



# Science & Technology Highlights

*in the Second Year of the  
Trump Administration*



*“We stand at the birth of a new millennium, ready to unlock the mysteries of space, to free the Earth from the miseries of disease, and to harness the energies, industries, and technologies of tomorrow.”<sup>1</sup>*

*– President Donald J. Trump*

## Foreword

The Office of Science and Technology Policy (OSTP) is charged with advising the President on how his Administration can effectively support the development and application of science and technology (S&T) for the benefit of the American people, the creation of new jobs and industries, the security of our homeland, the well-being of our Nation, and the prosperity of our people. The Trump Administration is ensuring the future is built in America by American workers for the good of the American people and true to American values. During the second year of the Trump Administration, OSTP has made great strides in supporting America's bright future.

### Welcoming a New Director

In January 2019, OSTP welcomed the confirmation of Dr. Kelvin Droegemeier as its new Director. Dr. Droegemeier brings to OSTP extreme weather expertise that has improved predictions and saved countless lives. He also has a deep knowledge in science policy from his time on the National Science Board over multiple administrations and a passion for science education. Dr. Droegemeier was a professor and Vice President of Research at the University of Oklahoma, where he taught for more than three decades.

### Developing National Strategies

OSTP has had an eye to the future, developing national strategies on education and emerging technology that have positioned America for success for generations to come. We restructured and streamlined Federal interagency collaboration on Research and Development (R&D) through the National Science and Technology Council. And we developed a new vision for ocean science and technology and released national strategies for 5G, advanced manufacturing, quantum information science, and STEM literacy for jobs of the future.

### Hosting Marquee Events

Often, the best ideas come from getting the right people together in a room. OSTP hosted major events that brought together industry leaders, CEOs, academics, nonprofit leaders, Nobel laureates, and government officials to discuss S&T subjects vital to our Nation's future. In 2018 we gathered these leaders at the White House to discuss quantum information science and Artificial Intelligence (AI) to chart a national course for coordinating and advancing research and development for these industries of the future.

### Celebrating First-Time Achievements

This past year, our Nation also celebrated numerous milestones. President Trump signed new legislation encouraging innovation in Unmanned Aircraft Systems (UAS) technologies. Scientists at our national labs discovered a new way to domestically produce at scale medical isotopes to treat late-stage prostate cancer. America is home again to the world's most powerful supercomputer, *Summit*. The United States-Mexico-Canada Agreement (USMCA) includes the strongest digital trade commitments ever negotiated and presents Congress with an easy bipartisan win. The Defense Advanced Research Projects Agency launched a \$2 billion AI investment to improve national security. And on June 19, 2018, the United States issued its 10 millionth patent, a testament to American ingenuity.

### Looking back...

...at the second year of the Trump Administration, this document highlights merely a selection of our Nation's tremendous S&T achievements.

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## 5G and Rural Connectivity

*“The growth in the availability of mobile wireless broadband connectivity over the past decade has reshaped the American experience — the way Americans work, learn, shop, run businesses, transport their families and goods across the Nation, farm, conduct financial transactions, consume entertainment, deliver and receive public safety services, and interact with one another.”*<sup>2</sup> –President Trump

**Developing a long-term national spectrum strategy.** In October, President Trump signed a Presidential Memorandum directing agencies led by the Department of Commerce (DOC) National Telecommunications and Information Administration (NTIA) to develop a national strategy for spectrum policy that accelerates America’s deployment of 5G. This strategy will help ensure American leadership in 5G, fuel American job growth and economic prosperity, and protect our national security through technological advancement.<sup>3</sup>

**Promoting public and private sector collaboration to advance the Nation’s 5G innovation and dominance.** In September, the White House gathered leaders from industry, government, and academia to discuss advancing American leadership in 5G.<sup>4</sup> The Federal Communication Commission discussed its 5G FAST (Facilitate America’s Superiority in 5G Technology) plan, which will push more spectrum into the marketplace, update infrastructure policy, and modernize outdated regulations.<sup>5</sup>

**Driving innovation in wireless technologies and connected communities.** In April, the National Science Foundation (NSF), in collaboration with an industry consortium of 28 computer networking companies and associations, initiated support for the development and deployment of the first two Platforms for Advanced Wireless Research (PAWR).<sup>6</sup> These platforms, based in Salt Lake City and New York City, will enable early-stage research to push forward robust, new wireless devices, techniques, protocols, and services. The collaboration will ena-

ble promising technologies to move quickly to market, with potential benefits ranging from autonomous vehicles to real-time emergency management.

**Coordinating agency actions to promote rural broadband deployment.** In January 2018, the Rural Prosperity Task Force Report recommended the development of an interagency strategy to promote the deployment of broadband in rural America.<sup>7</sup> In response, Federal agencies are taking action to increase private sector investment in broadband, including streamlining Federal permitting, leveraging Federal assets, and maximizing the impact of Federal funding.

**Streamlining and expediting requests to locate broadband facilities in rural America.** In January, President Trump directed the General Services Administration (GSA) to examine the effectiveness of the existing Common Form application for locating communications facilities on Federal property. GSA collected feedback and is working with agencies to make improvements. In addition, the Department of Interior (DOI) was tasked with developing a plan to increase access to tower facilities to facilitate deployment of commercial broadband.<sup>8</sup> The Administration and key agencies continue to implement the directives from the President and have made significant progress in increasing access.

## Advanced Manufacturing

*“Through clear-eyed economic and trade policies and advances made possible by cutting-edge research and development, American industry is thriving once again. Today, our country’s manufacturers are more confident than ever before about investing in factories and workers right here at home.”*<sup>9</sup> –President Trump

**Ensuring national security and economic prosperity through leadership in advanced manufacturing.** In the face of intense global competition, President Trump unveiled a National Strategic Plan on Advanced Manufacturing in October that focuses on defending the economy, expanding manufacturing employment, and ensuring a strong manufacturing

and defense industrial base and a resilient supply chain.<sup>10</sup>

**Advancing manufacturing skills in the workforce.**

From providing training for veterans to advancing technologies developed in the labs, the Federal network of Manufacturing USA institutes convened players across the manufacturing community to address the Nation’s pressing manufacturing technology and competitiveness needs. Through 2018, the institutes engaged more than 1,300 member organizations, sponsored more than 270 R&D projects, attracted more than \$2 billion in private investment leveraging \$1 billion in Federal funds, and equipped more than 200,000 people with advanced manufacturing skills needed to pursue high-paying jobs.<sup>11</sup>

**Driving advancements to realize the potential of additive manufacturing.**

The Department of Energy (DOE) Manufacturing Demonstration Facility (MDF) at Oak Ridge National Laboratory has hosted over 25,000 visitors in pursuit of state-of-the-art additive manufacturing technologies. Through over 130 Cooperative Research and Development Agreements, MDF collaborates with industry to develop advanced additive systems. Over 35 systems, totaling more than \$12 million – with \$7 million in systems awaiting arrival – are in use at the MDF today.<sup>12</sup> In June, the National Institute of Standards and Technology (NIST) hosted 175 participants from industry and academia at the Additive Manufacturing Benchmarks 2018 technical symposium to test and improve models used for process control and monitoring of additive manufacturing, a method that can revolutionize manufacturing sectors in terms of cost per part and system performance.<sup>13</sup>

## Artificial Intelligence (AI)

*“We’re on the verge of new technological revolutions that could improve virtually every aspect of our lives, create vast new wealth for American workers and families, and open up bold, new frontiers in science, medicine, and communication.”<sup>14</sup>*

–President Trump

**Multipronged approach to accelerating our national leadership in AI.** The President is supporting American leadership in AI through his landmark Feb-

ruary 11, 2019 Executive Order on Maintaining American Leadership in Artificial intelligence.<sup>15</sup> The Administration will take a multipronged approach which includes several important pillars: prioritizing research and development investments in AI; strengthening AI infrastructure by making Federal data, model, and computing resources more available to AI R&D experts; improving AI governance by establishing guidance for AI development and use across technologies and industrial sectors; preparing our workforce with skills needed to adapt and thrive in the age of AI; and engaging internationally to promote an environment that supports AI R&D and opens markets for American AI Industries, while also protecting our AI technology advantage against foreign adversaries.

**Unlocking the promise of AI for the American people.**

In May, the White House hosted the Artificial Intelligence for American Industry Summit to discuss the promise of AI and the policies needed to realize that promise for the American people and maintain United States leadership in the age of AI.<sup>16</sup>

**Coordinating R&D leadership on AI.**

In May, the White House chartered a Select Committee on Artificial Intelligence under the National Science and Technology Council (NSTC) to plan and coordinate R&D efforts across the Federal enterprise to ensure continued United States leadership in AI.<sup>17</sup>

**Updating the National AI R&D Strategic Plan.**

In September, the Select Committee on AI issued a Request for Information (RFI) to solicit input on the 2016 National AI R&D Strategic Plan and to determine ways in which the strategy should be revised or improved. The responses to this RFI are informing an update to the strategic plan to help ensure that the United States continues to invest in cutting edge AI innovations.<sup>18</sup>

**Developing the next wave of AI technologies.**

In September, the Defense Advanced Research Projects Agency (DARPA) launched the \$2 billion AI Next Campaign to create the next wave of AI technologies that can adapt to changing situations and demonstrate increased robustness, reliability, security, performance, and applications.<sup>19</sup>

**Delivering new AI-enabled capabilities in support of our national defense.**

In June, the Department of Defense (DOD) stood up the Joint Artificial Intelligence Center in response to the 2018 National De-

fense Strategy to enable DOD to accelerate the delivery of new, AI-enabled capabilities and experiment with new operating concepts to support military missions and business functions.<sup>20</sup>

**Approving the first ever AI-based device for medical diagnostics.** In April, the Food and Drug Administration (FDA), a component of the Department of Health and Human Services (HHS), approved the first ever AI-based device for medical diagnostics to detect diabetic retinopathy, the leading cause of blindness among working-age Americans.<sup>21</sup> This device can be used for early detection of this disease to improve the healthcare screening of people with diabetes by primary care physicians who are not normally involved in eye care.

**Piloting use of AI for regulatory compliance.** Because of the variability in contracting practices across agencies, regulatory compliance of contracts is a time consuming and challenging task. In March, GSA announced a pilot program to address this challenge through the use of an AI-based tool that automatically determines whether an agency's contract solicitation complies with Federal regulations.<sup>22</sup>

**Gaining international recognition of the importance of AI.** In March, OSTP negotiated the 2018 G7 Innovation Ministers' Statement on Artificial Intelligence, following an AI outcome document from the 2017 G7 innovation ministerial, which recognizes the importance of AI innovation for economic growth and supports efforts to promote trust in the adoption of AI technologies.<sup>23</sup> Outside of United States borders, the Administration is taking steps to ensure a fair and level playing field for AI technologies. At the World Trade Organization and in trade agreements like the United States-Mexico-Canada Agreement, the Administration is protecting United States intellectual property related to AI by limiting the ability of foreign governments to require disclosure of proprietary computer source code and algorithms to better protect the competitiveness of our digital suppliers, and promoting access to government-generated public data to enhance innovative use in commercial applications and services.

**Shaping the human-technology partnership in the workplace.** In 2018, NSF invested more than \$25 million in 26 projects to advance human-technology collaboration in the workplace and enhance productivity, innovation, and learning with technologies,

including AI.<sup>24</sup> The awards were issued under the Future of Work at the Human-Technology Frontier (FW-HTF) Big Idea, one of 10 Big Ideas for Future NSF investments.<sup>25</sup> These investments expanded NSF's more than \$100 million annual investment in fundamental AI research.

## Advanced Transportation

*“UAS [Unmanned Aircraft Systems] present opportunities to enhance the safety of the American public, increase the efficiency and productivity of American industry, and create tens of thousands of new American jobs.”<sup>26</sup> –President Trump*

**Safely integrating drones into our national airspace.** In 2017, President Trump directed the Secretary of Transportation to establish the Unmanned Aircraft Systems Integration Pilot Program, which the President signed into law with the 2018 Federal Aviation Administration (FAA) Reauthorization Act.<sup>27</sup> In May 2018, the Department of Transportation (DOT) selected 10 state, local, and tribal governments as participants in the Program.<sup>28</sup> Data gathered from these pilot projects will form the basis of a new regulatory framework.<sup>29</sup> Safe integration of drones into national airspace will have immediate benefits for commerce, photography, emergency management, public safety, precision agriculture, and infrastructure inspections.<sup>30</sup>

**Encouraging integration of safe new transportation technologies.** As part of the 2018 FAA Reauthorization Act, the Trump Administration is establishing new conditions for the recreational use of drones.<sup>31</sup> In January 2019, DOT proposed new rules to allow drones to fly at night and over people without waivers under certain conditions and to further integrate drones safely into the national airspace system. DOT also announced the Unmanned Aircraft System Safe and Secure Advanced Notice of Proposed Rulemaking. This proposal identifies major drone safety and security issues that may pose a threat to other aircraft, to people on the ground, or to national security. It solicited recommendations to reduce these risks as drones are integrated into our national airspace.<sup>32</sup>



**Encouraging safe integration of automated vehicles into transport systems.** In October, DOT released new guidance for automated vehicles, entitled “Preparing for the Future of Transportation: Automated Vehicles 3.0”. This report encourages the safe integration of automated vehicles into the multimodal surface transportation system.<sup>33</sup>

**Advancing the development of civil supersonic aircraft.** In October, as part of the 2018 FAA Reauthorization Act, the Trump Administration is taking a new look at supersonic air travel. The legislation initiates rulemaking activities on civil supersonic aircraft noise and supersonic flight-testing.<sup>34</sup> Additionally, National Aeronautics and Space Administration (NASA) continued research on methods to reduce sonic booms, completing a pivotal test flight in November.<sup>35</sup> In December, NASA and an outside partner began final design and initial manufacturing of the X-59 Quiet SuperSonic Technology (QueSST) aircraft that will study how reducing sonic boom could lead to acceptance of supersonic flight over land.<sup>36</sup>

## Cybersecurity

*“Collaboration among all United States Government departments and agencies... ha[s] improved Federal network cybersecurity, enhanced coordination with the private sector to protect critical infrastructure, strengthened our ability to detect and deter cyber threats, and expanded efforts to build the world’s best cybersecurity workforce.”<sup>37</sup>*  
—President Trump

**Employing a new National Cyber Strategy to protect Americans in the digital domain.** In September, President Trump released the first national cybersecurity strategy in 15 years.<sup>38</sup> The National Cyber Strategy identifies decisive priority actions to protect the American people in the digital domain, including fostering and protecting American invention and innovation, which is critical to maintaining the United States’ strategic advantage in cyberspace, and prioritizing national critical infrastructure security and resilience research and development.<sup>39</sup>

**Accelerating research, development, and demonstration of cyber-resilient energy delivery systems.** In February, DOE established a new Office of Cybersecurity, Energy Security, and Emergency Response

to focus on energy infrastructure security.<sup>40</sup> Among other missions, the Office will accelerate research, development, and demonstration of cyber-resilient energy infrastructure to reduce the risk that energy delivery might be disrupted by cyber incidents.<sup>41</sup>

**Establishing an implementation roadmap for Federal cybersecurity R&D.** In August, the Administration developed the FY2019 implementation roadmap identifying projects and programs being planned or carried out in fiscal years 2018, 2019, and beyond, to meet the objectives of the 2016 Federal Cybersecurity Research and Development Strategic Plan. The Administration, through the Networking and Information Technology Research and Development (NITRD) program, also initiated an interagency effort to update the Federal strategic plan, to be released in 2019. A Request for Information was posted in the Federal Register to encourage public input on Federal priorities in cybersecurity R&D.<sup>42</sup>

**Increasing awareness and adoption of cybersecurity risk-management best practices.** In April, NIST published version 1.1 of the NIST Cybersecurity Framework, providing additional guidance on authentication and identity, self-assessing cybersecurity risk, managing cybersecurity within the supply chain, and addressing vulnerability disclosure. In the first six months of its release, V1.1 of the Framework has been downloaded more than 205,000 times.<sup>43</sup>

**Enhancing the resilience of the Internet and communications ecosystem.** In May, DOC and the Department of Homeland Security (DHS) released a report that offers a guide to government, civil society, and industry actions that would dramatically reduce the threat of botnets and similar cyberattacks. The report, *Enhancing the Resilience of the Internet and Communications Ecosystem Against Botnets and Other Automated, Distributed Threats*, lists complementary goals and suggested actions that would improve the resilience of the Internet ecosystem.<sup>44</sup>

## Digital Economy

*“We will support a vibrant and resilient digital economy.”<sup>45</sup>* —President Trump

**Preventing international restrictions on digital trade and cross-border data flows.** The United States reached agreement with Mexico and Canada



on the USMCA: a new chapter covering Digital Trade. When enacted, this agreement will include the strongest digital trade commitments ever negotiated.<sup>46</sup>

**Leading negotiations in support of the digital economy.** OSTP worked with other countries to prevent regulatory barriers to the digital economy, promote the flow of information, and oppose data localization requirements through negotiated language at international fora such as the G20, the G7, the East Asia Summit, and the Asia-Pacific Economic Cooperation.

## Environment

*“We cherish our magnificent land and waterways, abundant natural resources, and unique wildlife. As a Nation, it is our duty to recognize the importance of these life-sustaining gifts, and it is our responsibility to protect them for our own benefit and that of generations to come.”<sup>47</sup> –President Trump*

**Addressing critical gaps in understanding drinking water contaminants.** In October, the Task Force on Emerging Contaminants released a cross agency plan for addressing contaminants of emerging concern (CECs), research gaps, existing programs and activities related to the gaps, and opportunities for strategic partnerships.<sup>48</sup> This new plan addresses critical research gaps related to detecting, assessing exposure, and identifying potential adverse health effects of emerging contaminants in drinking water.

**Meeting the global need for safe, secure, and affordable water.** In October, DOE announced the launch of the Water Security Grand Challenge, a White House initiated, DOE led framework to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water. Using a suite of prizes, competitions, early-stage research and development funding opportunities, and critical partnerships, the Water Security Grand Challenge sets ambitious goals for the United States to reach by 2030. DOE will partner with the Environmental Protection Agency to bring clean and safe water to communities across the country.<sup>49</sup>

**Advancing seismic research.** Data acquired by the U.S. Geological Survey (USGS) on the U.S. Atlantic Margin in August revealed new information about the distribution of gas hydrates and other geological structures stretching from the upper continental slope to deep water areas offshore New Jersey to North Carolina. USGS, DOE, and the Bureau of Ocean Energy Management (BOEM), sponsored a Mid-Atlantic Resource Imaging Experiment (MATRIX) which acquired marine seismic data that will be used for decades to support broader analyses of the margin’s hazards, stratigraphy, deep structure, and ecosystems by the USGS, other agencies, and the academic community.<sup>50</sup>

## Energy Dominance

*“America’s future has never been brighter, and American energy is leading the way in providing jobs, opportunity, and security for our Nation.”<sup>51</sup> –President Trump*

**Reviving and expanding our nuclear energy sector.** On January 14, 2019, President Trump signed into law the Nuclear Energy Innovation and Modernization Act. This legislation will accelerate licensing for advanced nuclear reactors.<sup>52</sup> In September 2018, President Trump also signed into law the Nuclear Energy Innovation Capabilities Act, the first stand-alone nuclear innovation legislation which calls for DOE to build a Versatile Neutron Source and to establish a National Reactor Innovation Center so that our innovators can build pre-commercial reactor prototypes here in America.<sup>53</sup> These two laws are critical steps to revive and expand our nuclear energy sector. DOE, in partnership with private industry, is also making excellent progress in developing Accident Tolerant Fuels to further enhance nuclear fuel reliability and the economics of nuclear reactor operations.<sup>54</sup> The successful development of Accident Tolerant Fuels will enhance the safety and efficiency of our nuclear fleet.

**Achieving energy dominance in exports of crude oil and natural gas.** In 2018, the United States became the world’s top producer of crude oil.<sup>55</sup> In addition, United States natural gas exports in the first half of 2018 were more than double the 2017 average. The increase in shale oil and gas production follows years of investment and research carried out by DOE and industry joint ventures.<sup>56</sup>

**Pursuing game-changing off-grid small mobile nuclear reactors.** DOD, supported by DOE, is evaluating the development of small mobile nuclear reactor designs that can address electrical power needs in rapid response scenarios. Small mobile nuclear reactors can make our domestic infrastructure resilient to an electrical grid attack by making more energy available and by drastically simplifying the complex fuel logistical lines that currently support existing power generators operating mostly on diesel fuel.<sup>57</sup>

**Producing high-assay low-enriched uranium.** DOE announced that it will fabricate high-assay low-enriched uranium (HALEU) fuel from the HALEU currently stored at the Idaho National Laboratory (INL), which is critical for many advanced nuclear technologies.<sup>58</sup> This will support near-term research, development, and demonstration needs for advanced reactor designs. These technologies allow for smaller plant sizes, longer core life, and higher burnup of nuclear waste. There is currently no commercial source of HALEU. In addition, DOE is planning to fund a demonstration project of United States enrichment technology to provide a strong signal to potential vendors that there will be a proven domestic capability to produce HALEU when the market demands it.

## Health and Medicine

*“We will work every day to ensure all Americans have access to the quality, affordable medication they need and they deserve.”<sup>59</sup> –President Trump*

**Improving veterans’ health.** DOE and the Department of Veterans Affairs (VA) built on the Million Veteran Program (MVP) Computational Health Analytics for Medical Precision to Improve Outcomes Now, a partnership launched in 2017 to leverage next-generation AI and supercomputing technologies to improve health outcomes for veterans.<sup>60</sup> Priority areas include suicide prevention, opioid abuse, and traumatic brain injury. Veterans with cancer who receive treatment from the VA will now have easier access to clinical trials of novel cancer treatments, thanks to the VA and HHS’s National Cancer Institute (NCI) Interagency Group to Accelerate Trials Enrollment, or NAVIGATE.<sup>61</sup> Launched in July 2018 at 12 VA facilities across the country, NAVIGATE will enhance the ability of veterans to participate in trials carried out

through NCI’s National Clinical Trials Network and the NCI Community Oncology Research Program.

**Galvanizing research to address the world’s leading infectious cause of death.** In 2018, the United States government led the world in funding the global effort to increase access to tuberculosis diagnosis, treatment, prevention and care, particularly in countries with the highest burden of disease. Accelerating research and innovation, including through collaborative research efforts and furthering of private sector partnerships, is one of four core pillars of the U.S. Global Tuberculosis Strategy. The United States government successfully mobilized increased commitments and funding from high-burden countries and other donors in support of this goal at the first-ever United Nations High-Level Meeting on Tuberculosis in September 2018.<sup>62</sup>

**Using space to better understand health.** HHS’s National Institutes of Health (NIH) National Center for Advancing Translational Sciences partnered with the International Space Station U.S. National Laboratory to send tissue chips into space to better understand the physiological changes experienced by astronauts when traveling in space, such as bone loss, muscle deterioration, and altered immune systems.<sup>63</sup> The launch will contribute to valuable knowledge on aging and may lead to the development of novel therapies. Also in 2018, NASA Twins Study investigators presented detailed findings following two years of research evaluating identical twin astronauts Scott and Mark Kelly.<sup>64</sup> In this first-of-its-kind national cooperative effort, investigators compared biological samples from the twins to study the impacts of extended time in space, following Scott Kelly’s historic year living on the International Space Station. The first application of genomics to evaluate potential risks to the human body in space, the Twins Study is a stepping stone towards long-duration human space exploration missions.

**Advancing precision medicine.** On May 6, NIH, an HHS component, opened national enrollment for the *All of Us* Research Program, a momentous effort to advance individualized prevention, treatment, and care for people of all backgrounds.<sup>65</sup> The overall aim is to enroll one million or more volunteers and account for communities that have been underrepresented in biomedical research to make the program the largest, most diverse resource of its kind. The program will enable such research to more

precisely prevent and treat a variety of health conditions.

**Providing the best tools to biomedical researchers.** HHS's NIH launched the STRIDES (Science and Technology Research Infrastructure for Discovery, Experimentation, and Sustainability) Initiative to harness the power of commercial cloud computing; provide NIH biomedical researchers with access to the most advanced, cost-effective computational infrastructure, tools, and services available; and reduce economic and technological barriers to accessing and computing on large biomedical data sets to accelerate biomedical advances.<sup>66</sup> NIH also released its first Strategic Plan for Data Science that provides a roadmap for modernizing the NIH-funded biomedical data science ecosystem.<sup>67</sup>

**Reducing underage vaping and smoking.** This year, FDA has worked aggressively to address youth use of e-cigarettes. In April, FDA launched a Youth Tobacco Prevention Plan, a series of actions to stop youth use of tobacco products, especially e-cigarettes.<sup>68</sup> In November, FDA, a component of HHS, announced a new policy to address central problems to the increasing youth use of electronic nicotine delivery systems (ENDS) which includes addressing flavored ENDS products and cigars and ENDS products marketed to youth.<sup>69</sup>

**Ensuring sufficient supply of valuable medical isotopes.** One of the most breathtaking developments in cancer treatment is recent success in trials that treat metastasized late-stage prostate cancer with the use of the alpha-emitting isotope Actinium-225 (Ac-225). The DOE Isotope Program formed a Tri-Laboratory Collaboration of scientists at Brookhaven, Los Alamos, and Oak Ridge National Laboratories to develop large-scale production capacity of Ac-225 to ensure sufficient supply and help advance the promising medical uses of this isotope.<sup>70</sup> In addition, DOE's National Nuclear Security Administration (NNSA) helped ensure a reliable supply of a vital medical isotope, which resulted in approval by FDA of the first domestically produced, non-uranium based molybdenum-99 (Mo-99). Mo-99 is the most widely used radioisotope in medical diagnostic imaging. One of NNSA's partners developed the RadioGenix™ System and neutron capture process to produce Mo-99 without the use of highly enriched uranium. Until now, the United States has had to rely on foreign producers to import 100 percent of its Mo-99 supply.<sup>71</sup>

**Driving innovation in bioscience.** NIST is developing the building blocks for bioscience by making high quality reference data and standardized materials available to enable confidence in gene sequencing and drug design through collaborative partnerships such as the Consortium for the Advancement of Genome Editing, announced in early 2018.<sup>72</sup> NIST works with industry experts to develop international standards and hosts the Standards Coordinating Body, focused on accelerating regenerative medicine therapies.<sup>73</sup>

**Improving healthcare records interoperability.** The Office of American Innovation held a series of White House Roundtables throughout 2018 to improve the interoperability of healthcare records. In February, the White House convened stakeholders to discuss various barriers to electronic health record interoperability and opportunities to address these barriers. In August, the White House hosted the Blue Button 2.0 Developer Conference, which brought together developers to learn and share insights on how to leverage claims data to best serve the Medicare population.<sup>74</sup> In December, the White House hosted an Executive Forum focused on Electronic Health Record (EHR) interoperability, bringing together several noted health IT experts from across the Nation to discuss the best role for government, technical standards and authentication, patient and physician engagement, and possibilities for public-private partnerships.<sup>75</sup>

**Putting patients first.** In March, HHS announced the Trump Administration's initiative to put patients at the center of the United States healthcare system.<sup>76</sup> This initiative, MyHealthEData, empowers patients by giving them control of their healthcare data, and allowing their data to follow them through their healthcare journey. In support of this new initiative, the Centers for Medicare & Medicaid Services (CMS) announced the launch of Medicare's Blue Button 2.0 API (Application Programming Interface), a new and secure way for Medicare beneficiaries to access and share their personal health data in a universal, standards-based digital format.

## High Performance Computing and Advanced Electronics

*“These new systems represent the next generation in supercomputing and will be critical tools both for our Nation’s scientists and for U.S. industry.”<sup>77</sup> –Secretary Perry*

**Unveiling the world’s most powerful and smartest supercomputers.** In June, DOE’s Oak Ridge National Laboratory unveiled Summit, the world’s most powerful and AI-capable scientific supercomputer. Summit will be used to make breakthrough discoveries in fields as diverse as genomics, extreme weather, materials science, and physics.<sup>78</sup> In addition, Lawrence Livermore National Laboratory unveiled Sierra in October, ranked the second-fastest supercomputer in the world on the latest TOP500 list. Sierra will provide high-fidelity simulations in support of NNSA’s core mission of ensuring the safety, security, and effectiveness of the Nation’s nuclear stockpile.<sup>79</sup>

**Advancing the future of advanced domestic electronic systems.** Critical DOD systems and platforms rely on advanced electronics to address national security objectives. To help tackle obstacles facing a half-century of electronics advancement, DARPA launched in December the Electronics Resurgence Initiative (ERI) – a five year, upwards of \$1.5 billion investment in the future of domestic electronic systems.<sup>80</sup>

**Developing novel materials for advanced computing systems.** DOC, NIST, and its partners in the Nanoelectronic Computing Research (nCORE) consortium awarded funding for a new research center to focus on novel materials for advanced computing systems. The multi-university partnership, Center for Spintronic Materials in Advanced Information Technologies (SMART), will develop innovative memory and processing architectures for future computing paradigms, including neuromorphic computing, probabilistic computing, in-memory computing, and wave-based information processing.<sup>81</sup>

**Building the Nation’s most powerful academic high-performance computing system.** On September 1, NSF made a \$60 million award<sup>82</sup> to fund the

largest and most powerful supercomputer the agency has ever supported to serve the Nation’s science and engineering research community. The new high-performance computing system, to be called Frontera, will be located at the University of Texas at Austin’s Texas Advanced Computing Center.<sup>83</sup>

**Advancing science through cloud computing partnerships.** On November 15, NSF announced a cooperative agreement to Internet2,<sup>84</sup> a nonprofit computer networking consortium, for the Exploring Clouds for Acceleration of Science (E-CAS) project. E-CAS will investigate the viability of commercial clouds for leading-edge research and computational science supporting a range of academic disciplines.

## Homeland and National Security

*“My Administration is focused on strengthening our Nation’s defenses against the full range of threats to our health and security, including those of a biological nature.”<sup>85</sup> –President Trump*

**Protecting the homeland from biological threats.** The White House published a National Biodefense Strategy which will address the full range of biological threats, including those that are naturally occurring, deliberate, and accidental—a first for the United States Government. The strategy will ensure a vibrant and innovative national science and technology base to support biodefense.<sup>86</sup> Implementation of the strategy will be led by HHS.

**Re-designating the Defense Innovation Unit.** The Defense Innovation Unit Experimental (DIUx) was made a permanent part of DOD, reflecting the Unit’s permanence. The Unit fosters innovation across the Department and experiments with new ways of delivering capability to the warfighter.<sup>87</sup>

**Driving the Army’s modernization efforts.** In February 2019, Army Futures Command was launched to drive the service’s modernization efforts – one of the most significant reorganizations since 1973.<sup>88</sup> Army Futures Command will focus on development of improved long-range precision fires, a next-generation combat vehicle, future vertical lift platforms, a mobile and expeditionary Army network, air and missile defense capabilities, and soldier lethality.<sup>89</sup>



**Restructuring to drive innovation and advancing warfighting capability.** In February, DOD finalized a major restructuring required by the 2017 National Defense Authorization Act. This restructuring established a separate Undersecretary of Defense (USD) for Acquisition and Sustainment (A&S) and an Undersecretary of Defense for Research and Engineering (R&E). The USD R&E will drive innovation and accelerate the advancement of the Nation's warfighting capability, while the USD A&S will deliver proven technology into the hands of the warfighter more quickly and affordably.<sup>90</sup>

**Protecting America's critical infrastructure.** In July, DHS established the National Risk Management Center (NRMC), an initiative driven by industry needs to create a cross-cutting risk management approach between the private sector and government to adequately defend our Nation's critical infrastructure.<sup>91</sup> The NRMC will identify, assess, and prioritize risks to national functions, integrate cross-sector activities on the development of risk management strategies and approaches to manage risks to national functions, and incubate strategic risk management initiatives. It will provide a simple and single point of access to the full range of government activities to defend against the cyber threat across sectors.

## Lab-to-Market

*"The drive for excellence, advancement, and innovation in the United States has brought forth significant discoveries, developed life-saving research, and improved the quality of life for millions of Americans."*<sup>92</sup> – President Trump

**Unleashing American innovation.** In April, OSTP and NIST held a symposium with leaders across government, industry, and academia to address systemic barriers to reaching the full potential of American innovation. The event launched the Lab-to-Market Cross Agency Priority goal, part of the President's Management Agenda.<sup>93</sup> Agencies across the Executive branch convene through the NSTC Lab-to-Market subcommittee to enhance the Nation's technology transfer efforts.

**Supporting innovative tools and services for technology transfer.** In July, DOE launched the Lab Partnering Service, an online, single streamlined point of access for industry to connect to experts at the National Laboratories.<sup>94</sup> In September, the Federal Laboratory Consortium for Technology Transfer (FLC) launched FLC Business 3.0, incorporating user feedback to improve this clearinghouse of Federal Laboratory information, including a technology locator chat service that provides personalized advice.<sup>95</sup> As part of the President's Management Agenda, the Administration seeks to improve engagement with private sector technology development experts and investors to enable even greater return on the Federal government's investment in research and development.

**Stimulating commercialization of federally funded R&D.** In December, NIST announced steps to modernize the United States system of technology transfer and innovation for the 21<sup>st</sup> century.<sup>96</sup> Based on broad inputs from key public and Federal stakeholders, the Administration will reduce regulatory and administrative burdens; increase private sector engagement; support entrepreneurship in R&D; develop new tech transfer tools; and improve methods of measuring the effectiveness of R&D investments.

**Elevating commercialization.** In September, DOE began InnovationXLab Summits. The XLab series is designed to increase engagement of the National Labs with the private sector on high-impact, potentially transformative technologies. In November, DOE announced the appointment of its first Chief Commercialization Officer.<sup>97</sup> This year DOE implemented expanded use of Agreements for Commercializing Technology (ACT) that facilitate the ability of lab contractors to engage with industry more flexibly on tech transfer projects.

**Celebrating American innovation.** In June, the United States Patent and Trademark Office issued U.S. patent number 10 million, marking a milestone in human ingenuity since the first patent was signed by George Washington in 1790. This was the first patent to use a newly designed U.S. patent cover, redesigned for only the second time in 100 years.<sup>98</sup>

## Natural Disaster Resilience

*“Disaster response and recovery is best achieved when it’s federally supported, state-managed, and locally executed.”<sup>99</sup>*  
 –President Trump

**Preparing for natural disasters.** On May 30, OSTP hosted a workshop on Whole Community Hurricane Information Flows where approximately 100 participants discussed ideas and opportunities to better share data and information in support of local, state, and Federal situational awareness and response in disasters.<sup>100</sup> In August, NIST published an exploratory technical report on research needs for building standards and codes that could ensure the rapid recovery and continued operation of buildings after natural disasters.<sup>101</sup> Throughout 2017-2018, DOE worked to enhance the capabilities of its Environment for Analysis of Geo-Located Energy Information (EAGLE-I) system, capitalizing on the capabilities of the DOE National Laboratories.<sup>102</sup> These enhancements are improving situational awareness on the status of energy infrastructure and incorporating predictive modeling, to improve preparedness and response efforts across State and Federal partners.

**Sharing information in disasters.** Throughout 2017 and 2018, the Federal Emergency Management Agency (FEMA) enhanced and utilized Disasters.Geoplatform.Gov to provide a unified environment for community partners to publish, share, and access authoritative geospatial data, high-resolution imagery, and advanced web-mapping applications used during disaster operations.<sup>103</sup>

**Improving earthquake and tsunami resilience.** Researchers from the National Oceanic and Atmospheric Administration (NOAA) and USGS have completed the first high-resolution, comprehensive mapping of one of the world’s fastest moving underwater tectonic faults in southeastern Alaska.<sup>104</sup> The seafloor mapping data will help communities in coastal Alaska and Canada better understand and prepare for the earthquakes and tsunamis. Also in support of this goal, NSF funded an expedition in New Zealand to better understand how shallow earthquakes and underwater landslides lead to tsu-

namis.<sup>105</sup> Additionally, President Trump in December reauthorized the interagency National Earthquake Hazard Reduction Program, led by NIST to foster interagency coordination to assess and monitor earthquake hazards and risk in the United States.<sup>106</sup>

**Leading the world in hurricane prediction.** During the 2017-2018 Hurricane Season, NOAA provided highly accurate and timely forecasts of hurricanes that impacted the United States, saving countless lives and protecting property.<sup>107</sup> The National Hurricane Center was able to predict the landfall location of Hurricane Florence within two miles of the observed landfall with five days lead time. This is a record setting weather forecast, and NOAA is investing in its weather prediction to make forecasts like these more common. Notably, NOAA made great strides in preparing its next generation weather forecasting model, known as the Finite Volume on a Cubed-sphere (FV3) model. This vanguard weather-modeling program is the realization of years of atmospheric modeling research and relies on cutting edge satellite observations and ocean measurement, which together drive the fastest and most accurate forecasting model the Nation has ever deployed. This new model will help meteorologists prepare more accurate forecasts to save lives and property.

**Supporting wildfire response with science and technology.** U.S. Forest Service fire scientists, along with Federal and state partners, applied advanced risk analysis tools to enhance firefighter and public safety and operational effectiveness during the 2018 fire season, notably including quantitative assessments of wildfire risk, firefighter hazards, response opportunities, and real-time monitoring of aerial suppression outcomes.<sup>108</sup> The U.S. Forest Service provided real-time, regional smoke maps and forecasts that were used to plan suppression activities and aircraft operations and to inform local governments and the public about potential air quality and health impacts.<sup>109</sup> Also, NASA’s Disasters program provided fire-related satellite products to help people on the ground and to assess wildfire impacts, including estimates of power outages and damaged structures, as seen from space.<sup>110</sup>

**Improving our Nation’s preparedness to address near-Earth objects.** In July, the Trump Administration released a national plan for reducing the risk of near-Earth object impacts.<sup>111</sup> The plan identifies a path to increased national preparedness across five



strategic goals: characterizing the threat, advancing our ability to predict consequences and mitigation outcomes, developing means to prevent asteroid impacts, working with international partners, and strengthening and exercising emergency procedures and protocols.

**Using UAS-mounted technology to study volcanoes and improve response.** For the first time, Unmanned Aerial Systems (UAS) technology was used to monitor and respond to a United States volcanic eruption.<sup>112</sup> During the Kīlauea volcanic eruption in Hawaii, USGS used UAS technology, including newly developed sensors, to map lava boundaries, identify new break-out points and overflow sites, detect property and infrastructure damage, map topographic changes due to collapse events, as well as to provide information on lava flow velocity and dangerous airborne gases like SO<sub>2</sub>. A USGS drone was credited with saving a life directly, and USGS personnel supported the Hawaii Emergency Operations to keep the response team apprised of data and developments.<sup>113</sup>

**Transforming public safety broadband.** Throughout 2018, DOC's First Responder Network Authority (FirstNet) made significant progress deploying and operating a truly nationwide, interoperable broadband public safety network for our Nation.<sup>114</sup> The FirstNet network supports the mission critical efforts of more than 425,000 subscribers across 5,250 public safety agencies.

**Modernizing the Nation's 911 centers.** In August, DOC's NTIA and DOT's National Highway Traffic Safety Administration (NHTSA) adopted final rules for a grant program that will offer up to \$110 million to help states, territories, tribal organizations, and the District of Columbia upgrade their 911 call centers to Next Generation (NG911) capabilities.<sup>115</sup>

## Ocean Science

*“The United States is a Nation whose identity, wealth, and security are inextricably linked with the ocean and coastal waters. From sea to shining sea, Americans benefit from the ocean’s bounty — from the industries it supports and the jobs it creates.”<sup>116</sup> —President Trump*

**Promoting the ocean economy, ocean security, and ocean environment.** On June 19, President Trump signed Executive Order 13840, establishing an ocean policy to advance the economic, security, and environmental interests of the United States.<sup>117</sup> The new ocean policy establishes an interagency Ocean Policy Committee to streamline Federal coordination, empowers States through Federal engagement with state-led Regional Ocean Partnerships, and focuses on growing the ocean economy, prioritizing scientific research, coordinating resources and data sharing, and engaging with stakeholders.<sup>118</sup>

**Ensuring United States leadership in ocean science and technology.** The NSTC released a ten-year plan identifying pressing research needs and areas of opportunity within the ocean science and technology enterprise for the decade 2018-2028. Produced by the Subcommittee on Ocean Science and Technology (SOST), this interagency plan presents a decadal vision for an innovative and collaborative ocean science and technology enterprise that promotes American security and prosperity while conserving the marine environment for present and future generations.<sup>119</sup>

**Increasing maritime awareness.** At the start of the year, DARPA began implementation of its new Oceans of Things program to enable persistent maritime situational awareness over large ocean areas by deploying thousands of small, low-cost floats to form a distributed sensor network. Each smart float would contain a suite of commercially available sensors to collect environmental data such as ocean temperature, sea state, and location, as well as data about commercial vessels, aircraft, and marine mammals moving through the area.<sup>120</sup>

**Enhancing ocean data tools.** NOAA and BOEM developed the Ocean Reporting Tool - a web-based application that provides geospatial analysis (of biological, navigational, military, social, economic, physical, and chemical parameters) for exploring, permitting, siting, and de-conflicting ocean uses such as fishing, aquaculture, recreation, conservation, energy, and military development. The ocean big data app, realized by IT advances and decades of environmental data collection, will allow the United States to remain competitive as ocean development continues its exponential growth through the 21st century.<sup>121</sup>

**Supporting marine industry with Big Data.** NOAA developed new computer-generated daily maps (EcoCast) that will help fishermen locate the most productive fishing spots, while warning them where they face the greatest risk of entangling sea-turtles, marine mammals, and other protected species. EcoCast will improve the economic and environmental sustainability of our Nation's fisheries. This big data (digital) tool is augmenting and may eventually replace expensive, depletive, and less accurate analog surveys, while also improving fishing efficiency and reduction of bycatch.<sup>122</sup>

**Revolutionizing fisheries monitoring.** NOAA developed innovative monitoring tools to identify and measure fish from digital images.<sup>123</sup> The agency deployed camera systems to record catches on fishing boats and remotely monitored compliance with Federal fisheries, assessed fish populations, and collected bycatch information more efficiently by using machine vision technology. While involving manned aircraft, new technological advances allow this effort to transition to unmanned aircraft systems complementing Federal fleets of unmanned surface vehicles and unmanned underwater vehicles that also monitor fishing.

## Opium Epidemic Response

*“Defeating this epidemic will require the commitment of every state, local, and Federal agency. Failure is not an option. Addiction is not our future. We will liberate our country from this crisis. And we will raise a drug-free generation of American children.”<sup>124</sup> –President Trump*

**Year of historic action to combat the opioid crisis.** In October, President Trump hosted 21 private-sector and nonprofit partners who are stepping up to solve the opioid crisis. Their innovative and groundbreaking work is promising for the millions of Americans who struggle with addiction or support loved ones who do. The Trump Administration has applied an all-of-Government approach to the epidemic, allowing each agency and department to do their part to help the cause.<sup>125</sup> To support this initiative, the Surgeon General of HHS's Public Health Service Commissioned Corps released his “Spotlight on Opioids” report released in September; the report as-

sembles opioid-related information from the Surgeon General's Report on Alcohol, Drugs, and Health into one document to better inform the general public, especially family and friends of people with an elevated risk of opioid overdose, opioid misuse, and/or opioid use disorder.<sup>126</sup>

**Combating the opioid crisis in rural America.** To help rural leaders build an effective local response to the opioid crisis, the United States Department of Agriculture (USDA) is providing resources to build infrastructure, facilitate partnerships, and drive innovation in rural communities.<sup>127</sup> The White House Rural Opioid Federal Interagency Working Group is working alongside the White House Office of National Drug Control Policy (ONDCP) to help address the opioid crisis by improving coordination of Federal response in the Nation's rural communities.<sup>128</sup>

**Reducing access to and the supply of opioids.** In October, President Trump furthered his commitment to addressing the opioid crisis and signed H.R. 6, the “Substance Use-Disorder Prevention that Promotes Opioid Recovery and Treatment for Patients and Communities Act,” which addresses the opioid crisis by reducing access to and the supply of opioids and by expanding access to prevention, treatment, and recovery services.<sup>129</sup> Researchers at NIST developed screening techniques to help protect the people on the front lines in the battle against opioids, from first responders to evidence examiners, from lethal exposure to synthetic opioids.<sup>130</sup>

**Ending addiction long-term.** At the 2018 National Rx Drug Abuse and Heroin Summit, NIH (an HHS component) announced the launch of the HEAL (Helping to End Addiction Long-term) Initiative, an aggressive, trans-agency effort to speed scientific solutions to stem the national opioid public health crisis.<sup>131</sup> Toward this effort, NIH has nearly doubled funding for research on opioid misuse/addiction and pain from approximately \$600 million in fiscal year 2016 to \$1.1 billion in fiscal year 2018. NIH's efforts contribute to a government-wide push to meet the President's goal of ending the opioid crisis.

**R&D to stem the opioid crisis.** The NSTC published a groundbreaking plan that identifies R&D critical to addressing key gaps in knowledge and tools, and opportunities to improve coordination of Federal R&D essential to combating the opioid crisis.<sup>132</sup> It builds on the recommendations from the President's Com-

mission on Combating Drug Addiction and the Opioid Crisis report, as well as recommendations from multiple other sources. In November, NIH called for public comment on the draft report. OSTP will issue the final updated report in 2019.

## Polar Science

*“The Arctic region has strategic and economic importance.”*<sup>133</sup> –President Trump

**Shaping the course of Arctic research.** In October, NSF, NOAA, and the United States Arctic Research Commission represented the Administration at the Arctic Science Ministerial held in Berlin, Germany.<sup>134</sup> International partners signed a Joint Statement committing to strengthening, integrating, and sustaining Arctic observations, facilitating access to Arctic data, and sharing Arctic research infrastructure; understanding the regional and global dynamics of Arctic change; and assessing the vulnerability and building resilience of Arctic environments and societies.

**Navigating the new Arctic.** As part of NSF’s 10 “Big Ideas” for future investment at the frontiers of science and engineering, the agency seeks innovations in Arctic observational networks and fundamental convergence research across sciences to accomplish goals such as informing United States national security and economic development needs and enabling resilient, sustainable Arctic communities.<sup>135</sup>

**Mapping polar regions.** In September, NASA launched a new satellite, the Ice, Cloud and Land Elevation Satellite-2 (ICESat-2), continuing NASA’s measurements of Earth’s frozen reaches with unprecedented accuracy.<sup>136</sup> Revealing previously unmapped surface and subsurface features of ice sheets and glaciers in Antarctica and around the world, new data from ICESat-2 will improve forecasts and understanding of mechanisms controlling ice sheet changes.<sup>137</sup>

**Pioneering Federal coordination of monitoring in the Arctic.** The Office of Naval Research (ONR), NOAA, NASA, NSF, DOI, U.S. Air Force, and U.S. Navy are, for the first time, coordinating the deployment of aerial, surface, and subsurface autonomous vehicles; manned aircraft; satellites; and sensors on the seafloor, in the water, and on the ice to gather and

synthesize a massive array of data that will be used to advance military and civil capabilities in the region and for the Nation as a whole. Building on ONR’s Stratified Ocean Dynamics of the Arctic (SODA) project,<sup>138</sup> data from this interagency mission will inform how sound travels underwater in the Arctic, improve forecasting accuracy for extreme weather events in the Arctic and in the continental United States, and contribute to improved short-term ice forecasts to help the U.S. Coast Guard and other authorities define and regulate the trans-Arctic shipping season.<sup>139</sup>

**Modernizing Antarctica’s research infrastructure.** The Administration’s Antarctic Infrastructure Modernization for Science (AIMS) project to improve McMurdo Station is designed to meet anticipated science support needs for the next 30 to 50 years.<sup>140</sup> AIMS will enable a range of critical scientific research capabilities such as nuclear test detection, earthquake monitoring, and real-time weather data ingestion for global forecasting. In 2018, the AIMS completed important pre-construction activities, including breaking ground on a new communications facility and embarking on pre-construction advanced design to prepare the project for construction once approvals are in place.<sup>141</sup>

## Privacy

*“A vibrant economy, fueled by consumer confidence, is at the heart of American prosperity.”*<sup>142</sup> –President Trump

**Protecting individual privacy while fostering innovation.** In September, DOC’s NTIA requested comments on a proposed approach to advance consumer privacy while protecting prosperity and innovation.<sup>143</sup> The public submitted feedback on a set of user-centric privacy outcomes that underpin the protections that should be produced by any Federal actions on consumer-privacy policy, and a set of high-level goals that should be created to provide those protections. Through a risk-based flexibility approach, the Administration is taking steps to ensure that users benefit from dynamic uses of their information, while still expecting organizations to appropriately minimize risks to users’ privacy.

**Managing privacy risks.** NIST initiated development of a Privacy Framework that it envisions will be a voluntary tool for organizations to better identify,

assess, manage, and communicate about privacy risks so that individuals can enjoy the benefits of innovative technologies with greater confidence and trust.<sup>144</sup> NIST issued a request for information to solicit information regarding organizational considerations for privacy risk management, the structure of the Privacy Framework, and specific privacy practices to be included.<sup>145</sup>

**Building trust in privacy practices.** Individual trust in the privacy and security of personally identifiable information is a foundation of trust in government and commerce in the 21st Century. In March, the International Trade Administration (ITA) within DOC announced enhancement for procedures conducting periodic compliance reviews under the Privacy Shield program.<sup>146</sup> These enhancements are intended to strengthen the administration and supervision of the Privacy Shield Framework, increasing the confidence of participants in the Framework and of EU individuals that their data will be protected. The Federal Trade Commission (FTC) is holding Privacy Shield participating companies accountable for their privacy protection activities.

## Quantum Information Science

*“It’s critical the United States, guided by American values and powered by the American workforce, drives quantum innovation and discovery on the world stage.”<sup>147</sup> –Michael Kratsios*

**Accelerating development of Quantum Information Science (QIS).** In December, the President signed the National Quantum Initiative Act into law. This bipartisan legislation establishes a coordinated multiagency program to support research and development in QIS.<sup>148</sup> In addition, the President signed the National Defense Authorization Act in August, which directs DOD to develop a National Defense Science and Technology Strategy and to establish a coordinated R&D program in QIS.<sup>149</sup>

**Advancing collaboration in quantum.** In September, the White House convened 14 Federal agencies, Nobel Laureates, technical experts, international luminaries, university leaders, American business leaders, and renowned academics and researchers who are prioritizing QIS in their own departments,

agencies, laboratories, and companies. Summit attendees participated in breakout sessions focused on taking a science-first approach to QIS development, creating a quantum-smart workforce, and engaging with the innovative ecosystem surrounding QIS.<sup>150</sup>

**Developing a national strategic overview for QIS.** In September, the NSTC’s Subcommittee on Quantum Information Science published a strategic overview for QIS and established next policy steps for implementation.<sup>151</sup> This was followed by a NSF request for information from the community to inform the subcommittee as they develop a potential implementation plan.<sup>152</sup>

**Coordinating and directing quantum research efforts.** The Administration is actively coordinating and directing millions of dollars for quantum R&D. DOE has announced \$218 million in funding for the emerging field of QIS, and NSF has awarded \$14 million to develop the first practical quantum computer.<sup>153</sup> In September, NIST announced the creation of the Quantum Economic Development Consortium that will work to expand United States leadership in quantum research and support the growing industry in this important sector.<sup>154</sup>

**Breaking the boundaries of quantum measurement.** Scientists at NIST, as part of the NIST-on-a-Chip program, are creating prototypes for small, inexpensive, low-power and easily manufactured quantum-based sensors. One example is a chip-scale device for measuring important quantities such as length. The device works by using a laser to probe atoms to generate infrared light at a precise wavelength. The prototype device demonstrates that these sensors could be mass-produced like semiconductors, using silicon materials and traditional chip-manufacturing techniques to make advanced measurements available to a much broader suite of applications.<sup>155</sup>



## R&D Fundamentals

*“America has long led the world in innovation and technological advancement. American ingenuity has launched industries, created jobs, and improved quality of life at home and abroad.”<sup>156</sup> –President Trump*

**Redefining the international system of weights and measures.** NIST worked with partner metrology institutes to move the system of units used world-wide to be entirely based upon fundamental constants of nature and quantum-enabled realizations. This new approach enables improvements in precision measurements that effect everything from pharmaceuticals manufacturing to experimental physics, and will create a new opportunity for the development of new quantum measurement technologies.<sup>157</sup>

**Stimulating innovation through public participation.** In March, the White House hosted an event on Federal prizes and challenges to drive innovation.<sup>158</sup> With over 875 federally sponsored prize competitions on Challenge.gov and over 400 Federal crowdsourcing and citizen science projects on CitizenScience.gov, the Administration is empowering Americans to use science and technology to solve the world’s most pressing issues. In FY18, more than 20 different Federal agencies or departments offered prize competitions, and more than 16 agencies initiated or continued citizen science and crowdsourcing projects. For example, NIH hosted a challenge for wearable alcohol biosensor development,<sup>159</sup> and 250,000 players of the Eyewire game drove the discovery of six new types of human brain neurons as part of the Federal Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative.<sup>160</sup>

**Reducing burdens in research.** In May, the NSTC released a report on efforts to improve the management of Federal awards to significantly reduce the regulatory burdens associated with federally funded research activities while maintaining accountability.<sup>161</sup> The report addresses substantial and unproductive administrative burdens which affect our Nation’s scientists, thereby impeding the rate of scientific and technological advancement. In November, DOE announced two regulatory re-form initiatives designed to reduce administrative barriers and enhance engagement with DOE’s laboratories.<sup>162</sup>

**Releasing the world’s highest resolution Earth system model.** In April, the first version of the Energy-Exascale-Earth System Model (E3SM) was publicly released as an open source model for use by the scientific community.<sup>163</sup> Designed to run on DOE’s fastest supercomputers, E3SM is currently the world’s highest resolution Earth system model. A team at DOE’s Lawrence Berkeley National Laboratory team used an artificial intelligence neural network running on Summit—and trained on E3SM simulation data—to identify extreme weather events.<sup>164</sup>

**Coordinating Federal science and technology programs.** OSTP has continued strong support for the NSTC, with interagency committees, meeting regularly on topics covering every aspect of the Nation’s science and technology enterprise spanning science, technology, the environment, and national security.<sup>165</sup> Experts from across the Federal agencies have worked together and with OSTP to coordinate R&D programs, develop and track strategic plans, and ensure that taxpayer dollars are well spent on the highest R&D priorities. In 2018, NSTC implemented a new organizational structure, as advised by the Federal science agencies, to more efficiently conduct interagency coordination.

**Advancing the state of battery science.** DOE-supported researchers made key advances in battery science and technology in 2018. For the first time, researchers at a DOE Energy Frontier Research Center reversibly inserted and extracted two lithium ions from a multi-electron lithium ion battery cathode, with full recovery upon recharging—a capability that could greatly increase battery capacity.<sup>166</sup> Scientists used the Advanced Light Source and the Stanford Synchrotron Radiation Light Source to improve understanding of lithium transport—a potential path to safer, longer-lasting, and higher-power batteries.<sup>167</sup>

**Supporting and celebrating key advances in nanotechnology.** In December, OSTP’s National Nanotechnology Coordination Office celebrated the 15-year anniversary of the establishment of nanotechnology as a national initiative by President George W. Bush.<sup>168</sup> The Office launched a series of podcasts with experts from academia, government, and industry to highlight key advances in nanotechnology catalyzed by the National Nanotechnology Initiative and how nanotechnology will enable breakthroughs and applications of the future. In 2018, the Admin-

istration invested approximately \$1.4 billion of Federal R&D in nanotechnology, advancing knowledge and providing new capabilities to a wide range of existing and emerging technologies.<sup>169</sup>

## Space Exploration

*“As history has shown, there is no limit to the imagination and determination of the American people, and we will continue this proud tradition of innovation in space exploration.”<sup>170</sup> –President Trump*

**First mission to explore the deep interior of Mars.** NASA’s InSight Mars Lander landed on Mars to conduct an in-depth study of Mars’ interior structure for the first time ever. The mission will help answer key questions about the early formation of rocky planets in our inner solar system.<sup>171</sup>

**Streamlining regulations on commercial use of space.** On March 23, President Trump unveiled a National Space Strategy that prioritizes American interests, ensuring a plan that will make America strong and competitive.<sup>172</sup> This new strategy drives a whole-of-government approach to United States leadership in space, in close partnership with the private sector and our allies. On March 24, President Trump signed Space Policy Directive-2, which aims to reduce the regulatory burden on space companies in the United States.<sup>173</sup> The policy calls for regulations that promote economic growth and protect public safety; a review of launch and re-entry licensing to remove unnecessary regulations; a review of commercial remote sensing policy; a reorganization of DOC to expand and elevate the Office of Space Commerce; a report on improving global competitiveness in radio frequency spectrum; and a review of export licensing regulations.

**Protecting the Nation’s vital assets in the congested orbital environment.** On June 18, President Trump signed Space Policy Directive-3 directing the United States to lead the management of traffic and mitigate the effects of debris in space.<sup>174</sup> The policy aims to establish roles and responsibilities for space traffic management and space situational awareness.<sup>175</sup> Goals for this policy include advancing science and technology in these areas, reducing the growing threat of orbital debris on space activities, encouraging and facilitating United States commer-

cial leadership, and providing United States Government-supported basic space situational awareness data and basic space traffic management services to the public. At the signing of SPD-3 and the third meeting of the National Space Council, President Trump directed DOD to begin the process necessary to establish a U.S. Space Force as the sixth branch of the armed forces.<sup>176</sup>

**Launching spacecraft of historical magnitude.** In August, NASA launched the Parker Solar Probe, the first spacecraft that will fly into the solar corona (the solar atmosphere) and the closest a human-made object has ever been to the Sun.<sup>177</sup> The mission’s findings will help researchers improve their forecasts of space weather events, which have the potential to damage satellites and harm astronauts on orbit and in deep space, disrupt radio communications, and overwhelm power grids. It will study the structure and dynamics of the Sun’s coronal plasma and magnetic field, explore the supersonic solar wind, and discover what accelerates solar energetic particles.

**Increasing readiness for space weather events.** In June, the Trump Administration released the NSTC Space Weather Operations, Research, and Mitigation (SWORM) Subcommittee initial benchmarks for five phenomena associated with space weather events: induced geo-electric fields, ionizing radiation, ionospheric disturbances, solar radio bursts, and upper atmospheric expansion.<sup>178</sup> Benchmarks for space weather will enhance awareness of threats among critical infrastructure owners and operators in the private sector, and will serve as an input for academic and private sector innovation toward building a space weather- and electromagnetic pulse-ready Nation.

**Demonstrating a power system that could enable long-duration crewed missions to the Moon and destinations beyond.** NASA and DOE’s NNSA successfully demonstrated a new nuclear reactor power system that could enable long-duration crewed missions on the surface of the Moon, Mars, and destinations beyond. The Kilopower Reactor is a small, lightweight fission power system capable of providing up to 10 kilowatts of electric power – enough to run several average households – continuously for at least 10 years.<sup>179</sup>



**Fostering partnerships at the International Space Station.** In FY 2018, NASA saw new research facilities and Earth observation instruments come online, new capabilities piloted and an increasingly diverse portfolio of commercial, fundamental science, and technology demonstration investigations conducted. NASA and the ISS National Lab combined to sponsor 226 U.S. research investigations, an increase of 27% from the previous fiscal year. The ISS National Lab selected 50 new projects and programs across diverse R&D areas, making FY18 the strongest year to date for portfolio growth. ISS National Lab new research partners in FY 2018 included large and small companies, nonprofits, academia, and other government agencies, with many projects individually or sponsor-funded. Third-party funding for spaceflight R&D continued to rise, allowing us to leverage ISS National Lab resources for maximum user success—which this year ranged from patents to first-ever technical demonstrations in orbit.<sup>180</sup>

## STEM Education and Workforce

*“We will continue efforts to provide our students with access to high-quality education in science, technology, engineering, and mathematics so that they are better equipped to innovate and compete in today’s economy.”<sup>181</sup> –President Trump*

**Helping students gain the skills they need to succeed.** President Trump and Congress reauthorized the Carl D. Perkins Career and Technical Education Act, which provides more than \$1 billion for States each year to fund vocational and career-focused education programs, benefitting more than 11 million students.<sup>182</sup>

**Establishing the President’s National Council for the American Worker.** Recognizing the irreplaceable value of the American worker, this Administration acted to protect our greatest strength to address workforce changes caused by automation.<sup>183</sup> President Trump issued an Executive Order in July establishing the President’s National Council for the

American Worker. The Council will develop recommendations for a national strategy for empowering American workers, foster close coordination among the Federal Government and other stakeholders, and work with agencies to foster consistency in policy implementation.<sup>184</sup>

**Releasing a Federal Strategic Plan to strengthen education in science, technology, engineering, and math (STEM).** In December, the NSTC Committee on STEM Education released the Federal 5-Year STEM Education Strategic Plan, which outlines the goals for American STEM education. The Administration’s goals include building a strong foundation of STEM literacy, increasing diversity in STEM careers, and preparing the STEM workforce of the future.<sup>185</sup>

**Holding a first-of-its-kind state-Federal STEM education summit.** The Trump Administration convened stakeholders to help inform the development of the Federal 5-year STEM Education Strategic Plan. OSTP joined NSF and 16 other Federal agencies for a summit that brought together STEM education stakeholders from all 50 States, five territories, and seven tribes.<sup>186</sup>

**Scaling diversity, inclusion, and equity across the Federal government.** NSF INCLUDES is one of the 10 NSF Big Ideas and focuses on making a lasting impact in diversifying the STEM workforce of the future through partnerships and collaboration at scale.<sup>187</sup> This year, NSF has committed \$44 million towards this initiative and going forward will expand partnerships with NASA, NOAA, NIH, and USGS to help them establish their own INCLUDES programs.<sup>188</sup> An outside partner has also committed \$1 million to NSF INCLUDES to support women returning to the STEM workforce.<sup>189</sup>

**Fulfilling and surpassing the Administration’s promise to invest in STEM.** In 2018, the Department of Education surpassed President Trump’s directive to invest \$200 million in high-quality education in science, technology, engineering, math, and computer science.<sup>190</sup> In total, the Department obligated \$279 million in STEM discretionary grant funds in Fiscal Year 2018.

## Conclusion

The second year of the Trump Administration was a tremendous year for our Nation's science and technology enterprise. These highlights are a select few from the many achievements made within the Federal Government and those enabled by the support it provides to the broader science and technology enterprise. Federal scientists and policymakers, collaborating with partners in industry, academia, and foundations, are continuously spearheading the advancement of science and technology and informing national policy to address our world's greatest challenges and provide benefits to the American people. Under the leadership of OSTP Director Dr. Kelvin Droegemeier, OSTP will continue supporting American scientists and technologists and working with the interagency and other collaborators to ensure that the United States maintains and accelerates global leadership in scientific and technological advancement.

- <sup>1</sup><https://www.whitehouse.gov/briefings-statements/the-inaugural-address/>
- <sup>2</sup><https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/>
- <sup>3</sup><https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/>
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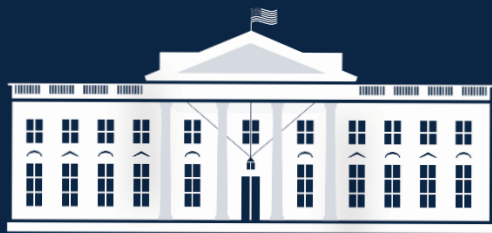
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