Testimony
The Honorable Deborah Wince-Smith
President & CEO
Council on Competitiveness
before the
House Committee on Science, Space, and Technology
United States, China and the Fight for
Global Leadership: Building a U.S National Science and Technology Strategy
February 28, 2023

Chairman Lucas, Congresswoman Lofgren and members of the Committee, thank you for this opportunity to testify today on science and technology competitiveness with China and how the National S&T strategy can provide a vision and path forward for the U.S. research enterprise.

I have had the privilege to serve as president and CEO of the Council on Competitiveness since 2001. Before joining the Council, I had worked for over 20 years as a senior U.S. government official, including as the first Senate-confirmed Assistant Secretary for Technology Policy in the U.S. Department of Commerce and as an Assistant Director for International Affairs in the Reagan White House.

Since its founding in 1986 by former Hewlett Packard CEO John Young, the Council has been the nation's preeminent group of business, academic, labor, and national laboratory leaders shaping an impactful, bi-partisan growth agenda for the United States – defining and calling for investments crucial to support the talent, technology, and infrastructure at the heart of U.S. prosperity.

The Council's work is grounded in the belief that despite the myriad of challenges that continue to ripple through the economy today, the United States' underlying strength as the global leader in innovation remains. However, we must develop and advocate for ever-evolving pathways to success in the 21st century.

Over the past three years, our work has been guided by our National Commission on Innovation and Competitiveness Frontiers. The Commission—comprised of almost 70 CEOs, university and college presidents and chancellors, national lab directors, and labor leaders—is working to both define the scope of the competitiveness challenge facing the United States, particularly from China, including persistent low productivity and its impact on U.S. citizens. The Commission will also develop a set of recommendations for a path forward to continued U.S. leadership across critical science and technology areas. The scope of the challenge and the path forward were most recently described in our report *Competing in the Next Economy*, and I'm pleased to share with you today important highlights from that work that are directly relevant to the Committee's work.

A NEW AGE OF INNOVATION

Now, in the third decade of the 21st century, America has entered a new Age of Innovation. Humanity is in the midst of the convergence and acceleration of the greatest revolutions in science and technology. A new phase of the digital revolution—characterized by vast deployment of sensors, the Internet of Things, and artificial intelligence—is making our physical world smart and generating the abundance of big data that is providing unprecedented levels of insight in nearly every domain and systems

optimization at every scale. Biotechnology and gene-editing have given humans the tools to manipulate the very "code of life," nanotechnology the power to build things from the atom up, and autonomous systems to work without human hands, and watch the world and react without a human's senses or intervention. Advanced computing, the big data revolution, and machine learning are accelerating research and transforming the tools of innovation, which will further propel discovery and new developments to new heights.

Each of these technologies and the innovations emerging from this deep ferment are just beginning to reveal their massive power and promise. They have numerous applications that cut across industry sectors, society, and human activities. And they are now converging on the global economy and society simultaneously, creating a new age of unparalleled knowledge and vast technological power—a new Age of Innovation—with profound implications for individuals, companies, for societies, nations, for the global community, and for U.S. economic and national security. These innovations are disrupting industries and business models around the globe, shifting labor markets, shaping the future, and altering the patterns of society and many dimensions of our lives. And by definition they are inherently dual use with profound economic and national security implications.

These technology-driven innovations also hold the potential to create solutions for some of humankind's greatest challenges—providing adequate food and clean water for the world's growing population, developing therapies to improve health and cure diseases, providing the clean energy needed to drive economic opportunity in developing and underdeveloped countries, and mitigating climate change and environmental problems that threaten our planet. New technology-based tools will open greater access to learning everywhere, further democratizing innovation and its benefits globally.

At the same time the United States faces an unprecedented opportunity for progress, it also must confront a set of new competitive realties. New knowledge, new technological advancements, and the capital and skills needed to transform this knowledge and technology into innovations, products, and services for the world are now all highly mobile—and more than ever before in history, many countries around the world have access to any of these resources. As result, game changing technologies and innovations now originate almost anywhere, and nations around the world seek to leverage these resources for global competitive advantage and economic gain. Among these nations, a rapidly strengthening China seeks global technology leadership as part of its quest to become the world's economic, military, and geopolitical leader and shaper of the foundational rules for the "next" global economy.

U.S. leadership in technology-based innovation and our long-term competitiveness are under threat. As a nation's ability to innovate becomes ever more fundamental to its competitiveness and economic success, the very foundations of the U.S. capacity and capability in science and technology are eroding. There are deficiencies in the U.S. innovation engine, and barriers in developing and scaling new technologies. And, the United States has entered the third decade of the 21st century with too few of its citizens equipped with the knowledge, skills, and opportunities to participate and thrive in an ever more innovation-driven economy.

There are many examples I could point to highlighting the challenges of bringing more Americans into the innovation economy, but if you think of the country as a team, we are leaving far too many players and regions on the bench. This is true geographically and demographically. One example being the inadequacy of post graduate compensation as a barrier to more Americans, especially those from low

socio-economic backgrounds, pursuing graduate STEM degrees. This issue has been echoed by the National Science Board who pointed out that we will not reach the "missing millions" of Blacks, Hispanics, American Indians, Alaska Natives, Native Hawaiians, and women who are underrepresented in STEM, if we don't address compensation and student debt, as well as the ever-escalating cost of higher education, in general.

How the United States and its leaders respond to the duality of this new age—unprecedented prospect for progress and prosperity on the one hand, and clear and present dangers at home and abroad on the other hand—will have profound implications for generations to come. If United States does not mount a strong all-of nation response to these opportunities and new competitive realities at home and from overseas, if we fail to make needed investments in our people and future, our nation's fundamental capacity to grow its economy, create jobs, maintain national security, solve societal challenges, and provide a social safety net will continue to erode, and our geopolitical leadership will be at increasing risk.

CHINA'S RISE

We will increase investment in science and technology through diverse channels and strengthen legal protection of intellectual property rights, in order to establish a foundational system for all-around innovation. - President Xi Jinping, Report to the 20th National Congress of the Communist Party of China October 16, 2022

In short, China seeks to supplant the United States as the world's technological, economic, military, and geopolitical leader. The United States has faced formidable strategic competitors in the past. During the Cold War, the Soviet Union sought military supremacy, but could not secure global economic and market leadership. During the 1980s, Japan sought commercial market dominance, but not military superiority. China seeks both.

To achieve its superpower goals, China seeks to build a science and technology capability rivaling the size and breadth of the U.S. capability. It seeks to create the mechanisms to innovate—commercializing its growing achievements in science and technology—and sees business enterprises as playing the prime role. The government's role involves overall planning, and promoting the linking of capital, technology, and markets. China recognizes the gap between basic research and technology commercialization, and states that government will work to resolve this connection problem.[i]

With the objective of dominating the next generation of innovation, China is pursuing aggressive plans for every strategic critical underlying technology, backed by commitments for hundreds of billions of dollars in investment. For example, the Made in China 2025 initiative, announced in 2015, seeks to transform China from a manufacturing giant into a global science and technology power by 2049 (the 100th anniversary of the People's Republic of China), while it set a target to become one of the most innovative countries by 2020 and a leading innovator by 2030.[ii] In one example, it was just announced that China has filed more patents than the U.S. for nuclear fusion technology.

Made in China targets advanced IT, advanced machine tools, robotics, aerospace technology, maritime equipment, new energy vehicles, biomedicine, advanced medical equipment, and importantly battery technology, including all aspects of the supply chain.[iii] China is targeting development of the entire

semiconductor ecosystem, including spending of more than $150 billion over 10 years for investments and acquisitions, which makes the $52 billion Congress included in last year's CHIPS Act seem both necessary and inadequate at the same time.[iv]

In August 2020, the Chinese government updated its semiconductor policy to emphasize foreign academic and industry collaboration (including domestic and overseas R&D centers), expanding China's role in developing international rules for protection of intellectual property, advancing Chinese standards, use of antitrust authorities, and priority financing vehicles.[v] China's semiconductor policies include a strong government role in directing and financing Chinese businesses to obtain foreign intellectual property related to semiconductors.

In another example, in 2010, China made a major move in life sciences research when its company BGI purchased 128 of the world's fastest gene sequencers, half the global capacity for gene sequencing at that time. Today, China accounts for 30 percent of the world's sequencing capacity.[vi] In a recently translated speech, Chinese President Xi Jinping emphasized that China must place greater emphasis on basic research in heredity, genetics, virology and related fields; accelerate R&D and technological innovation of related drugs and vaccines; and elevate the importance of applying information and data technologies to these fields.[vii] It plans to support the establishment of a cellular genetics and genetic breeding technology R&D center, a synthetic biotechnology innovation center, and a biotech and pharmaceutical innovation Center to accelerate the pace of innovation and development for the biotech industry

And, in September 2020, the Chinese Communist Party Central Committee and State Council released Guiding Opinions on Expanding Investment in Strategic Emerging Industries and Cultivating Strengthened New Growth Points and Growth Poles.[viii] The guidance is focused on economic and social development, including accelerated promotion of strategic emerging industries and industrial clusters. It calls for building out the ecosystems, supportive financing mechanisms, and investment in technology development, demonstration, and deployment across Chinese industry and society of every strategic critical technology. This includes technologies and industries pioneered and dominated by the United States, ranging from biotechnology to the digital creative industry.

China is deploying a multi-pronged strategy to acquire technologies and intellectual property from other countries by both licit and illicit means. I've seen this firsthand as a member of the Commission on the Theft of American Intellectual Property. This includes building research centers in U.S. innovation hubs, forming partnerships with U.S. research universities, forced joint ventures for market access, sending students to the United States for academic studies, cyber theft, and industrial espionage. To absorb foreign technologies, authorities have established engineering research centers, enterprise-based technology centers, state laboratories, national technology transfer centers, and high-technology service centers.

The U.S. Trade Representative reports that China has engaged in a range of unfair and harmful conduct, including investment and other regulatory requirements that require or pressure technology transfer, and direction or facilitation of the acquisition of foreign companies and assets by domestic firms to obtain cutting-edge technologies.[ix]

There is also growing concern about China's presence on U.S. college campuses. In 2021-22, there were more than 294,000 Chinese foreign nationals studying at U.S. colleges and universities, almost one-third

of all foreign students.[x] Many of these students are in U.S. science and engineering graduate programs. Most do not have visas to stay in the United States and will return to China. Chinese companies seek research partnerships with U.S. universities and are setting up research centers in the United States to access U.S. talent and technology. State-backed Chinese enterprises increasingly finance joint research programs and the construction of new research facilities on U.S. campuses.

China's talent recruitment programs are also raising red flags. These programs target U.S.-based and other researchers around the world who focus on or have access to cutting-edge research and technology. In recent years, federal agencies have discovered talent recruitment plan members who downloaded sensitive electronic research files before leaving to return to China, submitted false information when applying for federal grant funds, and willfully failed to disclose receiving money from the Chinese government on federal grant applications. In some cases, talent program members received both U.S. grants and Chinese grants for similar research, established "shadow labs" in China to conduct parallel research, and stole intellectual property.

Lastly, China is seeking to shape large swaths of the 21st century global economic and trading system. It has been using its growing role in multilateral institutions and in the global trading system to advance its mercantilist dominance, including deploying a debt-financed development infrastructure model in other countries, as the United States' international engagement has atrophied. For example, China's Belt and Road Initiative is staggering in scope, a new Silk Road of railways, energy pipelines, highways, shipping lanes, and special economic zones, fueled by $1 trillion in Chinese investment, and in recent years the aggressive acquisition and control of strategic ports around the world most recently Haifa in Israel. The initiative would touch more than 4 billion people, 65 countries, and $23 trillion in GDP.[xi]

Through Belt and Road, China is massively financing, constructing, gaining ownership, and operating critical infrastructure around the globe, including a new "Digital Silk Road." It seeks to transform global infrastructure in its model, and shape digital infrastructure and connectivity.

THE PATH FORWARD FOR U.S. LEADERSHIP

Of the hundreds of potential recommendations the Council compiled for its 2020 report, we identified 50 priority recommendations that were:

(1) urgent—failure to act could create serious consequences for the United States;

(2) strategic—they are fundamental to U.S. economic and national security; and

(3) pivotal—they could play a prime and determining role in the scope and rate of U.S. innovation.

The bottom-line is simple—to compete in the next economy requires playing a new innovation game, one whose goal is to boost U.S. innovation tenfold: 10x. The call-to-action from the Council on Competitiveness and its National Commission on Innovation and Competitiveness Frontiers—for local, state and national policymakers to come together with the private sector to focus in a bold and transformational way on all efforts to optimize the United States for a new, unfolding, challenging innovation reality.

While I commend the full *Competing in the Next Economy* report to you, I want to highlight for you today five specific steps I think are critical to our nation's success and should be part of a National Science and Technology Plan.

Federal Coordination at the Cabinet Level

There are many factors that affect a county's ability to innovate and compete. These include: investment in research and development; the availability of capital for innovation at critical stages; the access to and provision of education that develops a growing base of qualified, diverse, innovation-prepared talent; the ecosystem for entrepreneurship; and the general business environment including taxes, fiscal policy, trade policies, and business regulation. In addition, how these factors affect innovators and business can vary depending on company size, whether in an infant or mature industry, capital or labor intensity of the industry, services or manufacturing, and the life-cycle of technologies and products in the industry.

To address these diverse factors, some U.S. competitors have established high-level ministries, government departments, or other organizations devoted to stimulating technology and innovation and to guide national strategic plans. In the past, the United States has had federal entities that addressed the scope of issues and factors that affect innovation and competitiveness, and sought to better integrate the federal leadership role in program coordination, analysis, and policy development. Also, Congress had an Office of Technology Assessment that performed critical studies to advise Congress on the role of technology in the economy and society. However, these entities did not survive changes of Presidential Administrations, reached sunsets as provided for in their authorizations, or were eliminated as budgetary saving measures.

As a result, the United States does not have in the federal government a single leadership structure for U.S. innovation and competitiveness, and related capacity and capabilities. Instead, policy formulation is fragmented as responsibility for addressing the factors that affect innovation and competitiveness cuts across many stove-piped missions of federal departments and agencies, multiple bodies within the Executive Office of the President, competing Presidential Cabinet-level councils, and multiple Congressional committees.

The closest integrative bodies are the National Economic and Domestic Policy Councils. The White House Office of Science and Technology Policy's scope of work revolves largely around federal science and technology policy, and federal R&D investment and programming. However, many critical policies having an impact on the Nation's innovation capacity and outcomes are within the purview of other White House bodies, such as the Council of Economic Advisors, the Office of Management and Budget, the National Security Council, etc.

In contrast, for example, the President's Commission on Industrial Competitiveness of the 1980s—the precursor to the Council on Competitiveness—addressed a range of issues in addition to research and technological innovation, including global trade policy, tax policy, patient capital, intellectual property protection, manufacturing modernization, and regulation. Similarly, broader in scope, the Stevenson-Wydler Technology Innovation Act of 1980 and its amendments—one of the major legislative initiatives in technology and innovation, guiding the government role for decades—outlined the scope of responsibilities vested in the leadership organization at the U.S. Department of Commerce.[xii] Under these and follow-on authorities, the Commerce Department carried out a diverse range of activities related to competitiveness and innovation.

In today's even more complex and turbulent innovation environment, domestic and global, the federal government must elevate the innovation agenda to the highest levels of decision-making. The United

States needs a permanent, high-level, adequately and continually funded and staffed organization to lead national efforts to leverage new technology, and strengthen U.S. innovation and competitiveness, given their fundamental role in economic growth, job creation, and societal functioning.

The federal government should establish in the Executive Office of the President a National Competitiveness and Innovation Council (NCIC), with status similar to the National Security Council (NSC) and National Economic Council (NEC).

And an important mission of the National Competitiveness and Innovation Council is the establishment of a competitiveness and innovation intelligence and assessment program—in essence, an innovation radar for the Nation. The innovation radar initiative could:

- Identify, monitor, and analyze information on key U.S. competitors' major initiatives, policies, and programs to boost national innovation and competitiveness, develop and publish reporting of findings as appropriate, and apply what is learned to improve U.S. policies and efforts.
- Conduct special "deep dive" studies to provide further insight on the U.S. position, its strengths, weaknesses, and vulnerabilities.
- Assess U.S. global competitors along a continuum of competitive strength, including a view from a critical industry and critical technology perspective. In addition to the current competitive situation, create an early warning capability to signal and monitor competitor strengthening and capabilities building that could be realized in the decade ahead, and potentially challenge the United States in critical emerging technologies and innovations of importance. The goal would be to prompt the United States to take steps to ensure it is not over-matched in the future.

Expand and Fund Place-based Innovation Efforts

As competition in the global innovation landscape intensifies, there is a growing urgency to capitalize on untapped talent across America. Innovators in Silicon Valley and other coastal hubs have helped position the United States as a science and technology leader, but many communities and regions have yet to fully join, engage in, and benefit from the country's innovation economy. The innovation workforce is highly concentrated in major metropolitan areas, with the top five metro areas—Boston, San Francisco, San Jose, Seattle, and San Diego—accounting for more than 90 percent of the nation's innovation-sector growth from 2005 to 2017.[xiii] The costs of this hyper-concentration are playing out in real time. Coastal technology clusters are increasingly facing congested transportation, skyrocketing costs of living, and constrained housing, while lagging regions are excluded from participating in or benefiting from American innovation.[xiv]

To remain competitive in the next economy, the United States must expand its innovation footprint. Broadening the U.S. innovation ecosystem—which is a system of systems, rather than monolith—will require targeted efforts that meaningfully engage different communities and diverse populations as beneficiaries, workers, innovators, and entrepreneurs. Effective place-based innovation strategies that involve and engage a much broader swath of Americans in the innovation future can help to support U.S. science and technology leadership for decades to come.

The challenges and barriers facing the innovation landscape differ by geography, as do the unique opportunities presented by distinct assets, knowledge, and resources in each region. "One-size-fits-all" approaches to supporting regional innovation ignore these crucial geographic distinctions and fail to

capitalize on different regions' core competencies and advantages. Meanwhile, communities in certain regions often lack the resources and strategic guidance needed to gear up local innovation and ultimately compete against each other for talent and capital.

Finally, research has found that traditional place-based policies often create a zero-sum game that merely shift workers and firms from one area to another without increasing overall economic activity.

The United States must recognize the unique capabilities, resources, and competitive advantages present in every region and take active steps to include all corners of the country in its innovation future. Important steps have already been taken with passage of the CHIPS and Science Act last year laying the groundwork for the expansion of tech hubs. Still, the nation needs a coordinated national strategy for place-based innovation to help leadership in underutilized regions identify and leverage their local niche. Part of that strategy should include establishing regional centers dedicated to innovation fields that align with the specialized expertise, capabilities, or natural resources specific to the area.

Many regions across the country are already experimenting with novel place-based innovation strategies that seek to develop regional assets and leverage competitive advantages. For example, Oak Ridge National Laboratory—partnering with key regional stakeholders, including industry and universities—is finding new ways to turbocharge its regional economy, to provide students access to unique laboratory resources, and attract top-tier talent. This experimental evolution in place-based policies is likely to grow as regions coordinate and collaborate across longer distances in an increasingly digitized national innovation ecosystem.

And many universities across the country are building a more diverse STEM workforce and leveraging their role as drivers of regional economic revitalization, such as South Dakota State University and Morgan State University in cyber, Oklahoma University for hypersonics, and Kansas State University on biodefense, just to name a few examples.

Furthermore, the innovation economy suffers from a lack of socioeconomic and racial diversity. White children are three times more likely to become inventors than black children, and children with parents in the top 1 percent of the income distribution are ten times more likely to file a patent than children with below-median income parents.17 While these disparities indicate an extreme challenge, they also present a real opportunity.

The United States should engage underserved communities in its efforts to establish new centers of regional innovation and economic growth. Research shows that exposure to innovation is the greatest driver of innovative capacity, but many of these communities lack this crucial exposure.19 Embedding innovation in local school curricula, business skills training, and community programs will be a key step towards inspiring future innovators and revitalizing struggling communities. By offering educational and employment opportunities to community members, America can activate enormous untapped innovation potential.

The U.S. Must Embrace Technology Statecraft

As noted, the United States currently lacks a cohesive national strategy or dedicated federal body for advancing U.S. innovation and competitiveness. Importantly, domestic innovation leadership must be coupled with increased engagement on the international stage. The Council is strategically deepening

our collaborations with like-minded allies and leading tech nations such as the UK, Australia, Japan, and the bipartisan Quadrilateral Security Dialogue (U.S., Australia, India, and Japan). And finally, through the work of our sister organization, the Global Federation of Competitiveness Councils.

Technology is the driving force of the 21st-century global economy. Nations are mobilizing to capture their share. These countries work to strengthen their technology and innovation capabilities by influencing international economic, scientific, trade, and security institutions and arrangements. In recent years, though, the United States has put shaping the 21st-century economy on the backburner, and China has stepped into the vacuum. China is moving aggressively to assert leadership and shape the direction of global rules and institutions.

China announced it will set up a United Nations Global Geospatial Knowledge and Innovation Center, as well as International Research Center of Big Data for Sustainable Development Goals. Four of the 15 U.N. science- and technology-related agencies are now led by China; in contrast, the United States leads one. The United States also had to mobilize key allies to deny China — the world's top threat to intellectual property (IP) — leadership on the World Intellectual Property Organization, the global guardian of IP.

By increasing China's profile on international standards bodies, it aims to implement the nation's China Standards 2035 blueprint and Belt and Road Initiative, with the aim of influencing standards for next-generation technology such as advanced microchips, the internet of things, cloud computing, big data, 5G, intelligent health care, and AI.

Regardless of whether it's our foes, such as China, or allied counterparts, such as the European Union, the international community is upping its game and diminishing the reach and impact of American innovation, influence, and opportunity. We can't afford to fall behind any further. The United States must play a more muscular role in the international arena to defend its global competitiveness. We need to ensure that rules for governing technology and competition, as well as the flows of goods, services, and data in the next economy are shaped by liberal, democratic, and free market principles.

The United States must elevate the use of technology statecraft in U.S. economic and national security strategy. By focusing U.S. government actions on international rules, institutions, arrangements, deployment of capital and scientific resources, we can engage in mutually beneficial collaboration with likeminded foreign partners that share American values and interests in shaping rules for the 21st-century economy. This includes: international coordination on cross-border investment with national security implications; more robust U.S. participation in international scientific institutions and in international financial institutions affecting competitiveness; U.S. priority to new international rules for the digital economy; more partnering and collaboration on R&D with strategic allies; and, integrating science, technology, and innovation into our core diplomatic and foreign service capability - for example, building a new U.S. International Science, Technology, and Innovation Corps to substantially increase the number of Americans in these fields serving as foreign service officers, in the Foreign and Commerce Service, and as trade negotiators.

Just as China has a whole-of-government approach, we must take a similar one to achieve our national science and technology goals as its personnel carry out its foreign political, national security, and commercial engagements around the world. If we do not counterbalance the Chinese Communist Party's aggressive ambitions and moves in reforming the global governance system, we will be

challenged to constrain its authoritarian, anti-competitive, and illicit practices — and the competitiveness and economic security of many nations, including our own, will be under threat.

Developing and Deploying Technology at Scale

Throughout the 20th century, some U.S. corporations operated large, free-standing centralized industrial research laboratories that developed inventions and applications in response to real world problems, possibilities, and user needs. These laboratories housed specialized equipment and facilities to test and validate inventions and applications, and they were institutionally connected to integrated production facilities, simplifying the flow of new applications to production with no technology transfer gap or valley of death.

Corporations have refocused their technical efforts largely to product development. With few exceptions, the United States no longer has large, multidisciplinary-staffed industrial labs connecting broad areas of research and technology to problems and market possibilities. This has left the United States with a weaker capability to translate new technology developments into applications and economic impact. One exception is the large multidisciplinary laboratories run by some federal agencies, such as those at the Departments of Energy and Defense who are increasingly engaging strategically with companies, universities, and the start-up ecosystem. However, while similar in scale, scope, and capabilities of old industrial research laboratories, these laboratories are focused on achieving their government missions. Another exception are several large high-tech hubs on the coasts of the United States, which are world leaders in scaling applications in the digital and biotechnological domains. These hubs are anchored by large companies and/or top research universities or institutions. They are also start-up generators, but start-ups do not have the resources to bring their technologies to scale.

Now, with few exceptions, the U.S. innovation ecosystem is mostly broadly divided into two large research and innovation sectors:

• Academic research at universities, largely agglomerations of single-discipline, investigator-driven, small scale basic and exploratory research focused on discovery and knowledge generation.

• Product development in private companies

This division of labor has created a “missing middle” in applications research, where invention occurs and innovation begins. It has also resulted in a time-consuming technology transfer gap (when new discoveries or technologies are “transferred” to the private sector), and the valley of death (in which immature technologies emerge from universities or start-ups but they do not have the resources to de-risk them to make them more attractive for private sector investment and commercialization). In addition, most STEM students are trained to work in an academic research setting even though most will work in the private sector.

To fill this missing middle—in attempts to stimulate the transfer of university research to the private sector for commercialization, and close the valley of death—the United States has established numerous research initiatives, institutes, etc. However, they can be: diffuse, fragmented, and distributed; relatively small in scale; limited in their disciplinary domain, and; often disconnected from specialized equipment for testing and verification.

With few exceptions, such as the 15 Manufacturing USA institutes, they operate at arms-length from industrial production, the marketplace, and real-world problems. A new model of R&D organization that focuses and helps integrate the efforts of all parts of the innovation enterprise could help fill that missing middle. These entities—which could be institutes, consortia, smaller research and application centers, or hubs—should be distinct from, but complement the efforts at national laboratories, basic research at universities, and other institutes and initiatives.

With funds from an expanded public investment in R&D, the federal government should co-fund with industry several pilot at-scale initiatives to demonstrate new models of application-oriented R&D efforts with the above-mentioned characteristics. These should be selected based on a rigorous competition taking into account industry commitment, technical capability and capacity, opportunity landscape and potential for economic impact, and adequacy of supporting ecosystem elements.

The scope of the challenge will also require entirely new financing models beyond traditional venture capital such as a national infrastructure bank.

IN CLOSING – A CALL TO FUND THE "SCIENCE" IN CHIPS AND SCIENCE

I realize this is an appropriations issue and this Committee is to be commended for its leadership and support of increased federal science authorizations. Nonetheless, I would be remiss if I did not specifically call out the importance of fully funding the science provisions in the CHIPS and Science Act signed into law last year.

As I have detailed today, the United States faces global challenges and competition across the scientific, research, and innovation landscapes greater than we've ever seen before. China's share of global research and development has quadrupled over the past two decades and its investment in research has more than doubled. At the same time, U.S. investment has lagged in comparison to global competitors now ranking tenth as a percentage of GDP.

It is this global competitive reality that spurred Congress to act in a bipartisan manner and it is why the legislation includes $52 billion in emergency spending to bolster the U.S. semiconductor industry, so desperately needed to support U.S. economic leadership and national security. I know Congress provided significant increases in funding, but even those increases fell short of the authorized investments.

In this town, and especially within the S&T community, we often refer to major challenges as being "Sputnik moments" requiring generational responses. But so often those responses while loud in the moment, fade with time and become incremental rather than game-changing. I urge you not to let that happen with the funding envisioned for science and technology in the CHIPS and Science Act.

The Council is continuing its focus on competitiveness with the launch of the second phase of our Commission's work. We know we need new models and new ways of collaborating to meet the moment. Our business leaders, academic leaders, labor leaders and national lab directors are committed to finding the path forward for the United States to ensure continued opportunity and prosperity for all Americans.

Thank you.

[i] Speech on Certain Major Issues for Our National Medium- to Long-term Economic and Social Development Strategy, President Xi Jinping in April 2020 (translated), Center for Security and Emerging Technology, and Etcetera Language Group, November 10, 2020.

[ii] China's Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable A Strategic Competitor to Access the Crown Jewels of U.S. Innovation, Defense Innovation Unit Experimental,

[iii] *Made in China 2025*: Global Ambitions Built on Local Protections, U.S. Chamber of Commerce, 2017.

[iv] *Made in China 2025*: Global Ambitions Built on Local Protections, U.S. Chamber of Commerce, 2017.

[v] China State Council, "Notice on Issuing Several Policies to Promote the High-Quality Development of the Integrated Circuit Industry and the Software Industry in the New Period," August 4, 2020.

[vi] 2018 Global R&D Funding Forecast, R&D Magazine, Winter 2018.

[vii] Speech on Certain Major Issues for Our National Medium- to Long-term Economic and Social Development Strategy, President Xi Jinping in April 2020 (translated), Center for Security and Emerging Technology, and Etcetera Language Group, November 10, 2020.

[viii] Translation jointly produced by DigiChina, Stanford University Cyber Pol- icy Center, in partnership with New America and the Center for Security and Emerging Technology at Georgetown University.

[ix] Findings of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation Under Section 301 of the Trade Act of 1974, Office of the United States Trade Representative, March 22, 2018.

[x] OpenDoors Report on International Education Exchange, U.S. Department of State and Institute of International Education.

[xi] Center for Strategic and International Studies, China Power Project.

[xii] This scope included: determining the relationships of technology developments to U.S. economic performance; determining the impact of economic and labor conditions, industrial structure and management, and government policies on technological developments in particular industrial sectors; identifying technological needs, problems, and opportunities within and across industrial sectors; assessing the adequacy of capital and other resources being allocated to domestic industrial sec- tors which are likely to generate new technologies; proposing and sup- porting studies and policy experiments to determine the effectiveness of measures with the potential of advancing United States technological innovation; and considering government measures with the potential of advancing United States technological innovation.

[xiii] Brookings (2019), "The case for growth centers: How to spread tech innovation across America."

[xiv] Kenan Institute of Private Enterprise (2021), "Is Big Tech Headed for a Big Tumble?"