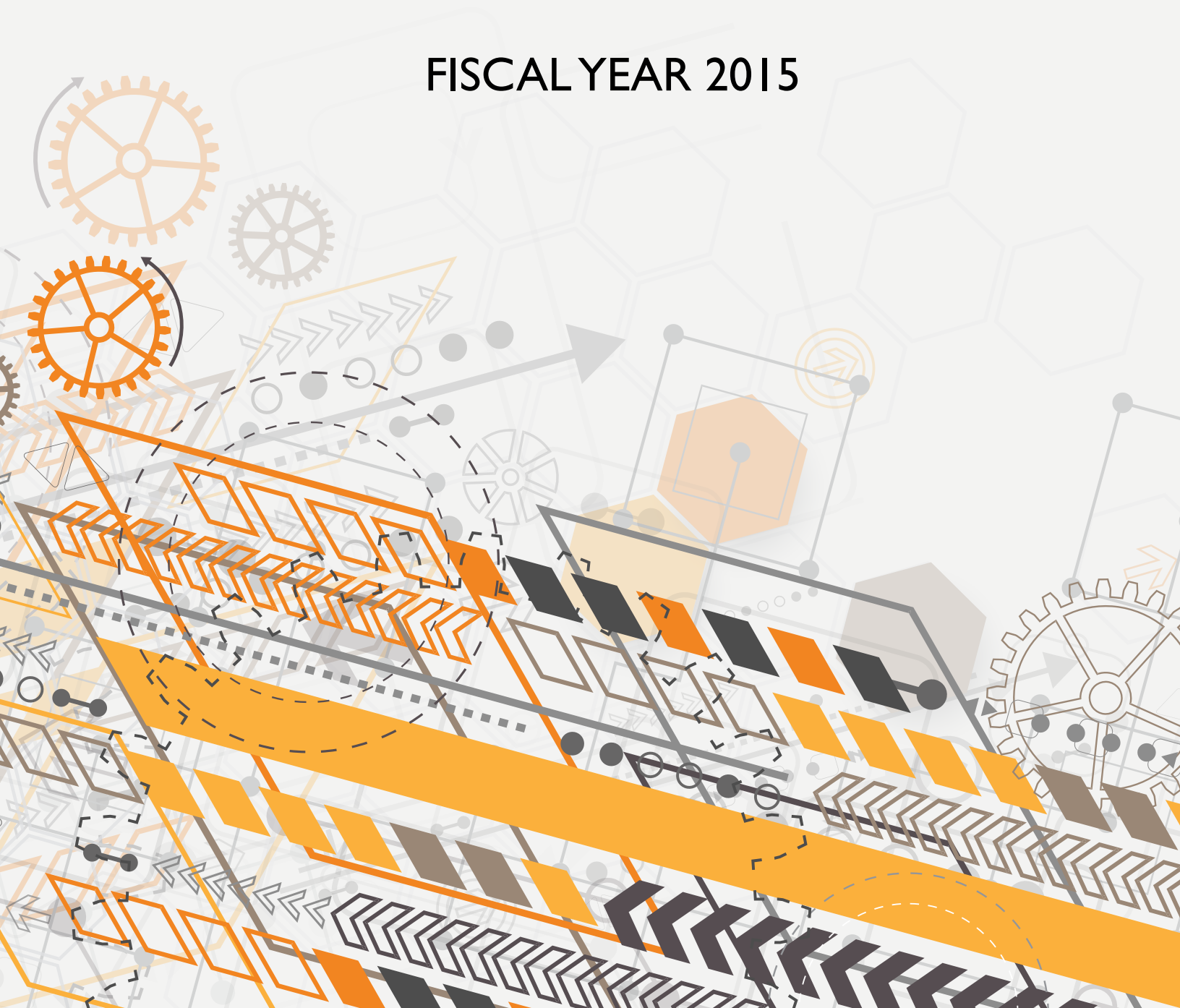




SCIENCE AND
TECHNOLOGY
POLICY INSTITUTE

REPORT TO THE PRESIDENT

FISCAL YEAR 2015



The logo for the Institute for Defense Analyses (IDA) consists of the letters 'IDA' in a bold, black, sans-serif font. A horizontal line is positioned below the letters 'I' and 'D', extending from the left edge of the 'I' to the right edge of the 'D'.

IDA

The Institute for Defense Analyses is a non-profit corporation that operates three federally funded research and development centers to provide objective analyses of national security issues, particularly those requiring scientific and technical expertise, and conduct related research on other national challenges.

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LETTER FROM THE DIRECTOR OF STPI

Dear Mr. President:

In one of the last speeches of his administration, President John F. Kennedy spoke about the role of science in modern society. He observed that “the question in all our minds today is how science can best continue its service to the Nation, to the people, to the world, in the years to come.” More than half a century later, with the myriad of challenges and opportunities before us, there is greater need than ever to understand how science can serve the Nation and the world. In this spirit, the Science and Technology Policy Institute (STPI) supports the Director of the White House Office of Science and Technology Policy (OSTP) in providing unbiased analyses and advice on science and technology developments and their relevance to domestic and international affairs.

Our organization was established by congressional direction in 1991 as a federally funded research and development center, sponsored through the National Science Foundation. In 1998, Congress laid out four goals for STPI: reporting on significant trends and developments in science and technology in the United States and abroad; analyzing those trends with attention to the Federal science and technology portfolio; performing studies that will ensure the long-term strength of American science and technology; and providing technical assistance and support to the President’s Council of Advisors on Science and Technology as well as other interagency science and technology committees and panels.

STPI provides an independent, objective source of analyses, with a focus on the intersection of science and policy. Though our primary role is service to the Executive Office of the President, at the urging of successive Directors of OSTP, our portfolio has expanded over the years to include analyses in support of other executive branch agencies and offices, including the National Science Foundation, the National Aeronautics and Space Administration, the National Institutes of Health, the Department of Commerce, the Department of Energy, the Department of Homeland Security, and the Federal Aviation Administration.

In accordance with our congressionally directed mandate, I am pleased to present to you the following overview of the past fiscal year’s activities at STPI. The research products and reports described here are all characterized by an unwavering commitment to deliver objective analyses grounded in data and discernible facts. The products generated by STPI’s research professionals reflect their diverse science and policy backgrounds, as well as a passion to apply our collective technical acumen for the betterment of the Nation.

On behalf of the entire research team at STPI, I thank you for the opportunity to serve the Nation in this capacity.

Sincerely,



Mark J. Lewis

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INTRODUCTION

The Science and Technology Policy Institute (STPI) was established by Congress in 1991 as a federally funded research and development center (FFRDC) under the name Critical Technologies Institute. In 1998, Congress re-named the Institute and assigned the following duties:

- Assembly of timely and authoritative information regarding significant developments and trends in science and technology research and development in the United States and abroad.
- Analysis and interpretation of the information with particular attention to the scope and content of the Federal science and technology research and development portfolio as it affects interagency and national issues.
- Initiation of studies and analyses of alternatives available for ensuring the long-term strength of the United States in the development and application of science and technology.
- Provision, upon the request of the Director of the White House Office of Science and Technology Policy (OSTP), of technical support and assistance to—
 - committees and panels of the President’s Council of Advisers on Science and Technology, and
 - interagency committees and panels of the Federal Government concerned with science and technology.

Consistent with congressional direction, STPI provides analyses of significant science and technology developments in the United States and abroad for OSTP, its primary sponsor, and for other Federal Government organizations with science and technology responsibilities. To ensure its continued relevance, STPI meets frequently with the Director of OSTP and his staff at all levels. Such close coordination—coupled with flexible tasking procedures—ensures STPI focuses on OSTP’s top priorities and emergent problems. The fiscal year (FY) 2015 contributions described in this report are the products of this close working relationship with OSTP, as well as the increasingly strong relationships being established with other Federal agencies.

To fully address STPI’s broad science and technology charter, STPI researchers possess educational training across the spectrum of scientific, technical, social, and behavioral science disciplines and professional experience in the academic, industrial, nonprofit, and Federal Government sectors.

The majority of doctoral-level or terminal degrees among STPI’s research staff are in mathematics, science, and engineering, with law, communication, and history balancing out the staff’s advanced education portfolio. STPI is one of three FFRDCs managed by the Institute for Defense Analyses (IDA).

When needed, STPI also calls on a deep bench of scientific and analytic talent resident in the staffs of other IDA research groups.

Highlights of STPI’s efforts in support of its sponsors during FY 2015 follow.

Energy and environment

Issues regarding energy and the environment were key policy priorities in FY 2015. STPI built on a long history of previous research in the realm of energy to consider such issues as the technology and policy aspects of methane emissions and whether natural gas can be a cleaner source of fuel. STPI's environment portfolio spans Earth observation systems, sensors, surveys, and networks for land and coastal zone management. Multiple activities with relevance to the polar regions are also in progress.

Disaster preparedness

Science and technology research and development contribute fundamental science, tools, and methodologies for the prevention, mitigation, protection, response, and recovery from natural and technological threats to the Nation. During FY 2015, STPI assessed the organization of science and technology resources in response to a possible power plant disaster, a hypothetical influenza pandemic, and an oil spill scenario to better define the roles and responsibilities of Federal agencies under such circumstances. For the National Institute of Standards and Technology, STPI analyzed resilience policy-making in Norfolk, Virginia; Los Angeles, California; and Flagstaff, Arizona. In addition, a series of STPI assessments of space weather effects on the electric power grid informed OSTP's understanding of Federal authorities in place to prevent and mitigate a possible catastrophic event that might be caused by the effects of a solar storm.

Innovation and workforce

STPI built on research on innovation, entrepreneurship, and the Federal workforce over the past several years to present recommendations for a revised national innovation strategy. In FY 2015, STPI developed a web-based collection of resources to improve innovation practices within core Federal Government processes. STPI researchers also conducted portfolio analyses of National Science Foundation programs established to support new innovations in smart systems and cybersecurity. Topics of study related to workforce included the effects of the Federal science, technology, engineering, and mathematics (STEM) workforce diversity on innovation in STEM fields; an examination of the plant breeding education and training in academia and industry; and the influence of media on decisions to pursue STEM careers.

National security, biosecurity, and privacy

Threat detection, laboratory biosafety and biosecurity, and personal data privacy and protection were also topics that STPI research touched upon in FY 2015. STPI contributed to the development of a framework for identifying and evaluating current and emerging science and technology prospects, a national strategy on infectious disease forecasting and analysis, and recommendations about Federal Select Agent Regulations and their effect on science, technology, and national security.

National research laboratories

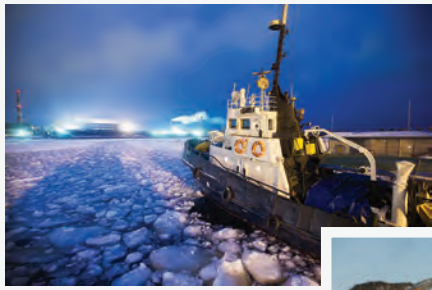
The Federal laboratory system provides critical research and development capabilities that address a spectrum of national priorities. STPI built on research conducted for OSTP in FY 2014 on decision mechanisms and Federal Government processes to help in an evaluation of all 17 Department of Energy Laboratories, in support of the congressionally mandated Commission to Review the Effectiveness of the National Energy Laboratories. STPI also continued its support to the National Science and Technology Council Committee on Homeland and National Security's Subcommittee on National Security Laboratories to develop a national strategy and implementation plan that addresses challenges related to the national defense laboratories' facilities and infrastructure.

Space, aviation, and transportation

OSTP and space mission-related Federal agencies asked STPI to analyze a number of topics related to space and aviation. These have included such wide-ranging topics as overall global trends in space technology to the more focused studies of power requirements for a range of deep space science and exploration missions. STPI assessed near-term civilian space missions and technology development in China, Europe, India, Japan, and Russia for NASA, and provided recommendations based on the implications of these findings. Other STPI research activities included an assessment of space situational awareness services, with an eye towards the growing civilian space market, and a cost-of-casualty estimate to inform calculations for third-party liability insurance for licensed launch and reentry operators.

Federal research assessment

STPI continued its long-standing portfolio of research assessments by embarking on three new projects in FY 2015: evaluation of the research outcomes and career impacts of the National Institutes of Health (NIH) New Innovator Award Program, assessment of the efficacy and research outcomes of the set of NIH Opportunity Network grants in strengthening basic behavioral and social science research, and development of technical requirements for a new NIH data system entitled Portfolio Analysis and Reporting Data Infrastructure. Projects for the National Cancer Institute involved research into cancer clinical trials, cancer care delivery, and performance measures for epidemiology and genomics research. The Intelligence Advanced Research Projects Activity asked STPI to examine how Federal program offices might use new technology forecasting tools to make portfolio investments, and the National Science Foundation requested an inventory of its programs that broaden participation of underrepresented groups and diverse institutions across all U.S. geographical regions. STPI also assessed the state of the science and technology for treating hearing loss.



ENERGY AND ENVIRONMENT

Interagency methane strategy

STPI supported the development of an interagency methane strategy by providing technical expertise to OSTP on monitoring and measuring methane emissions as well as general advice on developing a strategic research framework. The resulting *Climate Action Plan: Strategy to Reduce Methane Emissions* was published by the White House in March 2014. The plan cataloged the sources of methane emissions and proposed a strategy to reduce those emissions while providing more energy to consumers. In FY 2015, OSTP reconvened the interagency task force that had authored the methane measurement and monitoring portions of the strategy. This group was charged with reviewing ongoing research and development activities as well as potential future Federal investment priorities. STPI provided OSTP and the interagency task force with analysis and recommendations for coordinating those Federal efforts with ongoing research at academic and other non-government organizations, as well as State and local government facilities.

Natural gas technology development

As a follow-up to the President's 2013 State of the Union call to make natural gas a cleaner fuel source, OSTP asked STPI to assess the state of carbon capture, utilization, and sequestration at natural gas-fired power plants. STPI analyzed the technical feasibility of a variety of pre- and post-combustion configurations for carbon capture, storage, and utilization and recommended potential incentives that could be used to encourage natural gas power generation, carbon capture, utilization, and sequestration technology development. These findings informed discussions that included OSTP, the Office of Management and Budget, and the Department of Energy in setting funding priorities for research and development in this area. STPI researchers then continued to provide updates to OSTP on the progress of technology development and commercialization.

Earth observations

Earth observation systems, sensors, surveys, and networks provide crucial information on Earth processes, including data on land use and land cover, coastal zone management, weather, natural hazards, and many related Earth and atmospheric science fields. The national infrastructure that provides these observations can inform policy and decisions on critical topics such as climate, environmental health, human health, and extreme weather events. This national infrastructure is coordinated primarily through the U.S. Group on Earth Observations (USGEO) Subcommittee of the National Science and Technology Research Council (NSTC) and the USGEO Program. OSTP asked STPI to provide dedicated analysis to OSTP, the USGEO Subcommittee, and the USGEO Program in support of Federal Earth observation goals.

Following its participation in drafting the 2013 *National Strategy for Civil Earth Observations* and the first government-wide assessment of the U.S. civil Earth observation portfolio, STPI's responsibilities have expanded to include technical and analytical support for the Big Earth Data Initiative and the USGEO's international activities. Further, STPI led an analysis for the second government-wide assessment of the U.S. civil Earth observation portfolio. In FY 2015, STPI helped USGEO develop and release *Common Framework for Earth-Observation Data*, charter a new Satellite Needs Working Group, and establish a process in which civil user-agencies can articulate observing needs for consideration in NASA's systems engineering process. STPI is supporting OSTP in developing a revised national strategy and in outlining a new national plan based, in part, on the results of the second portfolio assessment.

Polar operations

The polar regions received special attention after remarks made in the President's 2015 State of the Union address that emphasized the strategic and environmental importance of the Arctic. Its importance was further underscored by the Executive Order *Enhancing Coordination of National Efforts in the Arctic*. That Executive Order created an Arctic Executive Steering Committee (AESC) to coordinate Federal Arctic priorities and activities among nearly 30 Federal departments and agencies, as well as State, local, and tribal governments. STPI helped OSTP coordinate national efforts in the Arctic through the AESC. STPI also assisted with the AESC's internal 2015 report on Arctic gaps and overlap, the 2015 progress report on the implementation of the national strategy for the Arctic region, and revision of the implementation framework for the national Arctic strategy. The latter two reports are scheduled for release in 2016.

STPI also examined the role of icebreakers—ships especially designed to break up sea ice—in maintaining access to remote, weather-restricted polar regions that may be used for research and national security. To help OSTP evaluate options for Federal policies, STPI assessed the need for and role of icebreakers in Federal mission-critical activities, as well as technical specifications, deployment schedules, and opportunities for agency, industry, and international cooperation. STPI provided OSTP with scenarios for meeting U.S. needs and innovative arrangements for maintaining icebreaking capabilities. The final report was released in November 2015.

The Antarctic Sciences Section in the NSF Division of Polar Programs asked STPI to develop a data collection instrument that would assist the NSF United States Antarctic Program in evaluating the interface between logistical support provided by the Antarctic Support Contract and scientific research conducted within the program. Following an extensive series of interviews and site visits, and in collaboration with NSF staff, STPI identified a set of data elements that assess the delivery of requested logistical support and unanticipated needs as well as specific contractor support functions. STPI also developed a prototype survey tool.

Also, NSF asked STPI to enhance the utility of Arctic data and information products by organizing them into priority areas identified by the various Arctic stakeholders. The priority areas include food, water, and energy security; human health and well-being, including patterns of health and disease, health care delivery, and resources for individual and community-based health decisions; and the environment, including patterns and availability of contaminants, changes in coastal and riverine ecosystems, and marine and terrestrial mammals' migration patterns. Climate concerns and the traditional knowledge of the indigenous Arctic peoples are also addressed in the priority areas. The resulting relational database was made publicly accessible in FY 2015 through the Arctic Hub portal.



DISASTER PREPAREDNESS

Disaster Response

Federal disaster response is made especially challenging by the wide variety of possible natural disasters in addition to the different types of potential large-scale terrorist attacks. OSTP asked STPI to analyze recent disaster response efforts and identify the best practices employed in all mission areas of Presidential Policy Directive 8: prevention, protection, mitigation, response, and recovery. Using a scenario-based approach, STPI assessed the intra- and interagency organization of science and technology resources in response to a power plant disaster, an influenza pandemic, an oil spill, and a Category 5 hurricane. STPI then identified science and technology challenges that arose, as well as opportunities to better define the roles and responsibilities of Federal agencies for surveillance, situational awareness, and communication with each other and government leaders.

OSTP also asked STPI to re-examine cancer risks and the Federal public health response to a hypothetical nuclear accident. The release of the radionuclide iodine-131 from a nuclear power plant accident could cause adverse thyroid conditions and thyroid cancer in exposed individuals. To mitigate this risk, the Federal Government makes potassium iodide available to the populations within a 10-mile radius of nuclear power plants. Potassium iodide can block the thyroid's absorption of radioactive material, thus reducing the risk from radioactive iodine in the environment. In consultation with OSTP staff, STPI developed estimates of the cost to the Federal Government of expanding the provision of potassium iodide to the population within an expanded 20-mile zone surrounding all nuclear power plants. STPI also compared the provisions of the 2002 Bioterrorism Act to current regulations concerning potassium iodide prophylaxis and finalized its report in FY 2015.

Consequent to these efforts, OSTP and the National Science and Technology Council (NSTC) Committee on Environment, Natural Resources, and Sustainability's Subcommittee on Disaster Reduction requested that STPI participate in a new NSTC National Preparedness Science and Technology Task Force. This task force is charged with providing recommendations to better align Federal science and technology activities with the goals of Presidential Policy Directive 8; identifying a process to assess the Nation's capacity to respond, mitigate, and recover from disasters; and coordinating Federal science and technology investments for national preparedness for all types of disasters. STPI will continue its efforts into the next year by providing analytic support to six interagency teams that will conduct a gap assessment and develop recommendations for meteorological, geological, space, biological, chemical, and nuclear hazards and threats. STPI is also participating in the Wildland Fire Science and Technology Task Force that is evaluating options to reduce the risk wildland fires pose to communities and natural resources.

Disaster Resilience

The study of disaster resilience is aimed at reducing the impact of hazard events by minimizing their effect and restoring a community to normal function as soon as possible. At the request of the National Institute of Standards and Technology's community resilience program, STPI performed case study analyses of resilience policy-making in Norfolk, Virginia; Los Angeles, California; and Flagstaff, Arizona. The purpose of the analyses was to understand the approaches to and mechanisms for supporting and institutionalizing disaster resilience policies. STPI identified critical elements of governance approaches, participatory and outreach mechanisms, and structures for policy leadership for resilience policy outcomes, as well as the need for interdisciplinary and cross-agency planning. In FY 2016, STPI will be performing an in-depth case study of the evolution of resilience policy and organizational structures in Boulder, Colorado, following major flooding in 2013.

At OSTP's request, STPI also provided a series of assessments of space weather effects on the electric power grid. These helped inform OSTP's understanding of Federal authorities to prevent and mitigate the impact of a national-scale catastrophic event that might be caused by a solar event. In FY 2014, STPI had analyzed twelve examples of national strategies and implementation plans and developed recommendations for an actionable space weather policy. OSTP used these recommendations to inform the space weather policy developed by a Federal interagency working group and released in FY 2015 in *National Space Weather Strategy* and *National Space Weather Action Plan*.

In parallel to these Federal efforts, the members of the President's Council of Advisors on Science and Technology (PCAST) developed recommendations outlining how the Federal Government can support private sector actions to increase resilience to extreme weather hazards. At PCAST's request, STPI analyzed Federal programs, executive actions, and relevant policies associated with extreme weather hazard resilience. STPI also performed a comprehensive review of best practices and recommendations for private sector engagement in this area. These analyses informed a June 2015 PCAST workshop with private sector participants and a November 2015 letter report from PCAST to the President.





INNOVATION AND WORKFORCE

Federal innovation

In FY 2014, at OSTP's request, STPI produced a series of reports to inform an Administration strategy on American innovation. The reports built on data from extensive interviews with national thought leaders in this area. They also examined new models for regional partnership, analyzed international science and technology innovation strategies, and examined opportunities for innovation in the service sector. In FY 2015, OSTP asked STPI to facilitate the development of a web-based tool to assist Federal agencies in improving innovation in the core processes of government (such as human resources, procurement, and performance management). STPI developed options for the structure and technical governance of an Innovation Toolkit, including processes for content modification and long-term management. The Innovation Toolkit has been highlighted in *A Strategy for American Innovation* as a mechanism for solving public sector innovation-related challenges.

Cybersecurity innovation

The National Science Foundation (NSF) asked STPI to conduct a portfolio analysis of the programs in support of new innovations in smart systems and in support of cybersecurity national priorities. STPI evaluated the Cyber-Enabled Materials Manufacturing Smart Systems (CEMMSS) program, an umbrella initiative consisting of five programs within NSF: National Robotics Initiative, Materials Genome Initiative, Cyber-Physical Systems, Robust Intelligence, and Advanced Manufacturing. STPI employed topic modeling methods to identify prominent themes, established connections between the topics and programs, developed a taxonomy for the CEMMSS initiative, and identified commonalities and gaps across the programs. NSF also requested that STPI assess the Secure and Trustworthy Cyberspace program. This program was designed to promote cybersecurity and support the Nation's ability to produce high-quality digital systems and a well-trained cyber workforce. STPI provided NSF with a cyberspace research and development taxonomy; an outline of the goals, activities, outcomes, and potential impacts of the program; and metrics that will ensure a robust program outcome evaluation.

Science and technology workforce and innovation

In FY 2015, STPI continued to build upon previous work to understand opportunities to strengthen the Federal science, technology, engineering, and mathematics (STEM) workforce. Specifically, OSTP asked STPI to analyze the quantitative impacts of workforce diversity on innovation in STEM fields. Among its findings, STPI determined that the relationship between workforce diversity and innovation depended on a range of factors, such as the type of leadership, effectiveness of human resource strategies,

organizational culture, task complexity, and team longevity. STPI also examined data on diversity in workforce experience, as well as networks and collaboration.

STPI analyzed specialized segments of the Nation's science and technology workforce. For example, OSTP asked STPI to assess the current status of the plant breeding workforce in academia and industry, as well as the educational pipeline supplying the future workforce. To determine the number of professional plant breeders, STPI surveyed academic institutions and private companies, collected institutional research data, and conducted interviews with a number of academics. The survey data and interviews indicated that there has been a significant drop in the number of plant breeders at academic institutions over the past few years. This is mainly due to a lack of funding, with a related result that faculty members are not being replaced following retirements. By providing evidence of a declining workforce and the reasons for the decline, these data can be used to inform efforts to increase the Nation's plant breeding workforce.

For OSTP, STPI also analyzed the role that media plays in influencing decisions to pursue STEM careers. STPI found that media affected awareness of, stereotypes about, interest in, and performance in STEM fields. STPI offered an overview of various reports that indicate young people's career choices are affected by a complex mix of peer influences, parents, teachers, and the surrounding environment, among other factors that may not be fully captured in the current body of literature on the role of media in encouraging STEM careers. The sum of these findings is intended to inform development of a national STEM media strategy.





NATIONAL SECURITY, BIOSECURITY, AND PRIVACY

Threat analysis and countermeasure capabilities

To help implement Presidential Policy Directive 20, OSTP asked STPI to analyze the status of Federal capabilities to counter the spread and use of weapons of mass destruction. STPI determined the current and near-term gaps, needs, and challenges in relevant research and development. For a different project, OSTP asked STPI to study portable air defense systems that can be carried and deployed by an individual. These systems have become increasingly sophisticated and lethal, requiring more advanced countermeasures. STPI evaluated inventories, technology capabilities and trends, threat potential, and countermeasures for these portable weapons and the need for a Federal strategy and coordination of agency activities.

Research for national security

Scientific discoveries have been important in sustaining U.S. national security. Such discoveries originate from a variety of sectors—universities, Federal research laboratories and institutes, and industry. Knowing where to best invest, and what developments to build upon, for national defense can be a challenge. It is not only difficult to identify and leverage emerging science and technology opportunities, it also requires both breadth and depth of knowledge across many disciplines. OSTP asked STPI to develop a prototype framework for identifying and evaluating current and emerging science and technology prospects using criteria such as feasibility, expected beneficial uses, and outcomes for national security. STPI analyzed current foresight techniques, products, and data sources; selected topic areas; and identified data sources for this framework.

Biosecurity

Following several biosafety incidents at U.S. Government laboratories reported in 2014, the National Security Council and OSTP issued a joint memorandum outlining a series of short- and long-term actions to enhance laboratory biosafety and biosecurity practices. Long-term actions included the engagement of the broader biosafety communities in determining how Federal Select Agent Regulations have impacted science, technology, and national security in the United States. STPI worked closely with OSTP staff and representatives from an interagency task force to engage the select agent research community, collect relevant information, and conduct portions of a comprehensive analysis. STPI also helped draft a report and develop a plan to implement the included recommendations. The resulting NSTC *Fast-Track Action Committee Report: Recommendations on Select Agent Regulations Based on Broad Stakeholder Engagement* was released in October 2015.

Infectious disease forecasting and mitigation

A national capability to identify an infectious disease outbreak rapidly, and forecast its probable trajectory, duration, and magnitude, will play a key role in protecting the future health of the American people. At OSTP's request, STPI provided the NSTC Committee on Homeland and National Security's Subcommittee on Biological Defense Research and Development with quantitative and qualitative assessments of short- and long-term science and technology gaps related to national biodefense capabilities. This analysis allowed the Subcommittee to conclude that the current surveillance systems are effective in determining where and when disease activity has already occurred, but they are not optimized to forecast disease progression or the impact of mitigation measures. Following that assessment, STPI worked closely with OSTP and the NSTC Pandemic Prediction and Forecasting Science and Technology Working Group to develop a national strategy on capabilities for epidemic forecasting and analysis. These capabilities are designed to provide authoritative information to assist decision makers in acting quickly to save lives and minimize the negative economic consequences of infectious disease outbreaks. Public release of the strategy is anticipated in 2016.

Privacy and public trust

As part of the Precision Medicine Initiative, the White House released a set of draft principles to protect privacy and build public trust when collecting medical data. These guidelines are specifically aimed at recruiting a cohort of one million or more participants who would voluntarily contribute their health data for medical research. OSTP asked STPI to provide information on policies and laws in all 50 States related to informed consent, data security, and health information privacy. STPI's analysis is continuing into 2016 and, when complete, will help to create privacy and security protocols for participants in the initiative.





NATIONAL RESEARCH LABORATORIES

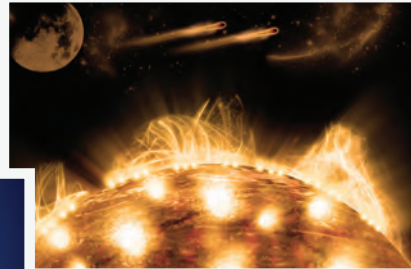
National energy laboratories

At the request of the Commissioners, and with the concurrence of OSTP and the Department of Energy, STPI provided strategic analyses and support to the congressionally mandated Commission to Review the Effectiveness of the National Energy Laboratories. Congress instructed the Commission to evaluate the laboratories in terms of their alignment with the Department of Energy's strategic priorities, looking for possible duplication, their ability to meet current and future energy and national security challenges, as well as their size and support of other Federal agencies. The Commission was also asked to review the efficiency and overall effectiveness of the laboratories, including overhead costs and the burden of the Department's oversight and management approach. Congress also had questions related to the use of laboratory-directed research and development (LDRD) funds such as the effectiveness of the Department's oversight approach and the extent to which LDRD funding supports recruiting and retention of qualified staff. STPI supported the Commission during its deliberations, from May 2014 to October 2015.

Working closely with the Commissioners, STPI gathered and analyzed information from literature reviews, site visits to all 17 national laboratories, interviews with staff at more than 100 offices across the government and other sectors, and testimony by 85 witnesses at monthly public meetings of the Commission. STPI scoped the review, determined the topics of focus, and wrote and incorporated comments into the Commission's interim report (released February 2015) and final report (released October 2015). In addition to organizing all public meetings, determining the topics and speakers with guidance from the Commissioners, and arranging all laboratory site visits for the Commission, STPI met frequently with OSTP staff to keep them informed of Commission developments, to provide analytical reviews of the Commission's multiple ongoing and recently completed studies, and to facilitate meetings between Commission and Executive Office members.

National security laboratories

The Office of the Secretary of Defense asked STPI to participate in the ongoing work of the NSTC Committee on Homeland and National Security's Subcommittee on National Security Laboratories. Through its involvement with the Subcommittee, STPI engaged with facility and program managers across the Federal research, development, test, and evaluation enterprise. STPI provided support for the development of a national strategy and implementation plan that addresses challenges in prioritization, budgeting, and evaluation of national laboratory facilities and infrastructure.



SPACE, AVIATION, AND TRANSPORTATION

Global trends in space

At the request of the Office of the Director of National Intelligence and NASA, STPI conducted several assessments related to emerging capabilities and trends in civilian and commercial space at the global and national levels. STPI also assessed the implications of those trends for the U.S. space community, principally NASA. STPI reported on trends that are likely to present challenges to U.S. science and technology leadership in space; research also examined space security and economic competitiveness. Two major findings were reported: first, the space sector is establishing its independence from the military/government sector in a few major space-faring countries; and second, demand pull is emerging from governments worldwide, as more countries act on their space aspirations, and from a private sector that is mostly based in the United States but with global reach. STPI concluded that, as the number of actors increases, the space sector will likely see increased competition and overcrowding, which, in turn, will lead to more products, services, and governance structures that can either support or detract from the needs of a growing sector.

Because space missions have become increasingly multinational, NASA asked STPI to explore the roles that major space-faring nations might play in its future missions. STPI identified the principal near-term civilian space missions and areas of technological development for China, Europe (with a focus on the European Space Agency, France, Germany, and Italy), India, Japan, and Russia. Based on the aggregate global trends and specific trends in selected emerging space powers, STPI identified and contextualized the implications for NASA and provided recommendations that would allow NASA to leverage these trends, especially in building partnerships.

Space nuclear power

Deep space missions require electric power that ranges from hundreds to thousands of watts for propulsion systems and, depending on the mission, for instrumentation such as onboard sensors, tele-operated rovers, remote science packages, and communication relay stations. Human space flight to planetary surfaces and outer planets will require even more power. OSTP asked STPI to assess the power requirements for a range of deep space science and exploration missions and to identify strengths, limitations, and current state-of-the-art of each power source. STPI is identifying potential deep space concepts and activities for the next 25–50 years, estimating the power requirements for these missions, and evaluating options for power generation. The final report will be delivered in FY 2016.

Space situational awareness and space traffic management

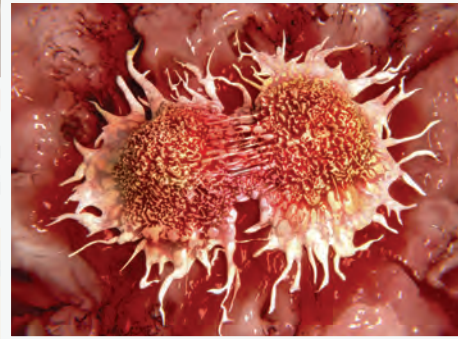
The President's November 2013 National Space Transportation Policy and the National Space Policy direct the Secretary of the Department of Transportation (DOT) to evaluate orbital debris mitigation practices for U.S.-licensed commercial launches. The policies also direct Federal agencies to lead efforts in improved information collection and sharing for orbital safety. As part of the Department of Transportation's response to this directive, the Federal Aviation Administration (FAA) asked STPI to independently and objectively assess space situational awareness services, identify policy implications and candidate space management architectures, and conduct a business case analysis to support future acquisition decisions and program development. This assessment will be completed in FY 2016.

The FAA determines the amount of insurance that licensed launch and reentry operators must obtain for third-party liability insurance. One factor that determines insurance estimates is the amount of damages, in terms of the likely payout per casualty. The FAA asked STPI to perform an analysis to identify a cost-of-casualty estimate to inform FAA's calculations for requisite insurance. To accomplish this task, STPI has been analyzing private sector and other governmental resources and reviewing insurance claims and settlements to identify relevant events to approximate the distribution of potential payouts in the event of a space launch or re-entry failure. These findings will be presented to FAA in 2016.

Strategy development and portfolio analysis

The 2006 National Aeronautics Research and Development Policy provided top-level guidance for U.S. aeronautics research and development programs. OSTP, working with the mission-related NSTC subcommittees, was charged with developing strategies and plans that enable implementation of that policy, as well as coordinating the relevant U.S. space technology research and development programs. STPI used the experience it gained through participation in the Space Technology Response to Congress and the National Rocket Propulsion Strategy to host, at OSTP's request, an FY 2014 stakeholder workshop that explored the research frontiers of biomass-to-jet fuel conversion and the supply chain for production and commercialization of cost-competitive alternative fuels. Building on this, STPI analyzed the workshop findings in FY 2015 and delivered a draft biofuels strategy that outlines research and development goals and objectives for feedstock development, production, and logistics; fuel conversion, scale-up, testing, and evaluation; and production, deployment, and environmental sustainability.

At the request of the Air Force Research Laboratory's Human Effectiveness Directorate (HED), STPI is building on the experience gained during its FY 2014 analysis of the Air Force Office of Scientific Research portfolio to assess the alignment of the HED's research with Air Force strategic vectors. As part of this effort, STPI is developing portfolio management approaches to best leverage the Directorate's research capabilities. In performing this review, STPI is analyzing the three current HED portfolio foci as they relate to overall Air Force research needs, as well as providing a review of research portfolio management best practices. A final report will be delivered in FY 2016.



FEDERAL RESEARCH EVALUATION

Program assessments

The National Institutes of Health (NIH) has sought STPI expertise for over 60 separate projects since 2008. These have primarily been efforts that evaluate NIH's extramural research enterprise, including program content and award process, outcomes and impact evaluation, and strategic planning. At the close of FY 2014, the Division of Program Coordination, Planning, and Strategic Initiatives (DPCPSI) in the Office of the NIH Director asked STPI to conduct an 18-month evaluation of the research outcomes and career impacts of its high-risk, high-reward research program, known as the New Innovator Award Program. During FY 2015, STPI reviewed definitions of creativity, high risk, high reward, and innovativeness; developed surveys, interviews, and statistical approaches; and provided three briefings to DPCPSI staff. Data collection will be completed in the first quarter of 2016, and the final report will be provided to NIH later in FY 2016.

STPI also developed technical requirements for the NIH Portfolio Analysis and Reporting Data Infrastructure (PARDI) system, which will add new capabilities to the existing NIH data system for portfolio analysis, reporting, and program evaluation. PARDI will support access to (1) enhanced data on publications, patents, and clinical trials enrollment; (2) publications associated with clinical practice guideline references; and (3) data on people trained through NIH grants. To help NIH meet its goals for PARDI, STPI conducted a needs assessment, analyzed existing databases and tools that would extract the relevant data, and developed a conceptual architecture for the system. NIH anticipates releasing the initial version of PARDI in late 2016.

STPI conducted three projects for the National Cancer Institute (NCI) in FY 2015. First, STPI provided guidance for coordinating the research program for cancer care delivery across NCI Community Oncology Research Program (NCORP); analyzed the care delivery infrastructure, the information technology infrastructure, and the organization infrastructure; and developed metrics for evaluating the performance of sites that provide cancer care. Second, STPI provided analyses in three areas: strategic priorities to guide future late-phase clinical trials; a process for assessing the quality of the ongoing clinical trials portfolio; and reengineering the clinical trials enterprise. Third, STPI helped develop performance measures for reproducibility, data sharing, and translation in epidemiology and genomics research. Following pilot analyses, literature reviews, and interviews with experts, STPI identified data sharing as the area in which NCI might benefit most directly from metrics of research efforts. This project is continuing into 2016 as STPI analyzes data sharing practices by two epidemiological cohorts to determine the feasibility of a larger evaluation.

In other efforts for NIH, STPI conducted a portfolio analysis of behavioral and social science research (BSSR) and basic behavioral and social science research (b-BSSR) using topic modelling to better understand the scientific content of the BSSR/b-BSSR research portfolio and the distribution of BSSR/b-BSSR research funding. In addition, STPI is conducting an evaluation of the Basic Behavioral and Social Science Opportunity Network, which was established in 2009 to strengthen basic behavioral and social science research at NIH.

Technology forecasting

Tools that can predict a technology's future characteristics or applications could help the Federal Government in a range of mission-specific goals, such as managing a research portfolio and identifying emerging threats. The Intelligence Advanced Research Projects Activity (IARPA) asked STPI to examine how Federal program offices currently use, or could potentially use, technology forecasts in making decisions. STPI interviewed Federal program managers, analysts, and policy advisors from 12 programs that use information about new or emerging technologies or technology applications for decision-making. Most of the interviewees generally rely on subject matter experts. The respondents have varying levels of distrust of automated forecasting tools, and would prefer automated tools that help analysts make technology forecasts rather than tools that automatically produce technology forecasts. These results could be used to develop use case scenarios that could guide IARPA's development and implementation of new tools.

Portfolio analysis methods

At the request of NSF, STPI developed a four-step portfolio evaluation framework. The framework defines themes and thematic portfolios, develops logic models to define model components, identifies data for collection, and collects the data for a given portfolio. The framework was tested with the theme of science learning for pre-kindergarten through 5th-grade students, and categories of outputs and outcomes from this exercise were mapped to the NSF Research Performance Progress Report system. This project was subsequently expanded to support the NSF Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (INCLUDES) Working Group. Also during FY 2015, STPI began an inventory of programs related to the participation of underrepresented groups and diverse institutions in NSF programs, with a goal of assessing best practices.

Hearing loss in the older population

In response to a request by the President's Council of Advisors on Science and Technology (PCAST), STPI assessed the state of the science and technology of hearing loss and mitigation. STPI reviewed the literature and interviewed subject matter experts to document the types of hearing loss that occur in older people, the methods used to assess hearing loss, and the current and emerging technologies to mitigate hearing loss. The impact of hearing loss on cognitive function and the ability to live independently, current health care coverage, and State and Federal legislation were also analyzed. PCAST released *Report on Hearing Loss* in October 2015.



CONCLUSION

STPI had a broad, comprehensive portfolio of projects in FY 2015 that cut across the spectrum of science, technology, and policy challenges facing the Federal Government. The various projects and reports undertaken this year have continued to position the Institute to provide OSTP and other Federal agencies with timely, rigorous, independent, and objective analyses.

To ensure its continued relevance, STPI meets frequently with the Director of OSTP and his staff at all levels. Such close coordination—coupled with flexible tasking procedures—ensures STPI focuses on OSTP’s top priorities and enables STPI to change course rapidly when needed to address emergent problems. The FY 2015 contributions described in this report are the products of not only the close working relationship maintained between OSTP and STPI, but also of the increasingly strong relationships being established between STPI and other Federal agencies with science and technology responsibilities. We look forward to sustaining and strengthening these relationships in support of the Nation’s science and technology interests.

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