Biennial Report to Congress on International Science & Technology Cooperation

A Report by the

SUBCOMMITTEE ON INTERNATIONAL SCIENCE & TECHNOLOGY COORDINATION

of the

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

February 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 (OMB) 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 the National Science and Technology Council

The National Science and Technology Council (NSTC) is the principal means by which the Executive Branch coordinates science and technology policy across the diverse entities that make up the Federal research and development enterprise. A primary objective of the NSTC is to ensure science and technology policy decisions and programs are consistent with the President's stated goals. The NSTC prepares research and development strategies that are coordinated across federal agencies aimed at accomplishing multiple national goals. The work of the NSTC is organized under committees that oversee subcommittees and working groups focused on different aspects of science and technology. More information is available at http://www.whitehouse.gov/ostp/nstc.

About the Subcommittee on International Science and Technology Coordination

The purpose of the Subcommittee on International Science and Technology Coordination (ISTC) is to enhance coordination of federal agencies' international science and technology cooperation and partnerships. The Subcommittee addresses long-term strategic engagement goals, policy issues related to high-value international collaboration, and short-term country- and issue-specific priorities. The Subcommittee serves as a forum to discuss Administration priorities and agency-level activities in support of those priorities.

About this Document

The American Innovation and Competitiveness Act[1] directs the Director of OSTP to submit a biennial report on international science and technology (S&T) cooperation efforts to the Senate Committees on Commerce, Science, and Transportation and Foreign Relations and the House Committees on Science, Space, and Technology and Foreign Affairs. The first biennial report from the ISTC Subcommittee in 2020 described ongoing S&T coordination and collaboration efforts with Israel, the Republic of Korea, and the United Kingdom, and provided examples of S&T collaboration in the areas of big data systems and science, infectious disease and pandemic research, and ocean observation systems. The second biennial report from the ISTC Subcommittee in 2022 provided an overview of the U.S. position in the global research and development (R&D) landscape at that time; it identified areas where the United States remained a global S&T leader and areas where the United States was losing competitiveness. That report also included recommendations to firmly establish U.S. leadership in international S&T

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[1] Reference: American Innovation and Competitiveness Act (Pub. L. 114-389) §208(e), 42 U.S.C. §6625(e) (Note: Sec. 208 of Pub. L. 114-389 is also known as the International Science and Technology Cooperation Act of 2016).

engagement. This third report focuses on changes to the global S&T landscape since the 2022 report and the importance of international S&T cooperation to the United States. It also provides an update on the actions of U.S. government departments and agencies to implement the recommendations included in the 2022 report.

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Abbreviations and Acronyms

AANAPISI Asian American and Native American Pacific Islander Serving Institutions

AI artificial intelligence

AI-ENGAGE Advancing Innovation to Empower Nextgen Agriculture

AIT American Institute in Taiwan

APEC Asia–Pacific Economic Cooperation

APEP DoD Administrative and Professional Exchange Program

ARPA-H Advanced Research Projects Agency for Health

ARPANET-H ARPA-H Health Innovation Network

AUKUS Australia–United Kingdom–United States Partnership

BIL Bipartisan Infrastructure Law

CETs critical and emerging technologies

CHIPS Creating Helpful Incentives to Produce Semiconductors

CPP DoD Cooperative Program Personnel

CSAR G20 Chief Science Advisers' Roundtable

CTAs critical technology areas

DEIA diversity, equity, inclusion, and accessibility

DHS Department of Homeland Security

DIADEM Discovery Acceleration for the Deployment of Emerging Materials

DIANA NATO Defence Innovation Accelerator for the North Atlantic

DOC Department of Commerce

DoD Department of Defense

DOE Department of Energy

DOI Department of the Interior

DOS Department of State

DOT Department of Transportation

ECA DOS Bureau of Educational and Cultural Affairs

E.O. Executive Order

EPA Environmental Protection Agency

EPSCoR Established Program to Stimulate Competitive Research

ESEP DoD Engineering and Scientist Exchange Program

ESF Embassy Science Fellowship

ESTH   Environment, Science, Technology, and Health

EU   European Union

FAR   Federal Acquisition Regulation

FIRST   Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology

FSI   Foreign Service Institute

FVEY   "Five Eyes" (Australia, Canada, New Zealand, the United Kingdom, and the United States)

G7   Group of 7

G20   Group of 20

GIST   DOS Global Innovation through Science and Technology

GPA/PLDOS Bureau of Global Public Affairs Office of Public Liaison

GRC   Global Research Council

HBCU   historically Black college or university

HHS   Department of Health and Human Services

HSI   Hispanic-serving institution

IPEDS   Integrated Postsecondary Education Data System

IRA   Inflation Reduction Act

ISTC   NSTC Subcommittee on International S&T Cooperation

JCM   joint committee meeting

LASER   USAID Long-term Assistance and Services for Research

LMICs   low- and middle-income countries

MOU   memorandum of understanding

MSI   minority-serving institution

NASA   National Aeronautics and Space Administration

NAS   National Academy of Sciences

NATO   North Atlantic Treaty Organization

NIH   National Institutes of Health

NIST   National Institute of Standards and Technology

NOAA   National Oceanic and Atmospheric Administration

NQI   National Quantum Initiative

NSC   National Security Council

NSF   U.S. National Science Foundation

NSTC   National Science and Technology Council

OECD   Organisation for Economic Co-operation and Development

OECD GFT   OECD Global Forum on Technology

OMB   Office of Management and Budget

ONR   Office of Naval Research

OPM   White House Office of Personnel Management

OPT   Optional Practical Training

OSTP   Office of Science and Technology Policy

OUSD(R&E)   DoD Office of the Under Secretary of Defense for Research and Engineering

PCAST   President's Council of Advisors on S&T

PEER   Partnerships for Enhanced Engagement in Research

PRC   People's Republic of China

QIS   quantum information science

R&D   research and development

RDT&E   Research, Development, Test, and Evaluation

RIIG   G20 Research and Innovation Initiative Gathering

S&T   science and technology

SEED   Scientists and Engineers in Exile and Displaced

SI   Smithsonian Institution

STA   science and technology agreement

STCU   Science and Technology Center in Ukraine

STEM   science, technology, engineering, and math

STO   NATO Science and Technology Organization

STPI   Science and Technology Policy Institute

TCU   Tribal college or university

TECRA   Taiwan Economic and Cultural Representative Office

TIPs   NSF Directorate for Technology, Innovation, and Partnerships

TTCP   The Technical Cooperation Program (Australia–Canada–New Zealand–United Kingdom–United States S&T Forum)

UK   United Kingdom of Great Britain and Northern Ireland

UN   United Nations

UNESCO   UN Educational, Scientific and Cultural Organization

U.S.   United States

USAID   U.S. Agency for International Development

USDA   U.S. Department of Agriculture

USG NSSCET   U.S. Government National Standards Strategy for Critical and Emerging Technology

USGS   U.S. Geological Survey

Executive Summary

The world is currently at an historic inflection point due to the end of the post-Cold War era and the start of fierce international competition to define what comes next. As the United States works to address the great unsolved challenges of our time, including climate change and prevention of future pandemics, international science and technology (S&T) cooperation is more important than ever. Building on the nation's historic and ongoing investments in research and development (R&D), the United States is working to be in the strongest position to compete and collaborate internationally by renewing and deepening established bilateral alliances and partnerships, forging new relationships with other nations, and strengthening its impact through multilateral S&T fora.

The first half of this *Biennial Report to Congress on International Science and Technology Cooperation* (2024 NSTC ISTC Report) describes recent developments on the world stage that amplify why international S&T collaboration is so important to U.S. interests. This includes a description of the effects that two years of Russia's unprovoked full-scale war against Ukraine has had on S&T, both in Ukraine and internationally, and three critical and emerging technologies (CETs) that are receiving global attention. It also highlights the increasingly important role of American leadership in global conversations on scientific norms and standards, as well as the importance of implementing best practices for S&T collaboration.

The second half of this 2024 NSTC ISTC Report describes the progress that U.S. departments and agencies have been making to implement 16 recommendations included in the 2022 NSTC ISTC Report to help ensure U.S. S&T advances the nation's economic and national security objectives. Since the 2022 NSTC ISTC Report was released, U.S. departments and agencies have made tangible progress on about half of these recommendations, although all remain relevant in an increasingly complex and competitive world. Making further progress on all 16 recommendations will require additional time, Congressional support, and sustained action from U.S. departments and agencies.

The 16 recommendations published in the 2022 NSTC ISTC Report are:

1. Explore mechanisms to support students from low- and middle-income countries (LMICs) to engage with the U.S. S&T enterprise.
2. Conduct research to understand why STEM [science, technology, engineering, and math] talent leaves the United States or chooses to go to other countries, including examining the entire innovation pipeline to identify research, development, regulatory, statutory, capacity, and infrastructure challenges to STEM talent recruitment and retention.
3. Expand the use and scope of Embassy Science Fellowships (ESFs) and other exchange programs, as well as long-term detail opportunities between government agencies in international S&T. Work to ensure that these opportunities are open to all levels of knowledge and experience to break down siloes and provide cross-agency integration at various professional levels. Identify and remove barriers for participation in these programs to better promote principles of DEIA [diversity, equity, inclusion, and accessibility] and ensure that the international S&T workforce better reflects the U.S. population and U.S. scientific community.
4. Explore transnational exchanges between U.S. and foreign technical agencies to increase opportunities for collaboration with close partners while addressing barriers to cooperation.
5. Strengthen the U.S. research and innovation environment to enable U.S. global S&T leadership, including working through multilateral fora, increasing opportunities for participation by and partnerships with LMICs, and motivating private sector research and development (R&D) and STEM professionals to remain in the United States.

6. Consider the development of flexible and longer-term approaches to funding international collaborative science to compete with other countries' longer-term research funding initiatives, such as those enabled by the People's Republic of China's (PRC's) five-year plans or the European Union's (EU's) seven-year multiyear financial framework.

7. Explore the creation of a flexible mechanism within the Department of State (DOS) to support joint S&T goals, research, and innovation with foreign partners. Projects and initiatives could include consortia support and support for international facilities that are of strategic scientific, national security, and/or foreign policy interest to the United States.

8. Explore the creation of a mechanism under which assistance for S&T collaboration can be provided to international partners who otherwise lack scientific capacity. Partners may include nations that do not qualify for development assistance and/or lack existing STEM capacity to participate in research collaborations intended to be mutually beneficial.

9. Expand detail opportunities between international offices in science and technical agencies to allow federal experts to better familiarize themselves with international S&T practices and networks in other parts of the U.S. government.

10. Encourage amplification of existing international S&T collaboration efforts through public diplomacy, media outreach, and sustained people-to-people-level engagement.

11. Explore mechanisms to support exchange visitor programs with Historically Black Colleges and Universities (HBCUs), other Minority-Serving Institutions (MSIs), and institutions in Established Program to Stimulate Competitive Research (EPSCoR) jurisdictions, as well as training and development programs at all educational levels that may increase the capacity of interested institutions to more readily engage with international partners.

12. Explore how researchers in both STEM and non-STEM fields at HBCUs, other MSIs, and institutions in EPSCoR jurisdictions are participating in international S&T collaborations, including as reflected in co-authored publications. Assess whether and how international engagement can act as a career accelerator for researchers and students from underrepresented groups and if additional mechanisms may be needed to positively impact representation in international S&T settings.

13. Critically review existing job series and consider new series that would allow the recruitment of technical professionals within agencies to support S&T diplomacy and enhance the government's ability to recruit skilled and specialized representation for highly technical international activities, including standards-setting bodies and international technical working groups.

14. Explore the creation of mechanisms within the U.S. government that mobilize and train federal scientists to communicate effectively to non-scientist decision makers within the U.S. government and abroad.

15. Consider providing incentives and training opportunities to experts who contribute to international standards-setting bodies and other relevant working groups to ensure that the appropriate technical experts are active contributors to these discussions.

16. Assess current STAs [science and technology agreements] for relevancy and gaps with a view to addressing with foreign partners as and when appropriate. Evaluate mechanisms for the United States to increase data and facility access, scientific exchange, and visa or customs and border flexibilities for visitors from private sector and academic institutions in connection with STAs or related agreements.

Introduction

At the 2023 National Medal of Science and National Medal of Technology and Innovation Awards, President Biden said, "…the greatness of a country is measured not only by the size of its economy or the strength of its military. The strength of the nation is also measured by the boldness of its science, the quality of its research, and the progress it helps bring forth for not only the country but the whole world."[2] By bringing together a wide range of viewpoints and resources that lead to scientific discoveries and technological innovations, international science and technology (S&T) cooperation generates vital economic, political, societal, national security, development, and diplomatic benefits for both the United States and the world. In October 2022, White House Office of Science and Technology Policy (OSTP) Director Arati Prabhakar highlighted a number of unsolved challenges, including those with a clear global nexus: health, climate, and competitive industries.[3] All can benefit from facilities, expertise, and partners from outside the United States, and through international collaboration the world can mobilize the scientific capacity needed to address these challenges.

International S&T cooperation has been a pillar of U.S. foreign policy and national security since the end of World War II, and it is at risk of deteriorating at a time when it is more important than ever. President Biden, Secretary of State Blinken, and National Security Advisor Sullivan have all described that the world is at an historic inflection point: as the post-Cold War era comes to an end, international competition to define what comes next has grown increasingly fierce.[4,5,6] The economic and national security of the United States calls for championing research, discovery, technology, and innovation, which in turn requires "…maintain[ing] and increase[ing] international cooperation on shared challenges even in an age of greater inter-state competition."[7]

This report documents recent developments on the world stage that amplify why international S&T collaboration is so important to U.S. interests; these developments include the effects that two years of Russia's full-scale war against Ukraine have had on international S&T and the critical and emerging technologies (CETs) that are the main arena of global S&T competition. This report also describes the progress that U.S. departments and agencies have been making to implement the 16 recommendations identified in the 2022 NSTC ISTC Report.[8]

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[2] The White House. Remarks by President Biden at National Medal of Science and National Medal of Technology and Innovation Ceremony. October 24, 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/10/24/remarks-by-president-biden-at-national-medal-of-science-and-national-medal-of-technology-and-innovation-ceremony/

[3] The White House. Remarks of Dr. Arati Prabhakar on Achieving America's Aspirations. October 21, 2022. https://www.whitehouse.gov/ostp/news-updates/2022/10/21/remarks-of-dr-arati-prabhakar-on-achieving-americas-aspirations/

[4] The White House. Remarks by President Biden on the United States' Response to Hamas's Terrorist Attacks Against Israel and Russia's Ongoing Brutal War Against Ukraine. October 22, 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/10/20/remarks-by-president-biden-on-the-unites-states-response-to-hamass-terrorist-attacks-against-israel-and-russias-ongoing-brutal-war-against-ukraine/

[5] The White House. On-the-Record Press Call by National Security Advisor Jake Sullivan Previewing the Biden-Harris Administration's National Security Strategy. October 12, 2023. https://www.whitehouse.gov/briefing-room/press-briefings/2022/10/12/on-the-record-press-call-by-national-security-advisor-jake-sullivan-previewing-the-biden-harris-administrations-national-security-strategy/

[6] Secretary Antony J. Blinken Remarks to the Johns Hopkins School of Advanced International Studies: "The Power and Purpose of American Diplomacy in a New Era." September 13, 2023. https://www.state.gov/secretary-antony-j-blinken-remarks-to-the-johns-hopkins-school-of-advanced-international-studies-sais-the-power-and-purpose-of-american-diplomacy-in-a-new-era/

[7] 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

[8] NSTC. *Biennial Report to Congress on International Science & Technology Cooperation*. September 2022. https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Biennial-Report-to-Congress-on-International-Science-Technology-Cooperation.pdf

International S&T Cooperation Promotes and Protects U.S. Interests

Championing U.S. S&T at Home Strengthens U.S. Influence Abroad

Domestic and foreign policy are fully integrated in the 2022 U.S. National Security Strategy.[9] To succeed abroad, the United States must invest in innovation and industrial strength at home. Likewise, to advance shared prosperity domestically and to uphold the rights of all Americans, the nation must actively shape the international order in line with our interests and values, including S&T.

Investing in its domestic S&T ecosystem puts the United States in the strongest position possible to collaborate, compete, and lead internationally. America's biggest investments in generations—the Bipartisan Infrastructure Law (BIL),[10] the Inflation Reduction Act (IRA),[11] the PACT Act,[12] and especially the Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act[13]—have taken place under the Biden-Harris Administration and are enabling the nation to upgrade its infrastructure, recharge its manufacturing base, propel research, bolster key industries, advance CETs, and lead the global energy transition. The United States has also invested in S&T that has led to discoveries and advances like the remarkable images from the farthest reaches of the universe produced by the James Webb Space Telescope and the first net-gain fusion energy reaction at the Lawrence Livermore National Laboratory. These concerted, deliberate investments in critical S&T priorities have caught the attention of other nations around the world and demonstrate U.S. credibility and resolve on the international stage. America's domestic renewal reinforces—and is reinforced by—American S&T leadership in the world.

Strengthening U.S. S&T Influence Around the World

Since taking office, President Biden's priorities have included rebuilding alliances and restoring America's standing around the globe.[14] In addition to pre-existing formal bilateral and multilateral partnerships, the United States has focused on expanding S&T partnerships, especially with respect to CETs. These efforts are ultimately investments in America's own future, creating more stable, prosperous, and innovative collaborative partners for the United States; a more secure future for U.S. national security; more markets for American workers, businesses, and investors; and a more sustainable planet for future generations.

Alliances and partnerships with other democracies have been the nation's greatest international advantage. They create a freer and more stable world, they deter or reverse aggression, and they mean that America never has to go it alone. Although these alliances were built in a different era, they remain the foundation of the nation's future on the global playing field. Accordingly, the Biden-Harris Administration has strengthened these alliances and partnerships in tangible ways that improve the U.S. strategic position and ability to respond to shared challenges, including with regard to S&T. A sampling of actions the Biden-Harris Administration has undertaken to enable U.S. global S&T leadership is enumerated under Recommendations 5 and 16 in the latter half of this report.

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9   The White House. *Biden-Harris Administration's National Security Strategy.* October 12, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf
10   Public Law 117 - 58 - Infrastructure Investment and Jobs Act. https://www.govinfo.gov/app/details/PLAW-117publ58
11   H.R. 812 (IH) - Inflation Reduction Act of 2023. https://www.govinfo.gov/app/details/BILLS-118hr812ih
12   Honoring our PACT Act of 2022. https://www.govinfo.gov/app/details/COMPS-16990
13   Public Law 117 - 167 - An act making appropriations for Legislative Branch for the fiscal year ending September 30, 2022, and for other purposes. https://www.govinfo.gov/app/details/PLAW-117publ167
14   The White House. "Biden-Harris Administration Immediate Priorities." https://www.whitehouse.gov/priorities/

The Biden-Harris Administration is also working to strengthen U.S. S&T leadership by reinforcing and reinvigorating long-standing multilateral international S&T fora. As First Lady Dr. Biden said when the United States rejoined the United Nations Educational, Scientific and Cultural Organization (UNESCO), "Some of the biggest challenges of our time cannot be solved in isolation."[15] Multilateral consensus is critical for establishing global norms for S&T cooperation. Openness, transparency, reciprocity, and equity are much more powerful when embraced, articulated, and practiced by many countries representing a diversity of cultures, political structures, and economic systems. As other governments—notably the People's Republic of China (PRC)—seek to influence the global science enterprise with different values, multilateral cooperation in which global S&T norms are emphasized and reinforced become more necessary and more powerful. Recent U.S. government engagements in multilateral S&T fora are enumerated under Recommendation 5 in the latter half of this report.

Competing Strategically

Over time, forging international S&T cooperation has become more complex, not only because of the mammoth scale of global challenges like the climate crisis, but also because of increased geopolitical tensions. An era of relatively open international cooperation and investment in S&T has given way to an intensifying competition with authoritarian powers.[16] Russia's full-scale war against Ukraine is an immediate, acute threat to the international order. Meanwhile, the PRC poses a significant long-term challenge because it not only aspires to reshape the international order, but it also increasingly has the economic, diplomatic, military, and technological power to do so; indeed, the PRC has been engaged in a whole-of-society effort to acquire critical technologies.

The United States is committed to responsibly managing its competition with the PRC, including in S&T. Federal departments and agencies are speaking openly, clearly, and credibly with allies and partners about relevant concerns, thereby demonstrating a commitment to cooperate strategically, and minimizing the risk of miscalculation that could lead to conflict. Researchers in the United States have a long history of scientific collaboration with counterparts in China, to the point that the two countries have been each other's most significant scientific collaborators for many years.[17] Alongside S&T cooperation with China where it is in the national interest, the United States and its partners continue to champion critical scientific norms around intellectual property, academic integrity, and openness in science, including pushing back on any PRC measures or efforts that could threaten these norms.

Many issues—including S&T—demand a broader set of potential partners than the United States' democratic friends. As Secretary of State Blinken has said, "While the United States will always look to fellow democracies first, we are determined to work with any country—including those with whom we disagree on important issues—so long as they want to deliver for their citizens, contribute to solving shared challenges and upholding international norms that we built together."[18] In addition to working toward resolving issues of common concern, widening the network of America's international partners

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15 The White House. Remarks as Prepared for Delivery by First Lady Jill Biden at the UNESCO Flag-Raising Ceremony. July 25, 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/07/25/remarks-as-prepared-for-delivery-by-first-lady-jill-biden-at-the-unesco-flag-raising-ceremony/

16 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

17 Zhu, Y., Kim, D., Yan, E., Kim, M.C., and Qi, G. 2021. "Analyzing China's Research Collaboration with the United States in High-Impact and High-Technology Research." *Quantitative Science Studies* 2(1): 363–375. https://doi.org/10.1162/qss_a_00098

18 DOS. Secretary Antony J. Blinken Remarks to the Johns Hopkins School of Advanced International Studies (SAIS): "The Power and Purpose of American Diplomacy in a New Era." September 13, 2023. https://www.state.gov/secretary-antony-j-blinken-remarks-to-the-johns-hopkins-school-of-advanced-international-studies-sais-the-power-and-purpose-of-american-diplomacy-in-a-new-era/

carries the added benefit of building stronger, more resilient relationships across the world. Federal departments and agencies undertake this type of cooperation with clear-eyed recognition of the importance of prioritizing and defending U.S. and international S&T norms and principles in any collaboration.

Impacts of Russia's Full-Scale War Against Ukraine on S&T Cooperation

Diminished U.S. and Global S&T Engagement with Russia

Two years of Russia's full-scale war against Ukraine has significantly changed the international S&T landscape and negatively impacted many initiatives that are key to making global progress on critical issues, such as climate change. For example, bilateral and multilateral Arctic frameworks and organizations, including the Arctic Council, have paused or altered their work with Russia. Because half of the land area in the Arctic is in Russian territory, this sidelines S&T research that is critical not only for the people of the Arctic who depend on its ecosystems and natural resources, but also for understanding the consequences of rapid Arctic warming on global climate. Our ability to observe changes in the Arctic (e.g., thawing permafrost) is severely impaired; thus, the data that inform climate change predictions and policy are now incomplete.

In response to Russia's full-scale war against Ukraine, OSTP released *Guidance on Scientific and Technological Cooperation with the Russian Federation for U.S. Government and U.S. Government Affiliated Organizations* in June 2022, which directed existing federally funded projects involving research institutions and individuals affiliated with the Russian government to wind down.[19]

While many multilateral bodies include Russian government participation in S&T activities (including G20, the United Nations [UN], Asia–Pacific Economic Cooperation [APEC], the Antarctic Treaty Consultative Meeting, and various facilities, such as ITER), their work is now disrupted when Russian officials are present. The U.S. government is not engaging bilaterally with Russian officials and continues to make every effort to condemn Russia's actions in these bodies, when appropriate.

As part of the G7, the United States endorsed the G7 Science Ministers 2022 Communiqué declaring a commitment to restrict government-funded research projects involving participation by the Russian government. Importantly, the statement distinguishes the involvement of the Russian government from engagements with individual Russian scientists, stating, "In the spirit of science diplomacy, we will continue the dialogue between civil societies, including exchanges with Russian scientists and students to the furthest extent possible, especially through the promotion of individual academic and student mobility."[20]

U.S. Support for Ukraine's S&T Ecosystem

Two years of Russia's full-scale war against Ukraine has damaged Ukraine's S&T ecosystem, destroying research and information infrastructure and making soldiers and refugees of many Ukrainian scientists and engineers. Recovering Ukraine's S&T capacity will be vital to rebuilding the country's economy and society. The G7 Science and Technology Ministers 2023 Communiqué "highlight[ed] the importance of

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[19] The White House. "Guidance On Scientific and Technological Cooperation with the Russian Federation for U.S. Government and U.S. Government Affiliated Organizations." June 11, 2022. https://www.whitehouse.gov/ostp/news-updates/2022/06/11/guidance-on-scientific-and-technological-cooperation-with-the-russian-federation-for-u-s-government-and-u-s-government-affiliated-organizations/

[20] G7 Science Ministers' Communiqué. June 12-14, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/06/06-2022-G7-Science-Ministers-Communique-2022.pdf

addressing research and innovation needs for Ukraine's recovery" and "acknowledge[d] that science, technology, and innovation will play a key role in rebuilding Ukraine as a modern and sustainable economy."[21]

The United States has launched numerous programs to support Ukrainian scientific and engineering capacity in the face of Russia's ongoing war:

- The Department of Energy (DOE) Office of Science has provided supplemental funds to support students and scientists impacted by Russia's war. Some are hosted at institutions in the United States, whereas others are supported through remote collaborations with institutions in Europe or Ukraine. As of June 2023, 26 awards have been made totaling about $2.6M. The DOE Office of Science is receiving additional requests for a second year of funding.

- In June 2023, the Smithsonian Under Secretary for Education, the Smithsonian Science Education Center, the Smithsonian Office of International Relations, the Department of State (DOS), and the Ministry of Education and Science of Ukraine came together, along with the Ambassador of Ukraine to the United States, to advance science education for learners ages 5–10 in Ukraine. Under a Memorandum of Understanding (MOU), both sides are working together to: promote hands-on science learning for students; provide professional development to science, technology, engineering, and math (STEM) teachers; and ensure all students have access to digital STEM education resources for parents and elementary children in Ukraine. This joint effort between the Smithsonian Science Education Center and the Ministry of Education and Science of Ukraine represents a significant step towards giving students in Ukraine engaging science education experiences that will create lasting impacts on the science learning landscape.

- IMPRESS-U is an NSF-led, multilateral program in partnership with the U.S. National Academies of Sciences, Engineering, and Medicine, the U.S. Department of Defense's Office of Naval Research (ONR) Global, the Estonian Research Council, the Latvian Council of Sciences, the Research Council of Lithuania, Poland's National Science Centre, the Polish National Agency for Academic Exchange, and the National Research Foundation of Ukraine.[22] Through engagement with partner countries in Eastern Europe that are already hosting Ukrainian researchers, this effort will offer significantly enhanced opportunities for Ukrainian researchers and students to work on international collaborative research projects. The aim is not simply to rebuild the previous ecosystem, but to enhance Ukraine's international S&T connectivity by supporting science and engineering research, education, and innovation through international collaboration and to promote the integration of Ukrainian scientists into the international research community.

- DOS's Bureau of Educational and Cultural Affairs (ECA) is using existing programs and networks to support Ukrainian researchers inside and outside of Ukraine. For example, ECA is using supplemental funding to increase Fulbright and undergraduate opportunities for Ukrainians, and ECA's Exchange to Internships program provides funding for career experiences for alumni of ECA exchanges in Ukraine.

- A new DOS BridgeUSA Program supports Ukrainian professors and research scholars in engineering, information technology, agricultural technology, and other STEM areas to work and

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[21] G7 Science and Technology Ministers' Communique. May 12-14, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/05/G7-ST-Final-Communique_05.13.2023.pdf
[22] NSF. "NSF announces International Multilateral Partnerships for Resilient Education and Science System in Ukraine." August 2023. https://new.nsf.gov/news/nsf-announces-international-multilateral

study in the United States.[23] There are 168 Ukraine exchange visitors in the United States in private-sector BridgeUSA STEM programs, with the majority in biomedicine, chemistry, mathematics, and other science disciplines.

- Since Russia's full-scale war began, DOS's Global Innovation through Science and Technology (GIST) program[24] has provided over $400,000 for Ukrainian S&T innovation and has sponsored 31 startups to travel to five international conferences and trade shows. A group of 13 Ukrainian entrepreneurs visited Washington, D.C. in March 2023, as part of the GIST Business Incubation program to meet with DOS and the Embassy of Ukraine, receive training and mentorship, and present their accomplishments to businesses and investors.

- DOS has developed a program that provides training, virtual fellowships, and tailored support to Ukrainian civilian scientists with expertise in dual-use technologies. The 6-month virtual fellowships—implemented through the Science and Technology Center in Ukraine (STCU)[25]—are opportunities for Ukrainian scientists focused on nuclear and chemical/biological-based weapons to gain skills in relevant knowledge, research vetting, and individual cybersecurity.

- Through the Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology (FIRST) Program,[26] DOS's Non-Proliferation and Disarmament Fund supports a six-month virtual fellowship program—also implemented through the STCU—for Ukrainian scientists working on 17 different projects in civil-nuclear energy.

- Beyond U.S. government efforts, it is notable that the U.S. National Academy of Sciences (NAS)—through its Scientists and Engineers in Exile and Displaced (SEED) initiative and in partnership with the Polish Academy of Sciences and the National Academy of Sciences of Ukraine—has provided several millions of dollars to support Ukrainian scientists who were forced to temporarily relocate due to Russia's war.[27] NAS has also established a Working Group under its Global Science Diplomacy Roundtable focused exclusively on Ukraine.

Emerging Technologies in the Global S&T Landscape

Since the release of the 2022 NSTC ISTC Report, the White House has released a number of policy documents concerning specific technologies that have the potential to affect the nature and extent of U.S. S&T cooperation with other nations. The Biden-Harris Administration is driven by a desire to establish international frameworks that will foster innovation and economic development while also mitigating potential threats to national security and the exercise of human rights. This report focuses on three CETs that have been subjects of recent White House policy documents: artificial intelligence

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[23] BridgeUSA: Connecting Global Leaders, Creating Lasting Impact. https://j1visa.state.gov/

[24] Global Innovation Through Science and Technology (GIST) Initiative. https://www.gistnetwork.org/

[25] STCU Announcement. November 1, 2023. http://www.stcu.int/documents/download/STCU_Announcement_01112023.pdf

[26] STCU Announcement: Virtual Advanced Nuclear Reactor Technology Fellowship Program for Ukrainian Civil Nuclear Energy Scientists, Technicians, and Engineers Sponsored by the FIRST Program through the STCU. November 28, 2023. http://www.stcu.int/documents/download/announcement/STCU_Announcement_Virtual_Advanced_Nuclear_Reactor_Technology_Fellowship_Program.pdf

[27] National Academies of Science, Engineering, and Medicine. August 10, 2023. "National Academy of Sciences Receives $2.1 Million from Breakthrough Prize Foundation for Ongoing Support of Ukrainian-Led Scientific Research Projects." https://www.nationalacademies.org/news/2023/08/national-academy-of-sciences-receives-2-1-million-from-breakthrough-prize-foundation-for-ongoing-support-of-ukrainian-led-scientific-research-projects

(AI), quantum information science (QIS), and biotechnology and biomanufacturing. Further CETs are identified in a recently updated CET list.[28]

To ensure that U.S. diplomats are well equipped to report on international developments and engage our allies and partners on all aspects of CETs, DOS's Foreign Service Institute (FSI) offers training courses on a wide variety of relevant S&T topics. In 2023, FSI began offering training on special projects and enhanced its CET coverage through its Tech-in-Focus, FSI Tech Talks, Conversations in Applied AI and Diplomacy, and Human Centered Design lecture series and webinars. FSI has also launched a new training program for senior leaders on CETs.

Artificial Intelligence (AI)

AI refers to machine-based systems that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments.[29] As President Biden has said, in order to realize the benefits of AI, we must first manage its risks.[30] The responsible development of AI based on the shared values of free and open societies will require international cooperation in standards setting, innovation, and adoption of the technology. Consequently, the *National Artificial Intelligence Research and Development Strategic Plan* was updated in 2023 to add a new strategy for establishing a principled and coordinated approach to international collaboration in AI research.[31] The National Institute of Standards and Technology (NIST) also released in 2023 an *AI Risk Management Framework*.[32] Most importantly, the Biden-Harris Administration released an Executive Order (E.O.) on AI in October 2023[33, 34] and federal departments and agencies are currently working to fulfill its mandates, particularly the call to *Strengthen American Leadership Abroad* (Section 11). For example, the E.O. calls on DOS and the U.S. Agency for International Development (USAID) to work with the National Science Foundation (NSF) and DOE on a Global AI Research Agenda. The Administration also secured voluntary commitments from leading AI companies to manage the risks and ensure that AI is safe, secure, and trustworthy.[35,36]

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[28] NSTC. *Critical and Emerging Technologies List Update*. February 2024. https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf

[29] Public Law 116 - 283 - William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021; Division E. National Artificial Intelligence Initiative Act of 2020. https://www.govinfo.gov/app/details/PLAW-116publ283

[30] The White House. "Remarks by President Biden on Artificial Intelligence." July 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/07/21/remarks-by-president-biden-on-artificial-intelligence/

[31] National Artificial Intelligence Research and Development Strategic Plan 2023 Update (Strategy 9). May, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/05/National-Artificial-Intelligence-Research-and-Development-Strategic-Plan-2023-Update.pdf

[32] NIST. *AI Risk Management Framework*. https://www.nist.gov/itl/ai-risk-management-framework

[33] The White House. *Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence*. October 30, 2023. https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

[34] The White House. "Fact Sheet: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence." October 30, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence/

[35] The White House. "Fact Sheet: Biden-Harris Administration Secures Voluntary Commitments from Leading Artificial Intelligence Companies to Manage the Risks Posed by AI." July 21, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/07/21/fact-sheet-biden-harris-administration-secures-voluntary-commitments-from-leading-artificial-intelligence-companies-to-manage-the-risks-posed-by-ai/

[36] The White House. "Fact Sheet: Biden-Harris Administration Secures Voluntary Commitments from Eight Additional Artificial Intelligence Companies to Manage the Risks Posed by AI." September 14, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/09/12/fact-sheet-biden-harris-administration-secures-voluntary-commitments-from-eight-additional-artificial-intelligence-companies-to-manage-the-risks-posed-by-ai/

Recent multilateral discussions focused on AI—including the G7 Hiroshima AI Process,[37] the United Kingdom's (UK's) AI Safety Summit,[38, 39] and those before the United Nations General Assembly—are important for building relationships in specific areas of common interest, like the design of safe and secure AI systems. The Biden-Harris Administration has also undertaken bilateral collaborations to advance AI technologies. In the U.S.-European Union (EU) Trade and Technology Council (TTC), the United States and EU have developed a *Joint Roadmap on Evaluation and Measurement Tools for Trustworthy AI and Risk Management*[40] and are advancing its implementation. International research collaborations, such as the Accelerated Data Analytics and Computing Institute[41] among the United States, Japan, Australia, and some European countries, provide a means of collectively sharing high-performance computing resources and expertise to address common AI R&D and deployment challenges. Since 2021, NSF has established bilateral cooperation in AI with Australia, Canada, Finland, and the Czech Republic, primarily supporting academic research collaborations.

International S&T cooperation has an important role in pursuing responsible AI to meet societal needs, including by: incorporating human rights, privacy, and security; ensuring accountability and transparency; building and maintaining public trust; and mitigating bias and harmful consequences. USAID's Emerging Technologies program is addressing the potential for discrimination and inequities in AI systems as a threat to digital transformation in U.S. partner countries. In 2022, USAID funded a series of challenge grants to support researchers and entrepreneurs in West Africa and North America to develop approaches to ensure equity is built into AI in low- and middle-income countries (LMICs). For example, USAID partners are developing gender equitable alternative credit scoring models in Mexico and working in Ghana to determine whether new forms of gender equitable data collection and AI can improve donors' ability to design programs to assess and improve household wealth. Of particular note is a grant that produced an ethical guide and checklist for policymakers and technical teams considering or already deploying AI systems.[42]

Quantum Information Science (QIS)

QIS is a CET that harnesses the principles of quantum physics to improve the acquisition, transmission, and processing of information. It has the potential to massively increase computational power relative to conventional computing processors and has implications for cryptography, simulation, communication, and sensing. The National Quantum Initiative (NQI) Act of 2018, which was amended and enhanced by the National Defense Authorization Act for Fiscal Year 2022[43] and the CHIPS and Science Act of 2022, has accelerated coordinated federal investment in QIS across six policy pillars: science, workforce, industry, infrastructure, security, and international cooperation. The CHIPS and Science Act also created the CHIPS for America Defense Fund that will provide funds for the activities of the Microelectronics Commons. In turn, the Commons is a national network that will create direct

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[37] The White House. "G7 Leaders' Statement on Hiroshima AI Process." October 30, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/g7-leaders-statement-on-the-hiroshima-ai-process/

[38] AI Safety Summit Hosted by the UK. November 2, 2023. https://www.aisafetysummit.gov.uk/

[39] AI Safety Summit. The Bletchley Declaration by Countries Attending the AI Safety Summit, 1-2 November 2023. November 1, 2023. https://www.gov.uk/government/publications/ai-safety-summit-2023-the-bletchley-declaration/the-bletchley-declaration-by-countries-attending-the-ai-safety-summit-1-2-november-2023

[40] NIST. "TTC Joint Roadmap." https://www.nist.gov/document/ttc-joint-roadmap-evaluation-and-measurement-tools-trustworthy-ai-and-risk-management

[41] ADAC: Accelerated Data Ana Analytics and Computing Institute. https://adac.ornl.gov/

[42] Riabov, A. *How Five Awardees Are Paving the Way for a More Equitable AI-Powered Future*. Market Systems Symposium 2023. June 6, 2022. https://www.marketlinks.org/blogs/how-five-awardees-are-paving-way-more-equitable-ai-powered-future

[43] National Quantum Initiative Act. Public Law 115-368. https://www.quantum.gov/wp-content/uploads/2022/08/NQIA2018-NDAA2022-CHIPS2022.pdf

pathways to commercialization for U.S. microelectronics researchers and designers, thereby contributing to the growth of a domestic semiconductor workforce in the United States.[44]

International cooperation, the final pillar in the *National Strategic Overview for QIS*,[45] bears significant weight as there are multiple technological approaches to implementing QIS devices being studied and developed in parallel in laboratories around the world. International cooperation diversifies the U.S. scientific portfolio, increasing opportunities for access to discoveries as they occur, and allowing the United States to benefit from the range of research strategies and priorities being pursued by allies and partners. Standards-setting, talent management, and supply chains are other areas that will require international cooperation to secure U.S. leadership in a rules-based global QIS ecosystem. In addition to government-led efforts, the industry-led Quantum Economic Development Consortium, which was envisioned in the NQI Act, has international and multisectoral participation.

International scientific cooperation is challenged by the national security implications inherent in QIS technologies.[46] However, formal and informal bilateral and multilateral cooperation continues to grow among nations that support transparency in science, as evinced by the 10 bilateral Quantum Cooperation Statements the United States has signed to date, and in the defense sector with QIS R&D prioritized by the North Atlantic Treaty Organization (NATO), the Quad, and the Australia–United Kingdom–United States Partnership (AUKUS).[47]

Biotechnology and Biomanufacturing

Biotechnology—"technology that applies to or is enabled by life sciences innovation or product development"[48]—is a rapidly expanding, globally competitive technology sector. E.O. 14081 launched the National Biotechnology and Biomanufacturing Initiative in September 2022 to accelerate biotechnology innovation and grow America's bioeconomy across multiple economic sectors, including health, agriculture, and energy. The E.O. directs the U.S. government to engage internationally to promote and protect the U.S. and global bioeconomy. It identifies a series of priority areas to bolster international ties around biotechnology and biomanufacturing, ultimately to strengthen the U.S. and global bioeconomy: R&D cooperation, joint trainings and workforce development, safe and secure data sharing, regulatory cooperation, and commercialization, as well as identifying and mitigating emerging biotech-related risks.

U.S. departments and agencies are accelerating international engagements and demonstrating U.S. leadership on the bioeconomy on a global stage. Since the E.O. was signed, the U.S. government has incorporated biotechnology and biomanufacturing as a pillar in several bilateral dialogues, securing high-level political commitments from India, Israel, Japan, the Republic of Korea, and the UK to deepen cooperation in these areas and open doors to new lines of cooperation with many others. For example,

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[44] DoD Undersecretary of Defense for Research and Engineering. "Microelectronics Commons." https://www.cto.mil/ct/microelectronics/commons/

[45] National Strategic Overview for Quantum Information Science. September 2018. https://www.quantum.gov/wp-content/uploads/2020/10/2018_NSTC_National_Strategic_Overview_QIS.pdf

[46] National Quantum Coordination Office Subcommittee on the Economic and Security Implications of Quantum Science. October 2021. "The Role of International Talent in Quantum Information Science." https://www.quantum.gov/wp-content/uploads/2021/10/2021_NSTC_ESIX_INTL_TALENT_QIS.pdf

[47] National Quantum Coordination Office. Enhancing Competitiveness. www.quantum.gov/competitiveness/

[48] The White House. *Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy*. September 12, 2022. https://www.whitehouse.gov/briefing-room/presidential-actions/2022/09/12/executive-order-on-advancing-biotechnology-and-biomanufacturing-innovation-for-a-sustainable-safe-and-secure-american-bioeconomy/

the NIST partnered with private sector and academic leaders to host an international standards workshop for the bioeconomy; DOE signed an MOU in April 2023 with the Korea Research Institute of Bioscience and Biotechnology to further cooperation between U.S. and Korean biofoundries;[49] NSF signed an implementation arrangement with India's Department of Biotechnology; and NSF's multilateral Global Centers program is focusing on bioeconomy topics in Fiscal Year 2024.[50] Biotechnology is an important defense focus at NATO and The Technical Cooperation Program (TTCP), and DOS championed the creation of the new OECD Global Forum on Technology,[51] including cementing "synthetic biology" as one of its first work streams, which will focus on values and principles of responsible biotechnology innovation. The recently created Advanced Research Projects Agency for Health (ARPA-H) within the Department of Health and Human Services (HHS) is also furthering biotechnology and biomanufacturing R&D aims both domestically and abroad, in cooperation with key international entities.

Progress and Action Advancing the 2022 NSTC ISTC Recommendations

This section provides an update on U.S. government progress in implementing 16 recommendations based on five areas of excellence[52] and seven gaps[53] in the U.S. approach to international S&T cooperation as identified in the 2022 NSTC ISTC Report. While that report is not itself a strategy, in the less than two years since its release, federal departments and agencies have taken notable steps

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[49] The White House. "Fact Sheet: Republic of Korea State Visit to the United States." April 26, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/fact-sheet-republic-of-korea-state-visit-to-the-united-states/

[50] NSF. "Dear Colleague Letter: Global Centers Program Competition." November 22, 2023. https://new.nsf.gov/funding/opportunities/global-centers-program-competition

[51] OECD Global Forum on Technology. https://www.oecd.org/digital/global-forum-on-technology/

[52] Areas of Excellence in the U.S. Approach to International S&T from the 2022 NSTC ISTC Report to Congress:
  1. The United States remains a global leader in many areas of S&T. Competitors are catching up.
  2. Investigator-driven international collaborations are working: U.S. government agencies actively collaborate with international partners, and are highly effective at supporting investigator and mission-driven research both domestically and internationally.
  3. The United States sets and informs standards for global science: U.S. experts inform and lead international discussions on technology, standards, ethics, and the responsible practice of science.
  4. The United States attracts and retains science, technology, engineering, and mathematics (STEM) talent, but can do more to ensure that international talent chooses to come to the United States and remain.
  5. The United States can achieve diplomatic and national security goals with international S&T engagement.

[53] Gaps in the U.S. Approach to International S&T Engagement from the 2022 NSTC ISTC Report to Congress:
  1. The United States is missing out on both short- and long-term strategic opportunities to engage internationally and is being left behind as a result. Countries and international organizations able to engage globally on S&T issues, including through funding for international initiatives, will have a strategic advantage.
  2. The United States spearheads a limited number of ambitious, large-scale international S&T research collaborations for specific topics. Foreign governments are increasingly supportive of multinational research consortia, and they are willing to spend billions of dollars to participate; the United States has no similar science diplomacy initiatives.
  3. Mission-driven scientific activity and foreign policy/national security interests must be more coordinated and balanced among Federal agencies to minimize siloes among development, national security, and research priorities.
  4. The United States is likely underperforming in achieving Diversity, Equity, Inclusion, and Accessibility (DEIA) goals in international S&T, which may be having a negative impact on U.S. competitiveness. The broader U.S. population is not well-represented in international scientific programs and exchanges at all levels, and likely is not experiencing equitable participation in international research collaborations.
  5. The legal requirement that F-1 or J-1 visa holders change their visa class or immigration status at the end of their studies if they wish to remain in the United States may serve to exclude foreign talent.
  6. Federal science agencies do not prioritize staffing for international collaborations and the U.S. government could do more to retain scientists who are trained in diplomacy.
  7. Science and Technology Agreements (STAs) are good tools for research-performing agencies to accelerate collaborative activities, but they may raise funding or bilateral engagement expectations that the United States is unable to fulfill.

forward to advance many of the recommendations, although others will require additional sustained action, additional time to implement, and/or Congressional support.

As U.S. departments and agencies considered ways to begin implementing the 16 recommendations of the 2022 NSTC ISTC Report, an internal review was undertaken to consider whether these recommendations were all still relevant in light of recent changes in the international S&T landscape since the 2022 NSTC ISTC Report was released. At that time, it was determined that no new recommendations were needed and that all 16 recommendations were still relevant, though some inherently have more immediate and visible impact than others, and some that address the same overarching issue could be effectively consolidated in a future report.

Recommendation 1

Explore mechanisms to support students from low- and middle-income countries (LMICs) to engage with the U.S. S&T enterprise.

The U.S. government has implemented numerous programs to help students from LMICs engage with the U.S. S&T enterprise for many decades, and these programs have been a critical part of the U.S. government's international S&T cooperation efforts. USAID engages LMIC students in collaborative research projects and offers training at U.S. institutions through its Partnerships for Enhanced Engagement in Research (PEER),[54] Higher Education Solutions Network,[55] and Feed the Future Innovation Labs.[56] DOS oversees the long-standing Fulbright program and International Visitor Leadership Program,[57] and the National Institutes of Health (NIH) Fogarty International Center has an exclusive international mission that includes a focus on building research capacity in LMICs by providing training and research support through a variety of programs to address emerging global health needs. This is in addition to training that occurs as part of grants to U.S. or LMIC institutions that are supported by grant-making NIH Institutes and Centers.[58]

Building on the effectiveness of these successful, long-standing programs, additional efforts supporting students from LMICs have been launched in the past two years. Though not specific to scholars from LMICs, DOS's ECA Bureau supports the Private Sector BridgeUSA program, which launched two STEM initiatives in collaboration with OSTP in 2022. The first of these, the Academic Training STEM Extension, provides pre-doctoral college exchange students on J-1 visas the opportunity to pursue work-based academic training in the United States for up to 36 months (increased from 18 months previously).[59] The second initiative, the Early Career STEM Research Initiative, connects U.S. STEM businesses and research institutions with J-1 visa exchange visitors seeking STEM training and research experience.[60]

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[54] USAID Partnerships for Enhanced Engagement in Research (PEER). https://www.usaid.gov/innovation-technology-research/research/peer

[55] USAID Higher Education Solutions Network (HESN). https://www.usaid.gov/innovation-technology-research/research/hesn

[56] Feed the Future Innovation Labs. https://www.feedthefuture.gov/feed-the-future-innovation-labs/

[57] DOS International Visitor Leadership Program. https://exchanges.state.gov/non-us/program/international-visitor-leadership-program-ivlp

[58] NIH Global Health Funding. https://www.fic.nih.gov/Funding/Pages/NIH-funding-opportunities.aspx

[59] BridgeUSA. Opportunity for Academic Training Extensions for J-1 College and University Students in STEM Fields. https://j1visa.state.gov/opportunity-for-academic-training-extensions-for-j-1-college-and-university-students-in-stem-fields/

[60] BridgeUSA. Hosting STEM Exchange Visitors: The Process. https://j1visa.state.gov/programs/early-career-stem-research-initiative/

Recommendation 2

Conduct research to understand why STEM talent leaves the United States or chooses to go to other countries, including examining the entire innovation pipeline to identify research, development, regulatory, statutory, capacity, and infrastructure challenges to STEM talent recruitment and retention.

OSTP asked the Science and Technology Policy Institute (STPI) to support the NSTC ISTC by reviewing published literature on the reasons that STEM talent comes to, stays in, and leaves the United States, and to use publicly available federal information to estimate the flows of STEM talent into and out of the United States. STPI's findings are summarized in the following synopsis; all references and data are documented in a publicly available report.[61]

STEM Talent Recruitment and Retention

In international comparisons, the United States is one of the most attractive destinations for STEM students and workers in the world. Data on the magnitude of outflow of domestic STEM talent (U.S. citizens and permanent residents) from the United States are sparse, but what information is available indicates that fewer Americans leave the country for STEM education or employment (and more choose to return, if they have left) than comparably educated citizens of other nations.

In terms of attractiveness to international students, the United States has the highest number of top-ranked university STEM programs, highly developed and extensive educational and research infrastructure, and an admissions system that is generally open to international students. International students report the primary reason for coming to the United States is the educational opportunity. In contrast, the primary reasons for leaving upon graduation are generally driven by family, personal, and cultural factors.

The attractiveness of the United States for high-skilled STEM workers is primarily based on professional and economic opportunities. A major deterrent diminishing recruitment and retention of STEM talent is the duration and difficulty of obtaining a temporary work visa or permanent residency (for example, due to country quotas on green card approvals, Indian and Chinese applicants can wait years or even decades before obtaining permanent residency). Programs in other countries designed to draw highly skilled talent attract much smaller numbers than flow into the United States.

Over 20% of both the U.S. STEM workforce and STEM graduates from U.S. colleges and universities is foreign born. Therefore, evaluating the magnitude of foreign STEM talent coming to and leaving from the United States is critical for understanding whether, where, and why loss occurs from the U.S. STEM ecosystem (see Table).

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[61] IDA STPI. *Characterizing the Loss of Talent from the U.S. STEM Ecosystem.* https://www.ida.org/-/media/feature/publications/C/Ch/Characterizing-the-Loss-of-Talent-From-the-US-STEM-Ecosystem/Product-3001891.pdf

Estimated Annual Gains and Losses of International Talent in the U.S. STEM Ecosystem

Students (based on degree completions in 2021)

International students lost upon graduation (104,000 grads) .... -27,000–29,000

     Doctoral (14,000 grads) .... -2000

     Master's (60,000 grads)... -7,000

     Bachelor's (30,000 grads) .... -20,500

International students eventually lost from U.S. workforce based

     on number that obtain a temporary worker or other visa .... -70,800

Post-Doctoral Scholars

Long-term loss of U.S.-trained doctoral graduates.. -2800–3500

Number of post-docs recruited from non-U.S. institutions ....+2500–3500

Workers

Total STEM workers obtaining H-1B visa ....+82,000–112,000

Number of STEM workers not transitioning from

     international student status (net import gain)...................................+55,000–75,000

Number of STEM workers gaining employment-based

     lawful permanent resident status...+80,000–88,000

Note: Numbers are based on federal data from multiple agencies on international STEM students, temporary workers, and permanent residents spanning 2012 through 2021/2022.[62]

STEM Student Talent

In 2021, 104,000 international STEM students graduated from U.S. institutions of higher education. Of these, around 75,000 to 76,000 are estimated to have stayed under the Optional Practical Training (OPT) program that allows international STEM graduates of U.S. institutions of higher education to work in the United States on their student visa for up to three years after completing their degree (an initial stay rate of 72% to 73%). Based on longer-term data from the past decade, only about 38,000 members of the international STEM class of 2021 will ultimately transition to an employment-based or other visa status before their student visa expires (a long-term stay rate of 37%). However, those with advanced degrees are much more likely to be retained in the U.S. STEM ecosystem, with long-term stay rates for international STEM doctoral students around 75%.

STEM Workforce Talent

Post-doctoral scholars make up a critical pool of highly educated and skilled STEM talent in the United States, 57% of whom are international. About 45% of international STEM post-docs in the United States are estimated to have been recruited from overseas institutions (assuming that doctorates coming to the United States stay in their post-doc for the same average duration as U.S.-trained post-docs), which translates to 2,500 to 3,500 incoming STEM post-docs annually. Data on the number of international post-doctoral scholars who eventually leave the United States were not found.

Foreign workers coming to the United States must obtain a temporary work visa, the most common for high-skilled STEM workers being the H-1B. The number of annual new H-1B approvals is capped at 85,000 (not including foreign workers at nonprofit academic and research institutions, who are exempt

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[62] The table represented here summarizes information based on multiple data sources. All primary sources are tabulated and cited in STPI's Report. *Characterizing the Loss of Talent from the U.S. STEM Ecosystem.* https://www.ida.org/-/media/feature/publications/C/Ch/Characterizing-the-Loss-of-Talent-From-the-US-STEM-Ecosystem/Product-3001891.pdf

from the cap). Based on reported approvals, approximately 82,000 to 112,000 H-1B visas were awarded to workers in STEM occupations annually between 2012 and 2022. After accounting for the 27,000 to 37,000 of these that represent transitions from international student status, approximately 55,000 to 75,000 temporary foreign workers coming directly from other countries join the U.S. STEM workforce each year.

H-1B visas can be extended for up to six years, after which visa holders must leave the country, transition to another visa status, or apply for permanent resident status (accepted applicants for employment-based permanent residency may stay in the country as long as their application remains open). Data on the number of H-1B visa holders who leave the United States annually were not found and represent a fundamental gap in knowledge regarding loss of talent from the U.S. STEM ecosystem. However, based on approved labor certification for lawful permanent residency, 65% to 69% of green card applicants work in STEM fields. Applying this percentage to the number of employment-based permanent resident approvals awarded between 2012 and 2022, between 80,000 and 88,000 new permanent residents per year work in STEM occupations.

Future Research

STPI's findings, which draw on publicly available federal data sources and published literature, illuminate important data gaps needed to validate inferred estimates and needs for future research relevant to attracting and retaining highly skilled STEM talent in the United States. One substantial ambiguity arises from inconsistency in the academic disciplines and occupations that are counted as STEM by different federal agencies, making comparisons across data sets uncertain. In addition, some federal data sets do not distinguish STEM from non-STEM occupations or even break out STEM as a whole, limiting the ability to document differences in recruitment and retention among different STEM fields. Lastly, the nationalities of students, workers, and visa holders are not always reported, limiting the ability to understand the flows of STEM talent to and from individual countries. Substantial progress addressing the questions posed in the statement of the recommendation could be made through interagency coordination of the data on STEM education and employment.

Recommendation 3

Expand the use and scope of Embassy Science Fellows (ESF) and other exchange programs, as well as long-term detail opportunities between government agencies in international S&T. Work to ensure that these opportunities are open to all levels of knowledge and experience to break down silos and provide cross-agency integration at various professional levels. Identify and remove barriers for participation in these programs to better promote principles of DEIA and ensure that the international S&T workforce better reflects the U.S. population and U.S. scientific community.

Through 2022 and 2023, DOS made a concerted effort to increase interagency awareness of the ESF program through virtual workshops and individual consultations. DOS encouraged more U.S. embassies and consulates to host ESFs, assisted them in proposal design, recruited additional federal agencies as participants in the program, and encouraged participating agencies to increase their applicant numbers. DOS also piloted a design model that encouraged agencies to codevelop proposals with U.S. embassies and consulates in places where a project might further international cooperation. These efforts increased ESF placements, assigning 71 scientists to overseas projects in 2022 and 52 in 2023, the two largest cohorts in the program's history. In addition, DOS has recruited the participation of additional agencies and federal science organizations, including the Department of Veterans Affairs,

Smithsonian Institution (SI), and the Food and Drug Administration, and expects these agencies to send ESFs in the coming year.

The COVID-19 pandemic resulted in increased and effective use of virtual and hybrid fellowship modalities, enabling participation by overseas posts who had not been able to support an in-person fellowship, thereby increasing accessibility of the program and thus opportunities for federal scientists to participate in the ESF program. DOS has consulted with some of the agencies that contribute large numbers of fellows to find ways to encourage more diverse participation and broader access to the program among federal scientists.

Recommendation 4

Explore transnational exchanges between U.S. and foreign technical agencies to increase opportunities for collaboration with close partners while addressing barriers to cooperation.

A key element of government-to-government S&T engagement is personnel exchanges of individual scientists, researchers, and engineers to encourage awareness of international opportunities early in STEM careers, promote international cooperation in research, and overcome potential barriers to cooperation through person-to-person engagement. Exchanges serve many purposes, including introducing foreign partner perspectives and tangible contributions in specific program or project areas. Department of Defense (DoD) programs that promote international exchange include Cooperative Program Personnel (CPP), the Engineering and Scientist Exchange Program (ESEP), and the Administrative and Professional Exchange Program (APEP). While DoD offices and programs benefit in countless ways from having foreign partners as part of the "U.S. team," COVID-19 impacted the ability of many of those individuals to fully engage in their assignments during the time they were in the United States. DOE, the National Oceanic and Atmospheric Administration (NOAA), and NIST also offer transnational exchanges, though others like NSF are not currently authorized to do so. Advancing this recommendation further will require expanding existing programs, both within the United States and overseas, by both the sponsoring agencies and DOS.

Recommendation 5

Strengthen the U.S. research and innovation environment to enable U.S. global S&T leadership, including working through multilateral fora, increasing opportunities for participation by and partnerships with LMICs, and motivating private sector research and development (R&D) and STEM professionals to remain in the United States.

As documented here, numerous recent international engagements, both bilateral and multilateral, have borne fruit for the nation's diplomatic and security relationships and global S&T. However, reaping the full benefits in terms of scientific knowledge, technological innovation, and U.S. leadership from these many bilateral relationships and multilateral fora requires continued and consistent engagement. Advancing Recommendation 5 requires a long-term commitment to including S&T throughout the United States' diplomatic and national security endeavors. Such commitment may help encourage action towards implementing the latter part of this recommendation ("*motivating private sector research and development [R&D] and STEM professionals to remain in the United States*").

Major New Federal Investments in S&T

One of the most important ways the United States has strengthened its domestic R&D environment— thereby lending credibility to the nation's global S&T leadership—is through implementation of the

"Science" part of the CHIPS and Science Act. This component authorized a $200 billion investment in the U.S. S&T enterprise by creating new initiatives at NSF, NIST, DOE, and the Department of Commerce (DOC). For example, in NSF's new Directorate for Technology, Innovation, and Partnerships (TIPs), the Act authorizes the establishment of the Regional Innovation Engines (NSF Engines) program, which aims to uniquely harness place-based S&T R&D to revitalize regional economies; 10 new NSF Engines were recently announced by the White House and are the biggest programs NSF has ever created.[63] The Act also authorizes critical activities in the DOE Office of Science to advance innovation for U.S. global S&T leadership, including investments in microelectronics research centers and increasing researcher access to quantum computing resources. Under the DOE Office of Science's Fusion Energy Sciences program and with support from the CHIPS and Science Act, there are now opportunities to advance fusion commercialization through public-private partnerships such as the Milestone-Based Fusion Development Program. Further through the CHIPS and Science Act, the White House has announced the Economic Development Administration's designation of 31 new innovation regional hubs across the nation to facilitate broader participation in the U.S. innovation economy.[64] However, without appropriations that much more closely align with the President's Budget, the goals and visions outlined in the CHIPS and Science Act will not be realized.

Additionally, in March 2022, the Biden-Harris Administration created ARPA-H to speed up U.S. innovation in health and biomedical research. ARPA-H was given the authority to fund health and biotechnology R&D outside of the traditional grant or contract structure by using solicitations designed for cooperative agreements and Other Transaction Authority that allow for flexibilities outside of the Federal Acquisition Regulation (FAR). When utilized by ARPA-H, this authority provides the U.S. government with a more attractive industry partnership mechanism, both domestic and international, to harness new solutions and to lead globally in high-impact health research. In 2023, ARPA-H also launched the ARPA-H Health Innovation Network (ARPANET-H), a nationwide health innovation network of people, innovators, and institutions connected through three regional hubs. These hubs have members or "spokes" that link ARPANET-H to prospective customers (patients, caregivers, doctors, etc.) and investors. While initially focused domestically, ARPA-H will be looking to expand the network around the world, providing another means for the United States to collaborate with the global research enterprise and to rapidly create and transition life-changing health solutions.

International S&T in the National Security Arena

DoD conducts defense international S&T engagement[65] through an extensive innovation ecosystem that includes DoD Components (Combatant Commands, the Military Services, and DoD laboratories

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[63] The White House. "Fact Sheet: Biden-Harris Administration Announces Innovation Engines Awards, Catalyzing More Than $530 Million to Boost Economic Growth and Innovation in Communities Across America." January 29, 2024. https://www.whitehouse.gov/briefing-room/statements-releases/2024/01/29/fact-sheet-biden-harris-administration-announces-innovation-engines-awards-catalyzing-more-than-530-million-to-boost-economic-growth-and-innovation-in-communities-across-america/

[64] The White House. "Fact Sheet: Biden-Harris Administration Announces 31 Regional Tech Hubs to Spur American Innovation, Strengthen Manufacturing, and Create Good-Paying Jobs in Every Region of the Country." October 23, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/23/fact-sheet-biden-harris-administration-announces-31-regional-tech-hubs-to-spur-american-innovation-strengthen-manufacturing-and-create-good-paying-jobs-in-every-region-of-the-country/

[65] For defense purposes, international S&T cooperation includes all arrangements and activities between the United States and one or more partner nations concerning cooperative research, development, testing, and evaluation of defense technologies, systems, or equipment. It excludes broader activities defined under International Armaments Cooperation including joint production and follow-on support of defense articles or equipment and procurement of foreign technology, equipment, systems, or logistics

and entities within and outside the Services) and the larger defense S&T community including industry, global academia, and foreign governments. To date, the Office of the Under Secretary of Defense for Research and Engineering's (OUSD(R&E)'s) international S&T engagement encompasses over 40 bilateral fora of varying levels of maturity, including traditional and new allies and partners, and several multilateral fora including TTCP, NATO Science and Technology Organization (STO), and AUKUS. Over the last two years, OUSD(R&E) established Under Secretary-level fora with Canada, India, Israel, and Japan, as well as new defense S&T working groups with France, Italy, Norway, and Singapore. Additionally, U.S. government, academic, and industry participation in the NATO STO technical activities has dramatically increased to over 1,000 individuals. In 2022 and 2023, the Under Secretary of Defense for Research and Engineering laid out a technology vision encompassing 14 Critical Technology Areas (CTAs),[66] followed by the *National Defense Science and Technology Strategy* in May 2023,[67] which articulates the S&T priorities, goals, and investments of the DoD. Both documents strongly emphasize the importance of allies and partners to maintaining technological advantage: "Allies and partner nations are an asymmetrical advantage for the United States, and the Department will partner with nations that are aligned with the principles of the United States to jointly develop and deploy technology."[68]

Bilateral S&T Alliances and Partnerships

Since the 2022 NSTC ISTC Report was released, the Biden-Harris Administration has renewed and deepened bilateral S&T alliances and partnerships. These include joint committee meetings (JCMs) held under the auspices of bilateral government-to-government science and technology agreements (STAs) with Australia, Finland, France, Italy, Japan,[69] the Republic of Korea,[70] Thailand, Vietnam, and the European Union, as well as an S&T dialogue under the auspices of the American Institute in Taiwan (AIT) and the Taiwan Economic and Cultural Representative Office (TECRO). While each JCM is distinct, all of them are structured to strengthen existing research partnerships and to develop new ones where there is mutual interest. DOS also concluded negotiations on updating STAs with Cyprus, Morocco, Pakistan, the Republic of Korea, and the Kingdom of Saudi Arabia. In addition, the Biden-Harris Administration launched a number of dialogues on CETs led by the National Security Council, including

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support. "Science and Technology" encompasses basic research, applied research, and advanced technology development including prototyping and experimentation. It excludes system development and qualification, and other activities concerning acquisition and sustainment. See *Department of Defense International Science and Technology Engagement Strategy: A Unified Approach to Strengthen Alliances and Attract New Partners*, December 2020, See https://apps.dtic.mil/sti/citations/AD1118108

[66] Under Secretary of Defense for Research and Engineering. *Technology Vision for an Era of Competition.* February 2022. These CTAs include: seed areas of emerging opportunity: Biotechnology, Quantum Science, Future Generation Wireless Technology (FutureG), and Advanced Materials; effective adoption areas, where there is existing vibrant commercial sector activity: Trusted AI and Autonomy, Integrated Network System-of-Systems, Microelectronics, Space Technology, Renewable Energy Generation and Storage, Advanced Computing and Software, Human-Machine Interfaces; and defense-specific areas: Directed Energy, Hypersonics, and Integrated Sensing and Cyber. https://www.cto.mil/usdre-strat-vision-critical-tech-areas/

[67] DoD. *National Defense Science and Technology Strategy*. May 2023. https://www.cto.mil/ndsts/

[68] DoD. Under Secretary of Defense for Research and Engineering's Technology Vision for an Era of Competition. February 2022. https://www.cto.mil/usdre-strat-vision-critical-tech-areas/

[69] The White House. "Readout of the U.S.-Japan Joint High Level Committee Meeting." May 16, 2023. https://www.whitehouse.gov/ostp/news-updates/2023/05/16/readout-of-u-s-japan-joint-high-level-committee-meeting/

[70] The White House. "Readout of the U.S.-ROK Joint Committee Meeting." May 19, 2023. https://www.whitehouse.gov/ostp/news-updates/2023/05/19/readout-of-u-s-rok-joint-committee-meeting/

with India,[71] Israel,[72] the Republic of Korea,[73] and Singapore.[74] As with JCMs, each of these dialogues is unique and tailored. Importantly, these new CET-centered dialogues are built on established relationships in S&T cooperation, ensuring mutual trust, elevating important issues, and avoiding duplication of previous efforts.

Multilateral S&T Alliances and Partnerships

Since the release of the 2022 NSTC ISTC Report, the United States has been an active leader and participant in numerous multilateral S&T fora, including those with significant LMIC partnership:

- **Asia Pacific Economic Cooperation (APEC):** The United States hosted APEC in 2023 and elevated priorities of "interconnected, innovative, and inclusive" S&T. U.S. leadership was seen through awarding the annual APEC ASPIRE Prize,[75] holding a workshop on inclusivity in STEM, and hosting field trips to multiple U.S. Geological Survey (USGS) research sites, U.S. universities, and to Microsoft. U.S. S&T participation in APEC groups—including the Policy Partnership for Science, Technology and Innovation, the Digital Economy Steering Group, and the Telecommunications and Information Working Group—promotes economic growth and development by supporting scientific, technical, and regulatory cooperation among APEC member economies. These fora are key opportunities for (1) advancing U.S. and democratic perspectives on international S&T issues in a geopolitically vital region, including increasing diversity and the participation of women in STEM; (2) promoting an environment enabling S&T cooperation, security, and integrity; and (3) advancing CETs such as 5G, AI, and the growing digital economy, which are enabled by information and communication technology.[76]

- **G20 Research and Innovation Initiative Gathering (RIIG):** Building on work from the G7 on transnational issues, under its 2022 presidency Indonesia launched a new workstream called the RIIG, which India continued under its 2023 presidency. Key topics for the RIIG in 2023 aligned with U.S. priorities, including open, equitable, and secure scientific collaboration; responsible research and innovation to respond to global challenges; materials for sustainable energy; eco-innovations for energy transition; circular bio-economy; and sustainable blue/ocean-based economy.[77] Elevation of the RIIG to a formal working group—the RIWG—has taken place under Brazil's 2024 presidency.

- **G20 Chief Science Advisers' Roundtable (CSAR):** India initiated the CSAR in 2023 to bring together Chief Science Advisors or their equivalents to discuss relevant policy issues and craft evidence-

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[71] The White House. "Fact Sheet: United States and India Elevate Strategic Partnership with the initiative on Critical and Emerging Technology (iCET)." January 31, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/01/31/fact-sheet-united-states-and-india-elevate-strategic-partnership-with-the-initiative-on-critical-and-emerging-technology-icet/

[72] The White House. "Fact Sheet: U.S.-Israel Strategic High-Level Dialogue on Technology." September 30, 2022. https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/30/fact-sheet-u-s-israel-strategic-high-level-dialogue-on-technology/

[73] The White House. "Joint Fact Sheet: Launching the U.S.-ROK Next Generation Critical and Emerging Technologies Dialogue." December 8, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/12/08/joint-fact-sheet-launching-the-u-s-rok-next-generation-critical-and-emerging-technologies-dialogue/

[74] The White House. "U.S.-Singapore Critical and Emerging Technology Dialogue: Joint Vision Statement." October 12, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/12/u-s-singapore-critical-and-emerging-technology-dialogue-joint-vision-statement/

[75] APEC. APEC's 2023 Science Prize Nominations Announced. July 19, 2023. https://www.apec.org/press/news-releases/2023/apec-s-2023-science-prize-nominations-announced

[76] Asia-Pacific Economic Cooperation. https://www.apec.org/

[77] G20. "G20 Research Ministerial Meeting: Outcome Document and Chair's Summary." July 5, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/07/G20_Research_Ministerial_ODCS.pdf

based, data-driven science advice. Key topics in 2023 aligned with U.S. priorities, including: opportunities in One Health for better disease prevention, control, and pandemic preparedness; synergizing global efforts to expand access to scholarly scientific knowledge; and DEIA in the S&T ecosystem.[78]

- **OECD Global Forum on Technology (OECD GFT):** The United States supported the 2023 launch of the OECD GFT, which brings together diverse government and private sector stakeholders from OECD member and non-member countries, including emerging economies, and serves as a venue for regular, in-depth, strategic and multi-stakeholder dialogues on issues at the forefront of the policy debate on CETs. Organized under the auspices of the Committee on Digital Economy Policy (CDEP) in close partnership with the Committee on Scientific and Technological Policy (CSTP), and supported through initial financial contributions from the UK and the United States, the GFT will focus on quantum, immersive technologies, and biotechnologies in its first year. Ultimately, the United States intends for the conversations at the GFT to advance dialogue within CDEP and CSTP to shape recommendations for responsible innovation and use of these key technologies.

- **U.N. Educational, Scientific and Cultural Organization (UNESCO):** In July 2023, the United States rejoined UNESCO with full membership privileges, restoring U.S. leadership on a host of issues of importance and value to the American people. In pursuing full membership with UNESCO, the United States made clear its commitment to multilateralism and diplomacy on critical issues, which among other things includes expanding access to education and shaping best practices on CETs.[79]

- **NATO Defence Innovation Accelerator for the North Atlantic (DIANA):** DIANA was institutionalized at the 2021 NATO Summit in Brussels with the goals of (1) enhancing and accelerating transatlantic cooperation on dual-use technology solutions, and (2) helping NATO work more closely with private-sector entities, academia, and other non-governmental entities.[80] DIANA is building a network of accelerators, test centers, and experimentation across the Alliance, including two accelerators in the United States, to help start-ups and non-traditional companies better support NATO's capabilities and requirements. Key emerging technologies DIANA seeks to support include AI, robotics and autonomous systems, biotechnology and human enhancement, data, electronics and electromagnetics, energy and propulsion, novel materials and manufacturing, quantum technologies, and space technologies. In December 2022, representatives from across NATO elected a U.S. candidate to serve as the first Chair of the DIANA Board of Directors. In 2023, a pilot program involving a call for proposals resulted in innovators from across NATO submitting 1,300 dual-use technology solutions for the challenge programs in energy resilience, sensing and surveillance, and secure information sharing. Subject matter experts from the NATO STO will contribute technical evaluations of the proposals, both in the pilot program and subsequently. DIANA will contribute to the broader effort of ensuring that NATO remains at the cutting edge of technologies.[81]

- **The 'Quad':** The 'Quad' is a diplomatic network of four democracies—Australia, Japan, India, and the United States—committed to supporting a free and open, stable and prosperous Indo-Pacific that is inclusive and resilient. One of many initiatives under the Quad is Advancing Innovation to

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[78] G20. "G20-Chief Science Advisers' Roundtable: Outcome Document and Chair's Summary." August 28, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/08/G20_CSAR_Outcome_Document_and_Chair_Summary_28Aug.pdf

[79] UNESCO. "The United States becomes the 194th Member State of UNESCO." July 11, 2023. https://www.unesco.org/en/articles/united-states-becomes-194th-member-state-unesco

[80] NATO DIANA. https://www.nato.int/cps/en/natohq/topics_216199.htm

[81] NATO Defence Innovation Accelerator for the North Atlantic (DIANA). https://www.diana.nato.int/

Empower Nextgen Agriculture (AI-ENGAGE). Through AI-ENGAGE, which was created in 2023,[82] Quad science agencies are leveraging joint funding, expertise, infrastructure, and other resources to deliver scientific advances to increase crop yield and resilience. By collaborating on cutting edge research and innovations in areas such as AI, robotics, communications, and sensing, and then disseminating research findings, AI-ENGAGE can transform agricultural approaches to empower farmers throughout the Indo-Pacific region and the world.

- **The Australia – United Kingdom – United States Partnership (AUKUS):** The AUKUS trilateral security partnership was established in September 2021. Under this framework, AUKUS partners are increasing trilateral cooperation on advanced capabilities, including AI and autonomy, cyber, electronic warfare, quantum, hypersonics and counter-hypersonics, and undersea warfare. In December 2023, the AUKUS Defense Ministers announced the establishment of the AUKUS Maritime Autonomy Experimentation and Exercise Series and highlighted key trilateral developments in AI, machine learning, and quantum positioning, navigation, and timing, among other areas.[83]

- **Global Research Council (GRC):** The GRC, which was founded by NSF in 2012, provides an important forum for the heads of science agencies from around the world.[84,85] NSF co-hosted the 2022 GRC Annual Meeting in Panama City, which included the development of Statements of Principles and Practices related to STEM Workforce Development and Research Ethics, Integrity, and Culture in the Context of Rapid-Results Research. NSF organized side events on research integrity and security at the 2023 GRC Annual Meeting and at the 2022 GRC-Americas regional meeting, with continued discussion and follow-up at the 2023 GRC-Americas regional meeting.

Two other multilateral fora should be noted. I2U2 (India, Israel, UAE, and the United States) was launched under the Biden-Harris Administration in October 2021 and has enabled joint initiatives on water, energy, transportation, space, health, and food security. In September 2023, the United States joined with 31 other countries across North America, South America, Africa, and Europe to create the Partnership for Atlantic Cooperation, a multilateral forum bringing together coastal Atlantic States to uphold a set of shared principles and advance shared interests. The Partnership gives members a new platform to work together to address a broad range of issues, from economic development to environmental protection to science and technology.[86]

Recommendation 6

Consider the development of flexible and longer-term approaches to funding international collaborative science to compete with other countries' longer-term research funding initiatives, such as those enabled by the People's Republic of China's (PRC's) five-year plans or the European Union's (EU's) seven-year multiyear financial framework.

The United States continues to face challenges in being agile and responsive to opportunities to fund international S&T collaboration. The 2022 NSTC ISTC Report identified existing long-term collaborative

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[82] The White House. "Quad Leaders' Summit Fact Sheet." May 20, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/20/quad-leaders-summit-fact-sheet/

[83] DoD. "AUKUS Defense Ministers Meeting Joint Statement." December 2023. https://www.defense.gov/News/Releases/Release/Article/3604511/aukus-defense-ministers-meeting-joint-statement/

[84] Global Research Council. https://globalresearchcouncil.org/

[85] Global Research Council. Multilateral Engagement Working Group. https://globalresearchcouncil.org/about/multilateral-engagement-working-group/

[86] The White House. "Declaration on Atlantic Cooperation." September 18, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/09/18/declaration-on-atlantic-cooperation/

research funding initiatives outside the United States, such as those sponsored by the PRC and EU.[87] Since the drafting of the 2022 NSTC ISTC Report, additional countries, including Japan and the UK, have deployed co-funding mechanisms to support collaborative international research. Canada, New Zealand, and the UK have also now joined Horizon Europe.[88] In the United States, a June 2023 report from the National Quantum Initiative Advisory Committee pointed to the need to fund and coordinate international collaborative research initiatives.[89] Taken together, these developments amplify the importance of developing a nimble and flexible U.S. funding mechanism to support international S&T collaboration and the continued relevance of this 2022 NSTC ISTC report recommendation.

Recommendation 7

Explore the creation of a flexible mechanism within the Department of State (DOS) to support joint S&T goals, research, and innovation with foreign partners. Projects and initiatives could include consortia support and support for international facilities that are of strategic scientific, national security, and/or foreign policy interest to the United States.

DOS is exploring a variety of mechanisms to support joint S&T goals, research, and innovation with foreign partners. At present, DOS is responsible for the $500 million International Technology Security and Innovation Fund appropriated in the CHIPS and Science Act. Starting in 2023, $100 million per year is being distributed to support diversification and innovation in the semiconductor supply chain and support the development of secure telecommunication networks. These investments strengthen global economic ecosystems and thus secure our global supply chains and infrastructure. While critically important and relevant to the interests outlined in this recommendation, this fund is earmarked for a specific type of S&T R&D, limiting its flexibility.

Further efforts are needed to develop more flexible mechanisms to support joint S&T goals, research, and innovation with foreign partners. Any new mechanism addressing this recommendation could also support Recommendation 8, which specifically focuses on international partners that have low scientific capacity.

Recommendation 8

Explore the creation of a mechanism under which assistance for S&T collaboration can be provided to international partners who otherwise lack scientific capacity. Partners may include nations that do not qualify for development assistance and/or lack existing STEM capacity to participate in research collaborations intended to be mutually beneficial.

Although multiple agencies have activities that strengthen the capacity of LMIC partners in S&T, no agency has developed a new mechanism since the release of the 2022 NSTC ISTC Report. Federal departments and agencies face several challenges in developing such a mechanism. First, not all agencies have authority to directly fund international partners. Some departments and agencies that lack this direct authority, such as NSF and DOE, can instead fund the U.S.-side of an international

[87] NSTC. *Biennial Report to Congress on International Science & Technology Cooperation.* September 2022. https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Biennial-Report-to-Congress-on-International-Science-Technology-Cooperation.pdf

[88] Science Business. "Canadian Universities, Agencies Gear Up for Horizon Europe Membership." November 28, 2023. https://sciencebusiness.net/news/horizon-europe/canadian-universities-agencies-gear-horizon-europe-membership#:~:text=Horizon's%20expansion%20to%20Canada%20is,with%20Switzerland%2C%20Korea%20and%20Japan.

[89] National Quantum Initiative Advisory Committee. *Renewing the National Quantum Initiative: Recommendations for Sustaining American Leadership in Quantum Information Science*. June 2023. https://www.quantum.gov/wp-content/uploads/2023/06/NQIAC-Report-Renewing-the-National-Quantum-Initiative.pdf

research team and thus help strengthen the scientific capacity of foreign partners, as well as assist in identifying external (non-U.S. government) funding to support foreign researchers and labs. Second, among those that do have authority to fund international partners, there is a need for greater coordination of effort (e.g., between DoD and USAID on funding LMIC scientists working at the intersection of basic research and international development). Third, there are some countries that do not qualify for development assistance as defined by the Foreign Assistance Act,[90] but which need additional scientific capacity. It is possible for some agencies to financially support countries that do not qualify for development assistance, but the ability to do so depends on Congressional directives and internal authorities. Mechanisms to provide funding to international S&T partners will need to address all of these obstacles.

Several U.S. agencies have navigated such obstacles via the interagency collaborative mechanism of the USAID PEER, which has provided USAID funding to researchers in LMICs who partnered with U.S.-based research grantees funded by NSF, the Department of Agriculture, NASA, NIH, SI, NOAA, and USGS. However, this program is scheduled to end in July 2024, increasing the importance of establishing a flexible, long-term mechanism. The design of the new mechanism could benefit from an analysis of the PEER program or other programs that have been developed to address some or all of the challenges in promoting scientific collaboration between U.S. scientists and those in LMICs. However, an analysis should not impede or delay efforts to develop a mechanism to replace PEER in the near future.

Recommendation 9

Expand detail opportunities between international offices in science and technical agencies to allow federal experts to better familiarize themselves with international S&T practices and networks in other parts of the U.S. government.

Training, detail opportunities, and rotations have the potential to break down barriers between agencies and provide cross-agency visibility and integration at all professional levels. International S&T work is inherently advanced through relationships, and detail/rotation opportunities grow and strengthen professional networks. Federal agencies offer professional development for their employees, including professional staff in the international offices. International S&T staff from the Environmental Protection Agency (EPA), NIST, DoD, NSF, and DOS have engaged in short-term and long-term details within and across agencies. DoD leverages career path indications, such as the Security Cooperation Workforce Development Program, to facilitate detail and rotation placements for international S&T staff. The DOS-run ESF program frequently serves as a kick-starter for longer-term engagements between federal agencies and international counterparts. In September 2023, DOS launched their first Learning Policy, which fosters a culture of career-long learning by rating supervisors on how well they support the professional development of their team members.

However, there is currently no government-wide platform explicitly designed to facilitate the promotion of these opportunities or to match potential candidates to opportunities that are appropriate for their professional development in the international S&T arena (including opportunities within NSC and/or OSTP). Establishing a government-wide platform to facilitate such exchange opportunities would increase the number and improve the quality of interagency exchanges.

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[90] Foreign Assistance Act of 1961. Public Law 87–195. https://www.govinfo.gov/content/pkg/COMPS-1071/pdf/COMPS-1071.pdf

Recommendation 10

Encourage amplification of existing international S&T collaboration efforts through public diplomacy, media outreach, and sustained people-to-people-level engagement.

Although all U.S. departments and agencies have public outreach and media teams, no agency has developed a new mechanism or public strategy specifically intended to amplify international S&T collaboration since the release of the 2022 NSTC ISTC Report, although public diplomacy programs have always featured international S&T collaborations as a regular part of their agencies' information missions. DOS is exploring opportunities for increased coordination between Environment, Science, Technology, and Health (ESTH) officers and public diplomacy programs, which would extend the visibility and impact of existing international S&T cooperation as well as seed new opportunities for cooperation. DoD officials consistently participate in a variety of public engagement and media outreach activities to strategically highlight the importance of incorporating ally and partner perspectives, competencies, and advantages in defense S&T. As noted in the National Defense Science and Technology Strategy 2023, "to increase the vibrancy of the ecosystem and enhance the effectiveness of research efforts, we will continuously communicate with our allies and partners to generate more opportunities to collaborate."[91] Further coordination and amplification would be useful to expand existing efforts and ensure they are not duplicative.

Recommendation 11

Explore mechanisms to support exchange visitor programs with Historically Black Colleges and Universities (HBCUs), other Minority-Serving Institutions (MSIs), and institutions in Established Program to Stimulate Competitive Research (EPSCoR) jurisdictions, as well as training and development programs at all educational levels that may increase the capacity of interested institutions to more readily engage with international partners.

In this report, MSIs refer to U.S. institutions of higher education that serve minority populations, either as part of their specific mission or by enrolling high numbers of minority students, including HBCUs, Hispanic-Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), and Asian American and Native American Pacific Islander Serving Institutions (AANAPISIs). EPSCoR jurisdictions are those States and some Territories (and the District of Columbia) that receive a disproportionately small portion of federal funding for research and related activities (eligibility varies by agency).[92]

DOS's Bureau of Global Public Affairs Office of Public Liaison (GPA/PL) and the DOS Diplomats in Residence program have long engaged HBCUs through briefings, conferences, and other events in Washington, D.C. and around the country to explain DOS's policies and priorities at home and abroad. GPA/PL also organizes DOS's annual HBCU Foreign Policy Conference, which is intended to provide students from HBCUs and other Predominantly Black Institutions with information on U.S. foreign policy priorities and DOS careers. DOS's ECA bureau sponsors several study-abroad programs promoted at HBCUs, including the Benjamin A. Gilman International Scholarship, the Critical Language Scholarship, and the Fulbright programs. NSF's Accelnet program, which provides support for students at U.S. institutions to specifically conduct research overseas, has active outreach efforts to promote awareness of the program at both MSIs and institutions in EPSCoR jurisdictions.

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[91] DoD. *National Defense Science and Technology Strategy 2023.* May 2023. https://media.defense.gov/2023/May/09/2003218877/-1/-1/0/NDSTS-FINAL-WEB-VERSION.PDF

[92] Harris, L.A. 2017. Established Program to Stimulate Competitive Research (EPSCoR): Background and Selected Issues. Congressional Research Service report R44689. https://crsreports.congress.gov/product/pdf/R/R44689/5

In addition to programs that encourage MSI students and scholars to study abroad, MSIs and institutions in EPSCoR jurisdictions can also host exchange visitors. However, many of these institutions do not have established exchange programs and are therefore not eligible to sponsor visitors on J-1 visas. Increasing the ability of MSIs and institutions in EPSCoR jurisdictions to host foreign exchange visitors will require helping them establish the necessary programs and ensuring that they are well advertised to overseas students and scholars with the help of federal agencies.

Several departments and agencies have also taken steps to increase participation in exchange visitor programs and increase the capacity MSIs and institutions in EPSCoR jurisdictions have to engage with international partners. USAID has signed several MOUs with MSIs to expand their participation in international development efforts and has partnered MSIs with developing nation researchers. For example, USAID's Long-term Assistance and Services for Research (LASER) program funded five research projects at $150,000 each over 12 to 18 months as part of a call for research proposals that partnered researchers from MSIs with researchers from foreign institutions. NSF has engaged in concerted efforts to increase participation in international collaborative scientific research activities of MSIs and institutions in EPSCoR jurisdictions to include outreach, capacity building, and networking to identify and support new collaborative teams. While there is still work to be done, early outcomes include NSF Global Centers awards both to MSIs and to institutions in EPSCoR jurisdictions.

Most of the activities addressing Recommendation 11 have focused on HBCUs and MSIs. Further effort is needed to expand the capacity of institutions falling within the scope of existing agency EPSCoR programs to send and host exchange visitors.

Recommendation 12

Explore how researchers in both STEM and non-STEM fields at HBCUs, other MSIs, and institutions in EPSCoR jurisdictions are participating in international S&T collaborations, including as reflected in co-authored publications. Assess whether and how international engagement can act as a career accelerator for researchers and students from underrepresented groups and if additional mechanisms may be needed to positively impact representation in international S&T settings.

OSTP asked STPI to support the NSTC ISTC by conducting original research using publicly available information from a variety of federal agencies and other resources to address the question posed by this recommendation.[93] A synopsis of STPI's publicly available report follows.

The participation of underrepresented groups in STEM within international S&T opportunities is not well understood. Although there is some understanding and research on international collaboration networks and their development, how underrepresented groups in STEM fit into such networks has not been addressed. NSF has started an analysis to explore how HBCUs, other MSIs, and institutions in EPSCoR jurisdictions are participating in international S&T collaborations based on proposals submitted as well as grants awarded, but international collaboration has otherwise received little attention in published literature, and HBCUs, MSIs, and EPSCoR institutions in particular have not been examined.

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[93] IDA STPI. *International S&T Collaborations at HBCUs, MSIs, and EPSCoR Jurisdiction Institutions.* https://www.ida.org/-/media/feature/publications/I/In/International-Sci-Tech-Collaborations-at-HBCUs-MSIs-and-EPSCoR-Jurisdiction-Institutions/Product-3001890.pdf

To address some of these gaps, STPI conducted an exploratory bibliometric study on the participation of HBCUs, enrollment-based MSIs[94], and institutions in EPSCoR jurisdictions in international S&T collaborations with two major research questions:

1. How do international S&T collaboration activities, as reflected in co-authored publications, at HBCUs, other MSIs, and EPSCoR jurisdiction institutions compare to appropriate comparison groups?

2. How do international S&T collaboration activities at an institution with HBCU, MSI, and/or EPSCoR status vary as a function of other institutional characteristics?

Institutions with HBCU, MSI, and/or EPSCoR status do not represent a random sample of U.S. institutions of higher education with respect to funding (e.g., R&D expenditures), size (e.g., student enrollment and number of tenured faculty), geographic locale (e.g., rural vs. urban setting), institution type (e.g., public vs. private institution), and Carnegie classification of research intensity.[95] To account for the potential influence of institutional characteristics on international S&T cooperation, a control sample was created by pairing every HBCU, MSI, and EPSCoR institution with a comparable non-HBCU, non-MSI, and non-EPSCoR institution using institutional characteristics from the National Center for Science and Engineering Statistics, the Integrated Postsecondary Education Data System (IPEDS) from the National Center of Education Statistics, and the Carnegie Classification of Institutions of Higher Education.[96]

Initial results show that MSIs and EPSCoR institutions perform similarly or better than their comparison institutions in number of international publications, when accounting for funding and size. HBCUs, on the other hand, differ from their comparison institutions in terms of international publication activity even after controlling for funding and size. Increases in R&D expenditures and greater number of faculty are correlated with higher numbers of international publications for both focal and comparison groups. HBCUs that are larger and have greater research expenditures were found to have comparable numbers of international publications with their peer, non-HBCU institutions, but smaller HBCUs showed less international S&T collaboration than peer, non-HBCU institutions. The observed differences could reflect institutional priorities like faculty time allocated to research relative to teaching or a legacy of historical exclusion of HBCUs from S&T opportunities. These preliminary findings suggest that HBCUs as a whole—although not MSIs and EPSCoR institutions—do not participate in international S&T collaboration to the degree that other, non-HBCU institutions do, particularly those with fewer resources. Further research is needed to understand why and to develop policies to address group-based differences.

Recommendation 13

Critically review existing job series and consider new series that would allow the recruitment of technical professionals within agencies to support S&T diplomacy and enhance the government's ability to recruit skilled and specialized representation for highly technical international activities, including standards-setting bodies and international technical working groups.

While not a new series, the White House Office of Management and Budget (OMB) has helpfully created a STEM portal on USAJobs to aggregate S&T postings, so that individuals looking for new federal

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[94] In this analysis, HBCUs were analyzed separately from other MSIs, as specified in the test of the recommendation.

[95] Carnegie Classification of Institutions of Higher Education. https://carnegieclassifications.acenet.edu/

[96] Full information on research expenditures was not available for all HBCUs, MSIs, and EPSCoR institutions. Only those with complete information on institutional characteristics were included in the analysis.

employment opportunities no longer need to search every possible term for an S&T job posting, including S&T diplomacy.[97]

Separately, DOS has begun implementing a new program called the Lateral Entry Pilot Program, which establishes a 3-year pilot program for lateral entry into the Foreign Service that seeks to recruit mid-career individuals from the civil service and private sector who have skills and experiences that would be extremely valuable to the Foreign Service.[98] DOS selected six priority areas for focused recruitment, three of which require S&T experience: cyber and emerging technology; climate, environment, and energy; and global health. The first cohort of up to 35 individuals will be selected in 2024.

In addition, in September 2023, OMB extended and amended the government-wide direct hire appointing authorities for STEM positions, acquisitions, and cybersecurity and related positions where severe shortages of candidates and/or critical hiring needs were identified.[99] However, as this is a time-limited authority, it expires one year from the date of the memorandum or until the White House Office of Personnel Management (OPM) terminates the authority, whichever comes first. OPM amended the original 2018 authority by adding two occupational series—data science (GS-1560) and operations research (GS-1515)—to support agency efforts to expand AI capabilities in the federal government. These positions are not necessarily specific to supporting S&T diplomacy or international activities, though they could be included.

Thus, while these actions are important and notable, they do not directly respond to the recommendation posed here from 2022. There is still a need to create a new job series focused on recruiting individuals with S&T experience especially for highly technical international working groups and international bodies, thereby implementing this specific recommendation across the U.S. government.

Recommendation 14

Explore the creation of mechanisms within the U.S. government that mobilize and train federal scientists to communicate effectively to non-scientist decision makers within the U.S. government and abroad.

In alignment with this recommendation from the 2022 NSTC ISTC Report, the President's Council of Advisors on S&T (PCAST) wrote a letter to President Biden in August 2023 focused on science communication that includes two recommendations: (1) call on federal agencies to make S&T communication and public engagement a core component of their mission and strategy, and (2) establish a new office to support federal agencies in their continuing efforts to develop and build participatory public engagement and effective S&T communications.[100] However, no concrete actions have been implemented to date to create the proposed mechanisms.

A possible venue available to all federal employees in S&T-related occupations to improve communication skills with the wider public and non-scientist decision makers is DOS's FSI. FSI has a history of designing new subject matter and skills development courses in response to recognized needs. For example, FSI recently piloted a new course for senior officials, intending to deepen

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[97] USAJOBS. STEM Jobs. https://stem.usajobs.gov/Search/Results?s=relevance&sd=asc&mco=07&p=1

[98] DOS. "State Department Announces New Lateral Entry Pilot Program." January 24, 2024. https://www.state.gov/state-department-announces-new-lateral-entry-pilot-program/

[99] OPM. *Extension and Amendment of the Government-wide Direct Hire Appointing Authorities*. September 29, 2023. https://chcoc.gov/sites/default/files/CHCO%20Memo%20re%20extension%20of%20Govwide%20DHA%20for%20STEM%20Cyber%209-29-2023.pdf

[100] PCAST. "Letter to the President: Advancing Public Engagement with the Sciences." August 2023. https://www.whitehouse.gov/wp-content/uploads/2023/08/PCAST_Science-Engagement-Letter_August2023.pdf

awareness of CETs for those involved in leading U.S. diplomatic and security efforts in an era of rapid technological advancement. Cross-agency support for a science communication course would benefit the U.S. diplomatic service (those who make the most use of FSI) and encourage other federal workers to take full advantage of this underutilized resource.

Recommendation 15

Consider providing incentives and training opportunities to experts who contribute to international standards-setting bodies and other relevant working groups to ensure that the appropriate technical experts are active contributors to these discussions.

The rapid pace of CET development means that standardization efforts in various international fora are in flux, creating a need for greater coordination across public and private sectors. In May 2023, the White House released the *U.S. Government National Standards Strategy for Critical and Emerging Technology* (USG NSSCET), which identifies collective actions needed to support U.S. engagement, reinforce U.S. leadership and competitiveness, and safeguard U.S. technologies in international standards development.[101,102] The USG NSSCET includes a specific objective focused on addressing standards workforce challenges that limit the United States' ability to effectively participate in the dynamic and growing number of international standards-setting bodies. The proposed action echoes the 2022 NSTC ISTC report recommendation and notes that the "U.S. government will invest in educating and training a cadre of professionals that can effectively contribute to and drive technical standards development. We will work with the private sector to find innovative ways to educate and train those in academia and industry." To understand (1) how to address barriers to participation in standards development activities and (2) how the U.S. government is uniquely positioned to support international standards development, NIST co-hosted a series of listening sessions and engagements to inform stakeholders, gather the collective wisdom of the community, and generate excitement and support for responses to a "Federal Notice: Request for Information" on implementing the USG NSSCET.[103]

Recommendation 16

Assess current STAs for relevancy and gaps with a view to addressing with foreign partners as and when appropriate. Evaluate mechanisms for the United States to increase data and facility access, scientific exchange, and visa or customs and border flexibilities for visitors from private sector and academic institutions in connection with STAs or related agreements.

DOS renews and negotiates new STAs to address key scientific, diplomatic needs and to signal the important role of S&T in our international engagements. In 2022 and 2023, the U.S. government signed updated STAs with Cyprus, Morocco, Pakistan, the Republic of Korea, and the Kingdom of Saudi Arabia and is in the midst of negotiations with a number of other countries.

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[101] The White House. "Fact Sheet: Biden-Harris Administration Announces National Standards Strategy for Critical and Emerging Technology." May 4, 2023. https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/04/fact-sheet-biden-harris-administration-announces-national-standards-strategy-for-critical-and-emerging-technology/

[102] The White House. *U.S. Government National Standards Strategy for Critical and Emerging Technology.* May, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/05/US-Gov-National-Standards-Strategy-2023.pdf

[103] Federal Register. "Request for Information on Implementation of the United States Government National Standards Strategy for Critical and Emerging Technology (USG NSSCET)." September 7, 2023. https://www.federalregister.gov/documents/2023/09/07/2023-19245/request-for-information-on-implementation-of-the-united-states-government-national-standards

To promote ease and benefit of scientific collaboration, and in consultation with S&T departments and agencies, as well as the U.S. Patent and Trademark Office and relevant technical agencies, DOS continues to assess and update language in STAs on data sharing, data and facility access, and intellectual property rights. When negotiating government-to-government STAs (both new and renewed) since the 2022 NSTC ISTC Report, DOS has added reference to openness and accountability, as well as language addressing DEIA, open data, and research integrity, to ensure alignment and understanding with foreign partners that match the Biden-Harris Administration's priorities.

Outlook and Future Prospects

The 2022 NSTC ISTC Report concluded by noting that the world faced many complex challenges, and these have only grown in the intervening timeframe. International S&T cooperation has been a pillar of U.S. foreign policy since the end of World War II, and it is at risk of deteriorating at a time when it is more important than ever in an increasingly competitive geopolitical climate. The United States uses science to advance diplomacy and diplomacy to advance science, and international S&T collaborations are a key component to constructively impact the nation's economic development, national security, and the welfare of its people over the near- and long-term future. Concerted U.S. government efforts to expand and deepen bilateral and multilateral S&T endeavors have been undertaken, but they must also be sustained over time. They are grounded in our domestic investments in S&T and innovation, which cannot be taken for granted and also require sustained attention and resources. Thus, maintaining and advancing U.S. S&T leadership in an increasingly competitive international landscape continues to require long-term attention, resources, and engagement from all parts of U.S. society.