

6. RESEARCH AND DEVELOPMENT

Science, technology, research, experimentation, and innovation have been critical to America’s long standing as a global leader, to our economic strength, and to shared prosperity because they allow us to expand what is possible and to solve seemingly intractable problems. Public investment in research and development (R&D) is a critical counterpart to private investment and Federal funding, in particular, is essential to ensuring that investments in new research and technologies meet our national and global opportunities and challenges. Continued broad bipartisan support for Federal investment in cutting-edge R&D will enable the United States to achieve the greatest aspirations of this century — improved health, a stable climate, increased economic opportunity, competitive industry, global security, and a robust democracy. It will ensure that the scale of our efforts matches the magnitude of today’s challenges. The Administration is building on recently enacted laws—like the CHIPS and Science Act (Public Law 117-167, “CHIPS Act”) and the Inflation Reduction Act of 2022 (Public Law 117-169, “IRA”)—to ensure that investment in R&D results in good jobs at home, green energy solutions, and just and equitable outcomes. The Budget proposes investments that reinforce and expand our commitment to innovation and that ensure that the benefits of scientific research and new technologies reach all people and communities.

The Administration is advancing policies to ensure that the results of federally funded research are made widely available to the public to facilitate understanding, participation, and inclusive decision-making; to the broader scientific community to promote the exchange of ideas that is key to the advancement of knowledge; and to innovators and entrepreneurs in every region of the United States, who will translate the research into world-leading businesses employing American workers. In addition to public access to research results, the Administration is placing a deliberate emphasis on ensuring that research funding extends to and can be accessed by disadvantaged communities that have been historically underserved, marginalized, and adversely affected by persistent poverty and structural inequality. The Budget continues to support funding for transformative and high-reward research approaches to tackling societal challenges. And, as we seek to make our supply chains more resilient, these R&D investments will protect intellectual property developed in the United States and help create products that are made by U.S. workers.

The President’s 2024 Budget proposes an historic investment in our Nation’s future, including \$209.7 billion for Federal R&D¹, a \$8.9 billion increase over the 2023

enacted level, including approximately \$18 billion for R&D in key agencies in the CHIPS Act (the Department of Energy (DOE), the National Science Foundation (NSF), and the Department of Commerce’s National Institute Standards and Technology). This Federal investment addresses societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments, particularly in the basic and applied research that has been a hallmark of the American innovation enterprise. The 2024 Budget provides \$101.2 billion for basic and applied research, an increase of \$3.5 billion above the 2023 enacted level.

The Budget advances the Administration’s focus on the innovation ecosystem itself by targeting Federal R&D investments for maximum impact on societal needs, including for breakthroughs based on the successful Defense Advanced Research Projects Agency (DARPA) model. Building on that model, the Budget proposes support for advanced research in additional areas of focus, including:

- \$2.5 billion, an increase of \$1 billion over the 2023 enacted level, for the Advanced Research Projects Agency for Health (ARPA-H) to drive biomedical and health breakthroughs – ranging from molecular to societal – to deliver transformative, sustainable, and equitable health solutions for everyone;
- \$650 million for the Advanced Research Projects Agency-Energy in DOE, a key element of the Administration’s game changing clean energy agenda; and,
- \$19 million for the new Advanced Research Projects Agency-Infrastructure in the Department of Transportation to accelerate the transformative transportation goals of the Infrastructure Investment and Jobs Act (Public Law 117-58) and conduct critical research to address the 43,000 annual roadway fatalities in the United States.

The Administration also prioritizes other potentially transformative agency approaches to investing in solutions to societal challenges, such as \$1.2 billion for the recently authorized NSF Directorate for Technology, Innovation, and Partnerships, which will focus on use-inspired and translational research to give rise to new industries and create new, high-wage jobs in STEM for a broader range of Americans. The Budget also supports efforts focused on bolstering regional innovation, including \$50 million in discretionary funding for the Regional Technology and Innovation Hub program at the Department of Commerce and \$300 million for NSF’s Regional Innovation Engines program.

¹ This total includes the conduct of R&D and investments in R&D facilities and equipment (see Table 6–1). Detailed definitions and discussion are available in Section II below.

INFLATION REDUCTION ACT & CHIPS AND SCIENCE ACT

The Budget complements and builds upon the one-time funding in the IRA and the CHIPS Act. For example, the IRA provided \$1.55 billion to the DOE Office of Science, which augmented investments in 17 scientific user facilities/major construction projects and 12 major items of equipment, enabling a more rapid completion. Four of these major construction projects and two major items of equipment are requesting final funding in the Budget. The IRA also provided \$190 million to NOAA for the procurement of high-performance computing, data processing capacity, data management, and storage assets to improve weather, ocean, and climate modeling.

To strengthen the role of the United States in semiconductor technology, the CHIPS Act provided the Department of Commerce \$11 billion to support semiconductor research and development and infrastructure investments, including programs to conduct research and prototyping of advanced semiconductor technology and to strengthen semiconductor advanced test, assembly, and packaging capability. The CHIPS Act provided NSF with \$200 million over five years for semiconductors and microelectronics education and workforce development activities, which will strengthen the workforce of the future to keep the United States the leader in the industries of tomorrow, including nanotechnology, clean energy, biotechnology, quantum computing, and artificial intelligence. The aforementioned are illustrative examples of R&D supported by the IRA and the CHIPS Act and are not meant to be exhaustive.

I. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

Research investments in the most promising areas for future industry, scientific discovery, and job creation are being largely addressed through multi-agency research activities coordinated through the National Science and Technology Council and other interagency forums, like the Net-Zero Game Changers Working Group and the National Biotechnology and Biomanufacturing Initiative, since some of these challenges cannot be addressed effectively by a single agency. This section highlights the Administration's multi-agency R&D priorities and the 2024 Budget's support of those priorities.

Cutting the death rate from cancer by at least half

The President has set the ambitious goal of cutting the age-adjusted death rate from cancer by at least 50 percent over the next 25 years and improving the experience of people living with cancer, their loved ones and families. The Cancer Moonshot initiative includes developing and deploying effective ways to prevent, detect, and treat cancer through new breakthroughs and ensuring existing tools reach more Americans equitably. At nearly \$2 billion in the area of R&D for Cancer Moonshot-related investments, the Budget supports laboratory, clinical, public health, and environmental health research programs that span five focus areas across more than a dozen departments and agencies, including:

- \$1.7 billion at the Department of Health and Human Services and a total investment of \$7.8 billion for the National Cancer Institute, plus expected critical contributions from ARPA-H to help deliver on Moonshot goals;
- \$94 million at the Department of Veterans Affairs (VA), which focuses on the etiology, pathogenesis, epidemiology, diagnosis, prognosis, treatment, and prevention of cancer as well as healthcare utilization, delivery of care to cancer patients, and the delivery,

efficacy and effectiveness of therapies (incl. chemotherapy, radiation, immunotherapy, gene therapy, bone marrow transplants) for the treatment of adult leukemia/lymphoma, solid tumors and cancer pain;

- \$40 million at the U.S. Department of Agriculture (USDA) for the National Institute of Food Agriculture and the Agricultural Research Service;
- \$47 million for the Department of Defense's Murtha Cancer Center (up from \$37 million in 2023), which supports the tri-agency Applied Proteogenomics Organizational Learning and Outcomes (APOLLO) project and its related research initiatives. The funding has expanded clinical trials, established an epidemiology division, and expanded the DOD serum repository for cancer research; and,
- \$5 million at the National Aeronautics and Space Administration (NASA) to pursue cancer-related research on the International Space Station National Lab.

Close the screening gap: To reduce the deficit in cancer screenings and to expand equitable access to effective early detection, the Budget supports the development of innovative approaches to screening and early detection, including more precise, less invasive, and even at-home methods. For example, the Budget invests in the Centers for Disease Control and Prevention's (CDC) National Comprehensive Cancer Control Program, including the Cancer Genomics program, to increase the number of individuals who share information on their family history of cancer with a health care provider and are appropriately referred to genetic counseling and testing. Investment at the National Cancer Institute includes a large national trial that, if successful, will identify effective blood tests for the detection of one or more cancers, providing the opportunity for additional, less-invasive tools for early

detection. The Budget also drives efforts to reach more communities with effective cancer early detection with a focus on those who are currently medically underserved, including American Indians and Alaska Natives.

Understand and address environmental and toxic exposures: To better prevent and mitigate certain types of cancers, the Budget invests in a robust scientific research agenda to enable increased understanding of the impact of environmental and toxic exposures. The Environmental Protection Agency (EPA) conducts extensive assessments to evaluate chemical hazards related to cancer outcomes. The Budget contains funding for EPA to continue investments in a variety of tools for evaluating the health hazards posed by chemicals, including the Integrated Risk Information System (IRIS), Provisional Peer-Reviewed Toxicity Values Program, and Integrated Science Assessments. The Budget also continues support for EPA to implement programs to improve air toxics data, characterize potential cancer risk, and issue regulations that result in lower emissions and reduced health risk for people across America. The Budget provides \$133 million increase for FDA to bolster its regulatory capacity, to modernize its oversight of food, and reduce exposure to toxic metals and chemicals in food, dietary supplements, and cosmetics. Additional investments at CDC will enhance funding for State public health laboratories for biomonitoring programs to increase their capability and capacity to assess human exposure to environmental chemicals of concern and conduct cancer cluster investigations. The Budget also provides \$68 million for military and environmental exposures research. This funding level includes \$46 million in the Toxic Exposures Fund to support research required under the Sergeant First Class Heath Robinson Honoring our Promise to Address Comprehensive Toxics Act of 2022 (Public Law 117-168, “PACT Act”), which stands as the most significant expansion of benefits and services for toxic exposed veterans in more than 30 years. To better understand the impact of toxic exposures, the PACT Act requires VA to conduct new studies of veterans who served in Southwest Asia during the Gulf War and analyses of post-9/11 veterans’ health trends. The Budget supports the law’s requirement that the Secretary of Veterans Affairs to convene a new interagency working group to develop a five-year strategic plan on toxic exposure research. At the Department of Defense, this includes a new program, PROMETHEUS, or the PROject for Military Exposures and Toxin History Evaluation in U.S. service members, which will bring together agency and private sector innovators to understand and address cancer in exposed service members—this involves the DOD Serum Repository, which contains blood samples for all service members.

Decrease the impact of preventable cancers: The Budget supports research efforts focused on fully understanding and developing additional approaches to reach people with cancer prevention tools and to decrease the impact of nutrition- and tobacco-related cancers, including through new investments in CDC’s Tobacco Prevention and Control program. The Budget also expands access to cancer-prevention approaches through evidence-based public

health and community health efforts to ensure these preventative tools are reaching all U.S. populations. The Budget increases investments in CDC’s National Breast and Cervical Cancer Early Detection Program to enhance breast and cervical cancer screening and diagnostic services for uninsured and underinsured American women, and supports efforts to increase HPV vaccine uptake to prevent HPV-associated cancers. Under the Budget, EPA will continue work to reduce public health risk associated with radon, the leading environmental cause of lung cancer death. Through a multi-agency effort and public private partnership, EPA co-sponsored the recent publication of The National Radon Action Plan 2021-2025, which has set a goal for the Nation to prevent at least 3,500 lung cancer deaths per year. The Budget supports EPA continuing its efforts to address radon as a health equity challenge and prioritize new strategies to reduce radon risk in underserved communities, including communities of color.

Bring cutting edge research through the pipeline to patients and communities: The Budget invests in the development and deployment of new ways to prevent, detect, and treat cancer to increase survival rates. The Budget also includes \$7.8 billion for the National Cancer Institute, an increase of \$500 million above the 2023 enacted level, and proposes to reauthorize the 21st Century Cures Act (Public Law 114-255) Cancer Moonshot through 2026. Investments in fundamental research would support precision medicine, target effective treatments to patients, improve cancer survivorship, and speed progress on some of the deadliest and rare cancers, including childhood cancers. Of the \$40 million for USDA noted above, the Budget invests \$13 million in USDA’s Agriculture Science Center of Excellence for Nutrition and Diet for Better Health, or ASCEND for Better Health. ASCEND will accelerate research through partnerships with Texas A&M University and six human nutrition research centers, enable research through big data and translate research through engagement with extension and community leaders.

Support patients and caregivers: To make the experience around cancer—from screening, to getting a diagnosis, to treatment, care, and surviving—easier on those living with cancer and their caregivers, the Budget supports evidence-based and scientifically-sound public health approaches, including through investments in CDC’s Cancer Survivorship Resource Center. The Budget also drives improvement in the quality of cancer care and simplifies the process for patients to identify high value cancer care.

Preparing for and preventing pandemics

The COVID-19 pandemic has claimed countless lives and cost the U.S. and global economy trillions of dollars, demonstrating our vulnerability to current and future biological threats. As COVID-19 variants and other pathogens spread globally, the Federal Government must accelerate the development of scientific and other capabilities that can stop outbreaks before they become epidemics or pandemics, regardless of natural, accidental, and deliberate origin.

Preparedness and biodefense: The Budget includes discretionary investments at HHS to better prepare the U.S. for emerging biological threats, including \$1 billion for the Biomedical Advanced Research and Development Authority, of which \$76 million will support the Division of Research, Innovation, and Ventures. The Budget also includes \$400 million in flexible discretionary resources within the Administration for Strategic Preparedness and Response to support the development of next-generation medical countermeasures, secure the domestic medical supply chain, and adapt response efforts to stay ahead of evolving biological threats. In addition, the Budget invests in CDC's capacity to respond to emerging threats, including surveillance and laboratory capacity. The Budget also includes \$20 billion in mandatory funding for HHS public health agencies in support of the Administration's pandemic preparedness and biodefense priorities as outlined in the *2022 National Biodefense Strategy and Implementation Plan for Countering Biological Threats, Enhancing Pandemic Preparedness, and Achieving Global Health Security*. The Budget builds toward a goal of making effective vaccines, diagnostics, and therapeutics available shortly after identifying a new pathogen by investing in basic and advanced R&D of medical countermeasures for high priority viral families and biological threats, including expansion and modernization of clinical trial infrastructure necessary to inform evaluation and subsequent authorizations or approvals, as well as expansion of domestic manufacturing capacity to ensure sufficient supply is available. The Budget also invests in laboratory capacity, domestic and global threat surveillance, and biosafety and security that would enable a rapid and robust response to future threats.

Strong public health system: A crucial safeguard against pandemics is a strong, resilient, public health system. The Budget supports a rapid, scalable, and equitable public health response, with investments in R&D to develop fundamental public health capabilities such as an integrated data infrastructure, evidence-based health communication strategies, and digital health technologies needed to implement high-quality virtual healthcare. For example, VA investigators continue to publish major studies examining the relative effectiveness of different vaccines, with and without boosters, the relative protection against infection, re-infection, and severe disease, and the durability of that protection. DOD is committing \$10 million to conduct a feasibility study on accelerating antibody and vaccine development.

Tackling Climate Change

The United States and the world face a profound climate crisis, with a narrow window to avoid the most catastrophic impacts and to seize the opportunities that tackling climate change presents. Climate change impacts are intertwined with and are exacerbated by related global change issues, such as nature and biodiversity loss, pandemics, and social inequalities. These interconnections have played out in several recent extreme-weather events; for example, Hurricane Laura had disproportionate impacts on low-income and underhoused communities,

and disaster response was hindered by the COVID-19 pandemic and an extreme heat event that immediately followed. The President has directed a whole-of-Government approach to achieve net-zero climate pollution in every sector of the economy, conserve nature, increase resilience to the impacts of climate change, drive environmental justice, support actions that protect public health and build resilience in those communities most vulnerable to climate impacts, while creating good-paying jobs that provide a free and fair chance to join a union and collectively bargain.

The 2024 Budget—with a total climate innovation investment of \$16.5 billion—prioritizes multi-agency R&D investments that advance the understanding of climate change, including its interactions with nature loss and human systems; necessary innovations in clean energy, climate technology, and infrastructure; the ability to evaluate responses to climate change, including climate mitigation, resilience, and climate and ecosystem services; equity and environmental justice, and, workforce capacity to develop and effectively implement mitigation and resilience solutions including for the most vulnerable Americans.

Climate science: Advancing climate science—including physical, biological, social, and economic science—improves our understanding of our Earth and its climate and the interaction of climate change with other global changes; improves Earth system modeling capabilities and our ability to feed outputs directly into derivative risk models (i.e., flood, wildfire, drought); and improves our understanding of the changes that pose the greatest risk to communities and ecosystems, and the most promising opportunities to avoid and reduce emerging risks. Global change research investments are coordinated through the U.S. Global Change Research Program. The Budget provides \$2.5 billion for NASA's Earth Science program, which will enhance our understanding of Earth systems and provide information to tackle the climate crisis and mitigate natural hazards. The Budget includes \$1 billion for NSF to better understand and prepare for the adverse impacts of climate change and \$8 million for a new activity that will harness the advances in computing technology to understand and analyze climate-driven problems such as extreme events that require more focused multidisciplinary research. The Budget includes \$24 million for advanced grid modeling research to build electricity sector capabilities to ensure the resilience of the Nation's electric grid. It will also support the Integrative Artificial Intelligence Framework for Earth System Predictability to enable automation and learning across heterogeneous data, data quality validation, and prediction. For the USDA's core climate related R&D activities, including the impacts of weather and water cycle variations on soil, air, and water resources needed for agriculture production, the Budget includes \$612 million. Agriculture is faced with adapting quickly to unprecedented climate changes and weather extremes with minimal interruptions in production. The Budget includes an increase of \$196 million over the 2023 enacted level for climate science, clean energy and adaptation and resilience research

at the Agriculture Research Service. The Budget includes \$10 million for ongoing research by the U.S. Army Corps of Engineers on forecast informed reservoir operations to improve water management at some dams based on recent advances in weather and water forecasts.

Innovation in clean energy and climate technology and infrastructure: The Budget spurs invention, development, commercialization, and deployment of clean energy and climate technologies, including those to lower costs, improve performance, and achieve net-zero emissions in the power, buildings, transportation, industrial, and agricultural sectors. The Budget invests \$11.3 billion in clean energy innovation, of which \$4 billion is focused on net-zero game-changer priorities that will help enable the United States to meet the President’s goal of cutting greenhouse gases (GHGs) by 50-52 percent in 2030 and get to net-zero emissions by no later than 2050. Prioritized game-changing innovations include net-zero power grid and electrification, industrial products and processes for a net-zero circular economy, net-zero aviation, efficient heating and cooling, and fusion energy at scale.

CHIPS Act climate priorities: In line with the CHIPS Act, the Budget supports emerging technologies to help study and mitigate climate impacts. For example, the Budget prioritizes the use-inspired research essential for the development of future generations of climate mitigation and game-changing clean energy technologies. DOE’s Office of Science will be increasing investments in fusion, requesting over \$1 billion to enable advancement in the potentiality of fusion as a clean baseload energy source. The program will enable greater cooperation with the private sector through milestone-based investments and four new R&D centers. The Budget includes \$1.56 million for DOE’s Office of Nuclear Energy, which will continue investments in fission research and development at national laboratories, universities, and with industry partners to support the existing fleet, secure and sustainable fuel cycles, and commercial deployments of zero-carbon advanced reactors. Investments at NSF will fund an Artificial Intelligence (AI) Research Institute, bringing together academia, Government, and private industry to develop user-driven, trustworthy AI that addresses climate change issues, which will improve the Nation’s understanding of severe weather and ocean phenomena, save lives and property, and increase societal resilience to climate change. In addition, NSF investments will foster transition of research by beginning work that couples climate and other priority investments to related AI institutes.

Climate change adaptation and resilience: The Budget prioritizes R&D investments that advance understanding of climate adaptation and resilience solutions. For example, NSF continues to support research that contributes to providing the scientific basis to inform and enable timely decisions on adaptation and mitigation. A key focus for NSF is developing better means of assessing and responding to the impacts of global change as well as the vulnerability and resilience of both human and natural systems to those changes, particularly in highly sensitive regions such as the Arctic and Antarctic. Activities

supported by the Budget include regional climate impact integration hubs, focused on climate innovation, mitigation and adaptation, and \$25 million for a new program to support resilient and adaptive collaborations for habitability, leveraging research at regional hubs more broadly applicable to other science and geographic areas.

Nature-based solutions: The Budget supports programs aimed at understanding and improving the effectiveness of nature-based solutions to achieve climate goals, improve equity and create economic prosperity. The Budget continues investment at the U.S. Geological Survey to support the development of a National Nature Assessment, which will take stock of U.S. lands, waters, wildlife and the benefits they provide to our economy, health, climate, environmental justice, and national security. The Budget also invests in greenhouse gas measurement and monitoring, including the transition of relevant research capabilities to operational use and enhancement of GHG data products to better meet user needs. The Budget supports improving visualization and accessibility of GHG data from satellites and other observing platforms as part of NASA’s Earth Information Center and interagency efforts to combine atmospheric-based data with activity-based “bottom up” data to enhance the accuracy and specificity of GHG emissions information. The Budget also invests in a new annual conservation data series to fill critical data gaps in USDA’s understanding of conservation data as they relate to reducing GHG emissions from agriculture.

Advancing national security and technological competitiveness

U.S. leadership in new technologies is critical to ensure future economic competitiveness and national security. The Budget builds on CHIPS Act investments in R&D to lay the foundation for the future breakthroughs that will yield new jobs, new businesses, and more exports. The Budget provides for agency investments in science, technology, and innovation to strengthen our long-term global competitiveness while reducing catastrophic risks from current and emerging technologies.

Critical and emerging technologies: The Budget invests in world-leading research and innovation in critical and emerging technologies, including: trustworthy AI aligned with the Administration’s Blueprint for an AI Bill of Rights, quantum information science, advanced communications technologies, microelectronics, nanotechnology, high-performance computing, biotechnology and biomanufacturing, robotics, advanced materials and manufacturing, digital assets, undersea technologies, and space technologies. The Budget provides \$96 billion for Department of Defense R&D programs. This total includes funding for the development of next generation microelectronics for defense applications, support to grow the bioeconomy, and investments in defense-related quantum R&D. To continue to recruit and train a national-security focused STEM-capable workforce, the Budget supports the National Defense Education Program. The Budget also makes strong investments in the comprehensive modernization of the strategic deterrent, providing \$7.2 billion for National Nuclear Security Administration

(NNSA) research programs to sustain a safe, secure, and effective nuclear deterrent; facilitate nonproliferation efforts and arms control verification; and power the U.S. Navy. Funding for NNSA will build on recent scientific successes including the achievement of fusion ignition at the DOE's National Ignition Facility. The Budget also includes R&D needed to mitigate risks associated with nuclear nonproliferation, supporting an integrated approach to strategic arms control and treaty verification in development with allies and partners. At NSF, the Budget provides \$30 million to pilot a National AI Research Resource, a shared computing and data infrastructure that will provide AI researchers across scientific disciplines with computing resources and high-quality data; and includes \$8 million for multidisciplinary, multi-institution research effort in digital assets focused on examining the technical and socio-technical benefits and risks of digital assets. The Budget includes efforts to understand the holistic state of global technological competition and inform the long-term policy investments that underpin economic leadership. The Budget also supports investments in the National Biotechnology and Biomanufacturing Initiative to further U.S. economic security and supply chain resilience.

Planetary Defense: In 2022, NASA demonstrated humanity's first-ever planetary defense test with the resoundingly successful Double Asteroid Redirection Test mission. The Budget makes the critical next step in America's planetary defense capabilities by providing \$210 million to the Near-Earth Object Surveyor, an infrared space telescope that will discover and characterize potentially hazardous near-Earth objects.

Innovation for Equity

Innovative funding mechanisms and programs: The Budget supports R&D program structures and policies to equip entities which have been systemically hindered from receiving their fair share of funding – including some Historically Black Colleges and Universities (HBCU), Minority Serving Institutions (MSI), Tribal colleges, community colleges, and institutions in underserved geographic regions – to successfully compete for R&D funding. Acknowledging that funds and resources are unevenly available, often exacerbating existing disparities, stunting innovation, and building distrust of the scientific system, these investments will open new doors of opportunity and significantly strengthen the Nation's ability to compete globally and achieve U.S. strategic priorities in science and technology. Through USDA, the Budget provides \$370 million for agriculture research, extension, and education to minority-serving land grant universities and Tribal colleges. At NSF, the Budget includes \$397 million to broaden participation of historically underrepresented groups in STEM. NSF investments also include \$281 million for the Established Program to Stimulate Competitive Research (EPSCoR) to increase geographic diversity of STEM capacity and capability. The Budget positions NASA to build on lessons from ongoing evalu-

ations to identify strategies that increase HBCU/MSI participation in NASA early stage innovation research opportunities through Small Business Innovation Research, Small Business Technology Transfer, and other NASA programs.

Equitable data infrastructure and access: The Budget supports the development of data infrastructure and data access that facilitates identification of inequities across sectors at scale, especially in underserved communities that have been systematically denied a full opportunity to participate. The Budget extends the Analytics for Equity pilot at NSF, a cutting-edge collaboration vehicle that pairs interested researchers directly with Federal agencies to produce rigorous empirical evidence and research in equity-related topics aligned to agency Learning Agendas. The initiative leverages Federal data assets and aims to broaden participation from academic institutions and researchers that may not typically have opportunities to access such data or work directly with Federal agencies.

Actionable assessments and equitable measurements: Following the Presidential Memorandum on Restoring Trust in Government Through Scientific Integrity and Evidence-based Policymaking, the U.S. Government must make evidence-based decisions guided by the best available science and data. Many R&D efforts in the Budget employ evidence-based approaches to assess and evaluate Federal investments for effectiveness and impact, as part of Government-wide efforts to ensure Federal resources are equitably and broadly disseminated.

Climate equity: Improving climate resilience requires increasing the Federal Government's effective and equitable communication of environmental and climate hazard information and various types of uncertainty in an assortment of domains to the American public. Drawing upon social and behavioral science scholarship increases the likelihood that diverse subpopulations of the American public will receive the information they need in ways that enable responses consistent with individuals' overall health and wellbeing, no matter where they live or how they identify. In line with the Justice40 initiative, the Budget supports resilience and adaptation planning, including for disadvantaged communities that are historically underserved, marginalized, and adversely affected by persistent poverty, structural racism, and systemic inequality, in order to co-create resilience solutions that address their specific long-term needs and are more just, inclusive, and equitable. The Budget provides \$15 million for a new NSF fellowship that would provide researchers studying disparate impacts of climate change with a broader skillset to address the interactions of science and policy in this complex area, allowing stakeholders greater knowledge and impact into the climate effects on and methods of adaptation and resilience in their communities. The Budget also includes \$35 million for an expansion of energy efficiency and renewable energy capacity at one or more Historically Black College or University or Minority Serving Institution.

Cultivating STEM education, engagement, and workforce ecosystems

The Budget supports our Nation's STEM students: the instructional, institutional, and informal environments for STEM learning; and the training and recruiting of our future STEM workforce. These investments help America to achieve its strategic priorities by tearing down institutional barriers which have long stood in the way of equitable participation in STEM fields and prevented the American innovation ecosystem from achieving its full potential.

Investments in STEM education: For NASA's Office of STEM Engagement, the Budget includes \$158 million, which will allow NASA to broaden participation in STEM and expand partnerships in K-12 STEM programming. The Budget includes \$155 million for DOE Office of Science's Reaching a New Energy Workforce and Funding for Accelerated Inclusive Research program. For

NSF's STEM Education Directorate, the Budget proposes \$1,444 million to make strategic investments in fellowships, scholarships, and traineeships to produce a diverse and well-prepared workforce in STEM for the Nation. The NSF proposal also includes \$8 million to build a network of regional-scale consortia, focused on developing thriving graduate student cohorts. The Budget proposes \$75 million to create the National Center for Advanced Development in Education to develop cutting-edge, transformative solutions to our Nation's most pressing education challenges.

These investments provide holistic support to students and their families, invest in a strong and diverse teacher pipeline, close the funding gap for communities historically excluded from key resources, scale solutions that root out bias, discrimination, and harassment in the classroom, laboratory, and workplace, and promote accountability across the STEM ecosystem.

II. FEDERAL RESEARCH AND DEVELOPMENT DATA

R&D is the collection of efforts directed toward gaining greater knowledge or understanding and applying knowledge toward the production of useful materials, devices, and methods. R&D investments can be characterized as basic research, applied research, development, R&D equipment, or R&D facilities. The Office of Management and Budget has used those or similar categories in its collection of R&D data since 1949. Please note that R&D crosscuts in specific topical areas as mandated by law will be reported separately in forthcoming Supplements to the President's 2024 Budget. OMB also intends to initiate an Arctic research crosscut, spanning the 2022-2024 Budgets later this year.

Background on Federal R&D Funding

More than 20 Federal agencies fund R&D in the United States. The character of the R&D that these agencies fund depends on the mission of each agency and on the role of R&D in accomplishing it. Table 6-1 shows agency-by-agency spending on basic research, applied research, experimental development, and R&D equipment and facilities.

Basic research is systematic study directed toward a fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in

mind. Basic research, however, may include activities with broad applications in mind.

Applied research is systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

Experimental development is creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

Research and development equipment includes acquisition or design and production of movable equipment, such as spectrometers, research satellites, detectors, and other instruments. At a minimum, this category includes programs devoted to the purchase or construction of R&D equipment.

Research and development facilities include the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the Government or by a private organization, and regardless of where title to the property may rest. This category includes such fixed facilities as reactors, wind tunnels, and particle accelerators.

Table 6–1. FEDERAL RESEARCH AND DEVELOPMENT SPENDING(Mandatory and discretionary budget authority ¹, dollar amounts in millions)

	2022 Actual	2023 Estimate ²	2024 Proposed	Dollar Change: 2023 to 2024	Percent Change: 2023 to 2024
By Agency					
Defense ³	78,642	92,854	95,986	3,132	3%
Health and Human Services	45,318	48,118	50,896	2,778	6%
Energy	22,562	23,218	24,220	1,002	4%
NASA	12,479	13,105	14,022	917	7%
National Science Foundation	7,126	7,992	9,320	1,328	17%
Agriculture	3,748	3,615	3,670	55	2%
Commerce	7,214	5,114	4,388	-726	-14%
Veterans Affairs	1,588	1,624	1,690	66	4%
Transportation	1,675	1,388	1,531	143	10%
Interior	1,140	1,264	1,478	214	17%
Homeland Security	830	634	625	-9	-1%
Environmental Protection Agency	527	568	614	46	8%
Education	390	349	330	-19	-5%
Smithsonian Institution	330	341	364	23	7%
Other	554	626	589	-37	-6%
TOTAL	184,123	200,810	209,723	8,913	4%
Basic Research					
Defense	2,681	2,972	2,519	-453	-15%
Health and Human Services	21,991	23,377	23,207	-170	-1%
Energy	6,483	6,605	7,014	409	6%
NASA	5,718	5,627	5,820	193	3%
National Science Foundation	5,649	6,150	7,068	918	15%
Agriculture	1,464	1,398	1,415	17	1%
Commerce	270	282	309	27	10%
Veterans Affairs	619	648	701	53	8%
Transportation .....	.....	.....	.....	.....	.....
Interior	91	101	121	20	20%
Homeland Security	88	68	60	-8	-12%
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education	34	34	37	3	.....
Smithsonian Institution	290	308	331	23	7%
Other	10	5	5	0	0%
SUBTOTAL	45,388	47,575	48,607	1,032	2%
Applied Research					
Defense	6,928	8,102	6,237	-1,865	-23%
Health and Human Services	22,979	24,257	27,209	2,952	12%
Energy	6,462	6,685	7,155	470	7%
NASA	2,427	2,484	2,672	188	8%
National Science Foundation	883	1,288	1,573	285	22%
Agriculture	1,602	1,525	1,614	89	6%
Commerce	1,391	1,668	1,714	46	3%
Veterans Affairs	933	940	953	13	1%
Transportation	1,358	1,055	1,206	151	14%
Interior	876	967	1,132	165	17%
Homeland Security	280	147	174	27	18%
Environmental Protection Agency	408	441	477	36	8%
Education	258	223	203	-20	-9%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Other	369	374	353	-21	-6%
SUBTOTAL	47,154	50,156	52,672	2,516	5%
Experimental Development					
Defense	69,013	81,780	86,978	5,198	6%
Health and Human Services	47	47	58	11	23%
Energy	4,807	5,046	5,730	684	14%

Table 6-1. FEDERAL RESEARCH AND DEVELOPMENT SPENDING —Continued
(Mandatory and discretionary budget authority¹, dollar amounts in millions)

	2022 Actual	2023 Estimate ²	2024 Proposed	Dollar Change: 2023 to 2024	Percent Change: 2023 to 2024
NASA	4,234	4,886	5,490	604	12%
National Science Foundation .....	.....	.....	.....	.....	.....
Agriculture	381	374	412	38	10%
Commerce	5,158	2,305	1,717	-588	-26%
Veterans Affairs	36	36	36	0	0%
Transportation	277	287	283	-4	-1%
Interior	171	194	223	29	15%
Homeland Security	449	364	312	-52	-14%
Environmental Protection Agency	119	127	137	10	8%
Education	98	92	90	-2	-2%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Other	175	247	231	-16	-6%
SUBTOTAL	84,965	95,785	101,697	5,912	6%
Facilities and Equipment⁴					
Defense	20	.....	252	252	100%
Health and Human Services	301	437	422	-15	-3%
Energy	4,810	4,882	4,321	-561	-11%
NASA	100	108	40	-68	-63%
National Science Foundation	594	554	679	125	23%
Agriculture	301	318	229	-89	-28%
Commerce	395	859	648	-211	-25%
Veterans Affairs .....	.....	.....	.....	.....	.....
Transportation	40	46	42	-4	-9%
Interior	2	2	2	0	0%
Homeland Security	13	55	79	24	.....
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education .....	.....	.....	.....	.....	.....
Smithsonian Institution	40	33	33	0	0%
Other .....	.....	.....	.....	.....	.....
SUBTOTAL	6,616	7,294	6,747	-547	-7%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2024.

² The 2023 Estimate column applies the *Budget* volume's approach of including all 2023 enacted appropriations.

³ DOD's contribution to the overall Federal R&D budget includes DOD Research, Development, Test, and Evaluation Budget Activities 6.1 through 6.6 (Basic Research; Applied Research; Advanced Technology Development; Advanced Component Development and Prototypes; 4 System Development and Demonstration; and Management Support).

⁴ The decline in Facilities & Equipment spending in 2024 is due in some cases to the completion of large construction projects and increased funding levels in the previous two years associated with the Inflation Reduction Act of 2022 (Public Law 117-169) and the Infrastructure Investment and Jobs Act (Public Law 117-58).

