





Diplomacy for the 21st Century: Embedding a Culture of Science and Technology Throughout the Department of State

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DIPLOMACY FOR THE 21ST CENTURY

EMBEDDING A CULTURE OF SCIENCE AND TECHNOLOGY
THROUGHOUT THE DEPARTMENT OF STATE

Committee on Science and Technology Capabilities at the Department of State

Development, Security, and Cooperation

Policy and Global Affairs

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Preface and Acknowledgments

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Enriqueta Bond, Burroughs Wellcome Fund, and Robert Frosch, Harvard University. Appointed by the National Academies, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Abbreviations and Acronyms

AAAS	American Association for the Advancement of Science
DOD	Department of Defense
DOS	Department of State
EST	Environment, Science, and Technology
ESTH	Environment, Science, Technology, and Health
FSN	Foreign Service National
FSO	Foreign Service Officer
IAEA	International Atomic Energy Agency
ICSU	International Council for Science
INR	Bureau of Intelligence and Research
NATO	North Atlantic Treaty Organization
NGO	Nongovernmental Organization
NIAID	National Institute of Allergy and Infectious Diseases
NIH	National Institutes of Health
NSF	National Science Foundation
OECD	Organization for Economic Cooperation and Development
OES	Bureau of Oceans and International, Environmental, and Scientific Affairs
OSTP	Office of Science and Technology Policy
PCAST	President's Council of Advisers on Science and Technology
PEPFAR	President's Emergency Plan for AIDS Relief
PIRE	Partnerships for International Research and Education
QDDR	Quadrennial Diplomacy and Development Review
R&D	Research and Development
S&T	Science and Technology
STAB	Science and Technology Advisory Board
STAS	Office of the Science and Technology Adviser to the Secretary
STEM	Science, Technology, Engineering, and Mathematics
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAID	U.S. Agency for International Development
USIP	U.S. Institute of Peace
USTR	U.S. Trade Representative

Summary

The mission of the Department of State (department) is to shape and sustain a peaceful, prosperous, just, and democratic world and foster conditions for stability and progress for the benefit of the American people and people everywhere. The strategy calls for the department to become more efficient, accountable, and effective in a world in which rising powers, growing instability, and technological transformation create new threats but also opportunities.

This report recommends steps that the department should embrace in order to carry out its mission more effectively by taking full advantage of the unmatched science and technology (S&T) capabilities of the United States. These capabilities provide the department with many opportunities to promote a variety of the interests of the United States and its allies in a rapidly changing world wherein S&T are important drivers of economic development at home and abroad. S&T also play critical roles in preventing and responding to efforts of hostile governments and rogue organizations determined to disrupt international security of importance to the United States and its allies. Thus, the department should continuously update its capabilities to keep abreast of S&T developments at home and abroad and be prepared to anticipate and respond promptly to S&T-related challenges on many fronts.

THE CHANGING GLOBAL LANDSCAPE AND COMMON S&T INTERESTS

Advancements in S&T are heightening aspirations of societies throughout the world at an unprecedented pace while dramatically changing the way personal and business affairs are conducted. More than one-half of the world's population is now able simply to reach in their pockets to be informed, to be in touch, and to call for assistance when available. The biological and health revolution is providing the basis for extending human life, improving agricultural productivity, and protecting essential ecological resources. Geoscientists are leading global efforts to strengthen the resiliency of population centers and infrastructure that can withstand the shocks of tsunamis, earthquakes, and floods.

However, population growth and unrestrained industrialization are threatening valuable ecosystems, changing climate patterns, and redirecting ocean currents where fisheries have thrived. The same Internet that unites

families and businesses also allows drug gangs and cyber criminals to prosper. Violent extremists effectively use the Internet and increasingly gain access to advanced destructive technologies.

Thus, international cooperation based on S&T is rapidly becoming a key dimension of foreign policies of a number of nations. The department is the critical focal point in the United States for addressing an ever-growing array of complex global challenges, drawing on contributions from many organizations in Washington and across the country. Such leadership by the department is essential as other like-minded governments also (a) adopt innovative approaches to promote economic growth, at times challenging the economic interests of the United States, (b) exercise restraint in reconfiguring the landscape created by nature, restraint that often depends on major U.S. commitments, (c) strengthen capabilities to prevent the spread of contagious diseases at home and across international borders, and (d) seek limitations on proliferation of weapons of mass destruction and other technology-driven threats to peace and security.

SCIENCE, TECHNOLOGY, AND U.S. FOREIGN POLICY

In recent years, the department has increasingly recognized the important role that S&T should play in development and implementation of U.S. foreign policy, and particularly the need to strengthen the S&T capabilities of its workforce. The department asked the National Academies (National Academy of Sciences, National Academy of Engineering, and National Academy of Medicine) to undertake an assessment and to make recommendations concerning the changing environment for the conduct of diplomacy in the years ahead, with a focus on the role of S&T in the development and implementation of U.S. policies and programs.

In response, this report concludes that prompt steps by the department's leadership are essential to increase comprehension throughout the department of the importance of S&T-related developments throughout the world and to incorporate this understanding into the nation's foreign policy for the 21st century. The department should accelerate its efforts to engrain within the Foreign Service an appreciation of the significance of the S&T advances taking place at home and abroad. It needs to support more fully our front-line diplomats with strong contingents of civil servants who are up-to-date on the technical dimensions of numerous issues on the department's agenda. Also, it should increase the cadre of Foreign Service Officers (FSOs) with technical backgrounds and provide increased training and education for all FSOs to prepare them for handling S&T-related issues, including assignments to positions that focus on S&T issues.

This report urges the adoption by the department of a broader whole-of-society approach in carrying out its responsibilities at home and abroad—extending beyond traditional interagency coordination and the narrow band of current external partners as it engages with these and other organizations in

search of fresh ideas, additional S&T assets, and achievable aspirations. Foundations, universities, research centers, non-governmental organizations, and private-sector companies are extending their international reach; and S&T engagement across geographic borders that has long-been pioneered by researchers now deserves greater recognition than ever before. The department needs to complement its focus on immediate-action in-boxes with greater attention to important global S&T trends that are increasingly recognized both internally and by others who are concerned of the consequences of neglect.

At the core of the ever-rising global interest in S&T are the prospects for new opportunities for nations to advance their economies and provide better livelihoods for their populations. In industrial and middle-income countries, innovative achievements often lead to improved economic competitiveness abroad. In less fortunate countries, locally produced goods and services that incorporate modern technologies frequently enhance the lives of some. The United States has opportunities to advance mutual interests through participation in both of these circumstances.

More broadly, the United States remains the leading nation in terms of military capabilities and economic prowess. But globalization has produced rising powers; and the United States is not able to establish global or regional security, political, or economic agendas unilaterally. Europe and Asia, in particular, have important S&T centers in a number of fields that rival or exceed U.S. capabilities. However, the U.S. capacity to use its S&T capabilities to support peace and prosperity in other countries remain unrivalled in scale and impact.

Governments and populations of almost all countries respect the S&T capabilities of the United States. A record number of science, engineering, and medical students from throughout the world seek admission to U.S. universities, with more than 300,000 foreign students addressing science, technology, engineering, and mathematics (STEM) throughout the United States in 2014. A green card has long been a prized possession of many established and emerging scientists with roots in other countries. However, with the spread of S&T capabilities in many countries, a growing number of energetic and talented foreign students and young researchers at U.S. universities and research centers are returning home as suitable laboratories and other facilities increasingly offer opportunities.

The activities of multinational firms with headquarters or research affiliates in the United States have considerable influence on the effectiveness of U.S. foreign policy and particularly trade policy. In particular, private sector investments in S&T with important economic outcomes at home and abroad are expanding in some areas, such as energy development, pharmaceuticals, and advanced manufacturing.

S&T DEVELOPMENTS WITHIN THE DEPARTMENT SINCE 2000

In 1999, the National Research Council released a report titled *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*, which was also requested by the department. It has served as a timely starting point for consideration of future strategic directions—and related program initiatives—to achieve diplomatic goals, with particular attention to the S&T dimensions of these goals.

A principal recommendation of the 1999 report was to establish the position of Science and Technology Adviser to the Secretary of State (S&T Adviser). The recommendation was widely accepted and incorporated in legislation; and during the past 14 years, the activities of the newly established Office of the S&T Adviser (STAS) have complemented activities of a number of other units throughout the department, which have policy and implementation responsibilities for S&T-related issues. However, the potential of STAS is far from being realized, and this report proposes steps that would upgrade the role and activities of STAS.

Other important upgrades in the S&T capabilities and interests within the department in Washington have been triggered in part by recommendations of the 1999 report. The changes include:

1. The issuance by the Secretary of periodic directives concerning S&T components of important foreign policy issues.
2. Expansion of S&T capabilities of a number of bureaus and offices of the department through the hiring of additional technically skilled civil servants.
3. Encouragement of talented FSOs to assume S&T-related responsibilities that provide opportunities for them to broaden their skill sets.
4. Support for programs that place one-year and two-year technically trained Fellows in important positions in the department (e.g., American Association for the Advancement of Science Fellows and Jefferson Fellows).
5. Assignment of technical specialists from interested U.S. departments and agencies to U.S. embassies for periods of up to 90 days to carry out short-term assignments proposed by the embassies.
6. Expansion of public diplomacy efforts that capitalize on the S&T strengths of the United States.

The S&T Advisers have played particularly important roles with regard to recruitment and guidance of Fellows, support of public diplomacy efforts that emphasize the mutual benefits of cooperation in S&T, and encouragement of the United States Agency for International Development (USAID) and other

agencies to develop innovative S&T programs abroad. Now the S&T Adviser needs increased authority and additional resources to play a more effective role in policy debates and in leading department-wide assessments of the intersections of S&T and foreign policy.

While the department has taken important steps in strengthening S&T capabilities in Washington, a “tale of two States” emerges when assessing activities at U.S. embassies abroad. Progress at the embassies in embracing S&T as a key component of diplomacy has lagged seriously behind. This report proposes steps to correct this weakness.

In recent years, several large program initiatives of U.S. Presidents and Secretaries of State have been based on S&T capabilities. For example, the department has led the interagency implementation of (a) the President’s Emergency Plan for AIDS Relief (PEPFAR) with about \$45 billion committed to this program during the past decade, and (b) global efforts to address climate change at the political, economic, environmental, and technical levels. The department has also strongly supported several other major initiatives, led by USAID, including (a) reducing infant mortality, (b) enhancing food security, (c) reducing malaria, (c) African education and energy initiatives, and (d) establishing the Global Development Lab.

A particularly significant initiative of the department was preparation in 2010 of the first *Quadrennial Diplomacy and Development Review* (QDDR), which identified major policy areas of interest to the department and USAID. Many S&T-related activities are explicitly identified in the QDDR. The QDDR provides an important organizational and policy framework for the department, and it identifies many issues for which S&T is an important factor. Additional S&T-related initiatives are set forth in the *FY 2014-2017 Department of State and USAID Strategic Plan*. **What is missing, however, is the commitment by the department to provide adequate resources to reach the laudatory S&T goals that have been set forth in these documents.**

Of special relevance for this report has been the reorganization of important components of the department. Several functional bureaus and offices with S&T responsibilities were consolidated under the purview of the Undersecretary for Economic Growth, Energy, and Environment. These include the Bureau of Oceans and International Environmental and Scientific Affairs (OES), STAS, and a new Bureau of Energy Resources. Together with the previously existing Bureau of Economics and Business Affairs that includes offices for (a) telecommunications and information and (b) agriculture, the Undersecretary now has a formidable array of offices with responsibilities for various S&T-intensive policies and programs. Other undersecretaries also have responsibilities for S&T activities, and especially the Undersecretary for Arms Control and International Security.

THE GOAL, OBJECTIVES, AND ACTION-ORIENTED RECOMMENDATIONS

For several decades, and increasingly since 2000, the department has addressed S&T as an important appendage to the mainstream of foreign policy formulation and implementation. Now S&T responsibilities and skills are firmly embedded within a few components of the mainstream itself. Other units of the department are increasingly sensitive to the importance of including considerations of S&T-related opportunities to advance their programs. However, the department should incorporate S&T considerations into an even broader range of activities. From senior officials to desk officers and from ambassadors to junior embassy diplomats, understanding the potential of S&T can present new opportunities for international cooperation. At the same time, if misused, S&T can create new security risks.

The committee's view on the overarching goal of efforts to upgrade S&T capabilities within the department is set forth in the subtitle of this report: *Embedding a Culture of Science and Technology throughout the Department of State.*

Four complementary paths toward achieving this goal are suggested in the objectives articulated in the four substantive chapters of the report: (a) Utilizing the department's S&T resources more effectively in responding to the dramatic changes in the global landscape that are determining the future of societies, states, and populations; (b) Engaging more fully the widely dispersed S&T capabilities of the United States, which are embodied in both government and nongovernment organizations, in a whole-of-society approach to foreign affairs; (c) Upgrading S&T capabilities of U.S. embassies that are on the front lines of diplomacy; and (d) Increasing the stature and capabilities of department officials responsible for S&T activities and providing challenging opportunities for highly qualified S&T Fellows from academia and industry and for deeply experienced S&T specialists from other agencies who are on short-term assignments to the department.

Twenty-seven action-oriented recommendations will contribute to achieving the four objectives discussed in the report. Nine of these recommendations that warrant priority attention by the leadership of the department are set forth below. All 27 recommendations are discussed in the full report, and they are consolidated in the final chapter. The priority recommendations were selected to highlight near-term actions that can help (a) achieve each of the four objectives, (b) engage the leadership of the department more fully in S&T activities, (c) upgrade the status of STAS as a critical node that together with OES can add cohesion to expanded roles of many components of the department and of external partners that should work together on S&T issues, and (d) strengthen department capabilities in Washington and abroad both to promote and support S&T engagement with other countries and to draw on the nation's broad range of S&T assets when appropriate.

The committee's findings that led to these recommendations are based primarily on (a) the personal knowledge and experience of the committee members, (b) presentations to the committee and its working groups by officials of many of the department's bureaus and by representatives of other interested organizations, (c) information concerning the international programs and activities of these and other organizations in response to requests for such information by committee members and staff, (d) reviews and analyses by the staff of authoritative reports of other organizations, and (e) responses to a survey of the activities of Environment, Science, Technology, and Health officers at a variety of posts. Also, staff analyses of relevant reports of experts and of databases of national and international organizations contributed to establishing the context for some key issues in this report.

Overall, however, the topic of this report covered a number of issues for which there are not well developed datasets or even significant reports; and the committee was well aware of the importance of rigor in considering anecdotal data in those cases wherein such data were an important resource. For this reason, a great number of sources were consulted for both official and informal views, consistent themes were extensively validated and cross checked; and all positions taken relying on such data were expressed carefully.

1. The Secretary should continue to provide both leadership and guidance on S&T-related policies and programs for addressing priority global issues and advancing U.S. bilateral and multilateral interests. (Chapter 2)

One topic of increasing interest throughout the department is technological innovation and economic entrepreneurship. A concise statement as to the essential aspects of the U.S. approach and sources for additional information would be of value to many offices within the department and at embassies. Also, the hosting by the Secretary and undersecretaries of broad-ranging international conferences wherein S&T play a critical role can continue to be significant. The conferences on higher education in 2011 and on the oceans in 2014 attracted wide-spread attention within the department and throughout the world. Other topics of possible interest include the declining condition of the world's forests, preventing and fighting global pandemics, improving access to water resources, and responding to natural disasters.

2. The QDDR and other broad-ranging policy documents should underscore the importance of the department adopting a whole-of-society approach to diplomacy, which includes the capabilities and contributions of not only many government agencies but also non-governmental entities that are deeply vested in S&T. (Chapter 3)

To the extent possible, widespread involvement of public and private sector organizations throughout the country can play important diplomatic roles in

many areas involving S&T considerations such as Internet governance, foreign trade, global scientific research programs, and humanitarian assistance.

3. The department should carry out S&T-oriented foresight assessments. The Policy Planning Staff should have responsibility for this foresight effort with leadership provided by the S&T Adviser to the Secretary who would be double-hatted as a member of the Policy Planning Staff for such assessments. The Bureau of Intelligence and Research, the Bureau of Energy Resources, OES, and other interested bureaus should actively participate in such assessments. (Chapter 2)

The foresight program should be conducted by the department in collaboration with the intelligence community and other organizations. It should synthesize actionable conclusions of over-the-horizon S&T assessments and bring them to the attention of appropriate department officials. The program should not just identify challenges: advising on what to do is critical. Today, policy is too often reactive. We have the knowledge and competency to look out years ahead. We should take advantage of this capability.

4. The Secretary should establish a Science and Technology Advisory Board (STAB) of independent S&T experts of noted accomplishments and deep expertise to provide insights on S&T-laden non-defense issues that are or should be related to the department's foreign policy agenda. (Chapter 2)

The board would be most effective if it established and provided leadership for small groups of experts, with each group focusing for a limited period on a specific issue of interest to the department's leadership. Among the topics of possible interest are (a) the future of solar energy, including breakthroughs in thin-film receptors, (b) the search for better battery and other energy storage devices, (c) developments in robotics, with applications in manufacturing and in field activities, (d) affordable telemedicine in refugee camps, isolated communities, and remote locations, (e) advances in tropical medicine, (f) developments in synthetic biology and their potential for profit and harm, and (g) the international competition for high-tech talent. Of key importance is how such developments will impact on foreign policy.

5. The department should provide the S&T Adviser with organizational status equivalent to that of an Assistant Secretary. (Chapter 5)

Such elevated status would allow the S&T Adviser to support policy development and implementation related to S&T issues within the department. Also, with this enhanced status, the S&T Adviser would be better positioned to improve linkages between the department and external S&T-oriented

organizations with global networks that can provide important perspectives on developments throughout the world.

6. The department should maintain S&T Counselors (currently called Science Counselors) at embassies where S&T issues are particularly important components of the bilateral relationship. Only highly-qualified individuals should be placed in these S&T Counselor positions. In most cases these will be outstanding Foreign Service Officers with extensive experience in S&T-related issues and other qualifications such as language fluency, regional expertise, and excellent diplomatic acumen. Some S&T Counselors might be drawn from the department's cadre of Civil Servants or exceptionally qualified outsiders. The department should also (a) ensure that S&T Counselors and other officers responsible for S&T activities at all embassies receive adequate training and preparation before assuming their duties, and (b) provide support for important efforts to initiate scientific collaboration by ensuring ready access by the embassies to available financial resources that could initiate or strengthen collaboration. (Chapter 4)

The department has relevant experience in all of these areas and should be able to quickly upgrade support of embassy staffs.

7. The department, while continuing to expand the use of new dialog mechanisms to reach large foreign audiences on U.S. values, interests, and policies (Facebook, Twitter, YouTube, and other emerging mechanisms), should increase efforts to better understand the composition, reactions, and influence of the audiences. (Chapter 4)

The department maintains about 1,000 official social media accounts around the world, representing hundreds of ambassadors, embassies, consulates, Washington bureaus, and the department as a whole. The department's flagship twitter account (@StateDept) recently broke the 1 million audience threshold, and the department's combined social media audience is over 40 million people world-wide. Given the extent and importance of the endeavor and the steady expansion of activities, assessments of the composition of audiences, their reactions, and their impacts are overdue.

8. While the most important factor in supporting S&T engagement should continue to be the advancement of science, engineering, and health capabilities in the United States and partner countries, the department, along with USAID, should give greater weight in determining allocation of funds for S&T engagement to the secondary impacts in the development and strengthening of civil society and good governance in partner countries. (Chapter 2)

Scientists, engineers, and medical specialists constitute large portions of the intellectual capital of most countries, often having considerable experience in managing important organizations. They are very significant members of civil society, frequently serving as cabinet ministers and other leaders of governments. Scientists in positions of authority in a number of middle and low-income countries, in particular, are increasingly committed to internationally accepted principles of responsible science based on transparent, objective, and evidence-based decision making, which are important attributes of good public sector governance. However, funds explicitly designated to be used for strengthening democratic institutions should not be used to support S&T engagement activities since this practice could raise serious international concerns about the legitimacy of S&T engagement.

9. The department should continue its efforts to increase its staff so that time available for training and professional development of both Foreign Service and Civil Service officers can increase from the current level of 5 to 7 percent of total available time (the float), with the goal of reaching as soon as possible 15 percent. (Chapter 5)

A larger float will provide more time for training, pre- and post-assignment briefings by and for U.S. S&T agencies, and professional development for all employees. Those with special S&T interests will be able to stay abreast of S&T advances along with opportunities for other officers interested in other specialties to also update their capabilities. To expand the knowledge base, the Foreign Service Institute should continue to broaden the scope and number of its classes and online offerings with significant S&T content to help achieve the goal of providing opportunities for continuing education for every employee of the department wherever located.

A CULTURAL SHIFT IN U.S. DIPLOMACY

In short, the entire workforce of the department should recognize that the breadth and pace of technological advancement throughout the world, along with the needs and aspirations of the global population, are increasing every day. In 2015, mobile phone subscribers will exceed 5 billion, with smartphone users surging to 2.4 billion and mobile–Internet use rivalling traditional cellular telephony. By 2030, the demand for food will increase by 35 percent over the demand in 2014 and for energy by 50 percent, with nearly one-half of the global population living in areas of severe water stress. In the near future, the Arctic region will be opened for new maritime routes and for resource exploration and exploitation of considerable economic and environmental significance. A series of dams is being planned to convert the Congo River basin into the world’s largest hydrological water complex, with environmental consequences of enormous proportions. The research and industrial communities need support by

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the department in investigating scientific challenges and investing resources in distant regions of the world, often with more difficult operating environments than in the past.

The related foreign policy considerations of S&T advances are driving diplomatic agendas throughout the world on a daily basis. The department needs to upgrade its S&T capabilities and related policies and programs accordingly. The recommendations set forth in this report, if supported by policy and budgetary commitments, should open new opportunities for the department to draw upon the expertise and ingenuity of the nation's S&T assets embedded in many institutions within and outside the government. S&T capabilities are the trump cards that are held by the United States, and we should not hesitate to use these capabilities when necessary to advance our nation's interests in a manner that in time will lead to peace and prosperity for the broader global community.

As reflected in the title to this report, a cultural change within the department is essential so that S&T competence will be considered equal in importance to language fluency and area expertise as a critical aspect of diplomacy that will be practiced throughout the world during the 21st century.

1

Introduction

In September 2012, Robert Hormats, then Undersecretary of State for Economic, Business, and Agricultural Affairs, requested the National Academy of Sciences (NAS) to prepare an assessment of the changed environment for the role of science and technology (S&T) in diplomacy. In 1999 the National Research Council (NRC), acting on behalf of the NAS, the National Academy of Engineering (NAE), and the Institute of Medicine (IOM and now named National Academy of Medicine—NAM) had prepared a report on the general topic. This second report again prepared by the NRC on behalf of the three academies provides an update on the department's recent activities related to science and technology (S&T) and looks to the future.

The Undersecretary identified the following examples of areas of interest to the department:

- Incentives for department officers, especially those in the foreign service, to follow career tracks that include international science engagement;
- How to reap the most benefit from scientific exchange programs;
- How to best incorporate S&T principles into programs designed to foster democracy and economic advancement; and
- How to leverage the science community to help strengthen relations between countries and to increase the role of S&T in policy decisions of foreign governments.

He noted that a broad assessment of diplomacy efforts of both governmental and non-governmental organizations that take into account the importance of partnerships to help achieve goals of the Department of State (the department) would be of particular benefit.

The NRC consulted with leading scientists and engineers; foreign policy experts; and veterans of international scientific, industrial, and health endeavors in preparing the terms of reference for the assessment. The NRC then approved the Statement of Task set forth below and established a committee that included members with relevant backgrounds and experience to carry out the assessment. Appendix B presents the membership of the committee.

An *ad hoc* committee will assess the adequacy of the capabilities of the Department of State to use effectively the nation's S&T assets in achieving U.S. foreign policy objectives during the next decade. It will consider whether and how enhancements of the department's S&T capabilities during the past decade should be augmented in view of the changing international political, economic, and scientific landscapes. The NRC's 1999 report titled *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State* will serve as a starting point and possibly as a framework for development of future strategic directions. The committee will issue an interim report on preliminary approaches the committee is considering to enhance the department's S&T capabilities. The committee will also issue a final report at the conclusions of the project, with recommendations.

The interim report, which took the form of a letter to Secretary of State John Kerry, is included in Appendix C. The report presented general observations concerning global developments that were linked with S&T capabilities of the United States and other countries and, in this regard, it offered a few preliminary recommendations concerning enhancement of the S&T capabilities of the department. This full report further develops these observations and recommendations. It also significantly expands coverage of relevant issues and recommends additional steps that should be considered by the department.

THE DEPARTMENT'S RESPONSE TO RECOMMENDATIONS OF 1999

A summary of actions promptly taken by the department in response to the recommendations included in the 1999 report is set forth below. The recommendations are in italics and the actions taken by the department are in bold type.

1. *The Secretary should articulate and implement a policy that calls for greater attention to the science, technology, and health (STH) dimensions of foreign policy.* **The Secretary promptly issued a department-wide directive that highlighted the importance of STH-based issues.**
2. *An undersecretary should be designated to ensure that consideration is given at all levels within the department to STH issues, and the title of that undersecretary should be amended to include "for scientific affairs."* **The recommendations were not accepted since the department judged that in the long run, they would impede rather than further the goal of raising STH capabilities across all bureaus.**

3. *The Secretary should select a highly qualified STH Senior Adviser to the Secretary. **The recommendation was accepted, and the position of Science and Technology Adviser to the Secretary was incorporated in legislation.***
4. *The department should adopt the most appropriate organizational structure in order to meet its STH responsibilities. **All bureaus were directed to designate a Deputy Assistant Secretary or an equivalent-level officer to lead S&T issues in each bureau. Also, the department established a Science Directorate in the Bureau of Oceans and International Environmental and Scientific Affairs.***
5. *The department should establish an STH Advisory Committee to the Secretary. **While recognizing that this proposal might be an option for the future, the department decided to continue to rely on existing mechanisms that would be equally effective, more flexible, and less costly.***
6. *The department should increase resources to meet essential STH requirements through steps recommended in the report. **The department recognized the importance of additional resources and gave responsibility to the embassies, the bureaus, and the S&T Adviser to identify needs and make the case for additional resources.***
7. *All FSOs and department officials should achieve a minimum level of science literacy, and the department should establish promotion and career incentives for successful service in STH positions. **The Foreign Service Institute (FSI) had already included Environment, Science, and Technology (EST) issues in many courses; and case studies involving EST had increased at FSI. But a comprehensive S&T curriculum review at FSI was in order. The department's FSO personnel assignment and promotion cones were to give weight to S&T credentials and service. In the future, the Global Affairs and Arms Control bureaus could nominate candidates for overseas positions of particular interest (e. g., Science Counselors and EST officers).***
8. *The department's five-year information-technology modernization plan should stay on course. **The department was to keep its plan on track, expand access to unclassified work stations with internet access, and establish easy e-mail connectivity for its officers.***
9. *Twenty-five carefully selected Science Counselors should be assigned to embassies where STH-related activities were particularly important. **The department began a review of this issue and announced re-establishment of a Science Counselor position in New Delhi.***

10. *Responsibilities for STH activities should be transferred to other departments and agencies when possible. **The department could not transfer congressionally mandated responsibilities or its core coordination role for international activities. However, it began a review as to whether some administrative responsibilities could be transferred.***
11. *The Circular 175 process for interagency reviews of proposed agreements and memoranda of understanding should be streamlined. **The department had already adopted a short-form process that was being used in 90 percent of cases.***
12. *Use of specialists from other departments and agencies as rotating employees should be increased. **The department recognized the value of such specialists and intended to use several personnel assignment methods to facilitate such assignments (U.S. Department of State, 2000).***

An important result of the 1999 report was the creation of the Office of the Science and Technology Adviser to the Secretary (STAS) and the appointment of advisers. The development, current activities, and future of this office are discussed throughout this report, and particularly in Chapter 5.

RECENT STRATEGY DOCUMENTS OF THE DEPARTMENT

In 2010, the department, together with the U.S. Agency for International Development (USAID), adopted the first *Quadrennial Diplomacy and Development Review* (QDDR), as an integrated policy and program strategy for the two organizations. Appendix D includes explicit references to science, technology, and innovation highlighted in the QDDR.

In April 2014, the department, jointly with USAID, set forth updated approaches for carrying out the nation's foreign policy and development assistance programs in the report *FY 2014-2017: Department of State and USAID Strategic Plan*. This document supplements a number of the approaches set forth in the QDDR.

Just as this report of the NRC was completed in April 2015, the department published the second QDDR, which had not been considered by the committee during its assessment and therefore could not be considered in preparation of this report. In the introduction of the second QDDR, Secretary Kerry states that it builds on the first QDDR, which was an important innovation for the department.

The first QDDR and the Strategic Plan address many aspects of foreign policy and development assistance that have S&T dimensions. Some are explicitly linked to S&T capabilities, particularly in the QDDR. Others are not identified in the documents as S&T-related activities because they are so

pervasive in the policy and program activities of the department and USAID that it is not practical to call out every relationship in such documents.

The first QDDR provides an important framework for considering all aspects of the department's activities, including the role of S&T within the department. Since the goal set forth in this report is to diffuse S&T literacy throughout the department, a framework for S&T-related activities that differs significantly from the framework for all foreign affairs activities is not appropriate, and indeed could be counterproductive.

Against the foregoing background, this new assessment prepared by the NRC committee considers many policy and program relationships between S&T and diplomacy, beginning with the principal recommendations of the 1999 report presented earlier in this chapter and then addressing more recent issues. The outcome of this assessment is a set of long-standing and fresh recommendations for further enhancement of the capabilities of the department to address effectively the intersections of S&T and diplomacy. In short, the department is immersed in S&T, and the sun never sets on the S&T-related activities in Washington and in the embassies around the world. S&T-related issues may not always command the highest priority attention within the department and abroad, but they are omnipresent.

ORGANIZATION OF THE REPORT

In order to drill deeper into the S&T interests and activities of the department in an organized manner, this report is structured in four chapters that focus on broad topics that encompass most S&T interests of the department. A few activities overlap two or more chapters, but this is the nature of S&T which play a role in many diverse policies and programs of the department.

Also of rapidly growing importance are the international activities of many other U.S. S&T-oriented organizations—government departments and agencies, foundations, universities, NGOs, professional associations and societies, and private companies, for example. Often the department enters into contracts and interagency agreements with external entities and assumes the task of responsible contract management. At other times, external organizations have well developed policy interests and financial resources and act on their own, only consulting with the department when they consider such consultation is necessary or when they believe that they can benefit from advice or support of the department. Frequently, the department establishes formal partnerships with external organizations that have objectives, which are consistent with the interests of the department,

After considering the vast array of S&T-related issues confronting the department and to a significant extent other internationally minded U.S. organizations as well, the committee focused attention on important issues within the four selected areas.

- The S&T dimensions of the existing and emerging political, economic, security, social, and demographic developments throughout the world and the rapid global spread of S&T interests and capabilities. (Chapter 2)
- The department's partners and other U.S. organizations from both within and outside the U.S. government that are involved in international S&T-laden activities that intersect in a significant manner with the interests of the department. (Chapter 3)
- S&T-related public diplomacy and other international outreach activities of the department, with an emphasis on the role of the U.S. embassies. (Chapter 4)
- Organizational and personnel policies and approaches of the department, including training and educational opportunities related to S&T for the department's work force. (Chapter 5)

Chapter 6 sets forth the principal findings and conclusions of the assessment and consolidates recommendations included in Chapters 2 through 5. Throughout the report, each of the recommendations is identified by the number of the chapter wherein it is discussed, followed by a number that indicates the order in which the recommendation is presented within the chapter.

Appendix E identifies a number of S&T-related activities that are carried out by the department but are not addressed in this report due to a limitation on time and resources available for the assessment. Of particular significance is the role of the department in working with USAID to meet the challenges of the new Millennium Development Goals, to be followed by the Global Post-2015 Development Agenda, which provide powerful diplomatic challenges. Also of concern is the need for an increasing capability of the department to not only participate in the expanding number of multinational activities but assume leadership positions. An internal review of the anticipated growth in U.S. commitments to multilateral diplomacy involving S&T issues would help clarify the personnel and financial requirements during the next several years. Finally, several of the many programs of other government agencies that intersect with the foreign policy interests of the department in very significant ways are identified in Appendix E. The general take-away from Appendix E is that S&T capabilities are rapidly spreading throughout the world, requiring many offices of the department and other departments and agencies to expand S&T-oriented international perspectives and activities.

INFORMATION SOURCES FOR THE REPORT

The committee's findings that led to these recommendations are based primarily on (a) the personal knowledge and experience of the committee members, (b) presentations to the committee and its working groups by officials of many of the department's bureaus and by representatives of other interested organizations (Appendix F), (c) information concerning the international

programs and activities of these and other organizations in response to requests for such information by committee members and staff (Appendix G), (d) reviews and analyses by the staff of authoritative reports of other organizations, and (e) responses to a survey of the activities of ESTH officers at a variety of posts (Appendix M). Also, staff analyses of relevant reports of experts and of data bases of national and international organizations contributed to establishing the context for some key issues in this report.

Overall, however, the topic of this report covered a number of issues for which there are not well developed data sets or even significant reports, and the committee was well aware of the importance of rigor in considering anecdotal data in those cases wherein such data were an important resource. For this reason, a great number of sources were consulted for both official and informal views, consistent themes were extensively validated and cross-checked, and all positions taken relying on such data were expressed carefully.

Extracts from key reports prepared by others are included in several of the appendixes. Also, Appendix H identifies other publications that were important sources of information. The results of the questionnaire sent to U.S. embassies concerning S&T interests and activities of the embassies are discussed in Chapter 4.

There are many databases related to the issues discussed in this report, and important data sets are available that bolster a number of the conclusions of the committee. Several examples that underscore the variety and extent of these data sets are as follows.

- U.S. Government—National Science Foundation: Biannual Science and Engineering Indicators ([nsf.gov statistics](http://nsf.gov/statistics)).
- U.N. Organization—World Health Organization: Periodic Updates of Data Base on Infectious Diseases (who.int/topics/infectious-diseases/factsheet/en).
- Responsible Journalism—The Economist: World Outlook for 2015, December 2014.
- Other Intergovernmental Organization—Organization for Economic Cooperation and Development: Annual Main S&T Indicators (<http://stats.oecd.org/index.aspx?datasetcode=msti-pub>).
- Nongovernmental International Organization—World Economic Forum: Annual Global Competitiveness Report (www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf).
- Private Industry—British Petroleum: Annual Statistical Review of World Energy, 2014.
- Higher Education—Institute for International Education: Annual Open Doors Report on Student Exchanges, www.iie/opendoors.

These and many other well-honed data sets and other types of documentation set forth in Appendix H were consulted by the staff and provided important context for the report. However, the topic is so broad that detailed data that are needed to support some conclusions in the report are simply not available. Thus, as previously noted, the committee relied at times on anecdotal evidence, which was considered with great care.

As to the committee process, the staff reviewed many information sources. The committee then took into account the findings of the staff, and at times also examined the original sources. At the same time the committee considered personal experiences and observations of its members in addressing issues that are discussed in the report. Their impressions were augmented with extensive briefings and discussions involving other experts who also have been deeply involved in the issues under consideration for many years. Then in looking forward, the committee relied on the collective expertise of its members to develop consensus recommendations, taking into account other formal proposals and informal suggestions that were put on the table in preparation of other reports. Of course, the committee heard conflicting views on some issues and took these into account before coming to a consensus on the recommendations.

As to participation in committee meetings, the committee consulted with three undersecretaries of the department, Chiefs of Staff of the Secretary and of two additional undersecretaries, and numerous other department officials. Consultations were also held with the department's Office of Human Resources and with the Office of Personnel Management. The committee met formally with the Administrator of USAID and his staff, many scientific leaders of the National Institutes of Health, and senior representatives of several other agencies. Staff had discussions with the Science and Technology Adviser to the President and the Director of the National Science Foundation who were not available for committee meetings. The committee also heard presentations by leaders of nongovernmental organizations, industry, and universities along with the three Presidents of the National Academies (see Appendixes F). In addition, committee members and staff consulted with U.S. ambassadors in Ankara and Astana, and with Science Counselors in Mexico City, Tokyo, and Moscow.

END NOTE

Department of State, 2000, May 15. Science and Foreign Policy: The Role of the Department of State: Report Prepared by the Department's Senior Task Force on Strengthening Science at State, March 28, 2000. Online. Available at http://www.state.gov/1997-2001-NOPDFS/global/oes/science/000328_dos_science_rpt.html.

2 A Rapidly Changing World

The mission of the Department of State (department) is “to shape and sustain a peaceful, prosperous, just, and democratic world and foster conditions for stability and progress for the benefit of the American people and people everywhere” (Department of State, 2014). The strategy calls for the department to “become more efficient, accountable, and effective in a world in which rising powers, growing instability, and technological transformation create new threats but also opportunities” (Department of State and United States Agency for International Development [USAID], 2010).

This report recommends steps that the department should embrace in order to carry out its mission more effectively by taking full advantage of the leading science and technology (S&T) capabilities of the United States. These capabilities provide the department with many opportunities to promote a variety of the interests of the United States and its allies in a rapidly changing world wherein S&T are important drivers of economic development at home and abroad and help ensure international security. Too often they are not given the weight that they deserve by the global community, or even by the department; and at times they are misused by others in ways that are inimical to the interests of the United States and the global community.

Advancements and spread of S&T capabilities are heightening aspirations of societies throughout the world at an unprecedented pace. International connectivity and expanding transportation capabilities are revamping the way of doing business almost everywhere. The biological revolution is providing new opportunities for combatting diseases, improving agricultural productivity, and protecting essential ecological resources. Expanding geoscience capabilities are contributing to the resiliency of population centers to withstand the shocks of tsunamis, earthquakes, and floods. However, unrestrained industrialization and vehicular transportation are smothering urban environments, changing climate patterns, and redirecting ocean currents. Military technologies pose their own challenges, as rocket capabilities spread and the overhanging cloud of proliferation of weapons of mass destruction remains ever-present.

International cooperation in S&T is rapidly becoming an important element of foreign policies of nations throughout the world. The department is a critical focal point for bringing to bear on an ever-growing array of global challenges technical contributions from organizations across the United States (a whole-of-society approach). Leadership by the department is essential as like-minded

governments also seek innovative approaches to promote economic growth, exercise restraint in reconfiguring the landscape created by nature, and band together in countering cyber-crime and preventing other types of hostile acts that disrupt daily life.

GLOBAL TRENDS

The following predictions underscore the broad dimensions of dramatic changes by 2030 using 2013 as a baseline.

- The global population will increase from 7.1 to 8 billion people, with urbanization growing by almost 60 percent.
- Demand for food will increase by 35 percent and for energy by 50 percent.
- Nearly one-half of the global population will live in areas of severe water stress.
- One billion workers from developing countries will be added to the global labor pool seeking meaningful employment, while “aging” countries face the prospect of economic decline.
- Asia will be set to surpass North America and Europe in global economic power, while China’s economy will be 1.4 times larger than Japan’s and India’s will be 16 times larger than Pakistan’s. China may have already passed the United States as the largest economy based on purchasing power parity. (National Intelligence Council, 2012)

Practitioners of economic development that is based on innovative applications of S&T can point to an increasing array of success stories in overcoming the hurdles in transforming research results into practical applications. At the same time, unfortunately, technological advances often create new types of problems that have touched all corners of the planet. They range from deforestation of the land, to depletion of fishery stocks in the oceans, to the dangerous cluttering of outer space. The outbreaks of the severe acute respiratory syndrome (SARS) and Ebola demonstrate that in a globalized age contagious diseases can have devastating effects across borders. Droughts and infestations continue to ravage many populated areas. Also, greater attention to conservation and more effective uses of water are needed desperately. Box 2-1 highlights additional concerns.

Of particular importance, the relative capacities of countries to generate innovations and to harness benefits of global S&T advances are changing. For example, China, Brazil, India, and other middle income countries have significantly increased their investments in research and technology development in many sectors to support their aspirations for economic growth, social progress, and political influence. Clearly, the United States should take

BOX 2-1**Global Challenges: Present and Future**

- Air pollution leads to an estimated 3.7 million premature deaths annually.
- Deaths from non-communicable diseases continue to increase, accounting for 68 percent of all deaths globally in 2012. Communicable, maternal, neonatal and nutrition conditions collectively were responsible for 23 percent of global deaths, and injuries caused 9 percent of all deaths. In low income countries, the major causes of death are lower respiratory infections, HIV/AIDS, and diarrheal diseases, but non-communicable diseases are becoming more prevalent.
- Almost 30 percent of the global population is overweight or obese. Fourteen percent is considered undernourished.
- World water use has increased at more than twice the rate of population growth and estimates suggest that by 2025 1.8 million people will live in countries with absolute water scarcity and more about two-thirds of the population in areas under water stress.
- Between 1990 and 2013 the urban population increased from 43 percent to 53 percent and is expected to continue to grow. Cities can provide better access to services such as improved water and sanitation, but the continued growth also strains environmental and natural resources.
- Global temperatures are expected to increase from 2 to 11.5 degrees between now and 2100 with temperatures over land increasing faster than over oceans. Average precipitation is also expected to increase as will the intensity of storms.

SOURCES: World Health Organization (2014a), World Health Organization (2014b), Dobbs et al. (2014), U.N. Water (2013), World Bank (2015), United States Environmental Protection Agency (2014).

advantage of such S&T developments around the globe while continuing to contribute to the base of science that provides the foundation for innovation efforts at home and abroad. See Appendix I concerning the rapid spread of S&T capabilities around the world.

Reflecting the importance of global awareness, many governments and private companies that are working at the leading edges of technology pay particular attention to activities in the United States. For example, foreign multinational companies invest about \$40 billion annually in research centers located in the United States. This investment is about 15 percent of the total U.S. business investment in research and development. At the same time, multinational companies with headquarters in the United States also invest a comparable amount in research activities carried out abroad. In short, companies interested in international trade cannot ignore relevant technical activities carried out in other countries (National Science Board, 2014; Industrial Research Institute, 2013).

Rapidly spreading S&T capabilities underpin economic progress and social advancement in many ways. They often lead to disruptions locally and more broadly. The department requires a strong and growing capability, including unwavering political and budgetary commitments, to draw effectively on the S&T capabilities of the U.S. government and the international S&T community more broadly, to assess changes of global consequences, and to develop policies and actions accordingly.

ROLE OF SCIENCE AND TECHNOLOGY IN THE EVOLVING WORLD ORDER

As S&T capabilities continue to contribute significantly to the reconfiguration of the world, for better and at times for worse, American diplomacy must take into account S&T as a factor of particular relevance. The international networking of S&T researchers and practitioners is unique. Their connections cross many boundaries, and their traditions of collaboration open many doors and provide important frameworks for joint efforts to address a wide array of problems of broad interest.

Advances in information and communications technologies are having remarkable impacts on every walk of life as people almost everywhere reach in their pockets to stay informed, stay in touch, and when necessary seek available assistance. More than one-half the world's population has access to cell phones, while our adversaries increasingly communicate with us not with diplomatic demarches but through social media. Ordinary travelers at home and abroad—and unfortunately violent extremists with hostile intentions as well—depend on GPS devices and other increasingly available electronic technologies to guide them to their destinations. Box 2-2 identifies seven technology areas of particular interest.

Beyond the electronics information revolution, discoveries in nanotechnology, synthetic biology, and earth sciences are unveiling new opportunities for improving human health, providing food and clean water, and issuing warnings of impending natural disasters. Advances in robotics, fuel cells, and plasticizers are finding new applications in manufacturing, transportation, and construction. Personalized medicine is extending lifetimes in many countries, while 3D printing and further advancements of the technology (including 4D printing) promise to bring new products to the market quicker and cheaper than before. Even reverse engineering of the human brain is on research agendas at many leading medical research centers.

At the core of the rising global interest in S&T are new opportunities for nations to advance their economies and provide better livelihoods for their populations. In industrial and middle-income countries, innovative achievements at home often lead to improved economic competitiveness abroad. In lower income countries, locally produced goods and home-grown services that incorporate modern technologies can contribute to economic and social progress.

BOX 2-2**Examples of Economically Disruptive Technologies**

- Mobile Internet: Since 2007, sales of smart phones and tablets have increased six-fold.
- Cloud technology: Server performance per dollar doubles every 18 months. The cost of owning a server is 3 times higher than renting in the cloud.
- Next generation genomics: It takes 10 months for the sequencing speed per dollar to double. There was a 100-fold increase in acreage planted in GMO crops between 1996 and 2012.
- Energy storage: There has been a 40 percent decline in price for a lithium battery pack in an electric vehicle since 2009.
- 3D printing: The price of an at-home 3D printer is 90 percent lower than four years ago.
- Advanced oil and gas exploration and recovery: There was a three-fold increase in efficiency of U.S. gas wells between 2007 and 2011.
- Renewable energy: The price for a solar photovoltaic cell per watt has fallen 85 percent since 2000.

SOURCE: McKinsey Global Institute (2013).

Both well established and new technologies can also increase threats to international security, disrupt travel and communications, and lead to exhaustion of natural resources. Extremely dangerous military confrontations in many regions, based on easy access to modern weaponry, are exposing the vulnerabilities of communities almost everywhere, including those in the United States and its allies. The dangers of cyber warfare are difficult to exaggerate, while the latent threats posed by nuclear weapons continue to cast dark clouds over the outlook for global stability. All the while, populations continue their reliance on fossil fuels as demands for electricity and modern transportation increase. Warnings as to the consequences of global warming are becoming realities that are changing important aspects of the way of life on all continents, with potentially severe effects on security and economic order.

The United States remains the leading nation in terms of military capabilities and economic prowess. But globalization has produced rising powers with capabilities that rival those of the United States. Europe and Asia, in particular, have centers of excellence in a number of fields that rival U.S. capabilities. In short, in many regions of the world the United States is not able to establish global or regional security, political, or economic agendas unilaterally, but must seek to collaborate with others to achieve its goals. At the same time, however, the U.S. tradition of using its S&T prowess to support peace and prosperity in other countries remains unrivalled in scale and impact.

SHARING OF RESEARCH AND EDUCATION ACHIEVEMENTS

The interests of American researchers in international sharing of some of the remarkable advances in S&T are broad. The example of international interactions at conferences on the “Frontiers of Engineering” and “Frontiers of Science” highlights international efforts that are regularly pushing the forefront of knowledge and skills. The National Academy of Engineering and the National Academy of Sciences sponsor these conferences with partners in other countries as exemplified in Box 2-3.

BOX 2-3

Conferences on Frontiers of Engineering

- U.S.-Japan, 2014: Bioimaging; Power Unplugged: Energy Harvesting and Power Transmissions; Noise Control Engineering in Healthcare Environments; Field Robotics for Disaster Response.
- U.S.-China, 2013: Nanotechnology: Synthesis, Functionality, and Applications; Future of the Internet and the Internet of Things; Biomems; Solar Energy.
- U.S.-E.U., 2013: Nanosensors; Big Data; Future of Transportation; Wireless Broadband.
- U.S.-Germany, 2013: Materiomics; Biomass Conversion; Additive Manufacturing; Transport in Complex Systems.
- U.S.-India, 2012: Engineering Large Infrastructures for Disasters/Hazards; Engineering at the Interface of Engineering with Science; Intelligent Transportation Systems; Technology Enablers for Advances in Aerospace Materials.

Conferences include 30 early career engineers from the United States and 30 from partner countries.

Conferences on Frontiers of Science

- U.S.-Korea, 2014: Epigenomics and Disease; Graphene: Tomorrow’s Electronics; Host-pathogen Arms Race: A view from the Molecular Battlefield; Nanomaterials That Can Save the World; Ocean Acidification: Past, Present and Future; Statistical Learning Theory and Its Applications; Stellar Alchemy: Genesis of Heavy Elements; Visualizing Neural Activities.
- U.S.-Indonesia, 2014: Artificial Intelligence; Big Data; Biomaterials / Bioenergy; Ethno-Botany / Tropical Medicine; Natural Disaster Mitigation; Omics / Genomics.
- U.S-Israel, 2013: Cellular Proteostasis; Cosmic Explosions; Cyber-Security; Global Change and the Future of Biodiversity; Neural Circuits, Synaptic Plasticity and the Brain Basis of Memory; Nanophotonics and the Art of Invisibility; Renewable Energy; Systems Immunology.

SOURCES: National Academy of Engineering: Program on Frontiers of Engineering (2014); National Academy of Sciences (2015).

Meanwhile, the number of recent scientific publications co-authored by U.S.-based and foreign-based researchers is impressive as summarized in Box 2-4.

The payoff in joint and parallel efforts of American scientists and their counterparts abroad can be profound. For example, as shown in Box 2-5, the prestigious award for game-changing engineering achievements, the Charles Stark Draper Prize, in 2012, 2013, and 2014 was shared by U.S. engineers and colleagues in other countries working on common problems.

BOX 2-4

Science and Engineering Publications by U.S.-based Authors (2012)

Publications	262,666
With international coauthors	91,183
Percent of co-authors from selected countries	
China 16.2 %	Japan 6.8 %
United Kingdom 14.43 %	Australia 6.0 %
Germany 13.3 %	South Korea 6.0 %
Canada 11.4 %	Spain 5.8 %
France 8.8 %	Netherlands 5.6 %
Italy 7.4 %	Switzerland 4.8 %

SOURCE: National Science Board (2014).

BOX 2-5

Charles Stark Draper Prize for Engineering

The Draper Prize is the highest engineering award that is given in the United States. In each of the most recent three years, the award was given to engineers from both the United States and two foreign countries, underscoring the mutual benefits that result from parallel research efforts of colleagues who are separated geographically but who stay in touch during their careers. The awards were as follows:

- 2012: Development of the liquid crystal display that is used in billions of consumer and professional devices: Recipients of award from the United States, Germany, and Switzerland.
- 2013: Contributions to the world's first cellular networks, systems, and standards: Recipients of award from the United States, Norway, and Japan.
- 2014: Engineering of the rechargeable lithium-ion battery that enables compact, lightweight mobile devices: Recipients of award from United States, Japan, and Morocco.

SOURCE: National Academy of Engineering (2014).

Scientists, engineers, and the general public of most countries admire the S&T capabilities of the United States. A record number of science, engineering, and medical students from throughout the world seek admission to U.S. universities (Figure 2-1). A green card has been a prized possession of many established and aspiring scientists with roots in other countries. However, with the spread of S&T capabilities reaching many countries, a growing number of talented foreign students and young researchers at U.S. universities and research centers are increasingly returning home where suitable laboratories and other facilities often await their arrival. Physicians and physician-scientists from Africa are examples of exceptions as their emigration rates remain high. At the same time, the international scientific community along with many governments, while recognizing the amazing number of U.S. technical achievements, may hesitate to accept U.S. political leadership even when the issues of concern are driven by S&T.

As to students from the United States seeking education abroad, the numbers are much smaller than those of foreign students seeking a U.S. education, but still significant as indicated in Figure 2-2.

An important development is the increased effort of a number of governments to have universities in their countries recognized as global leaders in higher education. To this end, some governments are investing heavily in their best universities in an effort to upgrade them to status in the top 100, 500, or 1,000 in the world. According to one well-recognized ranking service, in 2014, 45 of the world's top 100 universities were located in the United States,

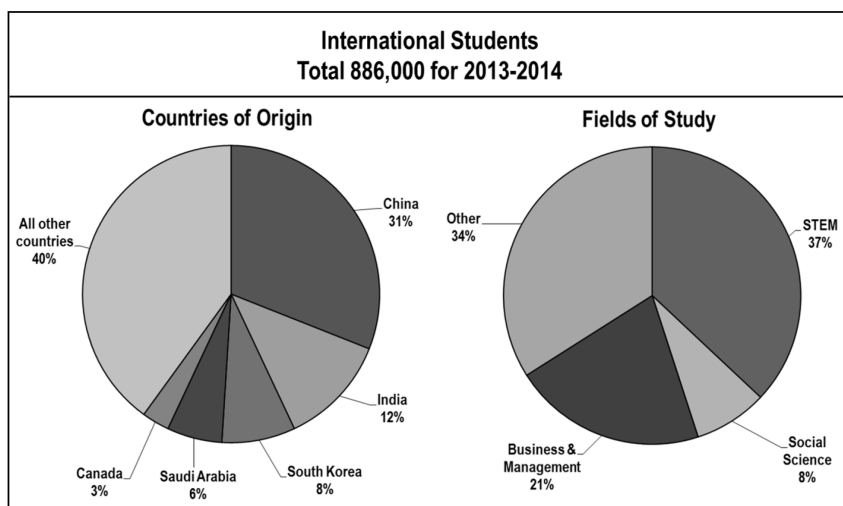


FIGURE 2-1 International students studying in the U.S. STEM stands for Science, Technology, Engineering, and Mathematics
SOURCE: Adapted from data from Institute of International Education (2014a, 2014b).

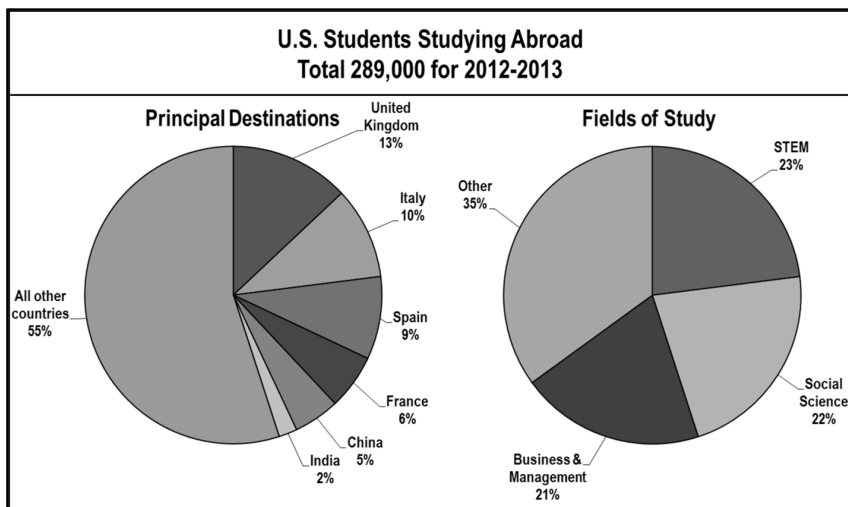


FIGURE 2-2 U.S. students studying abroad. STEM stands for Science, Technology, Engineering, and Mathematics.

SOURCE: Adapted from data from Institute of International Education (2014c).

with the countries next in line being the United Kingdom (6), Netherlands (6), Australia (5), Germany (5), and Switzerland (4). At the same time, the ranking committee noted that the dominant role of the United States was slowly declining as several state universities slipped, while leading Asian universities in China and Singapore were labeled rising stars. Turkey also received recognition for its progress (Baty, 2015). In short, the birthplaces of new technologies are spreading; and the new stars are becoming tough competitors for attraction of technological leaders of the future. The California Institute of Technology, Harvard, and Stanford will not be easily replaced as leaders in the world rankings; but new names will not be far behind.

IMPLICATIONS OF THE DIFFUSION OF TECHNOLOGIES

Achieving U.S. national security and diplomatic goals in an international system being shaped by the dynamism of globalization will require novel strategies and approaches that recognize the potential impact of S&T as a tool of diplomacy. Spreading the benefits of effective use of technical innovations, while reducing the dangers of inappropriate uses of technologies, requires unprecedented international cooperation. Thus the department needs strong capabilities to be alert to opportunities and challenges involving S&T advances at home and abroad.

Meanwhile, innovative activities of private sector firms, often operating on a global basis at their own initiative, at times have considerable influence on the

effectiveness of U.S. foreign policy. Frequently, their activities abroad are as important in advancing U.S. interests as initiatives of the department itself, other U.S. government agencies, or contractors carrying out tasks at the behest of the government. Of special interest are private sector investments in S&T with important economic outcomes at home and abroad that are on the rise, for example, in energy development, in pharmaceuticals, and in advanced manufacturing.

Large research-oriented companies and innovative high-tech start-ups are not only designing and commercializing inventions of immediate global interest. They also are working with government researchers and academic partners in driving the search for new discoveries. To a significant degree, private firms and entrepreneurs, often acting independently of governments, are setting the speed and direction of technological change. And foundations such as the Rockefeller Foundation and John Merck Foundation are now increasing initiatives to promote entrepreneurship abroad.¹

These evolving realities call for the department to take full advantage of the expertise of many departments and agencies of the U.S. government and also the private sector in addressing critical S&T-laden issues on the immediate and long-term horizons. Only then will the department be able to address adequately a number of the nation's foreign policy issues that are shaped by S&T. The department's interactions with a variety of partners to this end are discussed in Chapter 3.

As the breadth and rate of technological advancements increase, related foreign policy considerations change diplomatic agendas. The department has a continuing need for access to technical expertise and to evidence-supported advice as never before. At the same time, the scientific and industrial communities need the support of the department in investing resources in more regions of the world and under more difficult conditions than in the past. The recommendations set forth in this and subsequent chapters of the report are offered to assist the department in drawing upon S&T expertise and ingenuity embedded in many institutions within and outside the government that can contribute to effective diplomacy on an expanded scale.

GUIDANCE BY DEPARTMENT'S LEADERSHIP ON S&T-RELATED ISSUES

Recommendation 2-1

The Secretary should continue to provide both leadership and guidance on S&T-related policies and programs for addressing priority global issues and advancing U.S. bilateral and multilateral interests.

¹ A listing of foundations and other organizations that are involved in international grant making can be found at <http://staff.lib.msu.edu/harris23/grants/privint.htm>.

Given the broad spread of S&T interests throughout the department, articulation of department-wide policies on priority issues can be very helpful. The S&T Adviser to the Secretary (S&T Adviser) should bring to the attention of the Secretary and other senior officials of the department opportunities for such statements while ensuring they do not inadvertently create confusion as to roles and responsibilities of other departments and agencies. The Secretary's initiatives in underscoring the importance of climate change in 2013 and of education diplomacy in 2014 are good examples of this approach.

The department also took important steps in this direction during the preparation of the *Quadrennial Diplomacy and Development Review* in 2010 and *The FY 2014-2017 Department of State and USAID Strategic Plan*. These policy documents highlight the significance of S&T in many aspects of the department's diplomatic efforts, and they provide a strong foundation for development and implementation of policies and programs that undergird diplomacy. Within this context, statements by the Secretary would be particularly important in providing a more detailed framework for action on selected issues

An example of an important topic of world-wide interest that could be effectively highlighted by the department and its partners is technological innovation and economic entrepreneurship (see Box 2-6). Many countries are now committed to having innovation-driven economies that they believe will help them develop and produce high quality goods and services at lower cost as they compete internationally, and they often look to the United States as the foremost pioneer in this area. A number of department officials, and particularly those involved in foreign trade, as well as representatives of many U.S. companies would like to see other countries strengthen their technical capabilities, which in time would lead to new marketing opportunities for U.S. high-tech exports. At the same time, however, some U.S. companies may worry that in the short run such enhanced capabilities other countries could reduce the

BOX 2-6

Global Interest in Economic Payoffs from U.S. Approach to Innovation

Nearly every country gives high priority to becoming a more innovative country through the right policies and investments that will accelerate economic growth and enable it to compete in the globalized and networked world. Science and technology capabilities are seen as essential ingredients, and the United States is viewed as the most innovative and scientifically capable country. Hence, other countries want to engage with American scientists, engineers, universities, research laboratories, and entrepreneurs who participate in regional ecosystems such as Silicon Valley. They see potential for more rapid growth, faster expansion of the middle class, and increased trade.

SOURCE: S&T Adviser to the Secretary of State, February 2013.

demand for U.S. high-tech products.

A statement by the Secretary as to the essential aspects of innovation that have led to economic success for entrepreneurs in the United States and identification of readily available sources of additional authoritative information in this regard would attract considerable attention within and beyond the department. Both the department and its partners could benefit from subsequent discussions surrounding such a statement during international meetings and other opportunities to reach out to colleagues.

Also, the hosting by the Secretary and undersecretaries of wide-ranging international conferences wherein S&T play a critical role can be significant. The conferences on higher education in 2011 and on the oceans in 2014 are examples of gatherings that attracted wide-spread attention within the department and throughout the world. Other topics of possible interest include the declining condition of the world's forests, global pandemics, reduced access to water resources, and increased urbanization in many countries. Such conferences inevitably feature statements by the Secretary and undersecretaries concerning the importance and details of policies and programs.

IMPORTANCE OF ACTION-ORIENTED FORESIGHT STUDIES

Recommendation 2-2

The department should carry out S&T-oriented foresight assessments. The Policy Planning Staff should have responsibility for this foresight effort with leadership provided by the S&T Adviser to the Secretary who would be double-hatted as a member of the Policy Planning Staff for such assessments. The Bureau of Intelligence and Research, the Bureau of Energy Resources, OES, and other interested bureaus should actively participate in such assessments.

The department, other U.S. government agencies, and the U.S. nongovernmental sector, as well as many United Nations agencies and relevant organizations in other countries, frequently conduct assessments of S&T-related developments that are bringing to the foreground new challenges for foreign policy. Whether carried out by the intelligence community, intra-departmental or inter-agency committees, the industrial sector, academia, think tanks, or others, these studies often have bottom lines that underscore the importance of the U.S. government giving greater attention to the emergence of new S&T-driven challenges.

However, there is no established process whereby relevant observations of such studies are transformed into action-oriented recommendations for consideration by the leadership of the department. This situation is particularly significant concerning new emerging areas of growing importance. Such areas include, for example, the increasing use of drones that cross international boundaries for civilian purposes, the changing patterns of ocean currents that

alter coastal activities, ice melts in the Arctic that change maritime routes and alter whole ecosystems, drought conditions that result in internal and cross-border migration of large populations, and adequate food and water to meet the needs of a population expected to increase to 8 billion by 2030.

A decade ago several department officials, with encouragement by the then Secretary of State, launched *Project Horizon* to look forward. Eventually dozens of department officials became involved to a limited degree. But there was no institutional mechanism to help ensure that findings and recommendations of the effort would be seriously considered for action. After two years, the effort was abandoned due to lack of a staff capability at both the policy and the working levels to sustain the effort. The recommendation in this report calls for more focused foresight studies that address issues that are known to have interested audiences within the department.

The foresight program should synthesize, augment, and bring to the attention of appropriate policy-oriented department officials in actionable form (a) important observations of forward-looking assessments already undertaken within the government or by other organizations, and (b) conclusions of new analyses that address previously neglected issues. To the extent possible, unclassified documentation should be used to facilitate broad participation in the efforts. When necessary, tentative findings could be supplemented with classified reports.

The Policy Planning Staff, with direct and continuing access to the Secretary and other leaders of the department concerning formulation and adjustments of foreign policy, is ideally positioned to ensure that the findings and conclusions of well-defined foresight assessments receive prompt and serious consideration for supporting, transforming, or establishing important elements of the nation's foreign policy. Office of the Science and Technology Adviser to the Secretary (STAS) is well positioned to interact effectively at the working level with all units of the department interested in the S&T dimensions of foreign policy. Coupling the interests of the two offices to strengthen the department's efforts to look beyond immediate foreign policy challenges would provide an important new capability in anticipating changes driven by S&T that deserve immediate attention.

Of course STAS will need staff resources to carry out this responsibility. At least two staff members should devote full time to this effort, while loaners with relevant expertise could also provide the needed expertise for each assessment.

Of importance is the involvement in this undertaking of (a) significant policy officials of the department who should have leadership and oversight roles, (b) officials who have responsibility within the department for addressing related issues, and (c) other department officials who could benefit from short-term training/educational assignments to the project on a part-time or full-time basis. Specialists from other departments and agencies—and nongovernmental institutions when appropriate—who are interested in the topic could participate. The success of this effort would be best measured by the receptivity of the

leadership of the department of the policy suggestions included in the foresight assessments. While this initiative would focus on S&T-related developments, it could lead to consideration of a broader policy-oriented foresight capability beyond those which highlight S&T issues.

Recommendation 2-3

The Secretary should establish a Science and Technology Advisory Board (STAB) of independent S&T experts of noted accomplishments and deep expertise to provide insights on S&T-laden non-defense issues that are or should be related to the department's foreign policy agenda.

The organizational aspects of STAB should be similar to those of the President's Council of Advisers on Science and Technology (PCAST). Two distinguished independent experts with a combined breadth of expertise that covers wide areas of S&T, together with the S&T Adviser, should serve as co-chairs of STAB. The operational aspects should take into account the well-developed and effective approaches of the department's International Security Advisory Board (ISAB). Specifically, STAB should draw on relevant resources of the entire department and should rely heavily on small working groups that include both independent experts and department officials to address issues of priority interest. STAS and OES should provide secretariat support for STAB which would serve the interests of the entire department. Fortunately, during the last several years, STAS and OES have greatly improved their working relationship in many areas after a decade of continuous friction.

Of particular importance will be establishment of agendas for meetings that take into account efforts of other advisory bodies throughout the department. For example, effective internal and external advisory bodies are in place to address climate change and the President's Emergency Plan for AIDS Relief (PEPFAR). Turning to foresight assessments called for in Recommendation 2-2, coordination of activities of STAB with the selection and use of foresight studies should be a priority. At times STAB might play a role in identifying topics that should be considered in foresight assessments and in designing terms of reference for foresight efforts.

The primary activities of STAB should be to identify, in consultation with department officials, S&T issues that will soon be on the department's agenda but are not receiving adequate attention at present. Then small working groups could be quickly established to meet with appropriate department officials, alert them to the foreign policy implications of newly developing S&T advances, and determine whether the department would benefit from more detailed discussions or reports on the topic.

Of course, the Secretary and other senior officials of the department have access to a wide range of S&T experts throughout the department and from other departments and agencies when they need technical advice in addressing urgent issues. However, these *ad hoc* arrangements are frequently brief. There

may not be time to provide adequate perspectives on uncertainties and unintended consequences when considering solutions to complicated issues.

Having regularly scheduled meetings enables busy experts to block times on their calendars, while committee membership provides a degree of recognition for services to the government not usually accorded to participants in ad hoc meetings when crises arise. Also, turnover of committee members (perhaps every three years on a staggered basis) will help ensure a continuing inflow of fresh ideas. Moreover, drawing on the nongovernment community in selecting experts would complement the traditional reliance on in-house experts to address short-term crises, while contributing to a whole-of-society approach to foreign affairs, which is increasingly important.

Among the topics of possible interest are (a) the future of solar energy, including breakthroughs in thin-film receptors, (b) the search for better battery and other energy storage devices, (c) robotics, with applications in manufacturing and in field activities, (d) affordable telemedicine in refugee camps, isolated communities, and remote locations, (e) advances in tropical medicine, (f) developments in synthetic biology, and (g) the international competition for high-tech talent.

In developing this recommendation, the committee considered the experience of the department in establishing, reorganizing, and abandoning S&T advisory bodies since the 1960s. At times they were effective and influenced S&T approaches of the department. At other times they were not very helpful. Too often the emphasis was on large meetings involving all committee members with little attention given to small working groups that included not only committee members but also other independent experts and government officials. The approach supported by this committee should overcome the major weaknesses of previous efforts to obtain authoritative advice.

S&T INSTITUTIONS AS IMPORTANT COMPONENTS OF CIVIL SOCIETY

Recommendation 2-4

While the most important factor in supporting S&T engagement should continue to be the advancement of science, engineering, and health capabilities in the United States and partner countries, the department, along with USAID, should give greater weight in determining allocation of funds for S&T engagement to the secondary impacts in the development and strengthening of civil society and good governance in partner countries.

Scientists and engineers constitute large portions of the intellectual capital of most countries. Both as members of professional associations or groups and as individuals, these specialists are often active in promoting public discourse on many aspects of the appropriate role of government in countries that are

attempting to broaden participation of the public in shaping the governance of the countries. They are a large and important component of civil society; and at times S&T professionals rise to political leadership positions, serving as ministers and other high-ranking officials in administrations around the world.

However, the department gives little attention to how S&T engagement not only provides opportunities for American scientists and their foreign colleagues to advance professionally but frequently also indirectly encourage other governments to adopt principles embraced by responsible scientists.

In general, S&T professionals are committed to internationally accepted principles of responsible research and evidence-based decision making. Also, many S&T leaders throughout the world spend much of their careers managing large and complicated programs that involve decisions that are relevant to good governance. Their activities are often directly linked to priority interests of the governments, thereby putting them in positions where they are informed about political challenges and they have the attention of the leaderships and broader populations of the countries. In these positions, they often become sensitive to the long-term perils of mismanagement, corruption, and other barriers to good governance.

Activists in professional societies, science journalists, and members of advisory committees to parliaments are three examples of scientists and engineers contributing directly to the evolution of political processes, at times challenging political favoritism and other flawed approaches. These and other mechanisms involving scientists and engineers can play important roles in the shaping the internal discourses on important governance-related issues. But the department has not recognized in its programming the contributions to these ends that they and other mechanisms can play.

In 2012, the Global Network of Science Academies (the InterAcademy Partnership) representing more than 100 Academies of Sciences from a broad spectrum of countries, highlighted seven fundamental values in carrying out research. These values, which have relevance to good governance, are honesty, fairness, objectivity, reliability, skepticism, accountability, and openness. The commitment to research integrity often survive even the most radical transformations of ruling governments (InterAcademy Panel, 2012). Thus, in determining funding levels of various types of S&T engagement, the department should increase its familiarization with respect to the role of this global network and give adequate consideration to the long-term as well as to the near-term payoff from support of S&T engagement.

At the same time, funds allocated to support democracy activities should not be directed to S&T exchanges. Such a move could be misinterpreted as S&T-engagement programs being used as a cover to promote political change.

The foregoing discussion does not mean that scientists are necessarily more ethical people personally than other professionals. But the ethics of research do play some role in the behavior of scientists, and the internationally accepted values of the research enterprise are often in very short supply in the governance

of countries that are still developing their governing institutions concern. That said, the recommendation is simply to give greater consideration to all of the benefits from S&T engagement, including the strengthening of important elements of civil society, when the budgets for S&T engagement are determined.

STRENGTHENING GLOBAL NETWORKS OF S&T ORGANIZATIONS

Recommendation 2-5

STAS, in continuing consultations with participants in various international S&T networks, should give priority to seeking opportunities for leveraging the outreach capabilities of existing and proposed global and regional networks in addressing S&T issues of interest to the department.

Participation in activities of the networks is often important not only in addressing global issues but also in improving understanding of regional issues.

Many opportunities for strengthened relationships between the department and existing R&D networks are readily apparent. The department, along with many other U.S. departments and agencies and a variety of U.S. nongovernmental S&T organizations, participates in a large number of global networks of S&T institutions that have related interests and programs. At times the department is the direct sponsor of networks of researchers from the United States and other countries. But some networks could become more important contributors to keeping the department apprised of global developments. A few examples of networks of considerable importance follow.

The Consultative Group on International Agricultural Research, with funds administered by the World Bank, is one of the best known and most ambitious sustained networking efforts of scientists, with each annual budget totaling over \$900 million dollars. This group, with member research centers in 15 countries, carries out and coordinates agriculture research in a variety of fields. It has long been given credit for significant contributions to the green revolution.

Another science-oriented networking organization of large proportions is the non-governmental International Council for Science (ICSU). ICSU has 31 international scientific unions, each addressing a particular area of science. ICSU also has 121 National Scientific Bodies covering science activities of 141 countries.

A nongovernmental network that emphasizes both coordination of national and international policies to advance science and the conduct of study efforts to this end is the InterAcademy Partnership. It has a membership of more than 100 academies of science that work together to advise citizens and public officials on the scientific aspects of critical global issues. It has carried out studies and published reports in response to requests from the United Nations as well as from the governments of the countries of the member academies.

There are more than 100 science, engineering, and medical professional societies in the United States, with many thousands of members from abroad. These societies provide important mechanisms for international engagement of scientists who can then stay abreast of global advances in their fields.

As to intergovernmental activities, several U.N. organizations, such as the World Health Organization; United Nations Educational, Social, and Cultural Organization; and Food and Agriculture Organization, have designated research centers in a number of countries as members of networks that address specific science, engineering, or health issues. Also, regional and bilateral agreements, particularly in the environmental field, frequently designate research centers to carry out scientific responsibilities associated with international agreements.

Still other networks of research organizations have evolved over many decades. For example, the Pasteur Institutes for biological research are located in Europe, the Middle East, and Africa. Several global networks of physics institutes coordinate establishment and use of expensive facilities. An astronomy-oriented network of observatories circles the globe at a common latitude. Surrounding the Arctic is a multinational network of biological research stations to monitor and analyze conditions in the far north. Botanical institutes in a number of countries are linked together through joint efforts to catalogue the features of plant species in various types of terrain.

A number of efforts are underway to strengthen international capabilities for research and information exchange in preparing for and responding to natural disasters that threaten populations in coastal regions, in urban areas, and in seismic zones. The Rockefeller Foundation, for example, has launched a \$100 million program for support of resilience initiatives of mega-cities. Many of these cities are located in coastal areas. The University of Bologna has in recent years been leading an international effort to improve collection and analysis of seismic data. The Institute for Influenza in St. Petersburg has been in the forefront of global collaboration in studying the transmission of certain types of viruses from animals to human populations. All of these efforts are important, but not all are supported to the level of funding that may be required in the future. Awareness within the department of these and other types of initiatives is important, and STAS is well positioned to have appropriate contacts that can be of benefit both to the department and to key participants in the networks.

The informal networks among researchers working on common problems dwarf in number the formally established networks. The large quantity of co-authored papers in scientific journals each year (see Box 2-4) provides a basis for estimating the extent of such cooperation. A reasonable estimate is that there are more than 100,000 cross-border networks involving researchers in the United States working with foreign colleagues to address specific problems.

Five examples of the importance for U.S. foreign policy of bilateral networks engagement established at the initiative of U.S. scientific and educational institutions across boundaries are as follows:

1. *Iran*: Since 2000, the National Academies have sponsored 30 workshops, pilot projects, and other events with Iranian academies and universities involving more than 1,000 scientists and engineers from about 100 institutions in the two countries. Among topics of interest during 2012 to 2014 have been seismic engineering, water management and conservation, mathematics education, climate change and air pollution, planning of resilient cities, orthopedic procedures, and wildlife conservation and habitat management.
2. *Cuba*: During the past decade the American Association for the Advancement of Sciences (AAAS) has engaged Cuban scientists, working primarily through the Cuban Academy of Sciences. Topics have been wide ranging, often emphasizing biotechnology and ocean studies. In 2014, the AAAS and the Cuban Academy of Sciences signed a memorandum of understanding, emphasizing cooperation in infectious diseases, brain disorders, cancer, and anti-microbial drug resistance.
3. *Mexico*: For decades, S&T cooperation with Mexico at the university and academy levels, in addition to the official level, has been extensive and important.
4. *Chile*: California universities have long had strong relationships with Chilean universities. The exchanges of faculty members, training of students, and collaborative research programs have had a strong influence in not only advancing science and the economy but also in developing a culture of responsible governance.
5. *Pakistan*: In the last several years, the organization Engineers without Borders has paved the way for strengthening the engineering education infrastructure, which has become an important area for USAID programming.

The S&T Advisors have encouraged nongovernmental organizations to become involved in such activities when their participation would enhance efforts to overcome political divides.

MOVING APACE WITH RAPIDLY ADVANCING TECHNOLOGIES

Many of the observations in this chapter can be summed up in the following statement by the leading U.S. government intelligence official:

“Technological developments hold enormous potential for dramatic improvements in individual health, employment, productivity, global communications, and investments. Technology will continue to be a catalyst for the rapid emergence of changes difficult to anticipate or prepare for; these forces can test the strength of governments and potentially jeopardize U.S. citizens and interests overseas. Technological

advances also create the potential for increased systemic fragility as foreign governments and non-state actors attempt to leverage new and evolving technologies to press their interests” (Office of Director of National Intelligence. 2014).

At the top of the list of profound technological changes currently encompassing all societies are the advances in information and communication technologies. In 2015, mobile phone subscribers will exceed five billion, with smart-phone users surging to 2.4 billion and mobile–internet use rivalling traditional cellular telephony (The World in 2015, 2014). In the longer term, unpredictable environmental changes and disease patterns will accompany the construction of the dams that are eventually to make the Congo River a huge hydroelectric complex. And in the midst of such dramatic reconfiguring of the global landscape that are increasingly recognized by the global community, the biological revolution that is only now unfolding will affect the lives of populations of all countries. The department has no alternative to embracing S&T as keys to opening new roads to prosperity and peace, while adequately recognizing the implications in changing the forces of nature.

Strengthening the capabilities of the department to meet S&T-driven challenges of both the present and the future has been an important theme of this chapter and will continue to be addressed throughout the remainder of the report.

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3

A Whole-of-Society Approach in Incorporating Science and Technology into 21st Century Diplomacy

Hundreds of U.S. government departments and agencies (agencies), academic institutions, private companies, nongovernmental organizations, and other institutions play significant roles in international activities. At the same time, private foundations are becoming a more important force than ever before in determining the direction and character of U.S.-based international programs. At present, the Department of State (department) actively supports the establishment and implementation of programs of most agencies but is aware of only a limited number of the nongovernmental science and technology (S&T) activities. Yet many of these relatively unknown undertakings may have objectives that are consistent with U.S. foreign policy or they may lead to outcomes that diverge from broad national goals. The impacts of nongovernmental entities on S&T relationships among nations are on the rise. Thus, the department needs to work with foundations, industry, academia, and other private organizations to the fullest possible extent in developing and coordinating international policies and programs that advance the overall interests of the United States. The goal should be to support whenever possible appropriate S&T-related international efforts of many organizations. The department should facilitate laudable efforts of others while bringing to the attention of organizers of questionable undertakings the difficulties that their efforts could create or might encounter. In short, reconfiguring the international dimensions of foreign policy requires consultation across both the government and the broader nationwide S&T community.

The 1999 report of the National Research Council titled *The Pervasive Role of Science, Technology, and Health in Foreign Policy: An Imperative for the Department of State* recognized the overlapping interests of many U.S. organizations in the S&T aspects of diplomacy. Coordination of activities focused primarily on the interagency process. A list of S&T-related interagency responsibilities of the department included in that report is set forth in Appendix J.

The 1999 report called for more efficient interagency administrative procedures, with less burden on the department's staff. As discussed in Chapter 1 of this report, the recommendations included (a) transferring responsibilities

for science, technology, and health activities to other appropriate and willing departments and agencies whenever there are not compelling reasons for retaining responsibility within the department, (b) streamlining the Circular 175 process, which calls for interagency reviews of proposed international agreements and bilateral memoranda of understanding, and (c) increasing the use by the department of specialists from other departments and agencies as rotating employees assigned to positions in Washington and abroad, as participants in international negotiations, and as advisers on topics in their areas of expertise.

These and other concerns set forth in the 1999 report as to interagency coordination remain important although progress has been made in improving procedures for carrying out many of the responsibilities that the report singled out for attention. The need for effective and less burdensome coordination of interagency interests—including attention to the excessive frequency of lengthy meetings—has grown dramatically during the past decade, thus underscoring the continuing importance of earlier concerns. However, as noted in Chapter 1 of this report, existing legislation requires the department to continue to play a central role in many interagency activities although there may be opportunities to shift some administrative responsibilities to willing government partners.

Against this background, the committee considered the upsurge in interagency interests and activities linked to S&T and offers several recommendations to improve working together of the agencies. This new report also gives considerable attention to the activities of nongovernmental entities, recognizing the need to move well beyond interagency coordination to a whole-of-society approach for international S&T affairs.

RECOGNITION OF THE IMPORTANCE OF A WHOLE-OF-SOCIETY APPROACH

For many years, the department has been an important force in the gradual move toward a whole-of-society approach in addressing global issues. This approach should draw to the fullest extent possible on relevant ideas, assets, and aspirations of governmental and nongovernmental organizations in Washington and throughout the nation in establishing policies and carrying out programs. The importance of a whole-of-society approach is increasingly recognized throughout the department. Recent success stories in this regard are reflected in the President's Emergency Plan for AIDS Relief (PEPFAR) program in Africa, with about \$45 billion committed to this program during the past decade. This highly visible effort, coordinated effectively by the department, provides an important diplomatic tool in addressing an array of issues in Africa and elsewhere. Programs to reduce infant mortality, feed the future, reduce malaria, and provide expanded electricity for Africa are examples of USAID-led programs involving many private as well as government organizations that the department has strongly supported.

Whole-of-society approaches now characterize department efforts in a number of other fields as well. For example, the department's current effort within the Bureau of Economic and Business Affairs in developing a broad Global Entrepreneurship Program is based on active participation of dozens of representatives from financial and investment organizations, along with owners and operators of start-up firms in the United States and abroad. Another successful effort is the Global Innovation Science and Technology (GIST) program of the Bureau of Oceans and International Environmental and Scientific Affairs (OES) which has engaged dozens of promising young innovators from many countries. The department, backed by the unmatched prestige of the success of innovation efforts of U.S. firms, is continuing to build on these initial efforts.

In summary, as S&T capabilities continue to spread throughout the world, hundreds of U.S. organizations are expanding their S&T-related interests and activities in almost every country. Their programs may not only overlap with the interests of the department, but at times may place them in positions of significant players in determining the character of the relationships between the United States and other nations. Foreign policy decisions may not give adequate weight to important views of many U.S. organizations, the time available to the department to help facilitate private sector activities may be inadequate, and in some instances there may even be confusion as to who speaks on behalf of the United States on controversial or sensitive issues. Thus, special efforts are needed to broaden perspectives concerning the many U.S. interests abroad and the mechanisms available to promote those interests.

Further, agencies may have overlapping legislative requirements, thus confusing leadership roles within the government. Also, there may be significant disparities in available personnel and financial resources in different agencies and private-sector organizations that are important in addressing problems of broad interest, thereby unintentionally tilting the overall approach in favor of the interests of the best-endowed advocates. Different and sometimes conflicting views arise as to the appropriate approaches in addressing both immediate and long-term issues of common concern. Such conflicts can usually be reduced to an acceptable level through dialogue and compromise in order to set the best possible stage for sustained involvement of diverse partners.

ENHANCING INTERAGENCY COORDINATION

Recommendation 3-1

U.S. embassies should consult with American scientists, engineers, and health specialists residing in their countries, when appropriate, regarding research, development, and other programs that are relevant to ongoing or proposed engagement activities of interest to the embassies. Also such in-country specialists are important in identifying opportunities for initiating new programs of mutual interest. At the same time the

embassies should also be alert to possible contributions from other in-country specialists who are not affiliated with U.S. government activities.

A number of agencies that support large scientific research and development programs in the United States have offices abroad to help keep the agencies abreast of foreign S&T achievements that are of interest. The offices are usually staffed accordingly. Also, some of these agencies—and particularly the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Defense, the Department of Energy, and the Department of Agriculture—support many research contracts and grants that engage thousands of scientists from the United States who are working abroad. In France, for example, more than 25 agencies have offices.

NIH provides more than \$200 million annually in international grants. The largest amounts are for collaborative work with researchers in countries such as Canada, the United Kingdom, and Switzerland. Much of this research focuses on diseases and particularly cancer, diabetes, mental health, and addiction. In other countries such as South Africa, the National Institute for Allergy and Infectious Diseases (NIAID) funds numerous projects, many involving HIV/AIDS. It also supports studies on the prevention and treatment of TB and malaria (see Table 3-1).

NSF has long supported American researchers working abroad and also international collaborations. Through the Partnerships for International Research and Education (PIRE) program, for example, NSF works with foreign counterpart agencies to fund multinational research projects (National Science Foundation, 2014a). (See Appendix K for additional information.) NSF provides up to \$5,000,000 of support over 5 years to U.S. scientists, and the counterpart agencies provide support to the foreign side. One such multinational project, "Developing Low Carbon Cities in US, China, & India," (National Science Foundation, 2014b) brings together six U.S. institutions and eight Asian institutions to design low-carbon, sustainable cities in the United States, India, and China. Researchers are exploring how to best reduce greenhouse gas emissions, linking this effort with broader sustainability goals, including economic development, pollution, and public health. The project is training nearly 100 students (across all three countries) and partnering with NGOs to translate research into action. Recently NSF has teamed with USAID in supporting parallel research activities of investigators from the United States and the developing countries (PEER Program), and this approach has expanded to include USAID teaming with a variety of other U.S. government agencies (National Academies, 2015). The annual report of the NSF Board titled Science and Engineering Indicators presents a broad base of quantifiable information about the U.S. and international scientific enterprises. The document provides a good basis for keeping abreast of important trends that can help the department develop its overall approach to S&T engagement.

TABLE 3-1 NIH Grants to Foreign Investigators in 2013 Countries Receiving Over \$5 Million in 2014

Country	Number of Awards	Funding
Australia	22	5,546,000
Brazil	11	5,576,000
Canada	134	39,784,000
Finland	2	7,656,000
France	10	5,699,000
Germany	10	11,053,000
Netherlands	6	18,624,000
Nigeria	8	6,758,000
South Africa	45	38,611,000
Sweden	8	6,915,000
Switzerland	11	8,109,000
United Kingdom	54	21,587,000
All other foreign grants	159	5,631,000
Total	480	232,230,000

SOURCE: National Institutes of Health (2014). For an extensive listing of NIH international programs, see <http://www.fic.nih.gov/programs/pages/default.aspx>.

Table 3-1 presents a sampling of NIH grants to foreign investigators. Only in exceptional circumstances can the department influence the topics and funding levels of NIH programs (e.g., the NIH AIDS program was developed in consultation with the department). However, the U.S. embassies can encourage foreign scientists to apply for grants and for residencies at NIH.

Within this pool of American government scientists and engineers working abroad and also those working for the government as contractors and grantees is an extraordinary array of high quality talent. Often the U.S. embassies draw on this pool to provide insights as to S&T developments in host countries. Often, however, government employees and recipients of U.S. government contracts or grants who are living abroad have had little contact with the embassies.

In larger embassies with significant S&T activities across the interagency spectrum, Ambassadors at times create informal S&T clusters of representatives from all relevant agencies under the Science Counselor if a Counselor is in place. The Deputy Chief of Mission, assisted by the ESTH officer, often informs the embassy staff of ongoing activities to ensure coordination is appropriate. The ESTH officer at times meets with in-country Americans who are engaged in S&T activities as a way of promoting cooperation and transparency.

Recommendation 3-2

The department, in cooperation with the Department of Commerce, the Office of the Trade Representative, and U.S. industry, should continue to encourage governments of trade partners to adopt comprehensive approaches to development and use of technologies, including protection of their own and foreign intellectual property.

In its interactions with foreign counterparts, U.S. officials should stress that they will work with other governments that are lagging behind in developing effective innovation systems, including measures to protect locally generated technologies. Such an approach will underscore a U.S. commitment to technological development around the globe, which in the long-term should benefit U.S. companies. As noted in Chapter 2, innovation and economic entrepreneurship are popular topics for international dialogues; and emphasizing this topic in public diplomacy events should help underscore the balanced interests of U.S. agencies in the development of effective innovation systems. The international effort to upgrade innovation systems worldwide is increasing. It is desirable for the United States government and for U.S. private sector entities to be on the forefront of this effort.

It is difficult to attribute enhanced innovation capabilities of a country solely to the country's adoption of an internationally acceptable IPR system since many other factors also determine the environment for innovation. However, it is highly unlikely that significant innovation will thrive in a country that does not have a stable IPR system. Thus the department should give greater attention to identifying correlations between effective IPR systems of specific countries of interest and private sector investments in innovation as well as technology uptake in these countries. Empirical research, including case studies, would carry considerable weight in promoting IPR systems and Bayh-Dole technology transfer paradigms that serve the interests of both the United States and countries of interest.

Recommendation 3-3

The department should encourage USAID to initiate external reviews of its S&T programs every 3 to 5 years given the many overlapping goals of USAID and the department that often involve nongovernment entities. The 2006 report prepared by the National Academies titled "The Fundamental Role of Science and Technology in International Development: An Imperative for the Agency for International Development" provides a good starting point for the next review.

Of particular interest in considering a whole-of-society approach are the overlapping activities of USAID that have extensive linkages with the nongovernmental sector through many interagency agreements and contractual arrangements. The policies and programs concerning the role of S&T in

USAID's program have changed dramatically in recent years, including the closer alignment of these activities with the interests of the department. Also the extensive emphasis on S&T within USAID as of 2014 is unprecedented. Assessments, like the 2006 report, should address a wide range of policies, programs, and approaches of USAID, with particular attention to the agency's relationships with not only the department but with hundreds of U.S. and international partners from both the governmental and private sectors as well. The reviews should consider program content, anticipated impact, and operational procedures in developing and implementing programs. The linkages between the policies and programs of the department and USAID are emphasized in the *FY 2014-2017 Department of State and USAID Strategic Plan*, which identifies many complementary interests in S&T-related activities. In addition, the current and planned programs of USAID are well documented in congressional presentations and other publicly available documents.

Recommendation 3-4

The leadership of the department, in concert with senior Department of Defense (DOD) officials, should continue to give emphasis to the importance of collaboration between the two departments at many levels. Opportunities for joint planning, program development activities, and readiness for future contingencies should receive particular attention, perhaps in preparation of the Quadrennial Defense Review and the Quadrennial Diplomacy and Development Review.

This recommendation focuses on DOD's international activities that overlap with interests of the department. Of course, the department should also coordinate with many other agencies; but the extent and foreign policy implications of DOD activities are indeed profound.

DOD, with tens of thousands of personnel stationed abroad, including thousands of specialists highly trained in advanced aspects of S&T, has a large influence on the development and implementation of S&T-laden U.S. policies. Military officers are regularly assigned to important positions in offices of the department. Department advisers are assigned to the Pentagon and to combatant commands where they take special interests in the consistency of military activities with foreign policy. At the Pacific Command, for example, the Adviser assigned to the command by the department often has strong interests in S&T and organizes conferences that feature DOD's S&T activities in Asia. These conferences are wide ranging. They have been opened to international participants, and they now attract many foreign military and political leaders with S&T responsibilities as well as a broad range of specialists from the United States.

DOD has been an essential partner of the department in humanitarian, research, and technological development endeavors throughout the world for many decades. Responding to the Haiti earthquake, strengthening hurricane-

warning systems, and combating the spread of the Ebola virus are but a very small sampling of the many non-combatant challenges that have involved unique capabilities of DOD, often employing the latest technological achievements.

Of special interest for this report, the Assistant Secretary of Defense for Research and Engineering in 2014 issued a report titled *The International S&T Engagement Strategy of DOD*, which sets forth the following goal:

Coordinated DOD global S&T engagement to enhance interoperability, relationship-building, and collaboration with partner nations; accelerate the pace of U.S. research and development; leverage emerging global opportunities; improve U.S. capabilities and those of our partner nations; mitigate the risk of global threats; and gain economic efficiencies.

The technologies of interest include both military technologies (e.g., electronic warfare components, weapons technologies, and technical approaches to counter weapons of mass destruction) and technologies with broader applications (e.g., biomedical products, materials and manufacturing processes, and energy and power technologies). About 1,500 DOD and contractor employees are based abroad to carry out S&T scouting missions and technology development activities. The staffs are frequently housed within or near embassy complexes, often attached administratively to, but acting independently of, the Defense Attachés in the embassies. They sponsor conferences, carry out consultations with foreign experts, award research grants and contracts, and encourage international research that is consistent with U.S. interests. The research offices of the Army, Navy, and Air Force, along with the Defense Advanced Research Projects Agency, are the DOD entities most interested in the program. A particularly informative web site “Connecting Industry and DOD” provides further guidance as to the interests of DOD (Defense Innovation Marketplace, 2015).

Other DOD S&T activities are also of considerable interest. They include (a) research carried out at several DOD and service biomedical laboratories in South America, Africa, and Asia, (b) strengthening the biological research infrastructure in a number of countries with support by the Cooperative Threat Reduction Program carried out by the Defense Threat Reduction Agency, (c) and global disease surveillance that is coordinated with the international surveillance programs of the Centers for Disease Control and Prevention as well as with the department’s Biological Engagement Program.

Turning to S&T issues, a recent report of the department on global science, which was supported by DOD, identifies many overlapping interests (National Research Council, 2014). They range from engaging foreign research centers in contractual arrangements to working out the details of classification issues.

In summary, as S&T capabilities of countries throughout the world increase, coordination at many levels will be of greater importance. The approaches will vary in different situations. Frequently, the department, working with DOD, should be in the lead in implementing this call for coordination of S&T policies, programs, and operational implementation.

Recommendation 3-5

The department should ensure that U.S. delegations to meetings of international organizations include essential experts from other government departments and agencies. Other agencies that have important interests and expertise as to the topic of a meeting usually cover the travel costs of their specialists. However, when priorities of the department and other agencies do not align, the delegations may be lacking technical expertise for addressing specific agenda items.

International and regional organizations are steadily increasing their activities and interests involving S&T. While the department sets aside sufficient funding to enable key department officials to attend meetings, financial problems at times arise with regard to including experts from other agencies or from the private sector in delegations when these individuals are unable to find other sources of funds to cover costs.

There are seldom problems in financing delegations to meetings addressing issues of broad interest (e.g., climate change). But at times other agencies, and particularly small agencies, are unable to cover costs for attendance at less highly touted meetings. Then the department must decide the priority that should be given to financial support. The department should be, but does not always have resources. As the frequency of such meetings increases, reserve funds should also increase.

As to participants from the private sector, there are seldom problems. Either their organizations do not hesitate to cover costs or they find the funding elsewhere to participate in events that enhance their professional credentials.

Recommendation 3-6

The S&T Adviser to the Secretary, in consultation with the White House Office of Science and Technology Policy, should stay abreast of the activities of S&T-oriented committees and panels established by components of the Executive Office of the President and should help ensure that the department is appropriately represented when current and future international dimensions of research and development activities are discussed.

BOX 3-1**Offices with S&T-Related Responsibilities in the Executive Office of the President**

1. Office of Science and Technology Policy
 - National Science and Technology Policy Council
 - o Committee on Environment, Natural Resources, and Sustainability
 - o Committee on Homeland and National Forestry
 - o Committee on Science
 - o Committee on Technology
 - President's Council of Advisors on Science and Technology
2. Council of Economic Advisers
3. Council of Environmental Quality
4. Office of U.S. Trade Representative
5. National Security Adviser
6. National Economic Council
7. Domestic Policy Council (Visa Policy)

SOURCE: Executive Office of the President (2014).

Examples of areas of interest include development of new energy sources, new applications in material sciences, and advances in nanotechnology. Box 3-1 identifies relevant entities within the Executive Office of the President in December 2014. The S&T Adviser should coordinate his efforts with other interested units of the department, and particularly the Bureau of Intelligence and Research, which may be engaged in related discussions within the intelligence community.

For decades, the department has played an active role, and often a lead role, at the highest levels of government in the formulation, coordination, and implementation of policies that are at the core of near-term international security and other important foreign policy objectives. The department has undertaken similar roles in other policies with S&T dimensions as well, such as in development of international economic policies. The department has also been engaged in interagency discussions of technical developments leading to emerging technologies, including those that involve interactions among research communities throughout the world. However, officials of other U.S. agencies have commented that insights and guidance of the department are sometimes missing in important discussions within interagency panels and committees that address research and development activities of other countries as well as those of the United States.

The Office of Science and Technology Policy has long hosted an interagency committee or subcommittee specifically focused on international S&T issues that cut across many agencies. Frequently, the department's Bureau of Oceans and International Environmental and Scientific Affairs (OES) has chaired or co-chaired the activity. In addition, OES also hosts meetings of

representatives of agencies responsible for international activities to discuss common concerns and to keep the agencies up-to-date on policies and interests of the department. Some agencies have expressed the view that coordination meetings convened by OES should be more frequent, perhaps twice per year. They cite a gathering organized by OES in 2012 of over 120 agency officials that provided an excellent opportunity to discuss common international interests and concerns throughout the government. Finally, OES often convenes country-specific interagency meetings in connection with activities of bilateral joint commissions and at times organizes coordination meetings in preparation for other interactions with representatives of specific countries.

In short, when the meeting is about international affairs with S&T dimensions, the department will be well represented. When the meeting is about S&T developments with international dimensions, at times the department has higher priorities. Of particular concern are comments by officials of the Department of Defense that the Department of State does not give enough attention to discussions led by OSTP concerning advanced technologies that are having or will have significant international impacts. The importance of such exchange of information is significant and the S&T Adviser is well positioned to alert department offices of the need to follow up.

PROMOTING A WHOLE-OF-SOCIETY APPROACH

Recommendation 3-7

The Quadrennial Diplomacy and Development (QDDR) and other broad-ranging policy documents should underscore the importance of the department adopting a whole-of-society approach to diplomacy, which includes the capabilities and contributions of not only many government agencies but also nongovernmental entities that are deeply vested in S&T.

The first QDDR recognized the significant international roles of many organizations and the importance of nurturing approaches to diplomacy that leverage S&T and other relevant assets of the entire country. The approach is important not only in the formulation of foreign policy, but also in the carrying out of foreign trade, public diplomacy, and humanitarian assistance, which draw heavily on S&T expertise.

Recommendation 3-8

OES, STAS, the Bureau of Educational and Cultural Affairs, and other interested bureaus should jointly organize annual conferences for representatives of interested universities, professional societies, foundations, NGOs, companies, and other private sector organizations to meet with relevant department officials in assessing past and future opportunities for partnerships and other arrangements that will enhance mutual interests in the development and carrying out of international

non-defense S&T-oriented programs. The meetings should be primarily for information exchange, and they should not be construed as policy formulation meetings.

Many department bureaus and offices are in contact with universities and other private sector entities on a regular basis, often supporting S&T-oriented grants and contracts for specific projects of mutual interest. The bureaus involved in public diplomacy have long had extensive relationships with the academic and other nongovernmental communities. They traditionally have supported extensive programs involving S&T through the Fulbright Program and other mechanisms. Also, OES sponsors a number of S&T-oriented programs involving the academic and NGO communities, while STAS has become a focal point for consultations with U.S. universities and other organizations that are interested in working with the department in addressing global S&T issues but are not well connected with the program offices of the department. Against this background, an annual conference as suggested in this recommendation, open to all internal department offices and other organizations with relevant interests, should provide important encouragement for traditional partners and other institutions with latent capabilities to become better attuned to the interests of the department and thereby help spread the concept of a whole-of-society approach in carrying out programs abroad. A specific theme for each conference could help focus attention on both procedural and substantive presentations.

As an example of a new opportunity for engagement of universities in activities of interest to the department, in 2013 the Special Adviser to the Secretary for Partnerships established a program that initially engaged 14 U.S. universities in projects involving policy research and analysis of interest to the department. The approach was named the Diplomacy Lab. Offices of both regional and functional bureaus of the department submitted numerous requests to the Special Adviser for narrowly focused studies that professors and students could carry out as part of ongoing educational and research programs that would be of interest to the department. While no funding was provided for the studies, a number of universities have been motivated to participate, simply by knowing that the department is interested in their ideas.

LOOKING FORWARD

Good alignment of the interests of the department and those of multiple-stakeholders involved in activities of mutual interest is important. Efforts to improve the consistency between the approaches of the department and other U.S. organizations with related international objectives may delay implementation of programs. However, the long-term benefits from having single unambiguous messages supported by the major stakeholders may warrant such delays. This approach, for example, is currently guiding efforts of the U.S. government and the private sector in establishing a multi-stakeholder framework for internet governance.

Complementing the launch by the U.S. government or other U.S. organizations of S&T-related initiatives of world-wide interest are the many evolving programs of international and regional organizations, international development banks, and private foundations with global reach that have their own S&T agendas and priorities. Often such activities are of direct interest to U.S. agencies, and at times the U.S. government helps shape mutually acceptable approaches involving other organizations. Also, activities of multilateral organizations are usually far-reaching and involve many governments and their influential patrons. Appropriate U.S. agencies should be represented at such meetings that shape multilateral approaches.

In short, the department will never have a complete array of S&T expertise and experience needed in the complex world of global diplomacy. Yet through strategic partnerships involving both public and private sector entities, America's scientists and diplomats can frequently provide a broad array of needed know-how that helps transform well-developed policy into successful action on a solid footing.

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4

Support of Science and Technology Policies, Programs, and Outreach by U.S. Embassies

The Department of State (department) represents U.S. interests abroad through 285 embassies, consulates, and other posts located in 190 countries. This structure provides important channels for conveying foreign policy messages and representations directly to host governments and international organizations and also to the general public. On-the-ground staffs assist the department in understanding security, political, economic, and social dynamics in host countries and in identifying opportunities for positive interactions with government officials and nongovernmental organizations. Twenty-seven other U.S. departments and agencies such as the U.S. Agency for International Development and the Departments of Agriculture, Health and Human Services, Commerce, Energy, Homeland Security, Justice, Treasury, and Defense (referred to collectively as agencies) are also represented abroad by 11,000 employees within various embassies and related facilities (Kennedy, 2015).

FOCUS ON ENVIRONMENT, SCIENCE, TECHNOLOGY, AND HEALTH

For more than 50 years, the department has assigned personnel to embassies to focus on S&T issues. Initially, the officers assigned to these positions (now called Environment, Science, Technology, and Health [ESTH] positions) were primarily accomplished senior scientists recruited from research centers and universities. These external recruitment efforts had almost entirely ended by the early 2000s. Now Foreign Service Officers (FSOs) are usually assigned to handle ESTH issues (see Appendix L).

In recent years, ESTH officers have concentrated largely on the activities set forth in Box 4-1. Priorities vary from post-to-post and time-to-time. However, with the increased flow of information back to Washington through many internet, media, and other channels, the formal reporting requirements for ESTH officers have declined in importance due to the many other channels of communication and information dissemination. These include increased television time devoted to news from abroad, expanded use of oral reporting via mobile phones and e-mail, and social media (Bureau of Oceans and International Environmental and Scientific Affairs [OES], 2014). The S&T focus in most

BOX 4-1**Typical Responsibilities of Environment, Science, Technology, and Health (ESTH) Officers at U.S. Embassies**

- Alerting embassy and department officials to emerging problems and opportunities associated with new ESTH developments in the United States and abroad.
- Providing an informed technical perspectives during internal embassy deliberations on issues involving significant ESTH considerations.
- Assisting U.S. departments and agencies during the development and negotiation of bilateral ESTH agreements and programs and facilitating implementation.
- Obtaining and disseminating information concerning (a) changes and other developments in the ESTH policies of the host government, (b) local ESTH achievements that are noteworthy, and (c) regional and international ESTH activities supported by the host government of relevance to U.S. interests.
- Engaging with host government, non-government, and private sector to advance ESTH priorities of the U.S. government, including, for example, developments related to climate change, oceans, health, wildlife trafficking, and Arctic governance.
- Providing an informed point of contact for local officials and specialists interested in ESTH policies, organizations, and technical achievements of the United States.

SOURCE: OES, 2014.

embassies has turned in large measure to monitoring developments and expediting programs that are of interest to OES, the regional bureaus, and other government agencies. Looking forward, the *FY 2014-2017 Department of State and USAID Strategic Plan* identifies S&T-related policies and programs that should be of interest to the embassies in general, and to ESTH officers in particular.

In assisting other departments and agencies during development of bilateral projects (see Box 4-1, third bullet), ESTH officers should be able to comment on proposed activities and not just provide administrative facilitation. They also should reach out to host government officials to help resolve barriers to specific cooperative activities as well as to provide advice to both sides on neglected fields for cooperation.

In response to a questionnaire (See Appendix M) circulated by the department in 2014 at the request of this committee, ESTH officers at more than 50 embassies provided important insights as to on-the-ground challenges they face on a daily basis. Of particular interest, they identified the following science, technology, and innovation issues that they regularly considered, with the results indicating the following priorities on a world-wide basis.

- Climate Change
- Energy

- Health
- S&T Cooperation
- Water Issues
- Wildlife Trafficking
- Other Issues including Genetically Modified Organisms, Innovation, Food Security, and Forestry

Against this background and taking into account discussions with a number of current and former ESTH officers, a key finding of the committee concerning current S&T-related activities in Washington and at the embassies can be characterized as a “tale of two States.” Considerably more progress has been made during the past 15 years in Washington in building S&T capacity of the department and expanding use of S&T capabilities of the United States in promoting foreign policy interests than at the embassies where the preparedness and support of ESTH officers and the priority given to S&T issues have not advanced as much and too often have declined.

Embassies need clear mandates from Washington, well informed personnel, and ready access to financial resources to address a number of S&T-related challenges that are already important or are emerging on the near horizon as discussed in Chapter 2. Some of these challenges are on the department’s agenda, but others are not. The embassies should be able to help identify and characterize the principal issues in dealing with host countries and then contribute to the department’s efforts to address them effectively.

At the same time, ESTH officers do not stand alone at the embassies in considering S&T issues and opportunities for engagement. In particular, the Ambassador and the Deputy Chief of Mission often become involved in S&T issues and have important venues for promoting related interests with senior officials and important S&T leaders of the host countries. Economic Minister-Counselors or Economic Counselors at the embassies often have internal responsibilities for guiding S&T efforts as well as responsibility for following economic developments of interest in the host country that often involve development of technology. Indeed, Counselors who have supervisory responsibilities for ESTH officers should be familiar with a broad range of S&T issues, either through participation in training activities at the Foreign Service Institute (FSI) or self-study activities. Since economic officers who achieve the rank of Minister are highly talented and motivated, obtaining an adequate level of S&T literacy should not be difficult. Also, when S&T issues command the attention of the leadership of the host country, political officers within the embassy usually have important responsibilities for assessing the impact of developments on the overall relationship between the U.S. and host country governments.

More than 50 bilateral S&T agreements are in force (see Appendix N). In recent years, bilateral commissions co-chaired by the Science and Technology Policy Adviser to the U.S. President have actively guided implementation of six

agreements (i.e., agreements with Brazil, China, India, Japan, South Korea, and Russia). In those cases, the American Ambassadors in the countries of interest are directly involved when the bilateral commissions meet, thereby helping to ensure that the embassies are fully aware of programs that are underway or proposed. Similarly, when formal bilateral S&T discussions are held involving agreements with other countries which do not have commissions, the American Ambassadors usually ensure a high level of embassy participation in formal bilateral meetings, at times including the Deputy Chiefs of Mission.

The activities pursuant to some agreements that are not under the scrutiny of bilateral commissions are limited. Questions are frequently raised within and outside the department as to the need for retaining relatively inactive agreements, particularly those that have sunset provisions. Reasons for retaining these agreements are usually persuasive, including, for example, (a) providing the legal basis for an occasional activity of interest to a U.S. government agency or an agency of the partner country, (b) publicly recognizing the significance of S&T in a country that is an important political or economic partner, and (c) offering opportunities for the embassies to stay abreast of significant S&T achievements within the country. If there are political or technical reasons for retaining relatively inactive agreements, it seems appropriate for the department to retain these agreements, being aware that highly visible termination could be counterproductive. In short, the default position should be to retain and not to discontinue the agreements.

Of particular importance in addressing S&T issues are the roles and outreach of public affairs officers and public diplomacy specialists who are serving at the embassies. These staffs are led by Minister-Counselors at large embassies. At other embassies, Foreign Service Officers (FSOs) of lower rank are usually the senior public affairs/public diplomacy officials. Overall about 3,700 officials are deployed at embassies and other facilities, including about 200 Public Affairs Officers, 1,500 Public Diplomacy Officers and Specialists, and 2,000 locally hired public diplomacy staff members. Many of these local specialists have over many years developed very valuable perspectives on opportunities for public diplomacy involving S&T. (For details on the approach to public diplomacy see www.state.gov/pdcommission/reports/235008.htm.) In 2014, S&T were one of six priorities for public diplomacy programming at the embassies and in Washington. Other priorities included education and environmental issues that are interpreted at many posts as also having significant S&T dimensions. (See Boxes 4-2 and 4-3.)

Interest in most countries in S&T-engagement with U.S. institutions is strong. Unfortunately, a number of constraints on traditional in-person outreach by American diplomats to respond to such interest have become severe, due in considerable measure to limited staff capabilities and budget resources. At some posts, personal security concerns also constrain outreach activities. But most important, available time is scarce when handling portfolios bulging with a wide variety of issues.

BOX 4-2**Examples of Science, Technology, Engineering, and Mathematics (STEM) Oriented Exchange Programs**

- Fulbright Student and Scholar Program for exchanges in both directions (25 alumni are now science Nobel Laureates).
- Fulbright-Fogarty Awards that bring foreign scientists to the National Institutes of Health.
- Fulbright Specialist Program that sends American scientists and other professionals abroad for 2-6 weeks.
- Fulbright Distinguished Awards in Teaching.
- Humphrey Fellowship Program that brings early career and mid-level foreign research investigators to the United States for one year (non-degree program).
- International Visitors Leadership Program that receives visitors to the United States for up to three weeks and often focuses on S&T-related issues.
- International Speakers Program that arranges for participants, including scientists, to give lectures, lead seminars, and/or consult with counterparts abroad.

SOURCE: Office of Public Diplomacy and Public Affairs, 2014.

BOX 4-3**Examples of STEM Collaboration**

- Australia: Collaboration in Climate Change and Renewable Energy.
- China: American Chairs at Universities.
- Bulgaria: Award for American Scholar in Pure and Applied Science.
- Norway: Arctic Chair for American at University Centre in Svalbard.
- Russia: Chair for American at National University of Science and Technology.
- Czech Republic: Chair for American at Charles University (Faculty of Mathematics and Science).

SOURCE: Office of Public Diplomacy and Public Affairs, 2014.

Thus, new approaches to engagement initiated by the embassies that can reach appropriate and frequently large audiences have been essential. Among the efforts currently underway are expanding the use of social media, carrying out interactive telecasts and webinars, and making arrangements with highly respected local institutions to host events of interest both to the institutions and to the embassies. The American Corners program involves 400 arrangements between U.S. embassies and local institutions where the story of America is set forth for local audiences in easily accessible venues. These corners provide convenient locations for electronic connections and for talks and seminars involving S&T experts on visits from the United States.

In summary, effective approaches that capitalize on the S&T strengths of the United States in pursuing foreign policy goals should become an organic part of embassy agendas and diplomatic toolboxes. These strengths should reflect both (a) up-to-date and feasible efforts in developing content of policies and programs, and (b) effective means of communicating with diverse audiences about S&T developments on the horizon as well as about today's achievements.

ESTH STAFFS AT U.S. EMBASSIES

In October 2014, 223 FSOs were assigned to embassies with responsibility for ESTH activities, compared to 143 in 1999. Of these officers, 96 had full-time responsibility for ESTH activities, compared to 57 in 1999; and the others had limited time available, sometimes less than 10 percent of their time (OES, 2014).

The number of Science Counselors at embassies and missions declined from 10 in 1999 to six in 2015 with FSOs serving as Science Counselors in Moscow, Brussels, New Delhi, Tokyo, Beijing, and Mexico City. Sometimes FSOs selected for Counselor positions have technical backgrounds. These positions are highly sought in the annual requests by FSOs for their next assignments.

While the number of ESTH officers has increased, staffing has not kept pace with either the current or potential importance of S&T in bilateral and regional relationships. ESTH officers are usually supported by locally hired FSNs, often with strong educational and professional backgrounds in S&T. But the number of FSNs working on S&T issues is relatively static, and some work on S&T-related issues only part-time (see Appendix L).

Current ESTH incumbents, who are almost always FSOs, usually describe their responsibilities while serving in ESTH positions at embassies as providing interesting and rewarding work. However, in past years such postings had been considered by some FSOs as being outside the mainstream FSO career-enhancement tracks. They were convinced that such assignments would be unfortunate diversions from better opportunities leading to promotions, with service as political or economic officers in particular providing greater potential for advancement.

In Washington, some FSOs with S&T experience and interests favored assignments in the regional bureaus, which are focal points for political and economic developments. Such assignments often led to favorable embassy postings with bright prospects for promotion, whereas S&T-oriented functional bureaus, such as OES, did not have comparable influence over future assignments of FSOs serving in their bureaus. However, as discussed in Chapter 5, S&T assignments in Washington have now become quite popular, with many FSOs seeking such assignments in the face of stiff competition from their colleagues. While avoidance of S&T assignments undoubtedly exists among some FSOs, negative connotations of such assignments appear to have receded considerably in recent years.

Relatively few ESTH officers have in-depth S&T educational or professional backgrounds. But the number of newly minted FSOs with graduate degrees and/or experience in important S&T areas is growing as discussed in Chapter 5.

All ESTH officers are expected to attend a two-week familiarization course on the department's S&T interests at FSI prior to assuming responsibilities abroad. After arrival at the embassies, ESTH officers generally consider the course as a valuable but too brief an introduction to the variety and importance of S&T responsibilities in carrying out diplomatic assignments.

More than 80 percent of ESTH officers responding to the recent survey initiated at the request of the committee stated that more intensive department-provided preparatory training would have increased their effectiveness. Only one-half of the respondents considered that upon arrival at their postings, they were "well informed" or "adequately informed" about ESTH issues and how their posts might advance U.S. interests through S&T-related activities.

Only one-fifth of ESTH officers reported that their embassies had written strategic plans for advancing priority ESTH issues. Usually the Integrated Country Strategy (ICS), the major embassy planning document prepared at 3-year intervals, only addresses S&T issues in a very general sense. They seldom include specific objectives regarding S&T, even in countries where cooperation is formally considered within the framework of bilateral S&T agreements. Nearly one-third of embassy respondents indicated that important ESTH issues were not being addressed at their posts.

The survey indicated that many ambassadors, as well as the Science Counselors and ESTH officers, recognize the value of ESTH as an important tool to support diplomacy. One ambassador has described S&T strengths of the United States as the "golden road" to engagement with senior officials of the host country where he was stationed. Following in his steps would seem to be attractive to many senior embassy officials.

ESTH officers also reported successfully engaging colleagues throughout their embassies and having helpful relationships with others in Washington, particularly during interactions with OES. They underscored the importance of the interagency process to obtain strategic impacts of ESTH strengths on international policies and bilateral relations. At the same time, more than 60 percent of the ESTH officers surveyed put "more consultations with other U.S. government agencies before arriving at post and in conjunction with home leave" at the top of their lists of missing preparatory and consultative activities.

Data and metrics on embassy activities and performance are important in assessing the past and looking to the future. The department does not have a well-developed assessment process that regularly monitors embassy S&T interests and capabilities. While data on embassy staffing and perspectives were generated on a one-time basis for this report, information is not routinely collected that would permit a deeper analysis of ESTH staff interests and those

of their locally-employed staff colleagues, the professional capabilities within the embassy complex, or embassy achievements in dealing with ESTH issues.

Finally, financial reporting systems are not oriented toward analyses of the linkages between the importance of S&T issues and budget commitments of the department at the country or regional levels. The committee did not find any evidence that the increased attention to S&T in the QDDR was reflected in the staffing or funding of relevant activities of the embassies.

STRENGTHENING EMBASSY STAFFING

Recommendation 4-1

The department should maintain S&T Counselors (currently called Science Counselors) at embassies where S&T issues are particularly important components of the bilateral relationship. Only highly-qualified individuals should be placed in these S&T Counselor positions. In most cases these will be outstanding Foreign Service Officers with extensive experience in S&T-related issues and other qualifications such as language fluency, regional expertise, and excellent diplomatic acumen. Some S&T Counselors might be drawn from the department's cadre of Civil Servants, or exceptionally qualified outsiders. The department should also (a) ensure that S&T Counselors and other officers responsible for S&T activities at all embassies receive adequate training and preparation before assuming their duties, and (b) provide support for important efforts to initiate scientific collaboration by ensuring ready access by the embassies to available financial resources that could initiate or strengthen collaboration.

Elaboration of each of these aspects follows:

Assignment of S&T Counselors to Embassies. The change in title to “S&T” Counselors is important in recognizing the role of engineering and technology in influencing policies of countries throughout the world. Health and environment issues are generally considered as directly related to science interests, and the short title of S&T rather than ESTH seems more appropriate in diplomatic circles in characterizing activities of very senior embassy officials. The ambassadors at the embassies that need high-level S&T competence should of course justify the requirement for Counselor-level positions through the regular personnel procedures. In most cases, there should be appropriate candidates for these assignments from within the ranks of the Foreign Service. In unusual cases when highly specialized competence in a particular area of S&T is important, the department should consider recruiting appropriate candidates from other agencies, academia, or the private sector.

As previously noted, following issuance of the 1999 report (National Research Council, 1999), the department continued to decrease rather than

significantly increase the number of Science Counselors as recommended in the report. The committee is unaware whether a decision was taken to reduce the number or whether the attrition was simply the result of a personnel system with other priorities, or more likely limited funds provided by Congress.

In 1999, 10 embassies and missions had positions designated as Science Counselors. In 2015, officials responsible for ESTH activities with the rank of counselor, not necessarily given the formal title of Science Counselor, are posted in Moscow, Brussels, Paris, Ottawa, New Delhi, Tokyo, Rome Beijing, London, and Mexico City. Most of these positions are located in the Economics section of the embassy and thus are responsible for activities beyond ESTH. Sometimes the FSOs selected for Counselor positions have technical backgrounds. These positions are highly sought in the annual requests for FSOs for their next assignment.

However, the spread and intensity of international interest in the S&T aspects of diplomacy are now very evident as documented throughout this report. While the United States is still the leader in many aspects of S&T, other nations are becoming increasingly important sources of S&T and are catching up with the United States, particularly in Europe and Asia. The United States can benefit from their achievements. Also, a significant number of middle income countries are investing more heavily in S&T as they attempt to use S&T achievements as the basis for economic progress. Finally, the dual-use (civilian and military) of advanced technologies is a more serious concern than ever before. In short, an on-the-ground presence of senior S&T officials for addressing the implications of S&T advancement in key countries is clear.

Adequate Preparation for Newly Appointed ESTH Officers. The department should strengthen the preparatory program at FSI for newly appointed ESTH officers, lengthening the program from the usual 2 weeks, if necessary, and arranging for internet-based training when scheduling difficulties prevent new ESTH officers from participating in the preparatory program. While ESTH officers should have broad appreciation for developments in many fields, health and environment are nearly always of interest to embassies. These topics deserve special attention in sessions preparing ESTH officers for assuming their responsibilities. Additional on-line courses at FSI would allow officers to catch up in areas where they need more information.

Financing Exchange Visits. The embassies frequently identify opportunities for jump-starting or invigorating scientific engagement involving individual or small groups of scientists who are resident in the host countries and/or in the United States. Often, public diplomacy or other department travel funds are available to take advantage of these opportunities, but the opportunities to obtain such funds are not always clear to ESTH officers. Among the funds available in Washington, which appear to be seldom known to ESTH officers, are the Education Diplomacy Fund, the Environmental Diplomacy Fund, and the

Entrepreneurship Fund. While established to support public diplomacy efforts, S&T has become a priority for public diplomacy, and these funds should at times be able to accommodate initiation and support of exchanges of interest to ESTH officers.

In addition, there are other types of exchange programs administered by the department. Short lists of examples of STEM-related activities supported by these programs were set forth in Boxes 4-2 and 4-3 earlier in this chapter. Most regional bureaus have access to additional funds for priority activities, and the regional bureaus should also be aware of the availability of funds through the functional bureaus, USAID (including flexible Economic Support Funds available through the Foreign Assistance budget and managed largely by the regional bureaus of the department), and other government agencies.

In short, ESTH officers, in collaboration with public diplomacy officers and other staff members at the embassies, should be well-informed of funding available through traditional channels and should be able to make persuasive appeals for support of particularly worthy undertakings. Of course requests for immediate funding are more difficult to accommodate, but OES should reach out to other bureaus and agencies when good requests from the embassies for travel funds to stimulate important contacts that simply cannot be accommodated through channels available to the embassies. With advanced planning, it seems highly likely that funds could be available, particularly if requested by the ambassador.

Recommendation 4-2

To stimulate S&T awareness throughout the embassies, the department should establish a prestigious annual award for leadership by an embassy official who has made the most outstanding contribution during the year in enhancing science, technology, and innovation-related impacts in areas of priority interest to the department.

As noted above, while ESTH officers have explicit responsibilities for S&T issues, other embassy officers in the course of their political, economic, or public diplomacy activities also should be alert to opportunities for enhancing policies and programs with significant S&T and also explicit innovation content. This award would be comparable in importance and symbolism to awards of the department devoted to accomplishments in the fields of (a) environment—the Frank E. Loy award—and (b) global affairs—the Warren Christopher Award. Awards in these fields can in principle include S&T accomplishments, but they are so broadly based that many other factors can dominate selection of recipients. A new award would underscore that S&T-based achievements have become part of the mainstream of U.S. diplomacy, with specific attention to the expanding role of the embassies.

Recommendation 4-3

The department should continue to encourage short-term assignments of government specialists from other agencies to serve at embassies that request the support of specialists from other agencies. However, the department, in consultation with the requesting embassies and the interested agencies, should give greater attention to the lengths of assignments that are appropriate.

Requests by embassies for up to 90-day assignments of S&T specialists from other agencies to undertake embassy projects requiring specialized expertise will most likely continue to exceed the capacity of funds available to the department or to the parent organizations of the specialists interested in supporting many requested assignments. Examples are listed in Box 4-4. There have been cases wherein assignments to embassies for carrying out consultations on proposed projects could have been shorter, and therefore less expensive, if the specialists had limited their activities to the projects of interest and not become involved in broader embassy activities.

BOX 4-4**Examples of STEM Collaboration**

The Embassy Science Fellows Program provides U.S. embassies access to the expertise of U.S. Government officers in science and technology fields. The program is active throughout the world, and in 2013 the department received 55 technical proposals from 43 U.S. missions in 40 countries. Examples are as follows:

- Experts from EPA and DOE provided advice to the Japanese Ministry of the Environment on remediation of the areas off-site near the Fukushima reactors.
- An education program manager from the National Oceanic and Atmospheric Agency collaborated with provincial leaders in Vietnam to develop a climate literacy program.
- A researcher from the U.S. Department of Agriculture will work with Mexican stakeholders to develop an understanding of the science-related aspects of genetically modified crops and of the economic and social benefits of introducing these crops in Mexico.
- A geologist from the U.S. Geological Survey provided expertise in hydraulic fracturing to the U.S. Embassy in Warsaw. During his three-month tenure as a science fellow, he consulted on resource development potential, environmental impacts, and related policies for the embassy staff and for the government of Poland.

SOURCE: Department of State (2014b).

SCIENCE ENVOY AND DISTINGUISHED YOUNG INNOVATOR PROGRAMS

Science Envoys, initially appointed by the Secretary in 2011 based on a Presidential initiative, have been very effective in expanding the outreach of embassies to engage S&T leaders in countries of particular interest. The Science Envoys, or more appropriately S&T Envoys, who visit selected countries for an initial period of one-to-four weeks have identified opportunities for exchanges and at times have stimulated the development of new S&T-oriented programs. Initially there were concerns about the absence of funding to provide for follow-up activities of interest to the envoys, but OES has been quite effective in identifying second-round activities for most interested envoys.

Over a three-year period, the science envoy program has supported visits by nine leading American S&T researchers and practitioners to various countries for one to four weeks, with four more envoys appointed in late 2014.¹ The envoys add their expertise and reputations to efforts of embassies to engage local scientific leaders in dialogues and to stimulate the launch of new activities, either by the host countries or jointly between a host country institution and a U.S. institution (see Box 4-5). Prior to sending envoys to engage important local S&T communities, the department and the envoys should consider ways in which initial contacts could be sustained, including likely funding resources. Contacts with potential future funders should be on the agendas from the very outset. In particular, the department should consider setting aside additional funding for follow-up visits by the envoys to help facilitate program initiatives.

Recommendation 4-4

The number of Science Envoys (renamed S&T Envoys) should continue to increase.

In another initiative, a focus on early career innovators in the United States and abroad would effectively complement the S&T envoy program that emphasizes establishing linkages between scientists and engineers in the later stages of their careers. Also, a focus on technological innovations that lead to commercial success is quite consistent with the current emphasis on entrepreneurship now prevalent throughout the department. While public diplomacy activities of the department have long included international speaker visits abroad, a new program of carefully selected early career innovators with impressive achievements would raise the level of expertise and relevance to

¹ Envoys appointed in 2014 were as follows: Dr. Peter Hotez, Baylor College of Medicine; Dr. Jane Lubchenco, Oregon State University and former Administrator of the National Oceanic and Atmospheric Administration; Dr. Arun Majumdar, Stanford University and former Director of the Advanced Research Projects Agency-Energy; and Dr. Geri Richmond, University of Oregon (U.S. Department of State, 2014a).

international interests to new heights. As cited in Chapter 2, the Frontiers of Engineering programs carried out by the National Academy of Engineering together with similar Frontiers of Science programs that have been carried out by the National Academy of Sciences provide fertile grounds for recruiting outstanding representatives of the S&T strengths of the United States, who have early-career successes and look forward to multi-decade careers. In short, they

BOX 4-5
Science Envoys 2011-2014

- **DR. BRUCE ALBERTS** (biochemistry): Former Editor-in-Chief of Science and former President of the National Academy of Sciences. Launched a Frontiers of Science Program and USAID Partnerships for Enhanced Engagement through Research in Indonesia.
- **DR. ELIAS ZERHOUNI** (medicine, medical administration): Former Director of the National Institutes of Health. Promoted S&T cooperation at regional centers of excellence. Traveled to Morocco, Algeria, Tunisia, Libya, Kuwait, Saudi Arabia, and Qatar as well as UNESCO headquarters in Paris.
- **DR. AHMED ZEWAEL** (chemistry and physics): Director of the Center for Physical Biology at California Institute of Technology, 1999 Nobel Prize for Chemistry. Supported plans for Science Policy Centers. Traveled to Egypt and Qatar.
- **DR. RITA COLWELL** (bacteriology, genetics, oceanography): Former Director of the National Science Foundation, 2006 National Medal of Science Laureate. Encouraged lab-to-lab collaborations, women and girls in science, and STEM education. Traveled to Malaysia, Bangladesh, and Vietnam.
- **DR. GEBISA EJETA** (agronomy): Recipient of the 2002 World Food Prize. Encouraged university partnerships, and applying S&T to sustainable development and innovation. Traveled to South Africa, Tanzania, and Ethiopia.
- **DR. ALICE P. GAST** (chemical engineering): President of Leigh University. Promoted peer-to-peer linkages, merit based peer reviews, and science education. Traveled to Azerbaijan, Kazakhstan, and Uzbekistan.
- **DR. BERNARD AMADEI** (civil engineering): Founder of Engineers without Borders, Professor at University of Colorado. Launched Engineers without Borders Pakistan and conducted workshops on science, technology, and engineering for sustainable development and entrepreneurship for engineers. Traveled to Pakistan and Nepal.
- **DR. SUSAN HOCKFIELD** (neuroscience): President Emeritus and Professor of Neuroscience, MIT. Promoted public-private partnerships for innovation. Traveled to Turkey.
- **DR. BARBARA SCHAAL** (evolutionary plant biology): Dean of the Faculty of Arts and Sciences, Washington University. Supported embassy's outreach efforts on the effects of climate change on commercial agriculture and biodiversity. Traveled to Turkey.

SOURCE: OES, 2014.

could highlight the merits of the approach to developing S&T capability in the United States, identify new collaboration opportunities, and alert the embassy to rising young local stars who should be considered for participating in U.S.-sponsored activities.

Recommendation 4-5

The department should establish a program that supports short-term visits to interested countries by American scientists and engineers in their early careers who have already received national recognition for their innovative S&T achievements (the Early-Career Innovators).

GROWING IMPORTANCE OF SOCIAL MEDIA

The department maintains nearly 1,000 official social media accounts around the world, representing hundreds of ambassadors, embassies, consulates, Washington bureaus, and the department as a whole. The department's flagship twitter account (@StateDept) recently broke the 1 million audience threshold, but all told the department's combined social media audience is over 40 million people world-wide and is growing.

The department primarily uses social media to reach foreign audiences for public diplomacy purposes—directly connecting the U.S. government and American citizens to foreign citizens in order to improve their understanding about the United States, to inform audiences about U.S. policies, and to promote U.S. interest broadly. Given the extent of the endeavor and steady expansion of activities, careful evaluations of audience participation and significance are overdue.

Recommendation 4-6

The department, while continuing to expand the use of new dialog mechanisms to reach large foreign audiences on U.S. values, interests, and policies (Facebook, Twitter, YouTube, and other emerging mechanisms), should increase efforts to better understand the composition, reactions, and influence of the audiences.

REGIONAL HUBS

More than 25 years ago the department developed the concept of regional S&T-oriented Hubs located within selected embassies to address regional problems. However, these initial efforts were terminated due to changing priorities, failure to achieve regional relevance, and inability of the Hub officers to achieve the respect and support in embassies where they were not physically located.

Then during the 1990s, the department established at 12 embassies regional Hubs to address the regional challenges of trans-boundary water, biodiversity, erosion, and other regional environmental issues, with particular attention to

promoting adherence by governments to global and regional environmental agreements (see Appendix O). The challenge of adherence to agreements has largely passed. Of course environmental issues remain, but many other types of S&T issues beyond protection of the environment also have important regional dimensions (e.g., diseases, pipelines, transportation routes, mining, and land disputes).

Staffs at Hubs are spread extremely thin and in some cases can handle only one or two issues at a time, thereby limiting their regional impact. Fortunately, Foreign Service Nationals (FSNs) often play important roles in keeping the embassies informed of important developments of regional interest, although at times FSNs may stretch their areas of expertise when assessing developments in other countries. But still coverage of topics and local interests are limited. Given the changing nature of challenges in many regions of the world, the role of Hubs—and indeed the very concept of Hubs—need serious reconsideration. Should the Hubs be eliminated, some aspirants for regional S&T responsibilities may be disappointed, but organizational issues should take precedence.

Recommendation 4-7

OES, together with the regional bureaus, should assess whether the regional Hubs should remain in place as an important component of the department's overseas presence or whether other approaches would be more cost-effective in addressing regional S&T issues in the years ahead.

THE WAY AHEAD

The foregoing recommendations require both budgetary and personnel commitments. But these commitments are modest in comparison with the long-term payoff as S&T capabilities continue to spread throughout the world. Of special importance, the recommendations require recognition by the department that S&T developments increasing permeate the entire structure of both the Foreign Service and the civil service workforces. If implemented, the recommendations will have a significant effect in elevating the long-term S&T literacy of many individuals and key components of the department.

END NOTES

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5

Enhancing Organizational and Personnel Capabilities

This chapter considers steps to enhance the science and technology (S&T) capabilities of employees of the Department of State (department) and to strengthen the organizational framework of the department that enables them to develop and use these capabilities effectively. Many positions in the functional bureaus of the department and in Environment, Science, Technology, and Health (ESTH) units within the embassies call for a concentrated focus on S&T-related issues. In addition, many other positions throughout the department increasingly require higher levels of up-to-date S&T literacy. Strong capabilities of the entire workforce to address S&T-related issues should be an overarching goal for conducting effective diplomacy in the years ahead. Just as language fluency and area expertise have long been critical aspects of the practice of diplomacy, S&T literacy is rapidly becoming of comparable importance in the formulation and implementation of foreign policy.

THE CURRENT WORKFORCE

The department has 72,000 employees, including 14,000 Foreign Service Officers (FSOs), 11,000 civil servants, and 35,000 Foreign Service Nationals (FSNs). The remainder of the workforce is composed primarily of locally hired administrative-support personnel at the embassies. The leadership of the department includes about 900 senior FSOs, 150 senior civil servants, 80 politically appointed executives, and in 2014, 45 politically appointed ambassadors (Kennedy, 2015; Stimson Center, 2014).

Data as to the number of department officials that have a high-level of S&T expertise are not readily available, but the committee responsible for this report estimates that several hundred civil servants have the technical capability that is necessary to carry out their current assignments effectively; and this cadre is likely to continue to grow significantly during the next decade. Most of these officers are working in the functional bureaus of the department, and particularly in the bureaus reporting to the Undersecretary for Economic Growth, Energy, and the Environment and to the Undersecretary for Arms Control and International Security. A particularly important concentration of civilian-oriented S&T talent resides in the Bureau of Oceans and International Environmental and Scientific Affairs (OES).

Despite the uncertainties in the foregoing estimates, the number of department civil service officers requiring a high level of S&T expertise is clearly a small fraction of the total workforce. But it is an important fraction. Also, a growing number of FSOs during the course of their careers will be expected to deal with important issues that have substantial S&T dimensions. In short, many civil servants and FSOs will continually be called upon to update and expand their areas of special competence, and particularly S&T competence.

STEPS FOLLOWING THE LANDMARK REPORT OF 1999

Since the publication of the 1999 report of the National Research Council titled *The Pervasive Role of Science, Engineering, and Health in Foreign Policy: An Imperative for the Department of State*, a number of steps have been taken by the department to implement the report's recommendations. They included small but important modifications of the department's organizational structure and adoption of personnel policies to strengthen the S&T capabilities of the workforce. Chapter 1 identifies early steps taken by the department in response to several of the 12 major recommendations of the 1999 report, including those concerning organizational and human resource issues; and this chapter expands and updates that discussion.

Among the organizational actions that were promptly taken by the department after the release of the 1999 report was the establishment of the Office of the Science and Technology Adviser to the Secretary (STAS) as required by the new congressional mandate set forth in Box 5-1. The appointment of the first Science and Technology Adviser to the Secretary (S&T Adviser) then followed. The first four S&T Advisers were the following:

2000-2004: **Norman P. Neureiter** (Ph.D., organic chemistry, Northwestern University)

Prior to becoming S&T Adviser, he was Vice President for Asia of Texas Instruments, Inc. Earlier in his career, he served in the White House Office of Science and Technology Policy, following assignments as Science Officer in U.S. embassies in Bonn and Warsaw.

2004-2007: **George H. Atkinson** (Ph.D., physical chemistry, Indiana University)

Prior to becoming S&T Adviser, he was an American Institute of Physics Fellow within the department. Previously he had been a Professor of Chemistry and Optical Sciences at Arizona University and a visiting professor at universities and research institutes in Japan, Great Britain, Germany, and Israel.

2007-2010: **Nina V. Fedoroff** (Ph.D., molecular biology, Rockefeller University)

Prior to becoming S&T adviser, she was Professor of Biology at Pennsylvania State University and the first Director of the Life

BOX 5-1**Legislation Creating Position of Science and Technology Adviser**

SEC. 303. SCIENCE AND TECHNOLOGY ADVISER TO SECRETARY OF STATE.

- (a) DESIGNATION.—The Secretary of State shall designate a senior-level official of the Department of State as the Science and Technology Adviser to the Secretary of State (in this section referred to as the “Adviser”). The Adviser shall have substantial experience in the area of science and technology. The Adviser shall report to the Secretary of State through the appropriate Under Secretary of State.
- (b) DUTIES. —The Adviser shall—(1) advise the Secretary of State, through the appropriate Under Secretary of State, on international science and technology matters affecting the foreign policy of the United States; and (2) perform such duties, exercise such powers, and have such rank and status as the Secretary of State shall prescribe.

SOURCE: Public Law 106–113 (1999).

Sciences Consortium (now the Huck Institute for the Life Sciences).
She is a 2006 National Medal of Science Laureate.

2011-2014: E. William Colglazier (Ph.D., theoretical physics, California Institute of Technology).

Prior to becoming S&T Adviser, he was Executive Officer of the National Academy of Sciences and Chief Operating Officer of the National Research Council. Earlier in his career he was Professor of Physics and Director of the Energy, Environment, and Resources Center at the University of Tennessee following appointments at Stanford, Harvard, and Princeton Universities.

In 2005, the Office of the Inspector General of the department conducted an internal review of STAS that was generally positive about the contributions of the office, while offering the findings set forth below (Department of State and the Broadcasting Board of Governors Office of Inspector General, 2005). This committee’s comments on the topics that were addressed in the findings are set forth in bold italic print, and they provide an update on relevant activities and begin to set the stage for the committee’s recommendations concerning further strengthening of the department’s capabilities.

- A lack of clarity about the respective roles of OES and STAS at times leads to competition and confusion. ***There were difficulties over the years, but by 2014 a much improved relationship had been established between OES and STAS, with decisions concerning uncertainties as to respective roles made jointly by the two organizations on a case-by-case basis.***

- STAS has expanded some activities, such as science fellows programs, and created innovative programs for specific activities. But there should be a mechanism to evaluate their initiatives, manage funds that are donated by private foundations and other entities, and eventually transfer projects to appropriate and willing offices. *STAS has effectively managed the AAAS and Jefferson Fellows programs, but this committee has no basis for commenting on accountability for expenditures of funds. Extensive informal feedback indicates deep satisfaction throughout the department with the performance over the years of AAAS Fellows. An in-depth evaluation of the AAAS program would be useful to provide guidance on the future of the program. There have been regular—and positive—evaluations of the Jefferson Fellows program. The day-to-day activities of all types of S&T Fellows have been the responsibility of a variety of offices throughout the department which give high marks to the facilitative role of STAS. As to innovative activities of the S&T Advisers, this committee singles out as particularly important initiatives (a) multi-year STAS leadership in implementation of the bilateral S&T agreement with Pakistan, one of the most difficult and important S&T agreements to implement, (b) establishment of the Jefferson Fellows Program, with funding initially obtained by STAS from private foundations, (c) establishment of the first PEER program whereby USAID joins with a number of agencies in financing collaborative research projects, with the agencies supporting American collaborators and USAID funding developing country collaborators, (d) dual-hatting the S&T Adviser to also serve on a temporary basis as an Adviser to the USAID Administrator and then supporting the appointment of the first full-time S&T Adviser to the USAID Administrator, which in time led to establishment of USAID's Development Lab, (e) explanation and advocacy of technological innovation during public diplomacy dialogues with high ranking officials of a number of important countries, and (f) assistance to nongovernment entities in arranging many scientific visits to Iran and Cuba, including a visit to Havana in 2014 wherein the Deputy Director of STAS became the highest ranking U.S. government official to visit the island in many years. Finally, the comment that STAS should transfer projects to other offices is not clear since the definition of a project was not set forth.*
- By 2005, two respected scientists had led STAS; but there was no specified term for the job. There should be a more thorough, transparent, and efficacious process for finding and appointing suitable candidates for this prestigious and visible position. *The*

term is now for two years with the possibility of extension for one additional year. The turnover of the position has brought into the department expertise in important areas on the frontiers of science and technology along with fresh ideas on improving the effectiveness of international collaboration although there have been long delays in filling the position after the departures of three of the incumbents. The department has traditionally considered nominees for the position that are suggested by a number of S&T-oriented organizations, as well as internal candidates who step forward.

- Many department officials, leaders of science-oriented agencies, and representatives of the S&T community consider that despite establishment of STAS, the department had not made fundamental changes regarding increased attention to science. *This report reviews the progress that has been made in spreading S&T awareness and activities throughout the department. Limited progress has been made, and this report recommends additional steps.*
- It is important that the S&T Adviser's access to the Secretary and other senior policy makers be preserved. *The S&T Adviser has had little access to the Secretary but has had access to appropriate undersecretaries and other senior officials when needed. This committee recommends below that the status of the S&T Adviser be enhanced to improve such access both to the leadership of the department and to the flow of policy papers with significant S&T content.*
- For a subject so interwoven in the department's work and seen as a national core strength, science receives little mention in the department's basic priority-setting documents. *The first QDDR and the FY 2014-2017 Department of State and USAID Strategic Plan give considerable attention to the role of S&T in diplomacy. However, the policy pronouncements will be meaningful only if backed by commitments of resources that will enable implementation.*

Given the foregoing, STAS has much greater potential to be a catalyst for bringing S&T considerations into the mainstream of foreign policy formulation and implementation. Recommendations in that regard are offered throughout this report and consolidated in Chapter 6.

STAS policy priorities for 2014-2015 have been as follows:

- *Incorporate Science, Technology, and Innovation in Global Economic Growth Dialogues through Second-Track Diplomacy.*
STAS advocates the integration of science, technology, and

innovation (STI) as a tool for global economic growth and poverty alleviation in diplomatic dialogues. STAS uses existing or establishes new connections and partnerships with non-traditional diplomatic partners—universities, professional societies, nongovernmental organizations (NGOs)—to deepen global dialogues by including topics on entrepreneurship and risk-taking in STI as a catalyst for prosperity. By highlighting important emerging or lesser noticed perspectives or issues in STI—such as inclusion of women and minorities in technology activities—STAS raises their visibility to the diplomatic corps and the broader economic development community.

- *Enhance Scientific Capacity in the Department.* In partnership with several professional societies, STAS facilitates entry of about 30 Ph.D.-level scientists and engineers each year into the department through fellowship programs. Approximately 70 former Fellows have transitioned into positions at the department during the past three decades, which has greatly expanded scientific expertise at the department.
- *Build Effective Public-Private STI Partnerships.* STAS leverages science diplomacy and extensive connections across technical networks to assist regional and functional bureaus and to build flexible partnerships that harness STI capacity at home and abroad. Since many aspects of U.S. S&T capabilities exist in nongovernmental institutions, expanding cooperation requires close coordination with these organizations.
- *Translate Impact of Emerging Scientific Trends and Transformational Technologies for Better Long-Term Decision making.* Emerging technologies and trends can have significant global, political, and economic impacts that require thoughtful integration into present-day decisions. STAS monitors scientific advances and emerging technologies to translate their impact on U.S. foreign policy for decision makers (Department of State, 2014b).

In December 2014 the staffing of STAS to address these issues included 10 positions: three Schedule B limited-term civil service positions (S&T Adviser and two Policy Advisers), two civil service positions (Deputy S&T Adviser and Administrative Specialist), one FSO, two AAAS Fellows, one Franklin Fellow, and one paid graduate student intern. Each of the four program priorities of STAS are interesting and far-reaching; but given staff limitations there should be a focus on selected outcomes, while not ruling out activities beyond the four priorities.

This report recommends several additional activities wherein the new S&T Adviser should participate, including leading foresight activities (Chapter 2),

serving as co-chair of the S&T Advisory Board (Chapter 2), increasing contacts with S&T global networks (Chapter 2), and improving the department's awareness of international S&T interests within the Executive Office of the President (Chapter 3). These important new activities will require additional staff and budgetary support.

ORGANIZATIONAL ADJUSTMENTS WITHIN THE DEPARTMENT

In 2010, the first *Quadrennial Diplomacy and Development Review* called for consolidation of STAS, the Office of the Economic Adviser to the Secretary, OES, a new Bureau of Energy Resources, and the Bureau of Economic and Business Affairs under the broadened responsibilities of the Undersecretary for Economic Growth, Energy, and the Environment. The bureaus and offices that are now under the purview of the Undersecretary are set forth in Figure 5-1. Unfortunately, STAS lacks sufficient status to appear on the formal organization chart; and this report recommends steps to correct this deficiency.

Of special relevance for this report has been the continued increase in the responsibilities of OES, which now has a staff of 200 positions and a core budget of \$34 million. In addition, the bureau receives funds to support activities of international fisheries commissions, climate change negotiations, and several other important activities. OES now has a formidable array of S&T experts in a variety of fields and has gained a very prominent position in the department in developing and managing significant programs of broad interest. The current structure of OES is set forth in Figure 5-2.

While OES manages a large number of program activities, STAS has a broader writ to stimulate and facilitate S&T activities throughout the department when such intervention can be helpful. The most recent S&T Adviser and the Assistant Secretary for OES made excellent progress in reducing lingering animosities between OES and STAS through weekly meetings to discuss complementarity of activities and general divisions of labor. It would also be useful for OES and STAS to jointly review the OES responsibilities set forth in a 1974 Circular of the department together and the work plan of STAS and to modify these documents as appropriate. They should then have a better framework for working together.

After the release of the 1999 report, most regional bureaus of the department designated a Deputy Assistant Secretary to serve as a focal point for consideration of S&T issues in addition to other assigned duties. At times, a bureau has designated another official to handle S&T-related issues; but in general, coordination is maintained at a high-level. The designated officials have usually effectively coordinated S&T interests within their bureaus and reached out to STAS and OES as appropriate. The designees often have a primary responsibility for coordination of all public diplomacy activities throughout the regional bureaus, and public diplomacy activities frequently have important S&T dimensions.

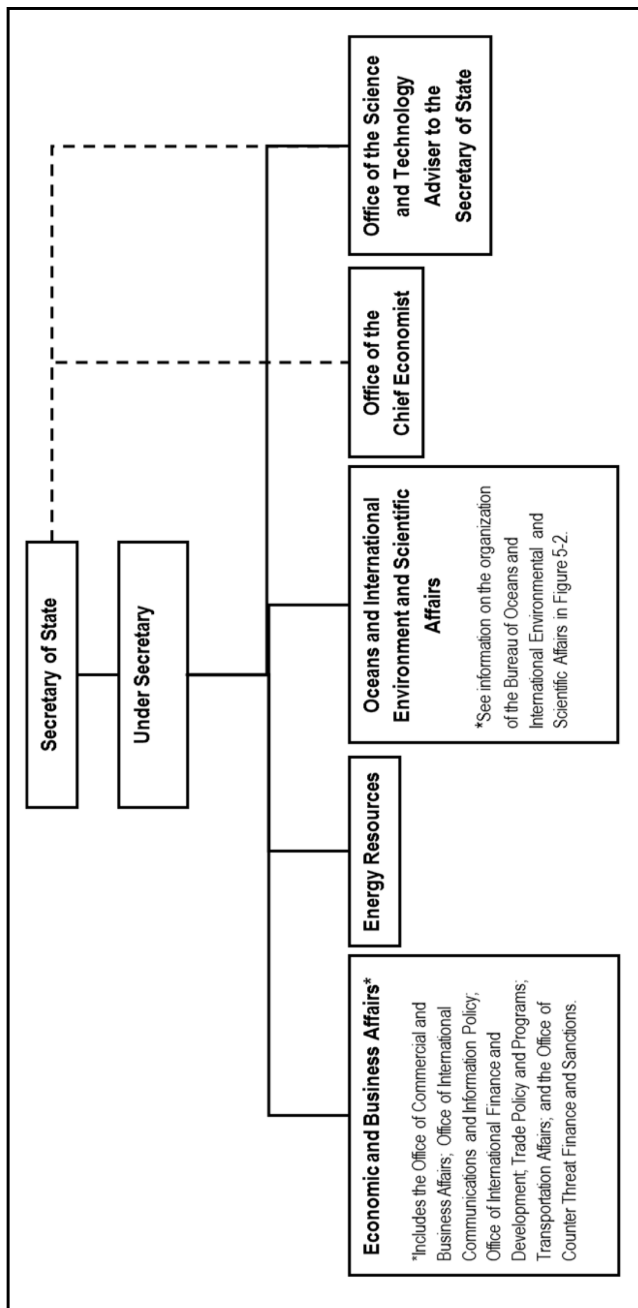


FIGURE 5-1 Units reporting to the Under Secretary for Economic Growth, Energy, and the Environment. The Office of Science and Technology Adviser to the Secretary of State were added to this figure to reflect the recommendation of the committee to provide the S&T Adviser with status equivalent to an Assistant Secretary.
 SOURCE: Department of State, 2014a.

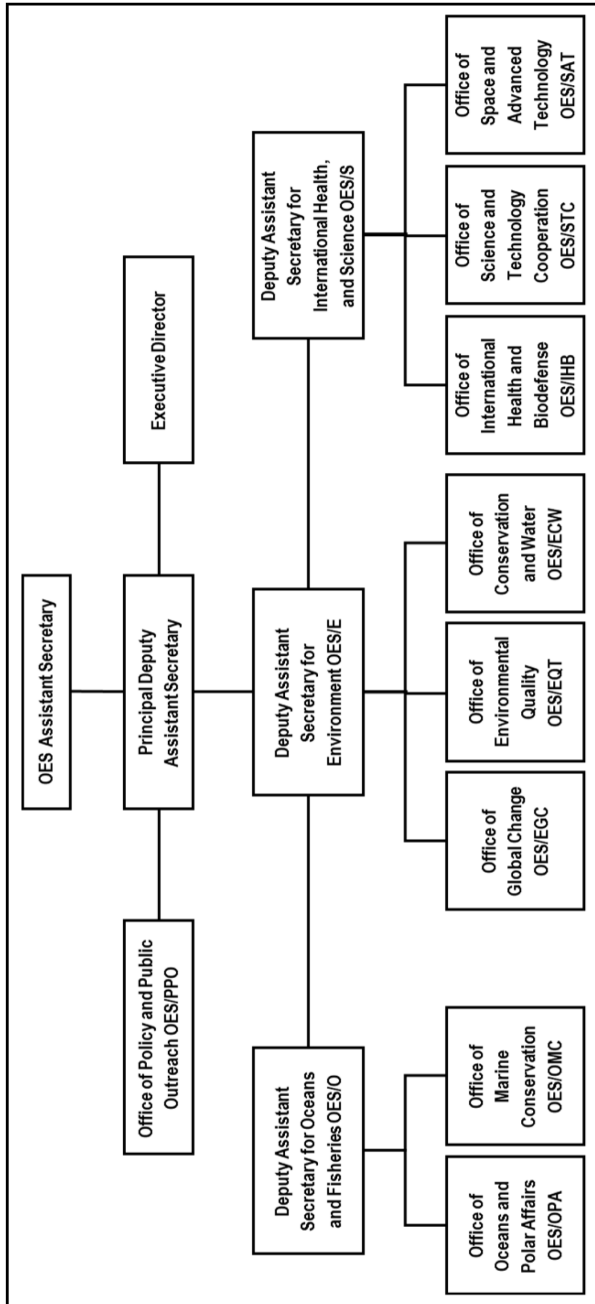


FIGURE 5-2 Organization of the Bureau of Oceans and International Environmental and Scientific Affairs (OES).

The foregoing organizational changes, together with personnel adjustments that are discussed below, have increased the department's capacity to engage with organizations in the United States and abroad on security, economic, foreign assistance, and political issues that have important S&T components. Of special importance for this report has been the involvement of the S&T Adviser in bilateral economic dialogues with a number of countries, which usually involve discussions of S&T-related topics, and particularly the role of innovation in economic development.

In short, the current organizational structure within the department consolidates selected types of technical expertise in functional bureaus and helps ensure that the country-oriented bureaus have access to S&T expertise when needed. This report offers four organizational recommendations for continuing to strengthen the department's capabilities for drawing on S&T capabilities from within and outside the government on a regular basis. First, a recommendation to establish a Science and Technology Advisory Board was discussed in Chapter 2. The second, recommending annual conferences for all interested parties within and outside the government, is set forth as a recommendation in Chapter 3. The third and fourth organizational recommendations follow.

Recommendation 5-1

The department should provide the S&T Adviser with organizational status equivalent to that of an Assistant Secretary.

This status would improve the S&T Adviser's ability to participate in discussions involving issues with significant S&T content, and policy papers on such issues *en route* to senior officials of the department would routinely be available to the S&T Adviser for comment when appropriate. This is not now the case. Such status would also increase the visibility and accessibility of the S&T Adviser to colleagues and other interested persons within and outside the department, not only by inclusion of STAS on the organization chart of the department, but also signaling that the S&T Adviser is indeed a senior official of the department. Of relevance, the Chief Economist of the department has been given the status recommended for the S&T Adviser.

As previously noted, the S&T Adviser is appointed for a period of two years, with an option for a third year. The committee considers that this arrangement, which provides for a steady flow of fresh ideas into the department, is appropriate. However, the time delays between completion of service of an incumbent and arrival of a replacement have reached unacceptable durations of many months, which degrade the effectiveness of STAS in addition to depriving the department's leadership of expert advice on important issues that cannot await attention. At the same time, however, the process that has been used in selecting recent S&T Advisers has been commendatory. Inviting leading American S&T organizations to nominate candidates, together with considerations of internal candidates, has led to excellent appointments. They

have met the criteria of having up-to-date S&T expertise, broad knowledge of the U.S. S&T enterprise, experience in managing and operating in a complex organizational environment, and deep appreciation of the intersections of S&T and diplomacy. While there have at times been suggestions of linking the appointment to the tenure of each Secretary of State, the committee rejects this suggestion which would be viewed as placing biased politics ahead of objective S&T advice that is based on the evidence emerging from well-established analytical and transparent processes

Recommendation 5-2

STAS should have (a) an increase in staff positions, and (b) access to support funds.

Several recommendations set forth in this report call for strengthening and expansion of activities of STAS. Such broadening of responsibilities will require additional resources for STAS. As noted, the office currently has positions for five civil service employees and one FSO, supplemented by several fellows. STAS has no financial resources other than limited funds for official travel by its staff. Funding for occasional consultant services would be quite beneficial in supporting activities that are of interest both to STAS and to other components of the department.

While the department is suffering from a four percent budget decline in Fiscal Year 2015, the leadership has been optimistic that the department's request for an increase during Fiscal Year 2016 will receive favorable consideration by the Office of Management and Budget and by Congress (Kennedy, 2015). Although budget pressures within the department are omnipresent, increases in the resources for STAS need not be large to have significant impacts by drawing on one of the strongest assets of the country in supporting diplomatic endeavors.

The number and types of positions and the budget for STAS and other units of the department should be determined through the usual process of requesting and justifying additional resources. As to support funds, contract arrangements with one or more appropriate U.S. organizations could assist STAS and other collaborating entities of the department in developing the basis for departmental initiatives on S&T topics of emerging importance.

At times there have been frustrations within and outside the department concerning the lack of authority and impact of the S&T Adviser, leading to occasional recommendations for alternative approaches, including (a) establishing the position of a senior science adviser and organizational entity with direct responsibility for all aspects of S&T carried out throughout the department, or (b) combining OES and STAS. As to a senior science adviser with responsibility for all S&T activities, there are so many bureaus and offices with deeply rooted S&T activities—based on legislative authorities and/or on well-proven departmental practices—that funneling all S&T related issues

through a single channel to the top levels of the department is neither advisable or feasible. Second, combining OES with STAS is unrealistic since OES is focused on a wide range of program activities and needs a full-time Assistant Secretary to manage these activities with direct access to the Secretary when necessary. STAS has a broader mandate to provide leadership, advice, and outreach in addressing selected S&T issues of interest to many components of the department, with access to the Secretary as needed. The realistic approach to reduce the concerns over lack of impact of the S&T Adviser is (a) to strengthen the department-wide S&T leadership role of the S&T Adviser in addressing emerging S&T trends and related foreign policy issues and to increase the integration of the nation's S&T capabilities into the mainstream of foreign policy considerations, and (b) to continue to strengthen the S&T capabilities of OES for developing and managing programs and to improve the S&T outreach and effectiveness of the U.S. embassies.

STRENGTHENING PERSONNEL CAPABILITIES IN SCIENCE & TECHNOLOGY

The department has taken a number of actions in recent years to upgrade S&T personnel strengths at several levels. The most significant steps have included frequent recruitments of civil servants with important technical skills to serve in functional bureaus throughout the department that acquired expanded requirements for special expertise. Also, the department has continued a number of arrangements for civil servants in other agencies with special skills to be loaned to the department for lengths of time ranging from several months to several years. In addition, functional bureaus and offices of the department have been drawing on a more frequent basis than in the past on technical personnel from private entities that are under contract with the department for support for specific activities requiring expertise that is not readily available within the department.

The bureaus of the department that have primary responsibility for defense-related issues have many experts addressing a wide range of S&T issues. More than 100 technically oriented staff members have STEM degrees. Many have decades of experience in dealing with issues concerning weapons of mass destruction, international arms trafficking, treaty verification, and biological and chemical terrorism threats, for example.

An issue facing this component of the department relates to the eligibility for retirement of many technical experts who joined the department at the time the Arms Control and Disarmament Agency and its staff of technical experts were folded into the department. While retirement losses will reduce the extensive experience base of the department for addressing the defense dimension of national security issues, the personnel turnover will also open opportunities to recruit early-career talent that is also up-to-date on new challenges and on modern tools available to help reduce the threats of armed conflict. However, the rigid civil service employment procedures complicate

efforts to recruit specialists with needed skills who do not qualify for priority hiring status, and planning efforts that take this reality into account are needed.

With regard to the two largest S&T-oriented fellows programs, the department has expanded recruitment of interested specialists from universities and other S&T-oriented organizations. These specialists include (a) post-doctoral fellows selected in a highly competitive program by the American Association for the Advancement of Science (AAAS Fellows) for assignments of two years within the department, and (b) fellows who are tenured professors or faculty members of comparable stature at U.S. universities and who are also selected on a competitive basis for assignments of one academic year (Jefferson Fellows). In 2014, 30 AAAS fellows were serving in the department. Each academic year, a new cadre of up to a dozen Jefferson Fellows arrives at the department for one-year assignments. Also, a few additional fellows selected through other programs bring S&T skills to the department for limited periods.

There are at times long-term as well as immediate payoffs from these programs. About 70 former AAAS Fellows have become civil servants within the department or entered the Foreign Service during the past 25 years. In 2014, the S&T Adviser to the Secretary, the S&T Adviser to the Administrator of USAID, the Assistant Secretary for OES, a Deputy Assistant Secretary for OES, and the Deputy Director of FSI were all former AAAS Fellows.

As to Jefferson Fellows, there are now more than 90 alumni of the program that began a decade ago, including a few who are actively engaged in follow-on programs in support of departmental activities. (See Box 5-2.) However, most Jefferson Fellows have limited involvement in activities of the department after completion of their one academic year of service in Washington even though they have committed to be on call for five years. It is not that the department has an overabundance of technical talent and could no longer benefit from availability of talented fellows. The incentives for department officials to stay in touch are often outweighed by the pressures within the department to address issues lying in inboxes. This issue deserves greater attention by the department.

Turning to specific personnel issues, the concerns of the committee responsible for this report are in many ways similar to the observations in the 1999 report. They include the importance of ensuring that policies and programs related to recruitment, training, employment, leadership, retention, and career development of foreign service and civil service personnel give appropriate weight to the department's needs for special S&T skills. Also, there has been a widespread impression within the department that assignments of FSOs with S&T interests to functional bureaus may slow promotion opportunities in competition with colleagues working in regional bureaus, which control overseas assignments. Another common theme has been that the department needs to ensure that promotion boards include members who understand the importance of S&T. Finally, the 1999 report's recommendation that all department personnel with substantive responsibilities should attain an appropriate level of S&T literacy, including awareness of important S&T

BOX 5-2**Examples of Jefferson Fellows' Post-Fellowship Engagement**

- **DAVID BRUCE CONN**, *Berry College*.
Engaged with the Office of International Health and Biodefense for advising on the U.S. response to the 2013 Chikungunya fever incursion into the Western Hemisphere, the U.S. response to the Ebola outbreak of 2014, and humanitarian action to combat neglected tropical diseases.
- **RAJ KHOSLA**, *Colorado State University*.
Continues to work on Asia-Pacific Economic Cooperation (APEC) issues by establishing an APEC Scholarship Program to promote cross-border education in STEM fields between the United States and the countries of the APEC region.
- **DEBORAH LAWRENCE**, *University of Virginia*.
Consults on scientific and technical aspects of forest carbon measurements and monitoring for SilvaCarbon, an interagency program on forest carbon. SilvaCarbon is also involved in implementation of the U.S. contribution to the Global Forest Observations Initiative.
- **DEVINDER MAHAJAN**, *Joint appointment at Stony Brook University and Brookhaven National Laboratory*.
Works with the Office of Intellectual Property Enforcement. Projects include: (a) developing an education module based on the Bayh-Dole Act, (b) participating in the United Nations Committee on Sustainable Development Goals; and (c) engaging China through the EcoPartnership program.
- **BROOK MILLIGAN**, *New Mexico State University*.
Advises OES on technical developments and policy aspects of genetics research and on emerging opportunities to develop genetic tools for combating illicit trade.
- **KATHERINE SELEY-RADTKE**, *University of Maryland, Baltimore*.
Has been "in residence" for 1-3 months for several years at the U.S. Embassy in Moscow, addressing issues related to emerging and re-emerging infectious diseases (HIV, tuberculosis, hepatitis), and has collaborated with Russian scientists while mentoring two students from Moscow in her laboratories.

developments remains important. Of course, policies governing the hiring, nurturing, and promoting S&T-oriented personnel must be consistent with the overall personnel policies of the department.

Accommodating both the department's personnel requirements and the interests of FSOs is challenging for personnel planners in the department. The need to assign personnel on short notice to cover crises, such as the wars in Iraq

and Afghanistan, and the changes of priorities with the arrival of new Secretaries of State complicate advanced planning.

At the same time, the department's approach to personnel management is sufficiently flexible to accommodate to a considerable degree the interests and career ambitions of S&T-oriented personnel. While career planning is the responsibility of individual FSOs, the department has 60 full-time career counselors who are prepared to work with interested FSOs in charting desired and feasible career patterns. But the department's Bureau of Human Resources notes that important advice for early and mid-career FSOs seeking to combine their interests in S&T and foreign policy can often be provided by more senior FSOs who have succeeded in this regard. That said, the Bureau of Human Resources has many challenges in helping shape careers that effectively mesh S&T talents and interests of FSOs with the opportunities for assignments that maximize benefits to individuals and units of the department as well as to the department more broadly.

All the while, the department needs to recognize the changes in career ambitions of current and future generations of university graduates and early-career professionals. Increasingly, the best and the brightest are adjusting career directions a number of times during their most productive years. The department should take into account the dropout rate of early-career FSOs who may be seeking more diversified careers. Similarly the department should take into account that more mid-career high performers may be seeking entry into the Foreign Service (with the average age at intake having risen to 32 years old by 2014).

Historically, members of the department's cadre of civil servants have been assigned to embassies only in exceptional cases. As to such stretch assignments, in 2014 the department revived a dormant program of stationing a few civil servants to U.S. embassies for one or two years to improve their understanding of conditions on the ground. This type of initiative requires capabilities of the department to backfill their positions in Washington during these periods with others who have the required skills and interests. While backfilling positions through temporary assignments may at times be difficult, overseas assignments of civil service personal can also lead to career advancements.

A growing requirement is stronger S&T capabilities of teams of department officials during interagency consultations and coordination concerning S&T-driven foreign policies and international cooperative programs. In many areas, other departments and agencies with deep technical capabilities play critical roles. But in all areas that have significant foreign policy dimensions, the department should be able to field fully capable teams that consist of not only experts on the foreign policy dimensions of various approaches but also well quailed specialists who understand the technical underpinnings that are being considered and the impacts on policies as technology continues to evolve. This need is particularly important in dealing with many complex cyber issues, for example, that will continue to expand in scope and importance.

In summary, the intake of FSOs with groundings in S&T should increase, the hiring and retaining of appropriate S&T-oriented civil servants in highly competitive employment markets should be addressed, and the S&T-related updating of many members of the current workforce is essential. Specialists on detail from other agencies, limited-term hires, and short-term fellows will continue to play important roles; but the need for a strong permanent cadre of S&T-trained foreign policy experts is clear.

Against this background the following steps are recommended.

Recommendation 5-3

The department should continue its efforts to increase its staff so that time available for training and professional development of both Foreign Service and Civil Service officers can increase from the current level of 5 to 7 percent of total available time (the float), with the goal of reaching as soon as possible 15 percent.

The float, often called a training float, is the time each employee should expect to spend on training and educational activities over the course of a career. Such training floats require managers to maintain staffing levels over and above the in-place staffing levels. For the purposes of this report, the float includes (a) full-time assignments to positions that do not have operational responsibilities, such as intensive language training, assignments to military war colleges, and experiences at universities or private companies, and (b) part-time activities away from the job—perhaps several hours per week—that are devoted to attendance at academic or practical courses at nearby institutions at home or abroad or participation on-line educational activities. At the same time, FSI should continue to broaden the scope and number of its classes and on-line offerings with significant S&T content to help achieve the goal of providing opportunities for continuing education for every employee of the department wherever located.

Recommendation 5-4

The department should (a) evaluate the adequacy of the number of AAAS fellows in its workforce and increase the number if warranted, while broadening their opportunities for career appointments; (b) encourage Presidential Management Fellows with science, technology, engineering, and mathematics (STEM) backgrounds, interests in foreign affairs, and hiring preferences in competitions for civil service positions to seek permanent employment opportunities at the department; and (c) create new pathways for Jefferson Fellows to continue to respond to the department's needs for their S&T skills after they complete their commitments of permanent assignments in Washington of one academic year.

AAAS Fellows

A number of offices throughout the department value the availability and temporary placements of AAAS Fellows. At times, AAAS Fellows express interest in obtaining permanent positions within the department, and frequently offices want to hire them. However, a number of the positions that become available are classified as Foreign Affairs positions. The Office of Personnel Management (OPM) does not recognize STEM degrees as adequate educational preparation for these positions. The department has considered the importance of a change in the standards but has not taken action in this regard. As the need for more S&T-trained FSOs and Civil Servants continues to increase, the department should conduct an in-depth evaluation of the AAAS program, as previously noted, which might provide a persuasive basis for expanding the program.

Presidential Management Fellows

The government-wide program that sponsors an annual cadre of about 400 Presidential Management Fellows for service in a variety of departments and agencies has received approval for a pilot effort that will include in the cadre 50 Fellows with STEM degrees who are interested in government service. This group of highly talented young professionals with preferential civil service employment status is a fruitful recruiting grounds for department offices seeking applicants for positions that become available. The functional bureaus, in particular, should become aware of the opportunities to hire Presidential Management Fellows with strong S&T backgrounds.

Jefferson Fellows

When Jefferson Fellows are selected, they agree to serve in the department for one academic year and then remain available to assist the department for five additional years after they return to their home universities. Frequently Fellows express disappointment that they are not asked by the department for assistance during the five-year period. On the other hand, others retain close connections with the offices of the department where they served and take the initiative to remain involved.

As the conclusion of the academic year that Jefferson Fellows serve in the department approaches, STAS should consult with the Jefferson Fellows concerning different routes that they can consider to remain involved in department activities and should encourage them to take the initiative in seeking further involvement. The fellows should be aware of opportunities through grants programs sponsored by the department (see Grants.gov for example), through newly established partnership programs, and through public diplomacy activities.

Recommendation 5-5

The department should formally request a change in the Office of Personnel Management Civil Service qualification standards throughout the Foreign Affairs series that will recognize that STEM degrees are appropriate in satisfying education requirement for positions in this series.

The arguments presented throughout this report concerning the increasingly important role of S&T in foreign affairs should easily provide a persuasive case that personnel standards should keep pace with the changes in the world that new personnel will encounter. This change would not affect only the department but also other agencies that recruit under the Foreign Affairs series.

FURTHER INSIGHTS ON PERSONNEL ISSUES

A few comments by representatives of the Bureau of Human Resources that shed additional light on S&T-related personnel issues are set forth in Box 5-3. Also relevant comments by representatives of OES are included in Box 5-4. These comments challenge the long-time assertions among a number of FSOs that S&T assignments are backwater positions with reduced potential for recognition and promotion. In short, broad generalizations in this area are no longer authoritative, if they ever were.

EXPANDED ROLE FOR THE FOREIGN SERVICE INSTITUTE*Recommendation 5-6*

Beginning with the recruitment of new FSOs and civil servants, the department should take advantage of the many opportunities to help them appreciate the integral role of S&T in the development and implementation of foreign policy and international programs of growing importance.

The introductory training programs for FSOs and civil servants at FSI should highlight the importance of staying abreast of developments in fields that have priority within the department such as climate change, cyber challenges, biotechnology, and spread of contagious diseases. Specialized training in economics and environment and preparatory courses for ambassadorships should include consideration of these and other S&T developments.

For decades, FSI has conducted a two-week training course to upgrade S&T awareness of department-based and embassy-based officials whose assignments include responsibilities for S&T issues. As discussed in Chapter 4, preparation for overseas assignments as ESTH officers has been an important driver for such training opportunities. Also, S&T developments are increasingly being

BOX 5-3**Observations on S&T-related Personnel Issues**

- We had three exceptionally well-trained scientists in the latest A-100 introduction class for new FSOs.
- New FSOs choose their own personnel cones wherein they compete for positions and promotions. Most S&T-oriented FSOs now select the economics cone.
- We can give increased emphasis to S&T skills in selection of new FSOs if the department decides to award points for these skills in determining the priority of highly qualified candidates on the selection registers, who are awaiting selection. Such priority is currently given to Arabic linguists, for example.
- We are sensitive to the importance of IT skills, as reflected by the large number of e-diplomacy-savvy officers within the department.
- FSOs who have not served in the Middle East or Afghanistan are at a disadvantage for promotion, and there are not many S&T-related positions in that region.

SOURCE: Representatives of the Bureau of Human Resources, April 2014.

BOX 5-4**Comments on Assignments and Training**

1. Bidding is heavy for assignments of FSOs to HUB positions within embassies, reaching 50 applications for a single slot (in Bangkok).
2. Bidding for assignments of FSOs as ESTH officers is also heavy, always resulting in more than one well-qualified candidate for each available position.
3. The importance to host governments of the rank and scientific credentials of ESTH officers varies, with some governments interested primarily in the bureaucratic clout of the officer in Washington, others concerned as to whether the officer represents all agencies of government, and others interested in the personal prestige of the officer.
4. Briefings of new ESTH officers at the Foreign Service Institute (FSI) by OES staff members often emphasize what OES is doing rather than focusing on what ESTH officers should be doing.
5. FSI is prepared to prepare on-line courses on S&T issues, but OES must prepare the content and does not have resources for this task.
6. Often OES assigns civil service staff members to cover ESTH positions at embassies for several months when there are vacancies due to timing of arrival of replacement FSOs. This tour is very valuable for the staffer.

SOURCE: OES representatives, April 2014.

introduced into economics-oriented training programs; and new environment-oriented training programs are now in place (Box 5-5).

BOX 5-5**Examples of FSI Courses that Have Been Offered in Recent Years**

- Biotechnology and Global Challenges: Trade, Food Security
- Energy, and Climate Change
- Coal and Power
- Environment, Science, Technology and Health for Foreign Service Nationals
- Environment, Science, Technology and Health Tradecraft
- Extractive Industries Seminar
- Global Health Diplomacy
- Intellectual Property Rights
- Petroleum and Gas Industry
- Washington Energy Seminar
- Hub Officer Orientation
- National Security Executive Leadership Seminar
- Understanding the Interagency A Primer for National Security Professionals.

SOURCE: Department of State (2012). Also <http://www.state.gov/m/fsi/>.

FSI has the potential to become much more than simply a training institute. Like most education institutions, it would benefit considerably from having an analytical research capability—starting small but eventually becoming an important adjunct to the many substantive offices of the department, and particularly offices with long-range S&T concerns.

A byproduct of a successful pilot project that reached out to the broad analytical community could be increased recognition of the importance of the linkages of educational, research, and operational activities. An example of a successful approach in linking analytical research and pedagogy is the activity at the Combating Terrorism Center, co-located with the Department of Social Sciences at West Point. Both the Center and the Department have close ties to operational organizations throughout the Department of Defense and other entities within the government. The Center has an ambitious research agenda that draws on a wide range of specialists while also providing opportunities for participation of cadets interested in specific topics.

An area of growing importance to FSI is a series of topics addressed in trade negotiations that have implications related to U.S. leadership in S&T, particularly issues that impact on high-tech U.S. companies. They include, for example, the Information Technology Agreement, government procurement codes and competition arrangements, rules of origin for global supply chains, rules concerning privileges of state-owned enterprises, and currency manipulations. While trade negotiations are often led by the Office of the Trade Representative and the Department of Commerce, the department plays a critical role. Also, as previously noted there is rapidly growing world-wide interest in

innovation and economic entrepreneurship. Thus, FSI should highlight relevant course offerings at FSI and elsewhere, with particular attention to the importance of recurrent and emerging S&T-driven issues that of broad interest throughout the department and other departments as well. Training opportunities should be widely announced.

Recommendation 5-7

FSI should continue its expansion of educational and training offerings through online courses—including both courses in preparation for specific assignments and broader overview offerings for more general educational and professional advancement.

With tens of thousands of employees dispersed around the globe, the department has both challenges and opportunities to transform the remarkable advances in internet-based education into practical opportunities for education of unparalleled reach and impact. Given the frequent and often complicated research achievements of global interest, S&T developments are a prime area for attention. Eventually on-line training courses and general educational offering should be available to the department's entire workforce.

Budget limitations have stymied past efforts, and it is important to capitalize on the many related efforts in this field underway at other institutions. Relevant activities of others will probably increase, particularly as universities expand on-line course offerings. Also the Department of Defense will probably continue its pioneering efforts in this field, both in Washington and other locations. By taking advantage of such efforts in developing programs of the department, a realistic goal should be professional development opportunities for every department employee wherever located.

END NOTES

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6

Findings, Conclusions, and Recommendations

This chapter presents significant general findings and overarching conclusions that are presented in the previous chapters. Also, the committee responds in this chapter to the special interests of the department that were set forth in the request for this assessment of the science and technology (S&T) capabilities of the department. Then the chapter consolidates the 27 recommendations of the committee, including 9 that are of highest near-term priority.

GENERAL FINDINGS AND OVERARCHING CONCLUSIONS

Findings and conclusions of the assessment of the department's S&T capabilities are as follows:

1. Goals, livelihoods, and activities of many populations throughout the world are being transformed due in significant measure to:
 - Advances and diffusion of S&T capabilities that open new doors for nations to respond to the aspirations of their populations for improved security conditions, greater economic opportunities, and better social conditions.
 - Increased reliance of nations on S&T as a basis for economic development, but at times not giving adequate weight to side-effects of deployment of established or new technologies, including impacts that stretch across the borders of sovereign states;
 - Increased information technology and transportation connectivity that enable individuals and organizations throughout the world to communicate and to have transactions more easily than ever before among themselves and with others who are nearby or at great distances; and
 - Growing concerns over security and political confrontations now and in the future that could lead to deadly use of technologies with ever-increasing potency, which are becoming widely available.

2. U.S.-based S&T-oriented companies, universities, and other nongovernmental organizations are playing increasingly important roles in expanding U.S. interests abroad while at the same time often influencing S&T-driven international policies and programs of the U.S. government.
3. While the department's achievements in strengthening its S&T capabilities during the past 15 years are clearly evident within many bureaus and offices of the department in Washington, progress in strengthening S&T capabilities at U.S. embassies has lagged behind, and at some posts has declined. The department needs to (a) elevate the level of preparation for foreign service officers to assume S&T responsibilities within U.S. embassies, and (b) strengthen the role of science envoys, renamed as S&T envoys, who can develop new opportunities for the embassies to promote important S&T programs of interest to the U.S. government.
4. The S&T Adviser to the Secretary of State (S&T Adviser) has played a significant role in strengthening the internal S&T capabilities of the department and the department's external linkages with S&T leaders in the United States and abroad. The S&T Adviser's office (STAS), with a small staff, has been particularly important in (a) enlarging the number of S&T Fellows serving effectively on short-term assignments within the department, (b) underscoring the importance of innovation and economic entrepreneurship capabilities in a number of countries through public diplomacy efforts, and (c) improving internal department communications and coordination concerning the importance of S&T and readily available sources of expertise to address specific topics. However, the S&T Adviser should play a much broader role in the mainstream of foreign policy development and in the conception and promotion of major department initiatives with significant S&T content. Also, the S&T Adviser should be more active in providing advice to the leadership of the department as to implications of newly-emerging technologies and attendant opportunities for the department to maintain global leadership through effective use of the S&T assets of the country.
5. The department's diplomatic efforts are driven in large measure by immediate issues confronting the department in Washington and at U.S. embassies. A broader foresight perspective, with particular attention to S&T-related developments, could effectively complement the intense near-term focus of the department and provide the basis for addressing authoritative S&T-related predictions of future trends by many credible organizations through foreign policy initiatives.
6. For many years, department officials have been committed to supporting interagency approaches in addressing issues that cut across the

responsibilities of many other departments and agencies. Also, the department has engaged a limited number of nongovernmental entities to expand the reach of U.S. organizations with experience and capabilities directly related to program interests of the government. Greater attention should now be given to adopting whole-of-society approaches in addressing broad-ranging issues, and particularly S&T issues, at both the policy and program levels.

7. Opportunities for effectively utilizing U.S. S&T strengths in public diplomacy activities are much more extensive than have been recognized by the department and deserve greater emphasis in highlighting the contributions of responsible use of S&T as a driver of development and economic prosperity while at the same time as a protector of human health and the environment.
8. In order for the department to reach the laudatory goals set forth in this report, a commitment by the department of a modest increase in the level of resources devoted to intensifying and expanding S&T-related efforts in selected areas is essential.

RESPONSES TO SPECIAL INTERESTS OF THE DEPARTMENT

In the request for this report, the department identified the issues set forth below in bold type as being of particular interest. The committee's views on the issues follow.

1. **Providing incentives for Foreign Service Officers to follow career tracks that include assignments devoted in large measure to international S&T engagement.** An important incentive is the challenge of and personal rewards from carrying out on a daily basis interesting and important S&T responsibilities that are being given increased attention within many bureaus and offices of the department and the embassies. There are unique opportunities within the Bureau of Oceans and International Environmental and Scientific Affairs (OES), in particular, for mid-level officials to have their own portfolios of issues and to serve as lead U.S. delegates to international gatherings. Also, for the near-term, the committee recommends an additional department award presented annually for outstanding S&T-related contributions by an embassy official to achievement of foreign policy goals or program success. In addition, appropriate recognition should be given to S&T competence and achievements in performance appraisals and promotion considerations. In the longer term, professional satisfaction from serving in the midst of an ever-increasing dimension of foreign affairs should continue to grow.
2. **Reaping benefits from scientific exchange programs.** The interagency process has greatly helped in the sharing of findings

from government-supported exchanges. However, most S&T cross-border exchanges are now carried out without direct involvement of the department. Articulation and implementation of a whole-of-society approach by the department, as advocated in this report, should help raise the stature of exchanges in general and encourage department officials to pay more attention to exchanges not addressed in the interagency process in their areas of interest and responsibility. Also, as S&T literacy continues to grow throughout the department, more department officials will be sensitive to the impacts of S&T cooperation that involves partnerships with centers of S&T prowess throughout the United States.

3. **Incorporating S&T principles into programs designed to foster democracy and economic advancement.** The department and the U.S. government more broadly should recognize S&T professional societies and networks that command widespread international recognition as important components of civil society. As such, they can become important platforms for promoting transparency, critical review of policy-relevant assertions, and objective decision making based on available evidence. These strengths of the scientific approach, which is accepted globally as an important component of economic advancement, have the potential for similar acceptance in the building of strong civil societies. A specific recommendation concerning this issue is set forth below as a priority recommendation of the committee.
4. **Leveraging the science community to strengthen relations between countries and to increase the role of S&T expertise in policy decisions of future governments throughout the world.** People-to-people programs supported by the department have been important components of the national effort to build bridges with countries that have been relatively closed to outsiders. S&T participants in these programs, from both the United States and cooperating countries, have played significant roles in encouraging the governments of isolated countries to give weight to S&T as a driver of economic development and an important aspect of responsible decision making. The extensive international S&T networks can also help ensure that governments appreciate the role of S&T in economic success and the importance of international cooperation to this end. This report highlights common interests in technological innovation as an example of shared interests among many countries on all continents, and the contributions of the S&T Advisers in sharing U.S. experience in this regard.

THE GOAL, OBJECTIVES, AND ACTION-ORIENTED RECOMMENDATIONS

The committee's view on the overarching goal of efforts to upgrade S&T capabilities within the department is encompassed in the subtitle of this report: *Embedding a Culture of Science and Technology throughout the Department of State*.

Four objectives to achieve this goal are set forth in the themes of the four substantive chapters of the report: Chapter 2: Utilizing the nation's S&T resources more effectively in responding to the dramatic changes in the global landscape that are determining the future of societies, states, and populations. Chapter 3: Engaging more fully the widely dispersed S&T capabilities of the United States, which are embodied in both government and nongovernment organizations, in a whole-of-society approach to foreign affairs. Chapter 4: Upgrading S&T capabilities of U.S. embassies that are on the front lines of diplomacy. Chapter 5: Increasing the stature and capabilities of department officials responsible for S&T activities and providing challenging opportunities for Fellows and officials from other departments and agencies on short-term assignments within the department and at the U.S. embassies.

Twenty-seven action-oriented recommendations that will contribute to achieving these objectives are then set forth in the report. Nine of these recommendations are considered to deserve priority attention by the leadership of the department, and they are singled out for inclusion in the Summary (indicated by ***). These priority recommendations were selected to highlight near-term actions that can be prompt steps toward (a) achieving each of the four objectives, (b) engaging the leadership of the department more fully in S&T activities, (c) upgrading the status of STAS as a critical node that together with the Bureau of Oceans and International Environmental and Scientific Affairs (OES) adds cohesion to expanded roles of many components of the department to work together and with external partners on S&T issues, and (d) strengthening department capabilities in Washington and abroad both to promote and support S&T engagement with other countries and to draw on the nation's broad range of S&T assets for achieving U.S. diplomatic objectives.

A Rapidly Changing World

*****Recommendation 2-1**

The Secretary should continue to provide both leadership and guidance on S&T-related policies and programs for addressing priority global issues and advancing U.S. bilateral and multilateral interests.

*****Recommendation 2-2**

The department should carry out S&T-oriented foresight assessments. The Policy Planning Staff should have responsibility for this foresight

effort with leadership provided by the S&T Adviser to the Secretary who would be double-hatted as a member of the Policy Planning Staff for such assessments. The Bureau of Intelligence and Research, the Bureau of Energy Resources, OES, and other interested bureaus should actively participate in such assessments.

*****Recommendation 2-3**

The Secretary should establish a Science and Technology Advisory Board (STAB) of independent S&T experts of noted accomplishments and deep expertise to provide insights on S&T-laden non-defense issues that are or should be related to the department's foreign policy agenda.

*****Recommendation 2-4**

While the most important factor in supporting S&T engagement should continue to be the advancement of science, engineering, and health capabilities in the United States and partner countries, the department, along with USAID, should give greater weight in determining allocation of funds for S&T engagement to the secondary impacts in the development and strengthening of civil society and good governance in partner countries.

Recommendation 2-5

STAS, in continuing consultations with participants in various international S&T networks, should give priority to seeking opportunities for leveraging the outreach capabilities of existing and proposed global and regional networks in addressing S&T issues of interest to the department.

A Whole-of-Society Approach in Using Science and Technology into 21st Century Diplomacy

Recommendation 3-1

U.S. embassies should consult with American scientists, engineers, and health specialists residing in their countries, when appropriate, regarding research, development, and other programs that are relevant to ongoing or proposed engagement activities of interest to the embassies. Also, such in-country specialists are important in identifying opportunities for initiating new programs of mutual interest. At the same time, the embassies should also be alert to possible contributions from other in-country specialists who are not affiliated with U.S. government activities.

Recommendation 3-2

The department, in cooperation with the Department of Commerce, the Office of the Trade Representative, and U.S. industry, should continue to encourage governments of trade partners to adopt comprehensive approaches to development and use of technologies, including protection of their own and foreign intellectual property.

Recommendation 3-3

The department should encourage USAID to initiate external reviews of its S&T programs every 3 to 5 years given the many overlapping goals of USAID and the department that often involve nongovernment entities. The 2006 report prepared by the National Academies titled “The Fundamental Role of Science and Technology in International Development: An Imperative for the Agency for International Development” provides a good starting point for the next review.

Recommendation 3-4

The leadership of the department, in concert with senior Department of Defense officials, should continue to give emphasis to the importance of collaboration between the two departments at many levels. Opportunities for joint planning, program development activities, and readiness for future contingencies should receive particular attention, perhaps in preparation of the Quadrennial Defense Review and the Quadrennial Diplomacy and Development Review.

Recommendation 3-5

The department should ensure that U.S. delegations to meetings of international organizations include essential experts from other government departments and agencies. Other agencies that have important expertise and interest concerning the topic of a meeting usually cover the travel costs of their specialists. However, when priorities of the department and other agencies do not align, the delegations may be lacking technical expertise for addressing specific agenda items.

Recommendation 3-6

The S&T Adviser to the Secretary, in consultation with the White House Office of Science and Technology Policy, should stay abreast of the activities of S&T-oriented committees and panels established by components of the Executive Office of the President and should help ensure that the department is appropriately represented when current and future international dimensions of research and development activities are discussed.

*****Recommendation 3-7**

The QDDR and other broad-ranging policy documents should underscore the importance of the department adopting a whole-of-society approach to diplomacy, which includes the capabilities and contributions of not only many government agencies but also nongovernmental entities that are deeply vested in S&T.

Recommendation 3-8

OES, STAS, the Bureau of Educational and Cultural Affairs, and other interested bureaus should jointly organize annual conferences for representatives of interested universities, professional societies, foundations, nongovernmental organizations, companies, and other private sector organizations to meet with relevant department officials in assessing past and future opportunities for partnerships and other arrangements that will enhance mutual interests in the development and carrying out of international non-defense S&T-oriented programs. The meetings should be primarily for information exchange, and they should not be construed as policy formulation meetings.

Support of Science and Technology Policies, Programs, and Outreach by U.S. Embassies*****Recommendation 4-1**

The department should maintain S&T Counselors (currently called Science Counselors) at embassies where S&T issues are particularly important components of the bilateral relationship. Only highly-qualified individuals should be placed in these S&T Counselor positions. In most cases these will be outstanding Foreign Service Officers with extensive experience in S&T-related issues and other qualifications such as language fluency, regional expertise, and excellent diplomatic acumen. Some S&T Counselors might be drawn from the department's cadre of Civil Servants, or exceptionally qualified outsiders. The department should also (a) ensure that S&T Counselors and other officers responsible for S&T activities at all embassies receive adequate training and preparation before assuming their duties, and (b) provide support for important efforts to initiate scientific collaboration by ensuring ready access by the embassies to available financial resources that could initiate or strengthen collaboration.

Recommendation 4-2

To stimulate S&T awareness throughout the embassies, the department should establish a prestigious annual award for leadership by an embassy official who has made the most outstanding contribution during the year

in enhancing science, technology, and innovation-related impacts in areas of priority interest to the department.

Recommendation 4-3

The department should continue to encourage short-term assignments of government specialists from other agencies to serve at embassies that request the support of specialists from other agencies. However, the department, in consultation with the requesting embassies and the interested agencies, should give greater attention to the lengths of assignments that are appropriate.

Recommendation 4-4

The number of Science Envoys (renamed S&T Envoys) should continue to increase.

Recommendation 4-5

The department should establish a program that supports short-term visits to interested countries by American scientists and engineers in their early careers who have already received national recognition for their innovative S&T achievements (the Early-Career Innovators).

******Recommendation 4-6***

The department, while continuing to expand the use of new dialog mechanisms to reach large foreign audiences on U.S. values, interests, and policies (Facebook, Twitter, YouTube, and other emerging mechanisms), should increase efforts to better understand the composition, reactions, and influence of the audiences.

Recommendation 4-7

OES, together with the regional bureaus, should assess whether the regional Hubs should remain in place as an important component of the department's overseas presence or whether other approaches would be more cost-effective in addressing regional S&T issues in the years ahead.

Enhancing Organizational and Personnel Capabilities

******Recommendation 5-1***

The department should provide the S&T Adviser with organizational status equivalent to that of an Assistant Secretary.

Recommendation 5-2

STAS should have (a) an increase in staff positions, and (b) access to support funds.

********Recommendation 5-3*

The department should continue its efforts to increase its staff so that time available for training and professional development of both Foreign Service and Civil Service officers can increase from the current level of 5 to 7 percent of total available time (the float), with the goal of reaching as soon as possible 15 percent.

Recommendation 5-4

The department should (a) evaluate the adequacy of the number of AAAS fellows in its workforce and increase the number if warranted, while broadening their opportunities for career appointments; (b) encourage Presidential Management Fellows with Science, Technology, Engineering, and Mathematics (STEM) backgrounds, interests in foreign affairs, and hiring preferences in competitions for civil service positions to seek permanent employment opportunities at the department; and (c) create new pathways for Jefferson Fellows to continue to respond to the department's needs for their S&T skills after they complete their commitments of permanent assignments in Washington of one academic year.

Recommendation 5-5

The department should formally request a change in the Office of Personnel Management's Civil Service Qualification Standards throughout the Foreign Affairs series that will recognize that STEM degrees are appropriate in satisfying education requirement for positions in this series.

Recommendation 5-6

Beginning with the recruitment of new FSOs and Civil Servants, the department should take advantage of the many opportunities to help them appreciate the integral role of S&T in the development and implementation of foreign policy and international programs of growing importance.

Recommendation 5-7

The Foreign Service Institute should continue its expansion of educational and training offerings through online courses—including both courses in preparation for specific assignments and broader

overview offerings for more general educational and professional advancement.

In closing, all the bits and pieces of more effective S&T underpinnings of diplomacy and of greater recognition of the value of facilitating S&T engagement between U.S. and foreign institutions should be in place if the recommendations in this report are adopted. Enhancing the S&T capabilities of the department will require some, but not many resources. The return on a modest investment will be substantial. However, greater cohesion of the organizational and policy frameworks of the department will be needed to ensure that appropriate personnel recruitment, resource allocation, and foreign policy and program adjustments take place. Important steps have been taken in this regard, and more steps based on this report may soon be on the table. But only through collaborative efforts between the department and other key elements of the U.S. S&T enterprise will the full S&T potential of the nation be reflected in foreign affairs.

In about 5 years, another independent assessment of the role of S&T in foreign affairs should be undertaken as to the progress in moving toward greater security and prosperity through pathfinding efforts based on S&T. Because international organizations are giving increased attention to documenting the role of S&T in global development and international affairs, by the time of the next report there should be a stronger basis of well-organized data on which to assess department S&T policies. In carrying out the next assessment, special attention should be given to whether the S&T Adviser has been empowered to play a more important role in providing authoritative and timely S&T counsel for the leaders of the department. Also, the diffusion of S&T literacy throughout the department, including the embassies, should be a primary concern of the assessment. Progress in both of the areas will be a good indicator as to the extent that personal S&T literacy has joined language fluency and area expertise as cornerstones of the diplomatic culture for the 21st century.

Appendixes

APPENDIX A

REQUEST FOR STUDY FROM THE DEPARTMENT OF STATE



United States Department of State
*Under Secretary for Economic Growth,
Energy, and the Environment*
Washington, D.C. 20520-7512
September 5, 2012

Ralph

Dear Dr. Cicerone:

Since the publication of National Research Council 1999 report titled *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*, our agency has made significant strides in strengthening science and technology (S&T) capabilities within the Department that have in turn expanded our international scientific cooperation efforts. Among our achievements are public recognition by our leadership of the importance of S&T in achieving foreign policy objectives, the appointment of a Science and Technology Adviser to the Secretary, and the expansion of AAAS and Jefferson Fellows programs.

As a result of the Quadrennial Diplomacy and Development Review, the Department has reorganized its S&T assets placing the Bureau of Oceans and International Environmental and Scientific Affairs and the Office of the Science and Technology Advisor under Economic Growth, Energy, and the Environment which I oversee as Under Secretary. This conscious effort to frame these issues within our economic statecraft priorities highlights how they have evolved to become an integral part of our smart diplomacy toolkit and are recognized as instrumental for achieving our economic, security and political goals.

I believe the Department would benefit from a new unbiased assessment by the National Academy of Sciences of the changed environment for the role of science and technology in diplomacy over the past decade. Some areas where your input could help the Department would be recommendations on incentives for officers, especially in the foreign service, to follow career tracks that include international science engagement; how to reap the most benefit from scientific exchange programs; how to best incorporate S&T principles into our work fostering democracy and economic advancement; and how the Department can leverage the science community to help strengthen relations between countries and to increase the role of S&T in policy decisions of foreign governments.

-2-

Recommendations that take a broad look at diplomacy efforts of both governmental and non-governmental organizations, taking into account the importance we now place on partnerships to help us achieve our goals, would be of particular benefit. We envision a product that would be useful for the next Secretary of State and other officials in the Department as well as leaders of foreign affairs agencies across the United States government and leaders of foreign governments looking to us for guidance on how to incorporate science into their foreign policy endeavors.

I hope you will consider our request positively. My staff and I are available to discuss this idea further. We look forward to hearing from you.

Sincerely,



Robert D. Hormats

Ralph J. Cicerone,
President, National Academy of Sciences,
The National Academies,
500 Fifth Street, NW,
Washington, DC 20001.

APPENDIX B

BIOGRAPHIES OF COMMITTEE MEMBERS

THOMAS PICKERING (Co-Chair), *Vice Chairman, Hills and Company*

Thomas Pickering, currently Vice Chairman at Hills and Company which provides advice and counsel to a number of major U.S. enterprises, retired as Senior Vice President for International Relations and a member of the Executive Council of The Boeing Company in 2006. Pickering joined Boeing in 2001, upon his retirement as U.S. Undersecretary of State for Political Affairs. Pickering holds the personal rank of Career Ambassador. In a diplomatic career spanning five decades, he was U.S. ambassador to the Russian Federation, India, Israel, El Salvador, Nigeria, and the Hashemite Kingdom of Jordan. Pickering also served on assignments in Zanzibar and Dar es Salaam. From 1989 to 1992, he was Ambassador and Representative to the United Nations in New York. He also served as Executive Secretary of the Department of State and Special Assistant to Secretaries William Rogers and Henry Kissinger from 1973 to 1974. In 1983 and in 1986, Pickering won the Distinguished Presidential Award and, in 1996, the Department of State's highest award – the Distinguished Service Award. He is a member of the International Institute of Strategic Studies and the Council on Foreign Relations. He speaks French, Spanish, and Swahili and has some fluency in Arabic, Hebrew, and Russian.

ADEL MAHMOUD (Co-Chair), *Professor at the Woodrow Wilson School of Public and International Affairs and the Department of Molecular Biology at Princeton University*

Adel Mahmoud retired as President of Merck Vaccines and member of the Management Committee of Merck & Company, Inc. His prior academic service at Case Western Reserve University and University Hospitals of Cleveland spanned 25 years, concluding with the positions of Chairman of Medicine and Physician-in-Chief from 1987 to 1998. Dr. Mahmoud's academic pursuits have focused on investigations of the biology and function of eosinophils, particularly in host resistance to helminthic infections as well as determinants of infection and disease in human schistosomiasis and other infectious agents. At Merck, Dr. Mahmoud led the effort to develop four new vaccines which were launched in 2005-2006. Subsequently, Dr. Mahmoud's leadership in setting strategies for Global Health shaped the agenda of the Forum on Microbial Threats of the Institute of Medicine. He has authored and edited several textbooks.

CATHERINE BERTINI, *Professor of Public Administration and International Affairs, Maxwell School of Citizenship and Public Affairs, Syracuse University*

Catherine Bertini teaches international relations and leadership courses to graduate students at the Maxwell School. She is also a senior fellow at the Chicago Council on Global Affairs where she has co-chaired its agriculture policy initiatives. She has worked extensively on issues related to agricultural development, food security, and gender. For two years, she was a senior fellow at the Bill and Melinda Gates Foundation. Also, she served as United Nations Under Secretary General for Management (2003-05) and as Executive Director of the UN World Food Program (1992-2002), where she was responsible for major organizational reform. She was Assistant Secretary for Food and Consumer Services at the U.S. Department of Agriculture (1989-92). Ms. Bertini is the 2003 World Food Prize Laureate. In 2012, she served as a member of the Department of State's Accountability Review Board on Benghazi.

KENNETH BRILL, *Board Member at the Stimson Center*

Kenneth Brill completed a 35-year diplomatic career in 2010. In his final Foreign Service assignment, he was the founding Director of the U.S. National Counterproliferation Center (NCPC), which is part of the Office of the Director of National Intelligence. Ambassador Brill served as NCPC's Director for almost five years for three different Directors of National Intelligence. His overseas assignments included Ambassador to the International Atomic Energy Agency and the UN Office in Vienna, Ambassador to the Republic of Cyprus, Acting-Ambassador and Deputy Chief of Mission at the U.S. Embassy in New Delhi, and Political Counselor at the U.S. Embassy in Amman. His assignments in Washington included Acting-Assistant Secretary for the Bureau of Oceans and International Environmental and Scientific Affairs, Executive Secretary of the Department and Special Assistant to the Secretary of State, Chief of Staff to the Under Secretary for Political Affairs, and Director of the Office of Egyptian Affairs. In addition, he spent a year as Deputy Commandant/International Affairs Advisor and Lecturer at the Industrial College of the Armed Forces. Finally, Ambassador Brill was the President of the Fund for Peace, a Washington, D.C.-based, internationally focused non-profit organization during 2010 and 2011.

THADDEUS BURNS, *Senior Counsel for Intellectual Property and Trade, General Electric Company*

As Senior Counsel for Intellectual Property and Trade, Thaddeus Burns leads a team of professionals supporting GE businesses and Global Research. Before joining GE, he worked in the appellate litigation practice at Jones Day in Washington and in Brussels on Intellectual Property and technology policy issues at Akin Gump. He also served at the U.S. Patent and the Trademark Office and Office of the U.S. Trade Representative. He clerked for now retired

Chief Judge Karen Williams on the U.S. Court of Appeals for the Fourth Circuit. He graduated from Catholic University School of Law in 1992.

MICHAEL CLEGG, *Professor Emeritus, University of California, Irvine*

Michael Clegg served on the faculty of four universities during a 42 year career and was most recently Donald Bren Professor of Biological Sciences at the University of California, Irvine. Clegg also served for 12 years as Foreign Secretary of the U.S. National Academy of Sciences and is currently Vice President (External) of the International Council of Science and Co-Chair of the Inter-American Network of Academies of Science. Clegg's research specialty is population genetics and molecular evolution, and he has published extensively in these fields. Clegg is a Member of the U.S. National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society. He is a Fellow of the Global Academy of Sciences and a Corresponding Member of several academies in Latin America and Africa.

GLEN DAIGGER, *President, One Water Solutions, LLC*

Glen Daigger is currently President of One Water Solutions, a professional services firm providing strategic consulting to a wide range of clients in the water sector. Prior to founding One Water Solutions, he was a Senior Vice President and Chief Technology Officer for CH2M HILL, an international firm providing services in a wide range of infrastructure areas. Throughout his 35-year tenure, CH2M HILL became the largest and one of the most highly regarded professional services firms working in the water sector, developing and delivering innovative water solutions through the full range of delivery mechanisms, including conventional design-bid-build, design-build, and design-build-operate approaches. Recognized as a technical expert and innovator in his own right, he has also led the development and implementation of many innovative solutions and advanced water practices. With strong ties to academia, between 1994 and 1996 he served as professor and head of the Environmental Systems Engineering Department at Clemson University. He is the author of numerous reports, articles, and conference presentations on wastewater treatment and sustainable wastewater infrastructure. Among the numerous topics he has addressed are bioreactors, nutrient removal, water quality, optimization, chemically-enhanced treatment, and activated sludge.

KENT HUGHES, *Public Policy Scholar, The Woodrow Wilson Center*

Kent Hughes is currently a Public Policy Scholar at the Woodrow Wilson International Center for Scholars, where he also founded and directed the Program on America and the Global Economy. Prior to joining the Center, he was Associate Deputy Secretary of Commerce where he supported Secretaries Ron Brown, Mickey Kantor, and William Daley. Before entering the Administration, he was the President of the private sector Council on

Competitiveness. Earlier he held a number of senior positions on Capitol Hill, including Chief Economist for Majority Leader Robert Byrd, Policy Director for Senator Gary Hart, and Senior Economist on the Joint Economic Committee. He has published two books, *Trade, Taxes, and Transnationals: International Economic Decision Making in Congress* and *Building the Next American Century: The Past and Future of American Economic Competitiveness* and a large number of reports and articles dealing with innovation and foreign economic policy. For several years he has taught political science as an adjunct professor for the Washington Semester Program of Boston University. He first worked in Washington as a staff attorney with the Urban Law Institute. He was also an International Legal Center Fellow and a Latin American Teaching Fellow in Brazil where he did research on the Brazilian economy and worked on a reform of Brazilian legal education at the Faculty of Law of the University of Sao Paulo. Dr. Hughes holds a Ph.D. in economics from Washington University in St. Louis, an LL.B from Harvard Law School, and a B.A. from Yale University in Political and Economic Institutions.

CINDY JEBB, *Professor, U.S. Military Academy*

Colonel Cindy Jebb is Professor and Head of the Department of Social Sciences at the U.S. Military Academy. She teaches courses on Comparative Politics, International Security, Cultural Anthropology, Terrorism and Counterterrorism, and Officership. Colonel Jebb has served in numerous command and staff positions in the United States and overseas, including tours with the 1st Armored Division, III Corps, and the National Security Agency (NSA). Before reporting to the U.S. Military Academy, she served as the Deputy Commander of the 704th Military Intelligence Brigade, which supported NSA. During 2000-2001, she served as a Fellow at the Naval War College (2000-2001), where she taught a graduate-level course on Strategy and Force Planning, and during 2006-2007, she served as a Visiting Fellow for the Pell Center. Her research focus has been in the area of human security, conducting field research in Chad, Niger, and Djibouti and working on projects in Iraq and Afghanistan. She has authored/co-authored three books on international affairs. A member of the Council on Foreign Relations, Colonel Jebb received a Ph.D. in Political Science from Duke University in 1997.

MICHAEL JONES, *Chief Technology Advocate, Google, Inc.*

Michael Jones is Google's chief technology advocate, charged with advancing the technology to organize the world's information and make it universally accessible and useful. He travels the globe to meet and speak with governments, businesses, partners, and customers in order to advance Google's mission and technology. He was previously chief technologist of Google Maps, Earth, and Local Search - the team responsible for providing location intelligence and information in a global context to users worldwide. He was Chief Technology Officer of Keyhole Corporation, the company that developed

the technology used today in Google Earth. He was also CEO of Intrinsic Graphics, and earlier, the director of advanced graphics at Silicon Graphics. A prolific inventor and computer programmer since the 4th grade, he has developed scientific and interactive computer graphics software, held engineering and business executive roles, and is an avid reader, traveler, and amateur photographer using a home-built 4 gigapixel camera.

ROBERT PERITO, *Executive Director, The Perito Group*

Robert Perito is a consultant at the U.S. Institute of Peace and the former director of USIP's Security Sector Governance Center of Innovation. He is an expert on security sector transformation and police reform in post-conflict societies and countries impacted by the Arab Spring. Before joining the institute, he was a career Foreign Service Officer with the Department of State, retiring with the rank of minister-counselor. He was Deputy Executive Secretary of the National Security Council. Perito received a Presidential Meritorious Service Award in 1990 for leading the U.S. delegation in the Angola peace talks and two State Department superior honor awards. He led the International Criminal Investigative Training Assistance Program at the U.S. Department of Justice, which trained police in international peace operations. He was a Peace Corps volunteer in Nigeria. He was a Visiting Lecturer in Public and International Affairs at the Woodrow Wilson School at Princeton University, Diplomat in Residence at American University and an adjunct professor at George Mason University. He is the author of *Where is the Lone Ranger? America's Search for a Stability Force*; and *The American Experience with Police in Peace Operations*; co-author of *Police in War: Fighting Insurgency, Terrorism and Violent Crime*; editor of *A Guide for Participants in Peace, Stability, and Relief Operations*; and author of 20 USIP Special Reports, plus book chapters and journal articles on Iraq, Afghanistan, and Haiti.

BRENDA PIERCE, *Program Coordinator for the Energy Resources Program, U.S. Geological Survey*

Brenda Pierce's primary area of expertise is energy resources with an emphasis on coal geology and quality, oil and gas resource occurrence and assessment, gas hydrate research, and geothermal energy. Her career spans 20 years with the Department of the Interior. She has led research teams studying various energy resources, from their formation to potential environmental impacts of their occurrence and use, both domestically and globally. In recent years, she has focused intensively on unconventional energy resources such as shale oil and shale gas. She manages the program within the Department of Interior responsible for providing the scientific basis on the availability and quantity of worldwide energy resources. She represents the Department on a variety of interagency committees concerning energy and climate change issues at home and abroad, and she assigns staff members to work at U.S. embassies abroad in response to requests from the Department of State. Pierce received

both bachelor and master degrees in geology and sedimentology from George Washington University.

STEN VERMUND, *Amos Christie Chair and Director, Vanderbilt University Institute for Global Health*

StenVermund is an infectious disease epidemiologist and a pediatrician with clinical and research experience in child, adolescent, and women's health. At Vanderbilt University, he serves as Professor of Pediatrics, Amos Christie Chair in Global Health, and Director of the Vanderbilt Institute for Global Health. He directs several training and research grants from NIH and CDC, including projects under the President's Emergency Plan for AIDS Relief. He served as the Principal Investigator for the HIV Prevention Trials Network from 2006-2102. For his service to the NIH/NIAID from 1988-1994, he was awarded the Public Health Service Superior Service Award in 1994, the highest civilian award in the U.S. Public Health Service.

In 2000, he co-founded the Centre for Infectious Disease Research in Zambia, an independent research organization working closely with the Zambian Ministry of Health, PEPFAR, and international academic partners. In 2006, he established Friends in Global Health, LLC, Vanderbilt's non-governmental organization in Africa to spearhead rural HIV/TB care, treatment, and prevention programs in Mozambique's Zambézia Province and in Nigeria's Kwara and Niger States. Dr. Vermund has published over 450 articles and chapters in the field of women, adolescent, and child health, infectious disease control and prevention, and in infectious disease and cancer epidemiology. He is an active member of the Institute of Medicine.

DAVID VICTOR, *Professor and Director, Laboratory on International Law and Regulation, University of California at San Diego (UCSD)*

David Victor is a professor at the School of International Relations and Pacific Studies and director of the School's new Laboratory on International Law and Regulation. His research focuses on how the design of regulatory law affects issues such as environmental pollution and the operation of major energy markets. He is author of *Global Warming Gridlock*, which explains why the world hasn't made much diplomatic progress on the problem of climate change while also exploring new strategies that would be more effective. Prior to joining the faculty at UCSD, he served as director of the Program on Energy and Sustainable Development at Stanford University where he was also a professor at the Stanford Law School. There he built a research program that focused on the energy markets of the major emerging countries—mainly Brazil, China, India, Mexico, and South Africa. Earlier in his career, he directed the science and technology program at the Council on Foreign Relations in New York, where he led the Council's task force on energy and was senior adviser to the task force on climate change. At Stanford and the Council he examined ways to improve management of the nation's \$50 billion strategic oil reserve, strategies

for advancing research and regulation of technologies needed for "geoengineering," and a wide array of other topics related to technological innovation and the impact of innovation on economic growth.

APPENDIX C

INTERIM RECOMMENDATIONS OF THE COMMITTEE (APRIL 2014)

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

Policy and Global Affairs Division
Committee on Science and Technology
Capabilities of the Department of State

500 Fifth Street, NW
Washington, DC 20001
Phone: 202 334 2425
Fax: 202 334 3694

April 30, 2014

The Honorable John Forbes Kerry
Secretary of State
Department of State
Washington, DC 20520

Dear Mr. Secretary:

We are pleased to submit this brief interim report of the National Research Council committee that, in response to a request from former Under Secretary Robert Hormats, is undertaking an assessment of the capabilities of the Department of State that are particularly important as science and technology become integral aspects of diplomacy. Based on our initial interviews and review of documents, we can report that during the past decade, the Department has significantly expanded its science and technology capabilities in Washington, but done less well at U.S. diplomatic missions abroad. We will continue our discussions with leaders and specialists within the Department and with others in the science and technology communities as we prepare a more expansive report for release in fall 2014.

We commend your leadership in elevating the importance of addressing climate change across all relevant Department activities, holding a broad international conference on the state of the oceans, and continuing strong support for the PEPFAR program. Building on your initiatives, we intend to provide suggestions in our final report to support the Department's science and technology agenda in these and other areas.

Technological progress, especially in information and communications technology, has driven much of the world's dramatic political, economic, and social change in recent years. New discoveries in nanotechnology, synthetic biology, and other fields have unveiled a multiplicity of opportunities for improving human health, protecting the environment, and ensuring adequate food supplies while strengthening our nation's economic competitiveness. But new technologies also have the potential to increase threats to national security, disrupt international communications, and exhaust our natural resources. Achieving U.S. foreign policy goals in the coming decades will require novel strategies that leverage the impact of science and technology on significant global issues in creative ways.

Nearly every country is focused on innovation as a driver of its economic future and its national security. Advanced and emerging market economies are building their own innovative capacities, often looking at successes in the U.S. system, while also developing new approaches of their own. Most countries are interested in working with U.S. universities, companies, investors, and governmental and non-governmental organizations to increase their capabilities.

Our collaboration with foreign science and technology counterparts should also deliver many economic and political benefits for the United States, and the Department and our embassies can often facilitate such efforts.

At the same time, the global innovation landscape itself is undergoing fundamental change. The development-related activities of private sector firms, often operating on a global scale, complement efforts of government research and development organizations in a number of sectors with investment in energy, information systems, and advanced manufacturing. Large research-oriented companies and innovative high-tech startups are not only designing and commercializing inventions, but they also are working with government and academic partners in driving the search for new discoveries. In some sectors, private firms and entrepreneurs are much more important players than governments in setting the pace and direction of technological change. This evolving reality calls for our diplomats to forge new partnerships with the private sector and other non-governmental organizations, while also taking advantage of the expertise of the many departments and agencies of the U.S. government.

Such an expanded perspective – global as well as national, private and academic as well as public sector – accords well with the four pillars of the foreign policy strategy set forth in the *FY2014-2017 Department of State and USAID Joint Strategic Plan* to enhance and protect the interests of American citizens, namely: promoting peace and stability, creating jobs at home by opening markets abroad, helping growth in the developing countries, and building partnerships to address global challenges.

To achieve these goals, insights into science, technology, and innovation systems need to be further woven into the fabric of the department, including the workings of the functional and geographic bureaus and the outreach of our embassies. The Department's work can benefit in many ways from creative approaches to strategic planning, to economic and environmental statecraft, to public diplomacy, and beyond. Enhancing and embedding science literacy throughout the department will strengthen its innovation capacity, and this capacity has never before been so important.

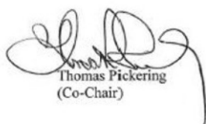
The committee is considering how the Department can draw more broadly on our nation's unmatched technical assets to further our foreign policy agenda. We are discussing activities in the four areas set forth below along with a few examples of approaches that might be considered. We would appreciate comments on these preliminary topics and ideas.

- Capabilities of the Department's Work Force: Broadening the opportunities for hiring AAAS Science and Technology Fellows serving in the Department who compete for civil service positions in regional and functional bureaus. Increasing the availability of electronic education for Foreign Service Officers and Foreign Service Nationals who are interested in improving their science literacy.
- Organizational Adjustments: Establishment of a Science and Technology Advisory Committee to the Secretary comprised of American experts in rapidly advancing fields. Increased involvement of the Science and Technology Adviser to the Secretary in the development of policies and diplomatic approaches with significant science and technology content.

- Embassy Capabilities and Interests: Improved preparation of Foreign Service Officers who assume environmental, science, technology, and health responsibilities at important embassies, including an enhanced short course directed to current and future science and technology challenges and expanded consultations with U.S. science and technology agencies. Encouragement of U.S. ambassadors to draw broadly on U.S. governmental and nongovernmental in-country resources in addressing foreign policy issues with important science and technology dimensions.
- Interagency Coordination and Partnerships with Other Organizations: More strategic use of the bilateral science and technology agreements as platforms for initiating and scaling up successful activities of U.S. government agencies and their partners.

We greatly appreciate the strong support that we have received from bureaus and offices throughout the Department during this effort. We would welcome their views on the preliminary ideas described in this letter and any other approaches the committee might explore.

Sincerely,



Thomas Pickering
(Co-Chair)



Adel Mahmoud
(Co-Chair)

Enclosure

cc. Under Secretary Catherine A. Novelli

APPENDIX D

THE QUADRENNIAL DIPLOMACY AND DEVELOPMENT REVIEW, 2011

This appendix contains brief examples of key references and actions for science, technology, and innovation.¹ Page numbers are referenced and text is verbatim, except where noted, with **bold** emphasis added. See the whole Quadrennial Diplomacy and Development Review (QDDR) at: <http://www.state.gov/s/dmr/qddr/>.

Secretary Clinton's Preface

In development, we are re-establishing USAID as the world's premier development agency. To make sure that our investments have the biggest possible impact, we will focus our efforts in six core areas where we have expertise. We're investing heavily in innovation to spark more advances in those areas. We're improving the way we measure results, and we will make funding decisions based on those results.

p. 16

A final critical trend reshaping the global context of U.S. foreign policy is a broad set of technological innovations that have increased the pace of international affairs and facilitated a new era of human connectivity. **Science, engineering, technology, and innovation are the engines of modern society and a dominant force in globalization and international economic development.** Despite fierce competition and rapidly increasing parity in science, technology, and engineering assets among nations, the United States remains predominant in most fields and is a world leader in education, research, and innovation.

Modern innovations themselves result in significant changes to the way foreign policy must be conducted and have changed aspects of diplomatic relationships. Innovations also both exacerbate other challenges and create potential new opportunities to resolve them. Today, information flows across the globe at rates and magnitudes never before imaginable. As a result, people

¹ Derived from longer document prepared by STAS in 2013.

everywhere know about events around the world within minutes, if not seconds. An economic or political development on one continent can immediately cause ripples across the world—be it an economic disruption, an act of violence, or a call for peace. Our responses must be in real time, with a premium on speed and flexibility.

pp. 101-103

Accelerate development with science and technology. Secretary Clinton, (USAID) Administrator Shah and the President’s Science Advisor, Dr. John Holdren, have set in motion an effort to collaborate with many of the world’s leading scientists and development thinkers, along with leaders of key federal science agencies, so that the world’s poor can benefit from advances in science and technology.

At State, the Office of the Science and Technology Advisor will continue to promote global scientific and technological progress and cooperation as integral components of U.S. diplomacy. The Office provides scientific and technological advice to the Department of State; enhances science and technology literacy and capacity within State; and shapes a global perspective on emerging and envisioned scientific and technological developments.

The Secretary of State’s newly created Office of Innovation will continue to expand its already decisive mark on development. Within its first 18 months, the Secretary’s Innovation Office dispatched “tech delegations”—small teams of technology executives, entrepreneurs, NGO leaders, and U.S. diplomats—to several countries, including Colombia and Iraq, helping these states transition to a brighter future, as well as to Russia, in support of its efforts to modernize its economy. These delegations have engineered mobile programs to better detect and report landmines in former-FARC strongholds throughout Colombia. In Iraq, they have piloted a program placing young Iraqi engineers into American technology start-ups for up to six months, teaching them the skills necessary to establish successful technology businesses back home. And in Russia, they have established a prize for Russian software developers and engineers to create new technologies to prevent trafficking in women and children.

At USAID, Administrator Shah has put forward a plan to ensure that USAID is a global leader in employing science, technology, and research to solve traditional development challenges. He has appointed a Science and Technology Advisor and established an Office of Science and Technology. He has also actively enlisted innovators from around the world in an effort to highlight game-changing innovations such as dirt-powered fuel cells that can light remote villages, irrigation pipes that can filter and desalinate water, and cheap, practical medical devices that can save lives. Going forward, we will use science and technology to address development challenges through:

- *Grand Challenges and Prizes for Development* that will challenge scientists to develop game-changing solutions to specific development problems, such as simple, cost-effective ways to provide clean water or inexpensive but durable computers.
- *High Risk, High Reward Research Funds* that will support U.S.-based research and support our overseas missions in applying new appropriate technologies and scientific solutions for the developing world.
- *“Apps” for Development* that will invest in promising new technological platforms, including cellular networks and devices, to create mobile applications to support development.
- *Leveraging the significant assets of the full federal science community* to find solutions for the next generation of shared development challenges. USAID will partner with the larger federal science community, facilitating connections between and among developing countries and this research community.

Additional Excerpts

p. 22

We will embrace new partnerships that link the on-the-ground experience of our diplomats and development experts with the energy and resources of civil society and the **scientific and business communities**.

Part of our approach is to **embrace new tools and technology and foster the freedom to connect**. The revolution in connection technologies—including the Internet, SMS, social media, and increasingly ubiquitous and sophisticated mobile applications—give us new tools for engagement and development and open new horizons for what diplomacy can mean. These technologies are the platform for the communications, collaboration, and commerce of the 21st century. They are connecting people to people, to knowledge, and to global networks.

p. 24

The accelerating pace of change and exponential increase in connectivity that mark today’s international system will produce unintended or perhaps even unexpected consequences. In an interconnected world, cascading changes can and will amplify the significance of a small initial event.... **To adapt to these trends, science and technology must be enlisted in an unprecedented fashion**—as part of both our bilateral and multilateral diplomacy.

p. 62

Investing more in science and technology activities. Strengthening the ability of our people to collaborate with others on science and technology is a crucial part of U.S. public diplomacy.

p. 100-101

The National Security Strategy and Presidential Policy Directive on Global Development recognize the power of innovation and modern technology to transform lives around the world and our development policy. **Innovation is a key engine of long-term economic growth. History shows how science and engineering open the door to revolutions in development...** Specifically, we will:

- **Promote new discoveries and scientific breakthroughs. Innovation, in all its forms, must be a centerpiece of the U.S. approach to development. We will promote new discoveries and scientific breakthroughs as well as both evolutionary and revolutionary changes in our programming and business practices.**

APPENDIX E

ISSUES THAT DESERVE ADDITIONAL ANALYSES BY OTHERS

S&T Activities of USAID

During the Obama administration, integration of the strategies and policies of the department and USAID reached new heights with common S&T interests often being highlighted. Recently, USAID decided to augment its long-term reliance on S&T for supporting many development priorities with a number of new S&T initiatives, including, for example, (a) establishment of a new Development Lab that is to emphasize opportunities for technological innovation in 20 countries, (b) joining with several U.S. departments and agencies in supporting activities of scientists in developing countries who are interested in working as partners of American recipients of grants from these agencies, and (c) supporting a number of grand-challenge contests whereby awards are given to innovators with particularly creative technical approaches to long-standing problems that inhibit development.

Taking into account these new initiatives as well as USAID's long-time historical reliance on S&T embedded in many of its programs, the committee responsible for this NRC report decided to focus on some of the overarching strategy and policy concerns that are common to both USAID and the Department of State. Also, the committee addressed the significance to the American embassies in USAID-countries to be able to draw on the outreach capabilities of USAID missions in carrying out the department's diplomatic responsibilities. Finally, the committee recognized the importance of coordination of activities of common interest between the department and USAID in the launch of new programs of broad interest.

However, with regard to USAID's many long-standing program activities, the committee recommends that a separate assessment be undertaken of the agency's recent achievements and its plans for the future involving S&T. The National Research Council carried out such an assessment and published the results in 2004 with the title *The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development*. This experience in establishing different committees with different sets of expertise for each of the two previous reports strongly supports the committee's decision to focus on the department in this report while recommending a separate report addressed to development

assistance rather than to attempt to consider the thrusts and details of diplomacy and foreign assistance within the same report.

Development Assistance Activities of Other Agencies

A number of other U.S. government departments and agencies in addition to USAID have development assistance responsibilities that involve reliance on S&T capabilities. For example, the Millennium Challenge Corporation has a multi-billion program to support economic development that is often based on enhanced scientific capabilities of carefully selected countries. The Department of Treasury has responsibility for U.S. contributions to the World Bank and other international development banks that have extensive programs wherein S&T play important roles. The Export-Import Bank and the Overseas Private Investment Corporation are significant contributors to development activities, often based in part on S&T inputs. And in recent years, the Department of Defense, the Department of Health and Human Services, and the Department of Agriculture have obtained expanded responsibilities directly linked to global health, the world's food supply, disaster relief, and other international development priorities that are intertwined with S&T considerations.

While this NRC report emphasizes inter-agency coordination and cooperation in carrying out a wide spectrum of responsibilities, it does not address effective use of S&T assets by the implementing organizations identified above.

Intelligence Activities

As a member of the intelligence community the department, acting primarily through the Bureau of Intelligence and Research (INR), needs strong S&T capabilities to interact with the 14 other departments and agencies that are involved. However, for security reasons, this aspect of the formulation of foreign policy is beyond the scope of this NRC report.

Timely Issuance of Visas

Of considerable interest to the science, engineering, and health communities is the timely issuance of visas by the United States and by other countries. This topic has long been high on the agendas of governments and scientific organizations throughout the world. However, the topic has many dimensions, U.S. policies and policies of other governments change frequently, and often the issues of concern are country-specific. The time and resources required to delve into the details of visa approval and issuance in Washington and other capitals were not available to the committee, which reluctantly must leave to others the development of recommendations to ease visa difficulties in the months and years ahead.

Support of Multilateral Institutions and Agreements

The department is regularly involved in debates and programming of many S&T-related approaches of multilateral and regional organizations. There are simply too many organizations in all regions of the world involved to assess the department's capabilities to effectively address relevant issues in this report.

Internal Concerns of the Department

The security of diplomatic personnel abroad has long been a priority of the department. In recent years, security of personnel and facilities has reached new heights. The committee commends the department's constant search for new technologies to address this issue. However, the committee has not considered the technical, financial, or diplomatic details of this effort to enable the committee to be in a position to offer conclusions or recommendations concerning further steps.

Also, the department has undertaken a broad effort, within constraints on funding that is embedded in administrative budgets, to green the department's facilities in the United States and its embassies overseas. The objective is not only to directly conserve energy and protect the environment (e.g., certification of its buildings as LEED buildings), but also to provide model facilities abroad worthy of emulation by host governments and their populations as they too seek to reduce carbon footprints. The committee has not had the opportunity to examine this very worthy initiative.

APPENDIX F

COMMITTEE MEETING AGENDAS

Meeting Agenda: First Meeting of the Committee

Monday, September 9th, 2013

Closed Session

8:30-10:30 am

Open Session

- 10:45-11:45 am – Global Trends, Mathew Burrows, Atlantic Council and Author of “Global Trends 2030” Issued by National Intelligence Council
- 11:45 am-12:00 pm – Recommendations of Previous Academy Studies concerning Science and Technology Capabilities of Department of State (1999) and USAID (2004), Glenn Schweitzer, Responsible Staff Officer for Previous Studies
- 12:00-12:45 pm – Use of Science and Technology Expertise and Information by the Department of State since the 1999 Study, William Colglazier, Science and Technology Adviser to the Secretary of State
- 1:00-1:30 pm – Views from the Nongovernmental Community, Vaughan Turekian, Chief International Officer, American Association for the Advancement of Science
- 1:45-2:30 pm – The Role of Science and Technology in U.S. Foreign Policy in the Western Hemisphere, Matthew Rooney, Deputy Assistant Secretary for Western Hemisphere Affairs
- 2:30-3:15 pm – Role and Activities of the Office of the Science and Technology Adviser to the Secretary, William Colglazier, Science and Technology Adviser to the Secretary of State
- 3:15-4:00 pm – Informing Decision making, Lee Schwartz, Director of the Office of the Geographer and Global Issues, Bureau of Intelligence and Research
- 4:00-4:45 pm – Activities of the Bureau of Oceans and International Environmental and Scientific Affairs, Assistant Secretary Kerri Ann Jones

Closed Session

4:45-5:30 pm

Tuesday September 10th, 2013

Closed Session

8:30-10:00 am

Open Session

10:15-11:00 am – PEPFAR Program and Other Health Activities, Eric Goosby, Ambassador and Global AIDS Coordinator and Coordinator for the Office for Global Health

11:00-11:45 am – Energy Challenges, Avi Gopstein, Senior Energy Technology Adviser, Bureau of Energy Resources

11:45 am-12:30 pm – Cyber Issues, Christopher Painter, Coordinator for Cyber Issues

1:00-2:00 pm – Priorities of USAID and Collaboration with Department of State, Raj Shah, Administrator of USAID

2:00-3:00 pm – Global Security Challenges, Rose Gottemoeller, Undersecretary for Arms Control and International Security

Closed Session

3:00-5:00 pm

Meeting Agenda: Working Group One of the Committee

Monday, January 6th, 2014

Open Session

1:00 pm – Bruce Alberts, Former President, National Academy of Sciences and Editor-in-Chief of Science magazine.

2:00 pm – Michael Moloney, Director, Space and Aeronautics at Space Studies Board and the Aeronautics and Space Engineering Board, The National Academies

3:00 pm – Edward Dunlea, Senior Program Officer, Board on Atmospheric Science and Climate, The National Academies

4:00 pm – Raymond Arnaudo, Bureau of Oceans and International and Scientific Affairs (Rtd)

Closed Session

5:00-5:30 pm

Tuesday, January 7th, 2014

Open Session

12:00 pm – William Colglazier, Science and Technology Adviser to the Secretary of State

1:30 pm – Panel on Innovation

- William Bonvillian, Director, Massachusetts Institute of Technology Washington Office; Robert Atkinson, President, Information Technology and Innovation Foundation; David Hart, Associate Professor of Public Policy, George Mason University; Patricia Falcone, Associate Director for National Security and International Affairs, Office of Science and Technology Policy

Closed Session

3:00-5:00 pm

Meeting Agenda: Working Group Three of the Committee

Monday, January 13th, 2014

Open Session

10:00-10:30 am – Anthony Rock, former Acting Assistant Secretary OES, and CEO of Association of Science and Technology Centers

10:30-11:00 am – Summary of information and perspectives on the situation at US Embassies

11:00 am-12:00 pm – Potential observations and recommendations (including candidates for an interim report, and a look at recommendations discussed by the co-chairs or other groups)

12:00-12:30pm – Discussion of next steps, further information needed to evaluate potential observations and recommendations, and future meetings/drafting/conference calls of Group 3

2:00 pm – Dr. Pham, French Embassy, S&T offices and functions of foreign embassies in Washington and elsewhere.

Meeting Agenda: Working Group Two of the Committee

Tuesday, February 4th, 2014

Open Session

8:30 am – Brenda Pierce, U.S. Geological Survey, David Downes, Department of Interior, and Robert Marlay, Department of Energy

Closed Session

11:00 am-1:00 pm

Open Session

1:00-3:00 pm – John Nkengasong, Laurence Slutsker, Jonathan Mermin, Donald Shriber, Tom Kenyon, and John Blandford, CDC

Wednesday, February 5th, 2014

Open Session

9:00 am – John Vaughn, Executive Vice President, Association of American Universities

10:00 am – Bruce Lehman Chairman, International Intellectual Property Institute

1:00-3:00 pm – NIH global health senior officials from multiple agencies, assembled by James Herrington and Robert Eiss of the Fogarty International Center

- National Cancer Institute (NCI):
 - Edward Trimble, M.D., M.P.H., Director, Center for Global Health, NCI
- National Institute of Allergy and Infectious Diseases (NIAID):
 - F. Gray Handley, M.S.P.H., Associate Director for International Research Affairs, NIAID
- National Institute of Mental Health (NIMH):
 - Pamela Collins, M.D., Associate Director for Special Populations, NIMH; and, Director of the Offices for Special Populations, Rural Mental Health Research, and Global Mental Health
- Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD):
 - Vesna Kutlesic, Ph.D., Director, Office of Global Health, NICHD
 - Caroline Signore, M.D., M.P.H., Deputy Director, Division of Extramural Research, NICHD
 - Marion-Koso Thomas, M.D., Program Officer, NICHD
 - Office of AIDS Research (OAR)
 - Paolo Miotti, Office of the Director
- Fogarty International Center (FIC):
 - Roger Glass, M.D., Ph.D., Director, FIC; and, NIH Associate Director for International Research
 - Ken Bridbord, M.D., M.P.H., Acting Deputy Director, FIC
 - Robert Eiss, M.A., Senior Public Health Advisor, FIC

- James Herrington, Ph.D., M.P.H., Director, Division of International Relations, FIC
- Myat Htoo Razak, M.B.B.B.S., M.P.H., Ph.D., Program Officer, Division of International Training and Research, FIC
- Thomas Mampilly, M.P.H., Program Officer, Division for International Relations, FIC

Closed Session

3:30-5:00 pm

Meeting Agenda: Working Group Four of the Committee

Thursday, February 6th, 2014

Open Session

9:00 am – The Science Fellows Programs: Frances Colon, Deputy Director, Office of the S&T Adviser to the Secretary

10:30 am – Undersecretary of State for Management, Patrick Kennedy

1:00 pm – Personnel and related issues: Kenneth Brill, Committee member

2:00 pm – Louis Bono, currently at the National Defense University and scheduled to be the Advisor to the Deputy Secretary of State for Management and Resources.

3:30 pm – The Science Envoy Program: Jonathan Margolis, Deputy Director of OES

4:00 pm – Views from USIP: Noel Dickover and Tim Receveur

Friday, February 7th, 2014

Open Session

9:00 am – Marc Ostfield, Deputy Director of FSI and staff-- Melissa Whitlock; Tin Cao; Jeff Fairbanks; Joan Perkins; Mirembe Nantongo; Nick Noyes; and Anne Imamura

12:00 pm – Roland DeMarcellus, Acting Director, Office of Development Finance, and Todd Kushner, Bureau of Economic and Business Affairs

Meeting Agenda: Second Meeting of the Committee

Monday, March 3rd, 2014

Closed Session

8:30-10:30 am

Open Session

10:30-11:30 am – Ambassador Francis Ricciardone, currently US

Ambassador to Turkey

11:30 am-12:15 pm – Discussion of workgroup reports

2:00-3:00 pm – Ambassador Scot Marciel, Principal Deputy Assistant

Secretary of State for East Asia and the Pacific; former Ambassador to Indonesia

3:00 pm – Catherine Novelli, Under Secretary of State for Economic

Growth, Energy and the Environment and David Wade, Chief of Staff to Secretary Kerry

Tuesday, March 4th, 2014

Closed Session

8:30 am-12:00 pm

Open Session

11:00-11:30 am – Edward Lacey, Deputy Director, Office of Policy

Planning

Closed Session

1:00-4:00 pm

Open Session

4:00-5:00 pm – William Colglazier, Science and Technology Adviser to the Secretary of State

Meeting Agenda: Working Group Four of the Committee

Thursday, April 24th, 2014

Closed Session

9:00-10:00 am

Open Session

10:00am – Linda Tagliatela, Deputy Assistant Secretary, Bureau of

Human Resources; and other OHR officials-- Elizabeth K. Mayfield;

Kaara Ettesvold; Jack E. Hinden; and Ambassador Marcia S. Bernicat

12:00 pm – William Colglazier, Science and Technology Adviser to the Secretary of State

1:00 pm – Richard Hartman and Christopher Herrick, International Security Advisory Board

2:30 pm – Jonathan Margolis and Alan Yu, OES

Friday, April 25th, 2014

Open Session

9:00 am – Jefferson Fellows--current fellows Stephanie Forrest and Gabriel Filippelli and former fellow Ross Corotis

Closed Session

10:00 am-12:00 pm

Meeting Agenda: Working Group Three of the Committee

Tuesday, May 27th, 2014

Closed Session

9:30-10:00 am

Open Session

10:00 am – Nicholas Griffith, Policy Planning and Resources, Public Diplomacy and Public Affairs

11:00 am – William Colglazier, Science and Technology Adviser to the Secretary of State

1:00 pm – Alan Yu, Director, Office of Policy and Public Outreach, OES and Jennifer Haskell, Director Office of Science and Technology Cooperation, OES

3:00 pm – Discussion with David Hermann, Mickael Cleverley, Deborah Klepp, former ESTH officers, and Douglas Walker, Regional S&T Officer for Central Asia

Closed Session

4:00-5:00 pm

Meeting Agenda: Working Group Three of the Committee

Friday, August 8th, 2014

Open Session

9:00 am – George York, USTR, Christopher Moore, National Association of Manufacturers, and Jake Colvin, National Foreign Trade Council

Meeting Agenda: Third Meeting of the Committee

Wednesday, August 20th, 2014

Closed Session

8:30-1:30 pm

Open Session

1:30 pm – Patrick Kennedy, Under Secretary for Management, Department of State,

3:00 pm – Catherine Novelli, Under Secretary for Economic Growth, Energy, and the Environment, Department of State

Closed Session

4:00-5:00 pm

Thursday, August 21st, 2014

Closed Session

8:00 am-12:00 pm

Open Session

12:00-1:00 pm – Conference call with Pablo Valdez, Science Counselor, US Embassy Mexico City

Closed Session:

1:30-4:30 pm

APPENDIX G

ORGANIZATIONS WITH EXTENSIVE INTERNATIONAL S&T PROGRAMS AND ACTIVITIES THAT PROVIDED DATA AND INFORMATION ON RELEVANT PROGRAMS TO THE COMMITTEE

Most of the information that was provided is on the websites of the various organizations. Other information that was provided and considered in preparing this report is identified in end notes and foot notes throughout the report and in the reports cited in Appendix H Selected References.

Government Agencies

U.S. Department of State

- Office of the Secretary of State
 - Office of the Deputy Secretary of State for Management and Resources
 - Staff for Quadrennial Diplomacy and Development Review
 - Office of Policy Planning
 - Bureau of Intelligence and Research
 - Office of the U.S. Global AIDS Coordinator
 - Office of the Coordinator for Cyber Issues
 - Office of the Special Adviser for Partnerships
- Office of the Under Secretary for Economic Growth, Energy, and the Environment
 - Office of the Under Secretary
 - Office of the Science & Technology Adviser
 - Bureau of Oceans and International Environmental and Scientific Affairs
 - Office of Science, Space, and Health
 - Office of Science and Technology Cooperation
 - Office of Environmental Quality and Transboundary-Issues
 - Office of Policy and Public Outreach
 - Bureau of Economic and Business Affairs
 - Office of Development Finance

- Office of International Communications and Information Policy
 - Bureau of Energy Resources
 - Office of the Under Secretary for Management
 - Office of the Under Secretary for Management
 - Foreign Service Institute
 - Bureau of Human Resources
 - Office of Career Development and Assignments
 - Office of Recruitment, Examination and Employment
 - Office of Overseas Employment
 - Office of the Under Secretary for Arms Control and International Security
 - Office of the Under Secretary
 - Office of the Chief of Staff
 - Arms Control, Verification and Compliance Bureau
 - Office of the Under Secretary for Political Affairs
 - Office of the Under Secretary
 - Bureau of Western Hemisphere Affairs
 - Bureau of East Asian and Pacific Affairs
 - Bureau of International Organization Affairs
 - Office of UN Educational, Scientific, and Cultural Organization
 - Office of the Under Secretary for Civilian Security, Democracy, and Human Rights
 - Office of the Chief of Staff
 - Bureau of Conflict and Stabilization Operations
 - Office of the Under Secretary for Public Diplomacy
 - Office of the Chief of Staff
 - Bureau of Education and Cultural Affairs
 - Embassy of the United States – Ankara, Turkey
 - Embassy of the United States – Mexico City, Mexico
 - Embassy of the United States – Astana, Kazakhstan
 - Embassy of the United States – Moscow, Russia
 - Embassy of the United States – Lima, Peru
 - Embassy of the United States – Buenos Aires, Argentina
 - Embassy of the United States – Addis Ababa, Ethiopia
 - Embassy of the United States – Tokyo, Japan
 - Embassy of the United States – Canberra, Australia

United States Agency for International Development (USAID)

- Office of the Administrator
- Office of the S&T Adviser
 - U.S. Global Development Lab

- Center for Global Solutions

U.S. Department of the Interior

- Office of International Affairs

U.S. Department of Energy

- Office of International Affairs

Centers for Disease Control

- CDC Center for Global Health
 - Division of Parasitic Diseases and Malaria
 - Division of Global HIV/AIDS
- CDC Office of Infectious Diseases
- National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention

National Institutes of Health

- National Cancer Institute (NCI)
- National Institute of Allergy and Infectious Diseases (NIAID)
- National Institute of Mental Health (NIMH)
- National Institute of Child Health and Human Development (NICHD)
- National Heart, Lung, and Blood Institute (NHLBI)
- Office of AIDS Research (OAR)
- Fogarty International Center (FIC)

United States Naval Academy

- Political Science Department

United States Military Academy

- Department of Social Sciences

Environmental Protection Agency

- Office of Research and Development
- Office of International and Tribal Affairs

Office of Science and Technology Policy

- Office of the Director
- National Security and International Affairs Division

Office of Personnel Management

- National Security and International Affairs Division

United States Department of Agriculture

- Office of the Under Secretary for Research, Education, and Economics

Department of Defense

- Office of Assistant Secretary of Defense for Research and Engineering
- Pacific Command, Office of the Science Advisor

Office of the US Trade Representative

National Intelligence Council

National Science Foundation

- Office of the Director

Other Organizations

- Association of American Universities
- University of California, San Francisco
- George Mason University
- Massachusetts Institute of Technology
- University of Colorado – Boulder
- University of New Mexico
- Indiana University – Purdue University - Indianapolis
- Syracuse University
- International Intellectual Property Institute
- United States Institute of Peace
- The American Association for the Advancement of Science
- Atlantic Council
- Rand Corporation
- Stimson Center
- Information Technology and Innovation Foundation
- National Association of Manufacturers
- National Foreign Trade Council
- AFL/CIO
- The National Academies—numerous units within the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine

APPENDIX H

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APPENDIX I

GLOBAL INVESTMENTS IN SCIENCE AND ENGINEERING —A DYNAMIC LANDSCAPE

The information in this appendix was provided by the National Science Foundation with major contributions from Arthur Fitzmaurice.

Over the past several decades, governments around the world have recognized that investment in science and engineering is integral to economic growth and wellbeing. Emerging science nations and developing countries have expanded their higher education systems and built indigenous research and development (R&D) capacity while mature R&D-investing countries work to maintain their competitive edge. These developments are changing the global context for U.S. science and engineering research and education, creating new opportunities as well as challenges for the National Science Foundation and the U.S. research community.

Increase in Global R&D expenditures

Worldwide R&D expenditure nearly doubled in the ten years leading up to 2009, reaching \$1.276 trillion in 2009 (Figure I-1; National Science Board. 2012). East Asia set the pace for the global expansion, led by China where annual real R&D grew by an average of 20 percent per annum from 1999-2009 and doubled between 2009 and 2012. U.S. real R&D increased by only 29 percent over the entire 1999-2009 period, reducing the U.S. share of global R&D from 38 to 31 percent.

R&D performance remains concentrated in three regions: North America, including the U.S., Canada and Mexico, with 34 percent of the global total, or \$433 billion, down from 40 percent in 1996; Asia, including East/Southeast Asia (Japan, China, Korea, Taiwan, Singapore, among others) and South Asia (India, for instance), accounted for 32 percent (\$402 billion) of the total, up from 24 percent in 1996; and Europe, including the European Union, was responsible for another 25 percent (\$319 billion) of world R&D expenditure, down from 31 percent in 1996. The rest of world—including South America, Africa, Australia/Oceania, and the Middle East—together was little changed at roughly 10 percent (National Science Board. 2012).

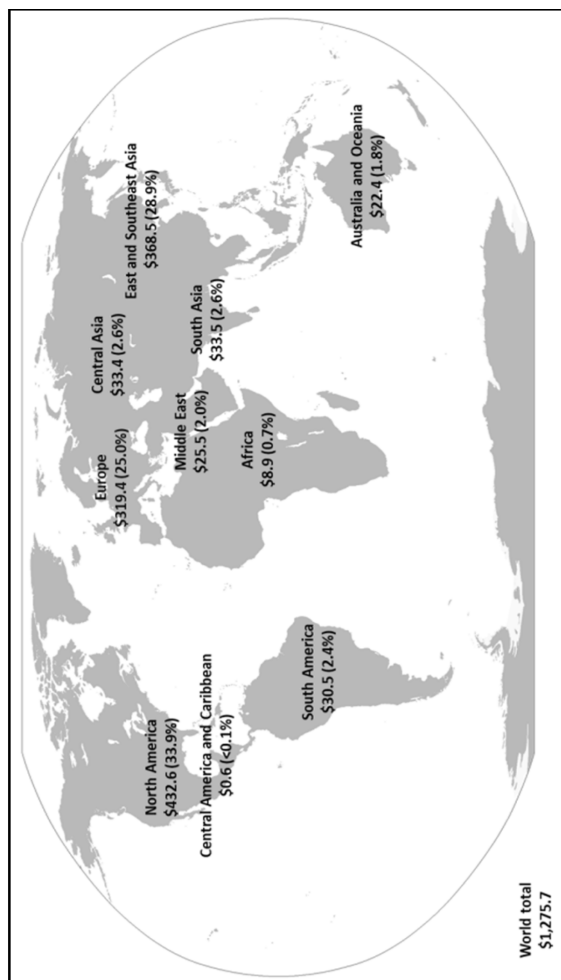


FIGURE I-1 Global R&D expenditures by region: 2009.

NOTES: Amount given in billions of U.S. purchasing power parity dollars. Foreign currencies converted to U.S. dollars through purchasing power parities. Some country figures are estimated. Countries are grouped according to the regions described by the World Factbook, www.cia.gov/library/publications/the-world-factbook/index.html.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, estimates, July 2011. Based on data from Organization for Economic Co-Operation and Development, Main Science and Technology Indicators (2011/1); and United Nations Educational, Scientific, and Cultural Organization Institute for Statistics, <http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx>, table 25, accessed July 13, 2011, Reproduced from Science and Engineering Indicators.

R&D intensity—the ratio of R&D expenditure to GDP, long considered a reliable indicator of a nation’s innovative capacity—adds another dimension to the story. In 1986 the United States led the world in R&D intensity, followed by Germany and Japan. The U.S. R&D intensity has been fairly stable over the last ten years, fluctuating between 2.6 percent and 2.9 percent, but such levels landed the United States in eighth place worldwide by 2009, behind countries such as Israel, Finland, South Korea, and Japan (National Science Board. 2012).

Shifts in the Global Science and Engineering Labor Force

Science and engineering (S&E) employment occurs throughout the world but is concentrated in developed nations. The Organization for Economic Cooperation and Development (OECD) reports that the number of researchers in its member countries increased 50 percent, from 1995 to 2007 (National Science Board, 2014). China reports a 300 percent increase in the number of researchers from 1995 to 2008, and South Korea, 100 percent. By contrast, U.S. and EU growth stood at 33 percent. The United States depends heavily on foreign-born S&E talent. In 2009 25 percent of S&E workers in the United States were foreign born, as were 42 percent of doctorate holders in S&E occupations (National Science Board. 2012).

The number of internationally mobile students more than tripled between 1980 and 2009 to 3.4 million, spurred in part by national programs in the country of origin (e.g. Brazil, Saudi Arabia). The United States remains the top destination for international students (Figure I-2), but its share declined from 25 percent in 2000 to 20 percent in 2009 (National Science Board. 2012) as competition for S&E graduates intensifies. To date, the implications for the United States’ ability to retain high caliber foreign born, U.S.-trained S&E doctorate recipients remain unclear. The portion of U.S. S&E doctorate recipients on temporary visas who plan to stay in the United States. peaked in 2007, but results vary by country of origin and totals remain near the historic high (Finn, 2012).

U.S. students in science and engineering disciplines are less mobile than their international peers and their U.S. counterparts in humanities (Institute of International Education, 2014). Furthermore, U.S. students who do seek study or research opportunities outside the U.S. disproportionately go to English-speaking countries, not the dynamic established and emerging investors in science and engineering research in Asia and other regions.

Growth in Collaboration

A broader distribution of research expenditures has generated a new global map of large facilities, unique infrastructure, and constellations of large equipment. Geographically distributed scientific infrastructure can also accelerate scientific progress, capture economies of scale and avoid duplication. Conversely, distribution can also mean that the best (or perhaps only) place for an American researcher to operate will be overseas. The very largest “big

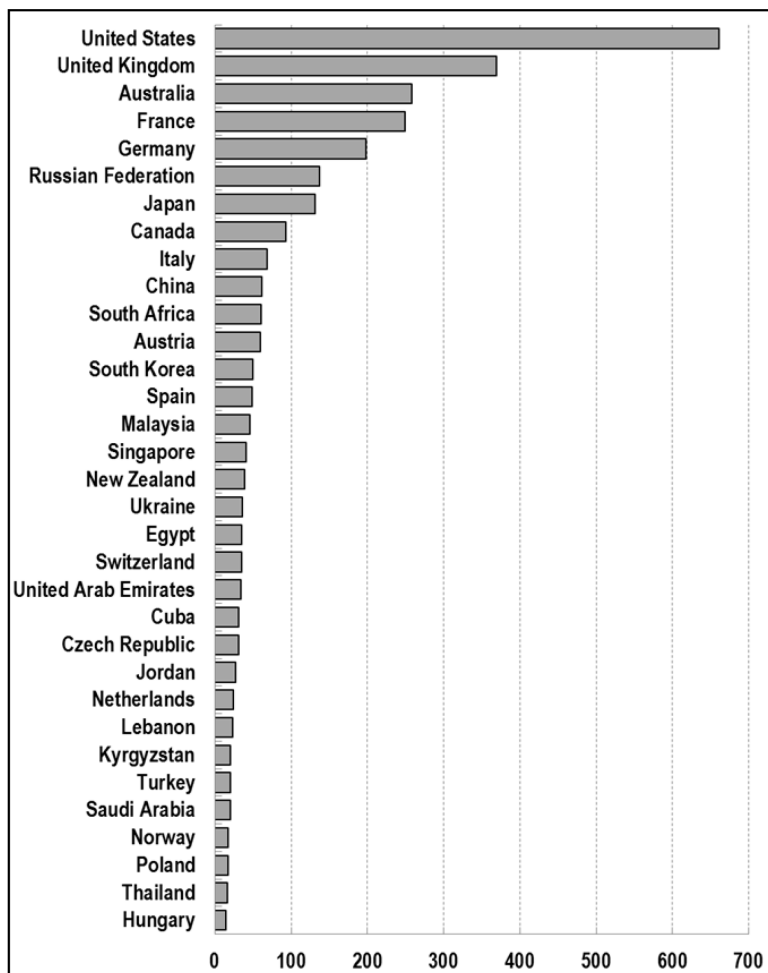


FIGURE I-2 Internationally mobile students enrolled in tertiary education, by country: 2009.

NOTES: Data based on the number of students who have crossed a national boarder and moved to another country with the objective of studying (i.e., mobile students). Data for Canada for 2007 exclude private institutions. Data for Netherlands and Germany exclude advanced research programs, e.g., doctorate. Data for Belgium exclude social advancement education. Data for Russia exclude tertiary-type B programs (e.g., associate's) in private institutions and advanced research programs (e.g., doctorate). Data for United Kingdom, United States, and Australia based on country of residence, data for Germany and Switzerland based on country of prior education; data from other countries based on country of citizenship. SOURCE: UNESCO Institute for Statistics, Global Education Digest (2011). Reproduced from Science and Engineering Indicators.

science” infrastructure projects are now typically constructed and operated through multinational consortia, enabling all partners to leverage resources with shared investment.

The dynamic landscape has given birth to burgeoning multinational collaborative research. Modern science is more likely to involve real and virtual networks of collaborators around the country and globe, crossing institutional and national boundaries to strengthen their research (The Royal Society. 2011). From 1990 until 2010, the rate of internationally co-authored papers increased markedly both in the United States (from 11.7 to 31.6 percent) and around the world (9.5 to 23.8 percent) (National Science Board, 2012). Citation statistics show that such internationally collaborative research can have the greatest impact (Adams, 2013). U.S. universities are devising new and innovative international science partnerships, as they adapt to the rise in student mobility, the unmet worldwide need for higher education, and the need to facilitate collaborative projects for their faculty (National Research Council, 2012).

This major change in how science is done has generated new science policy approaches to facilitate such international science collaborations and science networks (European Commission. 2012). The Global Research Council is one example, a virtual organization of science funding agencies to share data and best practices for collaboration among funders, laying informal groundwork to support greater partnership in research. Looking to the future, this intangible infrastructure to facilitate the collaborative process will be a critical underpinning of the best science.

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APPENDIX J

INTERAGENCY CHALLENGES SET FORTH IN THE 1999 REPORT

- Coordinated support of five vice-presidential-level bilateral commissions.
- Development of the concepts, frameworks, and details of umbrella inter-governmental Science, Technology, and Health (STH) agreements.
- Review and approval of requests from agencies for authorization to negotiate and sign memoranda of understanding.
- Support of bilateral STH relationships not called for in formal agreements.
- Assistance in gaining access to facilities, people, and geographic areas in other countries.
- Support of activities of international organizations and multilateral negotiations.
- U.S. responses to major security and humanitarian crises.
- Removal of impediments encountered in implementing long-duration international programs.
- Facilitation of programs carried out in the United States involving foreign participation.
- Individual consultations and visits abroad by agency officials, scientists, and contractor personnel.
- Acquisition and dissemination of information concerning STH developments abroad.
- Coordination of overlapping interagency interests and resolution of interagency disagreements.
- Use of department's external program funds, including support of activities of other agencies.

SOURCE: National Research Council, *The Pervasive Role of Science, Technology, and Health in Foreign Policy; Imperatives for the Department of State*, 1999.

APPENDIX K

INTERNATIONAL ENGAGEMENT ACTIVITIES OF THE NATIONAL SCIENCE FOUNDATION

The information in this appendix was provided by the National Science Foundation with major contributions from Arthur Fitzmaurice.

National Science Board Reports

- 2014: Science and Engineering Indicators
- 2008: International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise
- 2002: Toward a More Effective Role for the U.S. Government in International Science and Engineering

NSF International Science & Engineering Partnerships with Foreign Funding Agencies & Institutions

Partnerships for International Research and Education (PIRE) is an NSF program that provides support to U.S. academic institutions to engage with foreign academic institutions in developing and advancing scientific knowledge and discovery across all NSF-supported fields of study. The primary objective of the program is to help US researchers (faculty and students) connect with cutting-edge research around the world. The program provides support to advance research agendas of US faculty and to provide international research experiences to students and early career researchers. NSF has established partnerships with foreign counterpart agencies to develop these partnerships. The NSF provides up to \$5,000,000 of support over five years to the US side of the partnerships, and the foreign counterpart agencies provide support to the foreign side.

PIRE is currently undergoing an external evaluation by Abt Associates which is anticipated to be available in the coming year. Media highlights from PIRE programs [are available at http://www.nsf.gov/news/index.jsp?pims_id=12819&org=NSF]. As an examples of one project, "Developing Low Carbon Cities in US, China, & India" (IIA-1243535) brings together six US institutions and eight Asian institutions to design low-carbon, sustainable cities in the US, India, and China. Researchers are exploring how to best reduce greenhouse gas emissions, linking

this with broader sustainability goals, including economic development, pollution, and public health. The project is training nearly 100 students – across all three countries – and partnering with NGOs to translate research into action.

Award #1243535

PI: Anu Ramaswami, University of Minnesota Professor of Science, Technology, Public Policy

Countries: China, India, United States

Institutions: University of Minnesota, Yale University, Georgia Institute of Technology, National Center for Atmospheric Research, University of Colorado Denver, National Academy of Engineering Center for Engineering, Ethics & Society, TERI University, Indian Institute of Technology Kanpur, Tongji University, Tsinghua University, Chinese Academy of Sciences Institute for the Urban Environment

Disciplines: Engineering, Environmental Sciences, Industrial Ecology, Urban Planning, Public Affairs, Public Health.

NSF Award International Collaboration Data Metrics

Figures K-1 to K-4 have been reproduced from data provided by the National Science Foundation.

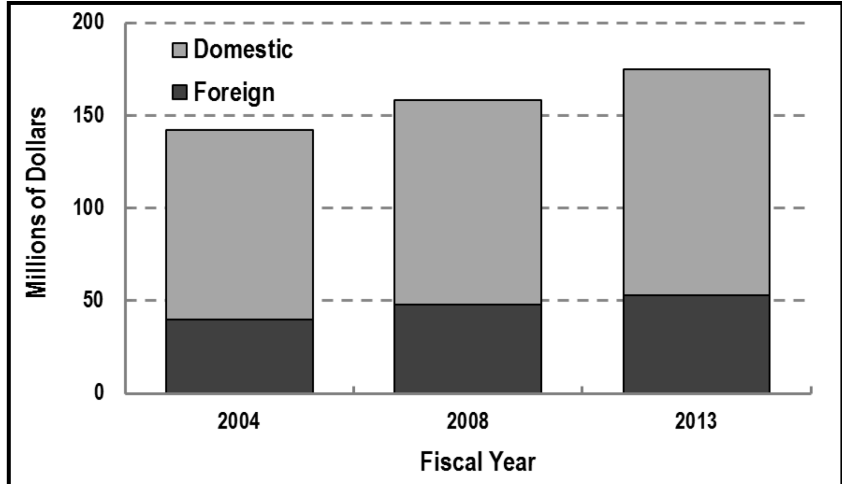


FIGURE K-1 NSF awards included \$51.8M budgeted for foreign travel in FY2013. Foreign travel budgets increased 35 percent in the past decade, while domestic travel budgets only increased 23 percent.

SOURCE: Reproduced from data provided by the National Science Foundation.

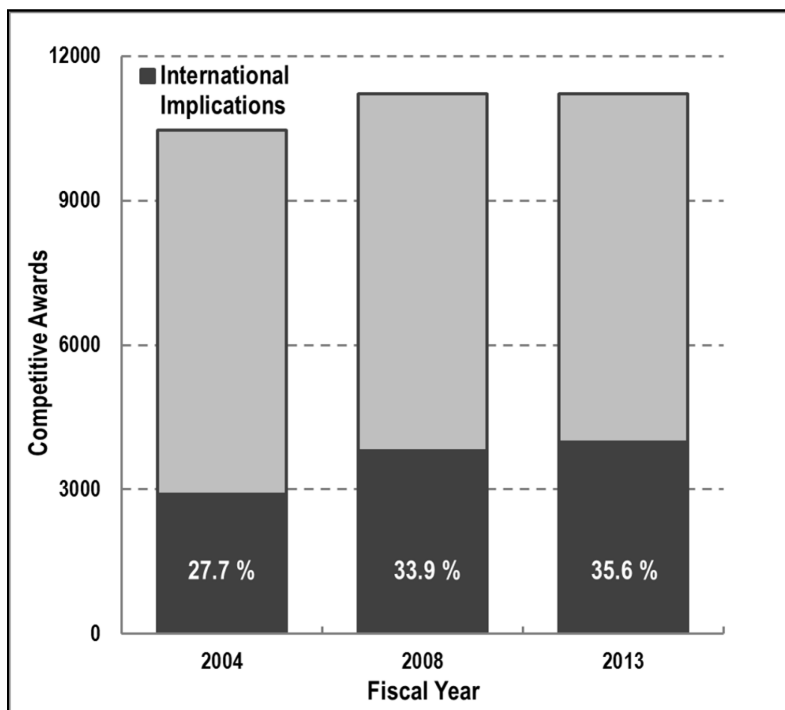


FIGURE K-2 The number and proportion of competitive awards with international implications have increased in the past decade. Overall, 36 percent of the competitive grant proposals that NSF awarded in FY2013 had international implications.

SOURCE: Reproduced from data provided by the National Science Foundation.

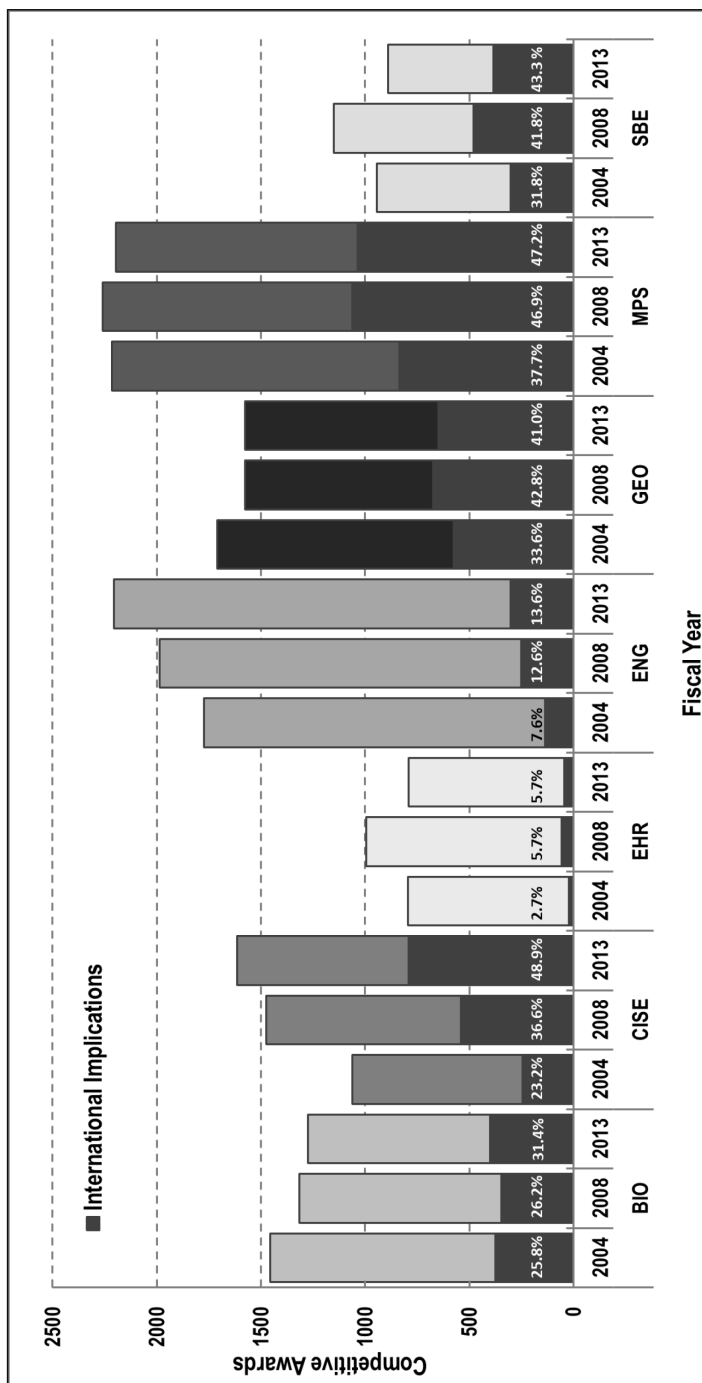


FIGURE K-3 In FY2013, over 40 percent of the awards made by CISE, GEO, MPS, and SBE included international cooperative activities. SOURCE: Reproduced from data provided by the National Science Foundation.

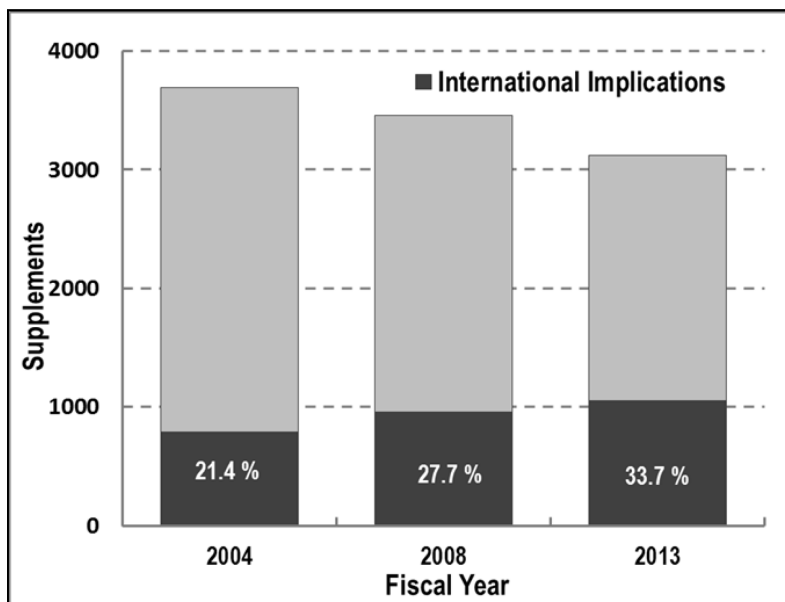


FIGURE K-4 Over the past decade, the number of supplements to competitive awards has decreased, but the number and proportion of supplements coded as having international cooperative activities have increased. Some of these are supplements for international travel not captured in the proposed award budgets.

SOURCE: Reproduced from data provided by the National Science Foundation.

APPENDIX L

ENVIRONMENT, SCIENCE, TECHNOLOGY, AND HEALTH
OFFICERS POSTED OVERSEAS

Tables L-1 (a-f) show the numbers of full (FT) and part time (PT) Foreign Service Officers and Locally Employed Staff (LES) by region and post. Totals for all regions are: FT = 96; PT = 223; LES = 218.

Table L-1 (a) Numbers of Full (FT) and part time (PT) Foreign Service Officers and Locally Employed Staff (LES) by region and post: Africa.

Africa	FT	PT	LES	Africa	FT	PT	LES
Total	7	46	43	Nouakchott		1	1
Luanda		1		Port Louis/ Victoria		1	2
Cotonou		1	1	Maputo		1	1
Gaborone	1		1	Windhoek		1	1
Ouagadougou		2		Niamey			1
Bujumbura		1		Abuja		1	2
Yaounde	T	2	1	Lagos		1	1
Praia	1		1	Brazzaville		1	1
Ndjamena		1	1	Kigali		2	1
Abidjan		1	2	Dakar		1	1
Kinshasa		1	1	Victoria		1	2
Djibouti		1	1	Freetown		1	2
Malabo		1	1	Cape Town		1	
Asmara		1	1	Durban		1	
Addis Ababa	1	1	1	Pretoria	2		1
Libreville		1	1	Juba		1	
Banjul		1	1	Khartoum		1	
Accra	1		1	Mbabane		1	1
Nairobi	1	2	1	Dar es Salaam		1	1
Maseru		1	1	Lomé		1	1
Monrovia		2	1	Kampala		2	1
Antananarivo		1		Lusaka		1	1
Lilongwe		1	1	Harare			2
Bamako		1					

SOURCE: Data provided by the Office of Oceans and International Environment and Science, Department of State, 2014.

TABLE L-1 (b) Numbers of Full (FT) and part time (PT) Foreign Service Officers, and Locally Employed Staff (LES) by region and post: East Asia Pacific.

East Asia Pacific	FT	PT	LES	East Asia Pacific	FT	PT	LES
Total	28	38	41	Vientiane	1		1
Canberra	1	2	1	Kuala Lumpur	1		1
Melbourne		1		Majuro		1	
Perth			1	Kolonia		1	
Sydney		1		Ulaanbaatar	1		
Bandar Seri Begawan		1		Auckland/Wellington		1	
Rangoon		1		Koror		1	
Phnom Penh		1	3	Port Moresby		1	
Beijing	9	3	7	Cebu			
Chengdu		2	1	Manila	1		1
Guangzhou	2		2	Seoul	1	1	2
Hong Kong	1			Apia		1	
Shanghai	1		2	Singapore		1	
Shenyang		1	1	Kaohsiung			1
Suva/ Honiara	1		1	Taipei	1	1	1
Denpasar		1		Bangkok	2		2
Jakarta	3		2	Chiang Mai		1	1
Medan		1		Dili		1	1
Surabaya		1		Hanoi	2	1	
Fukuoka		1	1	Ho Chi Minh City		1	1
Nagoya			1				
Naha			1				
Osaka-Kobe		2					
Sapporo		1	1				
Tokyo	1	4	4				

SOURCE: Data provided by the Office of Oceans and International Environment and Scientific Affairs, Department of State, 2014.

TABLE L-1 (c) Numbers of Full (FT) and part time (PT) Foreign Service Officers, and Locally Employed Staff (LES) by region and post: Europe.

Europe	FT	PT	LES	Europe	FT	PT	LES
Total	25	57	61	Rome	2		1
Tirana		1	1	Pristina		2	1
Yerevan		1	1	Riga		1	2
Vienna – US		1	1	Vilnius		2	1
Mission to				Skopje		1	1
OSCE				Valletta		2	1
Baku		1	1	Chisinau		1	1
Minsk			1	Podgorica		2	1
Brussels		2	1	The Hague		1	1
Brussels – US	2			Oslo	1		1
Mission to EU				Krakow		1	
Sarajevo		1	1	Warsaw	1		1
Sofia		1	1	Lisbon		2	1
Zagreb		1	1	Bucharest	2	2	1
Nicosia		1	1	Moscow	6		8
Prague		2	2	St. Petersburg		1	1
Copenhagen	1		1	Vladivostok		1	
Tallinn		1	1	Yekaterinburg		1	1
Helsinki		1	1	Belgrade		1	1
Paris	2	1	2	Bratislava		1	
Paris – US Mission		2	1	Ljubljana		1	
to OECD				Madrid	1		
Tbilisi		1	1	Stockholm		2	2
Berlin	1	1	1	Bern		1	1
Hamburg		1	1	Geneva	2		1
Leipzig		1		Ankara		1	1
Munich		1		Kyiv			2
Frankfurt		1		London	3		2
Luxembourg-city			1	Vatican City		1	
Athens		2					
Thessaloniki		1	1				
Budapest	1		2				
Reykjavik		1	1				
Dublin		2	1				

SOURCE: Data provided by the Office of Oceans and International Environment and Scientific Affairs, Department of State, 2014.

TABLE L-1 (d, e) Numbers of Full (FT) and part time (PT) Foreign Service Officers, and Locally Employed Staff (LES) by region and post: Near East, and South & Central Asia.

Near East	FT	PT	LES	South & Central Asia	FT	PT	LES
Total	5	26	19	Total	10	25	20
Algiers		1	1	Kabul	1		1
Manama		2	2	Mazar-e Sharif		1	
Cairo	2	2	1	Dhaka		1	
Baghdad		2	1	Chennai		3	1
Erbil			1	Hyderabad		2	2
Tel Aviv	1		1	Kolkata		2	3
Amman	1	1	1	Mumbai	1	3	2
Kuwait City		1	1	New Delhi	5	2	2
Beirut		1	2	Astana	1	1	1
Casablanca/ Rabat		1		Bishkek		1	1
Muscat		2	1	Kathmandu	1	1	2
Jerusalem		2	2	Islamabad		1	
Doha		2	2	Karachi		1	1
Dhahran		1		Peshawar		1	1
Jeddah		1		Colombo		1	1
Riyadh	1		1	Dushanbe		2	1
Tunis		1	1	Ashgabat		2	1
Abu Dhabi		3	1	Tashkent	1		
Dubai		2					
Sana'a		1					

SOURCE: Data provided by the Office of Oceans and International Environment and Scientific Affairs, Department of State, 2014.

TABLE L-1 (f) Numbers of Full (FT) and part time (PT) Foreign Service Officers, and Locally Employed Staff (LES) by region and post: Western Hemisphere.

Western Hemisphere	FT	PT	LES
Total	21	31	34
Buenos Aires	4		1
Nassau		1	
Bridgetown/ Antigua		1	
Belmopan		1	1
Hamilton			1
La Paz		1	1
Brasilia	2		
Recife			1
Rio de Janeiro		2	
Sao Paulo	1		
Calgary		1	1
Halifax			1
Montreal		1	
Ottawa	3		1
Quebec City		1	1
Toronto		1	
Vancouver			1
Winnipeg		2	
Santiago		2	1
Bogota	1		
San Jose	1		2
Havana		1	

Western Hemisphere	FT	PT	LES
Santo Domingo		1	
Quito		1	1
San Salvador	1		3
St. Georges		1	1
Guatemala City		1	1
Georgetown		1	1
Port au Prince		1	
Tegucigalpa	1		
Kingston		1	1
Guadalajara		1	1
Mexico City	2		2
Monterrey	1		3
Tijuana	1	1	1
Managua	1		1
Panama City		1	
Asuncion		1	1
Lima	2		1
Paramaribo		1	2
Port of Spain		1	
Montevideo		1	1
Curacao		1	
Caracus		1	

SOURCE: Data provided by the Office of Oceans and International Environment and Scientific Affairs, Department of State, 2014.

APPENDIX M

RESULTS OF DEPARTMENT STATE'S
QUESTIONNAIRE TO ESTH OFFICERS**July 2014; Total responses: 96**

1. If there were consultations you wish you had done before arriving at post or in conjunction with your home leave, but did not, what were they? Check all that apply. (weighted average rating, 1-5, with 5 being the highest)

More with OES	3.46
More with other parts of DOS	3.43
More with other USG agencies	3.66
More with non-USG entities	3.28
	N = 93

2. Do you feel adequately informed on ESTH issues and how your Post can advance them? Please check the box that applies (percent of respondents)

Not informed	4.55%
Slightly informed	28.41%
Adequately informed	31.82%
Well informed	17.05%
It depends on the issue	18.18%
	N = 88

3. What is the most useful method of receiving information from the State Department and other agencies in Washington on ESTH matters? Rate 1-5, with 5 being the most useful and 1 being the least useful. (weighted average rating)

Newsletter	2.83
E-mail	4.14
Cable	3.61
Telephone call	3.13
Intranet website	2.49
	N = 88

4. How do you communicate with the State Department (OES, Regional Bureau, etc.) and other agencies in Washington on ESTH matters? Rate 1-5, with 5 being the most useful and 1 being the least useful. (weighted average rating)

E-mail	4.51
Cable	3.41
Telephone call	3.29
Intranet website	1.92
	N = 88

5. How do you communicate with the Regional ESTH Office on ESTH matters? Please number in order of frequency with 1 being the most frequently used method of communication. (1—5, weighted average)

E-mail	2.96
Cable	2.62
Telephone call	2.82
Intranet website	2.64
	N = 81

6. Does your mission and section (or if you are a single officer, do you) have a written strategic plan for advancing priority ESTH issues in your country of assignment? (percent of respondents)

Yes	19.74%
No	80.26%
	N = 76

7. What ESTH issues are in your embassy's Integrated Country Strategy? (percent of respondents)

None	10.39%
I don't know	15.58%
Please list*	74.03%
	N = 77

*Examples included Presidential initiatives such as PEPFAR and climate change, energy, health, water, S&T cooperation, environment, and wildlife trafficking.

8. Are there important ESTH issues not being addressed at your post that should be? (percent of respondents)

No	67.53%
Yes	32.47%
	N = 77

9. If yes, what are the ESTH issues not being addressed?

N = 28

Examples included: e-waste; energy efficiency, sustainable energy projects, and water; climate change

10. If yes, why are these issues not being addressed? (1-5, weighted average rating)

No capacity—skills	2.78
No capacity—not enough time/people	4.26
No support from Washington or Embassy Front Office	3.13
No interest from host country	3.16

N = 34

11. Do you routinely collaborate with other embassy sections or USG agencies at post on ESTH activities? (percent of respondents)

Yes	85.9%
No	14.1%

N = 78

12. If yes, check the agency with which you collaborate most often. (percent of respondents)

USAID	54.72%
Foreign Agricultural Service	30.19%
CDC	1.89%
DOD	13.21%

N = 53

13. If no, please tell us why you don't collaborate with other sections or agencies at post.

N = 13

Examples: small post; few or no other agencies here; ESTH not as high a priority for the other sections/agencies

14. How do you engage on ESTH issues at post? (% of respondents)

Delivering demarches	17.33%
Public outreach	20.00%
Reporting	30.67%
Programs	12.00%
Policy engagement/public diplomacy	20.00%

N = 75

15. Do you think training would help you be a more effective ESTH officer? (percent of respondents)

Yes	85.71%
No	14.29%
	N = 77

16. If yes, what training would be helpful? (percent of respondents)
N = 56

Examples: Anything; technical training on climate change; issue-specific, ESTH-specific writing

17. Please rate the support you receive from OES, with 5 being excellent and 1 being virtually nonexistent. (percent of respondents)

5 Excellent	6.49%
4 Good	38.96%
3 Fair	33.77%
2 Poor	12.99%
1 Virtually nonexistent	7.79%
	N = 77

18. Please rate the support you receive from the Regional Bureau on ESTH matters, with 5 being excellent and 1 being virtually nonexistent. (percent of respondents)

5 Excellent	11.84%
4 Good	30.26%
3 Fair	32.89%
2 Poor	18.42%
1 Virtually nonexistent	6.58%
	N = 76

SOURCE: Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State, 2014.

APPENDIX N

SCIENCE AND TECHNOLOGY AGREEMENTS CURRENTLY IN FORCE

1. Algeria
2. Argentina
3. Australia
4. Brazil*
5. Bulgaria
6. Chile
7. China*
8. Colombia
9. Cyprus
10. Czech Republic
11. Denmark
12. Egypt
13. Estonia
14. European Union
15. Finland
16. France
17. Georgia
18. Germany
19. Greece
20. Hungary
21. India*
22. Indonesia
23. Italy
24. Japan*
25. Jordan
26. Kazakhstan
27. Korea*
28. Libya
29. Lithuania
30. Macedonia
31. Malaysia
32. Mexico
33. Morocco
34. New Zealand
35. Norway
36. Pakistan
37. Philippines
38. Poland
39. Romania
40. Russia* (uncertain future)
41. Saudi Arabia
42. Serbia
43. Slovakia
44. Slovenia
45. South Africa
46. Spain
47. Sweden
48. Switzerland
49. Thailand
50. Turkey
51. Uruguay
52. Uzbekistan
53. Vietnam

*Commission Chaired by the Office of Science and Technology Policy

SOURCE: Bureau of Oceans and International Environmental and Scientific Affairs, 2014.

APPENDIX O

REGIONAL ESTH HUB LOCATIONS AND STAFFING

- **Western Africa**
Accra, Ghana (1 Foreign Service Officer [FSO], 1 vacant LES [locally employed staff])
- **Eastern Africa**
Addis Ababa, Ethiopia (1 FSO, 1 LES)
- **Southern Africa**
Gaborone, Botswana (1 FSO, 1 LES)
- **Baltic and Nordic States**
Denmark, Copenhagen (1 FSO, 1 LES)
- **Central and Eastern Europe, the Balkans**
Budapest, Hungary (1 FSO, 2 LES)
- **East Asia and South East Asia**
Bangkok, Thailand (1 FSO, 1 LES)
- **Pacific**
Suva, Fiji (1 FSO, 2 LES)
- **Near East**
Amman, Jordan (1 FSO, 1 LES)
- **South and Southern Asia**
Kathmandu, Nepal (1 FSO, 1 LES)
- **Central Asia**
Astana, Kazakhstan (1 FSO, 1 LES)
- **South America Hub**
Peru, Lima (1 FSO, 2 LES)
- **Central and Caribbean Hub**
Costa Rica, San Jose (1 FSO)

SOURCE: Bureau of Oceans and International Environmental and Scientific Affairs, 2014.

