



**Michael Kratsios
Chief Technology Officer of the United States
White House Office of Science and Technology Policy**

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**on
“Industries of the Future”**

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Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, it is a privilege to be here with you today to discuss U.S. leadership in the Industries of the Future.

From the earliest days of the Trump Administration, the White House Office of Science and Technology Policy (OSTP) has recognized the profound importance of what we call Industries of the Future. Key emerging technologies including artificial intelligence (AI), quantum information science (QIS), 5G, biotechnology, and advanced manufacturing will shape the U.S. workforce, sustain our nation’s prosperity, strengthen our national security, and make all Americans safer, healthier, and better off.

In the summer of 2017, the White House held its first event on American Leadership in Emerging Technologies, gathering our Nation’s brightest academic minds and top industry leaders to discuss opportunities and challenges to advancing innovation. This kicked off an effort that has spanned the nearly three years since and resulted in the development and execution of bipartisan legislation, national strategies, and presidential actions and initiatives.

When the U.S. leads in the Industries of the Future, all Americans can reap the benefits of these emerging technologies. And as we look at the international landscape, American leadership in technologies like AI, QIS, and 5G have never been more of an imperative.

Our work leverages the United States’ unparalleled innovation ecosystem comprised of industry, academia, non-profit research institutions and science philanthropies, and the federal government. And every step of the way, we have asked the same basic question: How can the federal government contribute most effectively to supercharge the innovation ecosystem and ensure America’s technological dominance?

To this end, we identified four key pillars that underpin our efforts across AI, 5G, QIS, biotechnology, and advanced manufacturing—fundamental research and development (R&D), workforce development, light-touch regulation, and international engagement.

The federal government has a central role in supporting research and development in areas where there is little or no commercial incentive. My colleagues here today representing the National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST) are integral to U.S. R&D efforts and have done incredible work on behalf of the American people—making sure taxpayer dollars are used as effectively as possible to improve R&D in the areas that need it the most.

Thanks to the bipartisan efforts of this Committee, in December 2018 the President signed the National Quantum Initiative Act, which established a National Quantum Coordination Office and authorized robust funding for QIS R&D activities across the federal government. This includes investing in quantum consortia—research centers where industry, government, non-profits, and academia can come together to advance QIS.

Further, in February of 2019, the President launched the American AI Initiative—the U.S. national strategy for AI—which includes R&D as its first area of emphasis.

To build and prepare the American workforce of the future, the Trump Administration has placed important emphases on STEM education, Pell Grant reform, apprenticeships, and reskilling and upskilling opportunities. Through the National Council for the American Worker, we've partnered with private sector leaders to support the 21st century workforce.

For American innovation to flourish, the federal government must remove barriers, streamline processes, and be careful to not impose burdensome or preemptive regulation. That's why the President has taken action to eliminate hurdles to 5G deployment and create opportunities to enable new types of commercial drone operations so that they can legally develop, test and deploy their innovations in America. As part of the American AI Initiative, the White House recently proposed regulatory guidance principles for AI technologies which reflect our values of freedom, human rights, and civil liberties, and created a plan for federal engagement in the development of AI technical standards.

On the international stage we have worked with our global partners to advance R&D and innovation underpinned by shared values. Demonstrating our commitment, the United States joined our global partners in the Organisation for Economic Co-operation and Development (OECD) to reach consensus on international principles supporting the trustworthy development of AI. And just last month, the United States joined the Government of Japan in signing a cooperative research agreement to advance QIS and technology for economic, societal, and security benefits.

I am thrilled to discuss with you the Administration's proud record of achievement in advancing emerging technologies that underpin the Industries of the Future.

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Artificial Intelligence

Over the past several decades, AI has advanced tremendously and today promises better, more accurate healthcare; enhanced national security; improved transportation; and more effective education, to name just a few benefits.

To ensure America's continued global leadership in AI, nearly a year ago the White House unveiled the American AI Initiative—our Nation's AI strategy—which has resulted in significant progress over the past year. First, the Initiative prioritizes investments in AI R&D, as demonstrated in the President's FY2020 Budget request that included nearly \$1 billion in non-defense AI R&D. A detailed agency-by-agency breakdown of these AI investments was provided in the *Networking and Information Technology Research and Development Program (NITRD) Supplement to the President's FY2020 Budget*—the first ever such reporting of non-defense AI R&D investments. This reporting process provides an important mechanism and baseline for tracking U.S. AI R&D spending moving forward. The *2016-2019 Progress Report on Advancing AI R&D* shows the breadth and depth of federal investments in AI that are transforming the state of the field. These investments are focused on key areas of strategic priority, as outlined in the Administration's June 2019 *National AI R&D Strategic Plan*.

Examples of impactful R&D investments include the Defense Advanced Research Projects Agency's (DARPA) \$2 billion AI Next Campaign (September 2018); NSF's launching of the National AI Research Institutes Program in collaboration with the Department of Homeland Security, the Department of Transportation, the Department of Veterans Affairs, and United States Department of Agriculture (USDA) (October 2019); the release of the National Oceanic and Atmospheric Administration's AI Strategy (November 2019); the National Institutes of Health's Strategic Plan for Data Science (June 2018); and establishment of the Department of Defense (DOD) Joint AI Center (June 2018). To ensure strong coordination of these federal activities in AI R&D, the White House chartered the Select Committee on AI (May 2018), which meets regularly to oversee and prioritize federal R&D activities in AI.

Second, the AI Initiative is unleashing federal resources for AI R&D, including improved public access to high quality federal data that can drive even more AI research and testing. To gather public input on this process, the White House issued a request for information on federal data and models for AI R&D and testing (July 2019). This feedback is now being used to pursue opportunities for increased access and use of federal data and models, while also protecting safety, security, privacy, and confidentiality.

Third, the Initiative is removing barriers to AI innovation. On January 13, 2020, the White House issued a request for public comment on proposed guidance to federal agencies on regulatory and non-regulatory policies to govern the development and use of AI in the private sector. When finalized, the guidance will ensure that agencies consider ways to reduce barriers to the development and adoption of AI before regulating technologies and industrial sectors that are empowered or enabled by AI. The White House's draft guidance also sets out these policy principles for the stewardship of AI applications that support American innovation while appropriately protecting privacy, civil liberties, and American values and while allowing for sector- and application-specific approaches. The principles promote the development of trustworthy AI, and require regulators to consider fairness, transparency, safety, and security when considering any action related to AI.

Additionally, the American AI Initiative led to the release by NIST of the *Plan for Federal Engagement in Developing Technical Standards and Related Tools* (August 2019), which focuses on the development of technical standards that are necessary for achieving trustworthy AI.

Fourth, the Initiative focuses on the importance of the American worker by directing federal agencies to prioritize AI in their grants and their fellowships. The Administration is also helping Americans gain AI relevant skills through apprenticeships, workforce training, STEM education, and other learning opportunities. The AI workforce development efforts support and leverage other Presidential workforce initiatives, especially the National Council for the American Worker and the Pledge to America's Workers, which are preparing America's workforce for the jobs of today and the future.

Finally, the AI Initiative promotes an international environment supportive of American AI innovation. In May 2019, the Trump Administration joined together with democracies of the world that share common values by signing an international consensus document on AI Principles at the OECD in Paris. The U.S. joined with other G20 countries to adopt similar principles (June 2019), and collaborates with the G7 nations to support increasing trust in and adoption of AI. The Administration continues to advocate for the development of new AI technologies in a way that advances innovation, promotes public trust, protects civil liberties, and remains consistent with American values.

Quantum Information Science

QIS offers a foundation for new technologies that will have broad applications, including quantum computing, quantum networking, and quantum sensing. Each uses quantum effects to enable new and often more efficient applications across national security, health care, communications, manufacturing, and more.

In December 2018, President Trump signed the National Quantum Initiative Act (NQIA) into law. This landmark bipartisan legislation, which originated in this committee, supercharges U.S. quantum R&D and advances our leadership in this critical Industry of the Future. Over the past year since it was signed, OSTP has been charged with its implementation.

In response to the NQIA, the Administration launched the National Quantum Coordination Office, which serves to coordinate federal R&D efforts across government. The legislation also authorized significant R&D funding and called for the creation of quantum consortia. Last month marked important progress, with the inclusion of funding for quantum R&D and the research centers included in the fiscal year 2020 appropriation package the President signed into law in December 2019.

NSF and the Department of Energy (DOE) are working now to set up the QIS Centers called for in the NQIA. NSF is currently reviewing full proposals for Quantum Leap Challenge Institutes, while the DOE has just released a Funding Opportunity Announcement for larger QIS Centers. NSF and DOE, through a formal agreement, are working to ensure a coordinated review and implementation of these new QIS Centers to promote American leadership in QIS and quantum technologies.

NIST has convened a quantum consortium through its Other Transaction Authority (OTA) from the NQIA. This Quantum Economic Development Consortium (QED-C) is identifying the critical needs of the growing QIS industry. Over 80 companies have signed letters of intent and are participating in the ongoing QED-C activities, including a recent workshop on cryogenics. This represents the first of

several industry-driven efforts to ensure American leadership in quantum technologies. The Air Force Research Lab (AFRL) has also become heavily involved in the QED-C as part of its QIS-based efforts.

We've also made important QIS progress internationally. In December 2019, the United States and the Government of Japan announced the Tokyo Statement on Quantum Cooperation in support of continued collaboration in research and development between the two nations. The statement encourages increased engagement in quantum through international conferences and events; supports cooperative efforts to prepare the next generation of scientists and engineers; and promotes the sharing of research methodologies, infrastructure, and data.

5G and Advanced Communications

To keep America's edge, we must accelerate our development and deployment of 5G and beyond—the next generations of wireless networks that can move massive amounts of data at exponentially faster speeds than existing 4G LTE networks. The United States is investing in state-of-the-art means and methods to use spectrum efficiently and reap the benefits of the advanced technologies that 5G and future generations of wireless technologies will support: automated vehicles, telemedicine, emergency communications, and untold next-generation technologies that will result from increased data capacity and connectivity.

The Trump Administration is committed to making sure America wins the global race to 5G and future generations of wireless technologies, and is coordinating all related efforts through an interagency group led by Larry Kudlow, Director of the National Economic Council. In October 2018, President Trump directed the development of a *National Spectrum Strategy* to establish a balanced, forward-looking, flexible, and sustainable approach to spectrum management. As part of that initiative, OSTP issued the *R&D Priorities for American Leadership in Wireless Communications* and the *Emerging Technologies and Their Expected Impact on Non-Federal Spectrum Demand* to address how the United States can lead the world in sharing federal spectrum with commercial users. Applying AI to spectrum sharing, DARPA awarded prizes to the top performers in the Spectrum Collaboration Challenge. In its second year, the NSF Platforms for Advanced Wireless Research (PAWR) program launched the POWDER-RENEW mid-band 5G wireless test bed in Salt Lake City, UT; supported construction on the COSMOS high-band 5G wireless test bed in New York, NY; and started construction on the AERPAW aerial 5G wireless test bed to accelerate the integration of unmanned aerial vehicles into the national airspace. NSF also took delivery of the Colosseum test bed from the above-mentioned DARPA challenge, making it a national resource for 5G wireless research and beyond.

The Department of Commerce's National Telecommunications and Information Administration continues to collaborate with the Federal Communications Commission (FCC) to make spectrum available for 5G and other advanced wireless services. The FCC concluded two high-band spectrum auctions and is in the midst of a third, so far receiving close to \$10 billion in bids in these three auctions. As a result, the U.S. currently leads the world in allocation and use of high-band spectrum, with nearly 5 GHz of spectrum awarded or in the process of being auctioned. This spectrum provides incredibly fast speeds, low latency, and device density. The U.S. is also on par with the rest of world in the total allocation and use of spectrum in low- and mid-bands for 5G.

Additionally, working through the American Broadband Initiative, the White House continues to coordinate the efforts of our federal agencies working to lower barriers to broadband deployment to ensure that broadband, including 5G networks, can be stretched more effectively across rural America. While America strives to be a leader in 5G and advanced communications, the Administration is also committed to a more prosperous rural America. Underpinning that mission is access to reliable, secure, high speed internet. With that in mind, in January 2018 President Trump directed the General Services Administration (GSA) to examine the effectiveness of the form used to locate communications facilities on federal property. GSA collected feedback and is currently working with the USDA/U.S. Forest Service as well as OMB, to make improvements to the form. In addition, the Department of Interior was tasked with developing a plan to increase access to tower facilities to facilitate broadband deployment. The White House continues to build on these two Executive actions through the American Broadband Initiative, and collectively the Administration is making significant progress in removing barriers to broadband deployment and making it easier to build networks in rural communities. Finally, NSF is now collaborating with USDA on the aforementioned PAWR program to support a fourth advanced wireless test bed focused on affordable, high-speed, rural broadband connectivity.

Along with future wireless technology comes a more complex technical environment that presents a critical challenge to the security of America's communications networks. In order to meet this challenge head on, last year President Trump signed the *Securing the Information and Communications Technology and Services Supply Chain* Executive Order and signed the John S. McCain National Defense Authorization Act for Fiscal Year 2019 into law. President Trump has kept his promise to do what it takes to keep America safe—we will no longer use Federal funding to pay for insecure and untrusted network equipment. In November, 2019, the FCC adopted rules to prevent taxpayer dollars from being used to purchase equipment or services from companies that pose a national security threat to the integrity of American communications networks or the communications supply chain.

Modern communications networks are highly interconnected and global in scope. Earlier in 2019 the United States, along with like-minded partners, met to develop a set of proposals to govern safety, security, and freedom, to create what is known as the Prague Proposals. The Administration welcomes and fully supports these proposals, such as following the rule of law, respecting individual rights, and supporting innovation. Thanks to the work of this Committee and the Administration, we are taking action to address wireless security.

Biotechnology

The Administration recognizes the potential of biotechnology innovation to drive economic growth and improve lives in the United States. Biotechnology outputs are incredibly diverse, and future applications are limitless in both potential and value, including new ways to treat cancer; manufacture products that are safer, more sustainable, and novel; create pest and disease resistant crops; and support DNA-based information systems. Advances realized over the past two decades have resulted from the unique U.S. innovation ecosystem and the convergence between biology and other disciplines and sectors, such as nanotechnology and computer science.

By identifying R&D in the biological sciences and biotechnology as a top priority for federal investment in the Administration's FY 2021 R&D Budget Priorities Memo, the Trump Administration has taken seriously the rapid advances in the life sciences and the technical applications that are transforming the way we solve problems for the American public.

Take, for example, CAR-T—an amazing new way that we are able to treat cancer. Traditionally, the only way to battle cancer was surgery, chemotherapy, and radiation. With CAR-T, we can develop a biologically engineered and individually tailored treatment from the patient’s own immune cells. Under the Trump Administration, the Food and Drug Administration approved for the first time CAR-T cells to help treat children with acute leukemia and adults with advanced lymphomas. We still have a long way to go, but this therapy is brimming with potential and bringing hope to patients.

Likewise, DOD has identified biotechnology as one of its modernization priorities in support of the *National Defense Strategy*; is partnering with industry under the BioFabUSA to make practical the large-scale manufacturing of engineered tissues and tissue-related technologies for our warfighters; is working to establish a Synthetic Biology Manufacturing Innovation Institute (SynBio MII) in support of the U.S. biomanufacturing ecosystem; and DARPA’s “Living Foundries: 1000 Molecules” program has demonstrated a biologically-based way to grow a manufacturing pipeline and deliver versatile molecules and materials that could secure joints on airplanes through novel adhesives that previously would have required welding, improve optics for machinery, provide high-efficiency fuel sources, enable flexible electronics, and even deliver cells for use as medicines.

Additionally, DOE has announced the Innovation XLab for Biomanufacturing aimed at showcasing how U.S. industry can leverage world-leading national laboratory bioscience capabilities, like Agile BioFoundry, to bridge the gap between research and commercialization and pave the way for a stronger bioeconomy. USDA Biotechnology Risk Assessment Research Grants (BRAG) will help to prioritize opportunities for direct dialogue between regulators and the agricultural innovative community to advance regulatory science for biotechnology products.

Last year, President Trump signed an Executive Order to streamline the regulatory process and promote innovation biotechnology in agriculture. The White House also hosted a summit bringing together the nation’s foremost biotechnology leaders across industry, academia, and government to discuss U.S. bioeconomy leadership challenges and opportunities. The Administration updated the Coordinated Framework for the Regulation of Biotechnology (2017), delivered the *National Biodefense Strategy* (2018) to strengthen our nation’s defense, and produced the *Executive Order to Modernize Influenza Vaccines in The United States to Promote National Security and Public Health* (2019).

American leadership in biotechnology rests on our ability to maintain science- and risk-based review and regulation of biotechnology products, promote and safeguard critical biotechnology infrastructure and data, and prepare the next generation of biotechnology scientists, engineers, and innovators. We look forward to continued efforts across the federal government, the private sector, and the academic community in partnership with Congress to inform our policies on biotechnology leadership and advancement for the American people.

Advanced Manufacturing

Advanced Manufacturing is an engine of America’s economic power and a pillar of its national security. Advances in manufacturing enable the economy to continuously improve as new technologies and innovations increase productivity, enable new products, and create entirely new industries. Manufacturing is among the highest paying sectors of the economy, and has a broad impact on jobs in other sectors. Advances in manufacturing—and America’s ability to translate those advances into products, processes, and services—make R&D a key element of the Administration’s overall manufacturing strategy.

In the face of intense global competition, President Trump unveiled a *Strategy for American Leadership in Advanced Manufacturing* (October 2018) that focuses on defending the economy, expanding manufacturing employment, and ensuring a strong manufacturing and defense industrial base and a resilient supply chain. Federal investments are focused on key areas of strategic priority, including smart and digital manufacturing and advanced industrial robotics, especially systems enabled by the industrial internet of things, machine learning, and AI.

The Federal network of Manufacturing USA institutes brings together industry, academia and federal partners within a network of advanced manufacturing institutes to increase U.S. manufacturing competitiveness and promote a robust and sustainable national manufacturing R&D infrastructure. The most recent Manufacturing USA annual report details some of the institutes' successes in developing world-changing manufacturing technology and equipping the U.S. manufacturing workforce with the high-value skills needed to make tomorrow's products. In fiscal year 2018 alone, the institutes engaged more than 1,937 member organizations, sponsored more than 475 R&D projects, and helped more than 200,000 workers, students, and educators through institute workforce efforts.

The Administration recognizes the irreplaceable value of the American worker, and has acted to address the workforce changes caused by advanced manufacturing and other Industries of the Future. Since the advancement of new manufacturing technologies requires new skill sets for the U.S. workforce, Presidential workforce initiatives, such as the National Council for the American Worker and the Pledge to America's Workers, seeks to expand programs that educate, train, and reskill American workers from high-school age to near-retirement. By ensuring skills-based training, advancing opportunities for lifelong learning, and promoting multiple pathways to family-sustaining careers, all Americans can benefit from the nation's historic economic boom and record low employment rates.

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The priorities I've outlined today are bipartisan. We look forward to continuing to work with this committee to accomplish our shared goals for U.S. leadership in the Industries of the Future.

Thank you for the opportunity to testify today and for your support of this initiative. I will be pleased to answer any questions you may have.