that drives discovery as well as developing treatment and technologies that reduce illness and support longer, healthier lives. Additionally, the Biden-Harris Administration has created ARPA-H, a new biomedical research agency with the mission to drive innovation to improve human health outcomes. The Administration has also taken significant steps to increase R&D focused on disease prevention and on improving public health and health care delivery. For example, the Bipartisan Infrastructure Law and Inflation Reduction Act have propelled efforts to address environmental injustice, and understand as well as mitigate environmental and toxic exposures that lead to negative health outcomes.

Yet, despite all of this progress, there is still more that needs to be done. Implementing a priority to improve human health outcomes begins with a focus on health, not disease. R&D can drive new understanding in how to improve prevention and health maintenance, address social determinants of health, accurately and efficiently diagnose disease, and survive a disease or manage a chronic health condition. Additionally, R&D, including implementation science, can provide evidence on how to reach more Americans with the tools we have to prevent, detect, treat, and survive diseases, disorders, and conditions.

President Biden's Cancer Moonshot is an example of how ambitious goal-setting can drive progress that matters for American lives. The Biden Cancer Moonshot is mobilizing people and organizations across government and the private sector to reduce the age-adjusted death rate from cancer by at least 50% over 25 years, preventing more than 4 million cancer deaths by 2047, and improve the experience of people living with and surviving cancer and their families. The Biden Cancer Moonshot has delivered more than 100 actions across many federal agencies and department to improve prevention, reduce environmental and toxic exposures, increase early detection, drive innovation and access to care, and boost support for families facing cancer.

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[29] NSTC. "Environmental Justice Science, Data, and Research Plan." July 2024. https://www.whitehouse.gov/wp-content/uploads/2024/07/NSTC-EJ-Research-Plan-July-2024.pdf

[30] National Center for Health Workforce Analysis. "State of the Primary Care Workforce, 2023." November 2023. https://bhw.hrsa.gov/sites/default/files/bureau-health-workforce/data-research/state-of-primary-care-workforce-2023.pdf

d. Harnessing the Power of AI

With its powerful capabilities and broad applications, artificial intelligence has become the most consequential technology of our time. Around the world, many countries are investing heavily in AI R&D, racing to use AI to build the future. At this pivotal moment, American leadership is essential for a future that embodies our values rather than those of authoritarian regimes.

Used responsibly and wisely, AI has the potential to help our world become more prosperous, productive, innovative, secure, sustainable, and healthy. But the irresponsible use of AI can pose risks to national security; exacerbate harms such as fraud, discrimination, bias, and disinformation; displace and disempower workers; and stifle competition. That's why President Biden and Vice President Harris have been clear that we must manage the risks of AI in order to seize its benefits. Through President Biden's Executive Order on the Safe, Secure, and Trustworthy Development and Use of AI, the Biden-Harris Administration prioritized standards for AI safety and security, protecting privacy, advancing equity and civil rights, and standing up for consumers and workers. The Biden-Harris Administration has also delivered the first-ever voluntary commitments from AI companies, has been working with allies and partners globally, and continues to work with Congress on bipartisan legislation.

Today, technology companies are investing in advancing AI technology and applying it for both business and consumer applications. If we are to achieve the promise of AI for the American people, federal R&D also needs to play several essential roles. These include providing the research foundation to evaluate and design AI systems that are safe, effective, and trustworthy, as well as creating a robust research infrastructure—the massive compute and data resources that fuel AI technology advancements. In addition, federal R&D is necessary to apply AI for public missions. AI holds tremendous promise for helping us achieve America's great aspirations in areas from national security to health to meeting the climate challenge, and more. OSTP outlined visions and plans for this kind of AI R&D recently,[31] including:

- We can use AI to help us develop and approve new medicines for seemingly intractable diseases in months rather than decades.
- We can design AI to deliver weather forecasts that save lives and protect property with neighborhood-level, longer lead projections that people across the country can count on.
- We can harness AI to help create transportation projects that prevent traffic accidents and keep America moving.
- We can use AI to help us deliver critical government services to Americans anywhere in the country right when they need them.
- We can use AI to develop new high-performance, sustainable materials in years rather than decades for globally-competitive semiconductor manufacturing and other critical applications.
- We can use AI to help us build more flexible, reliable electrical grids that can meet growing demand and respond to evolving threats, all while accelerating clean energy deployment.
- We can use AI for individualized learning to help every teacher help every student achieve their own American dream.

[31] OSTP. "AI Aspirations: R&D for Public Missions". June 2024. https://ai.gov/aspirations/