FAS FEDERATION OF AMERICAN SCIENTISTS

Written Testimony

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"American Global Competitiveness at 250: Legislative Proposals to Secure U.S. Technology Leadership."

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Chairmen Guthrie, Bilirakis, Ranking Member Pallone, Schakowsky, and members of the committee: thank you for the opportunity to testify on American technology competitiveness at a moment when the United States is approaching its 250th anniversary and facing a generational test of scientific, economic, and strategic leadership.

My name is Dr. Jedidah Isler, and I serve as Chief Science Officer at the Federation of American Scientists (FAS). FAS is a nonpartisan, nonprofit policy organization dedicated to using science, technology, and evidence to improve the lives of the American people and strengthen the nation. That mission is not new for us. FAS was founded by scientists who understood that scientific discovery could reshape the world, for good or for harm, and that scientists therefore had a responsibility to help democratic institutions govern powerful technologies wisely. In one of FAS's earliest newsletters in 1946, the organization was already urging scientists to engage in debates over whether science and technology would be used for war or to advance peace. How the government aligns scientific power with democratic responsibility and public benefit is the founding concern that remains central to our work today.

FAS's own policy work today, which I am proud to steward as Chief Science Officer and policy lead, reflects the same core idea. In our recent recommendations to the Office of Science and Technology Policy (OSTP) on accelerating the American scientific enterprise, we argued that American science remains extraordinary but must become more agile, better connected to public benefit, and more capable of translating discovery into shared prosperity, security, health, and flourishing. That requires government capacity: the ability to coordinate across agencies, support high-risk research, use flexible authorities, build modern technical workforce pathways, improve federal grantmaking, and ensure that federally funded scientific advances reach the American people.

The bills before the committee in this hearing cover a wide set of technologies: robotics, immersive technology, semiconductors, open-source artificial intelligence, quantum engineering, biotechnology, memory chips, and connected vehicles. They differ in design, scope, and domain, but they share the single premise that American leadership in critical technologies is valuable, vulnerable, and worth protecting. Right now, we are rapidly ceding that leadership and my goal is to illuminate how to get us back in the game.

That premise – that America can and should lead global technological innovation – is correct but not self-executing. This is not a subscription service that renews automatically. It is more like a garden that has to be cultivated over time. While the harvest we wish to see in areas under discussion in these bills, areas like quantum, artificial intelligence and advanced manufacturing are undoubtedly the harvest we need, they depend critically on the "soil health" that is easy to take for granted: basic and use-inspired research, commercialization and de-risking of emerging technologies, technically trained experts, resilient supply chains, and a federal government capable of moving at the speed of technology.

At the Federation of American Scientists, we approach technology competitiveness from this science-first perspective because that is our history and our institutional purpose. FAS was founded by scientists who had seen, through World War II and the atomic age, that scientific discovery could become world-shaping technology faster than democratic institutions were prepared to govern it. That lesson is just as relevant for artificial intelligence, quantum engineering, biotechnology, robotics, semiconductors, and connected systems today. Technology is what science becomes when knowledge is translated into tools, products, systems, and capabilities. The United States cannot lead in the technologies of the future while neglecting the science enterprise that produces them

The True Legacy of American Competitiveness: Sustained Investment in the S&T Workforce

Over the last 250 years, the United States has enjoyed extraordinary advantages. We have led the world in science and technology not because leadership was inevitable, but because previous generations made deliberate choices to cultivate it. We built world-leading universities, national laboratories, federal research agencies, companies, capital markets, and regional innovation ecosystems. We supported basic research before its applications were obvious. We created institutions that could take risks and connect discovery to national needs.

Fundamentally, though, America's scientific leadership advantage has always been a people story. The United States became the world's science and technology superpower because it built institutions capable of training, attracting, and empowering extraordinary talent. Generations of students, technicians, engineers, researchers, program managers, entrepreneurs, and skilled workers turned public investment into discovery and discovery into public benefit. Some were trained in American public schools, community colleges, universities, and national laboratories. Many of them came from around the world because the United States offered something rare: open inquiry, world-class institutions, freedom to pursue ambitious ideas, access to capital, and a credible pathway from research to impact. That combination produced the modern American innovation system and the people who built the semiconductor industry, launched the space age, decoded the human genome, created the internet, advanced modern medicine, and seeded the technologies being considered now before this committee.

Talent is also the slowest crop in the science and technology garden. We can lose it quickly, but it takes years, decades or even generations to rebuild.

Today the U.S. science, technology, engineering, and math (STEM) workforce stands at 37 million people and 43% of doctorate-level scientists and engineers working in the United States were born abroad. For generations, America has been the premier destination for the world's most talented scientists, engineers, and entrepreneurs to immigrate here, train here, work here, build companies here, and live here. That advantage has depended on thoughtful immigration policies that attract rather than dispel talent. Training more Americans in STEM and attracting the world's best scientists and engineers are not competing strategies. They are mutually reinforcing requirements for American technology leadership.

NCSES data show that in 2023 the median time to earn a science and engineering research doctorate was 8.0 years after a bachelor's degree and 6.8 years after entering graduate school. That timeline isn't negotiable; you cannot decide in 2030 that you need more quantum engineers in the United States in 2031. It takes time to educate and train researchers who can design, build, operate, maintain, and improve the semiconductor fab, quantum lab, robotics company, or biofoundry of the future. FAS has warned that unstable federal funding, deteriorating research infrastructure and networks, restrictive immigration policies, and declining international collaboration are driving an American brain drain that threatens U.S. competitiveness, national security, and global leadership.

According to recent reporting, some 10,109 federally employed, doctoral-trained experts in science and related fields left their jobs last year, that is 14% of the total number of federally employed Ph.D.s in STEM or health fields. If the country sends talented people away today we cannot simply manufacture replacements next year. We will feel the consequences through fewer breakthroughs, weaker startups, thinner technical agencies, slower manufacturing scale-up, and diminished leadership in the very fields before this Committee.

This damage isn't just to talent on hand; the S&T ecosystem relies on an ongoing cultivation of future talent. In science, as in any competitive field, those with the talent and ability to move are often the first to do so when conditions deteriorate — and we are watching that happen in real time. A March 2026 STAT survey found that 22% of labs had rescinded offers to students, staff, or postdoctoral researchers; 53% of researchers had advised their students to consider opportunities outside the United States; and the European Research Council had seen a fourfold increase in applications from Americans for advanced grants. International graduate student enrollment in STEM programs fell in 2025 – one of the largest single year declines outside the pandemic – driven by visa restrictions and a harsher policy environment. Meanwhile, our competitors aren't waiting. China is the most dramatic example, but India, South Korea, and the EU are all accelerating investments in this academic market.

American universities are, for the moment, still the primary global engine for turning public investment into scientific discovery, and into the people who carry that discovery forward. American research shapes what the world builds on. According to the recently released 2026 National Science Board's Science & Engineering Indicators, the U.S. ranks first globally in citation impact for science and engineering publications, though that lead has been narrowing since 2014 with China now ranked second. International rankings place American institutions highly, such as QS World University Rankings listing four of the top ten spots globally, with more ranked universities than any other country. Institutions like MIT, Stanford, Caltech, Johns Hopkins are top forums to train the physicists who design semiconductors, the biologists who work in biosafety labs, and the computer scientists who develop AI systems. It took decades to build that institutional advantage, but it is being drawn down faster than most people realize. Times Higher Education's 2026 rankings show only 102 American universities in the global top 500; the lowest on record. Our research university system was already losing ground before 2025, and what has happened since is an acceleration of damage that will take years to reverse.

The federal laboratory system bridges research infrastructure with private sector to enable discovery and invention on a scale and time horizon that no sector can do alone. The Department of Energy manages a preeminent federal research system: 17 national laboratories, 28 world-class user facilities including particle accelerators, light sources, and supercomputers, used by tens of thousands of researchers from universities, industry, and government annually, with more than 100 Nobel laureates associated with its work, over a quarter of whom were immigrants. Beyond DOE, NIH is the primary federal funder of the biomedical research that underlies the bioeconomy, a sector that now generates over 5 percent of U.S. GDP and is directly relevant to the biosecurity and biomanufacturing provisions in the legislation you are examining. NIST provides the measurement and standards backbone that semiconductors, quantum, and AI all depend on — without NIST's role in setting technical standards, commercializing any of these technologies at scale is harder and slower.

It would be remiss not to meaningfully connect this hearing and the legislation considered to the foundational science that preceded it. The National Science Foundation is not within this committee's jurisdiction, but every technology under discussion today rests on decades of federally supported basic research, much of it conducted long before a commercial application was obvious. If we want American leadership in 2036, 2046, and 2076, we must protect and modernize the scientific and technical engine that produces the breakthroughs of tomorrow and protect investments and operations of scientific agencies like NSF, which has undergone significant disruption and undermining to the extent that it threatens all technological leadership progress and the success of the legislation under consideration in this hearing.

What makes this ecosystem so powerful is the interconnection. A diverse array of institutions contribute to a powerful interconnected ecosystem, from universities that produce talent and early-stage discovery to industry that draws on the fruits of this system and contributes substantial later stage research and development (R&D) to it - representing over 75% of total R&D spending in the United States. Our past efforts at making this ecosystem thrive is how the United States turned basic science into technological and national security advantage for eighty years. It is now stressed at multiple points simultaneously. As FAS has documented, the damage compounds: reduced research funding forces universities to shrink labs, cut graduate cohorts, and pull back from Department of Energy (DOE) collaborations, while each researcher who exits takes specialized training and institutional knowledge that took years to accumulate. The connections in this ecosystem require protection.

America's science and technology leadership has also depended on a spirit of innovation and entrepreneurship unique to our history and identity. America has been strongest economically when it paired open scientific inquiry with competitive markets, private initiative, and public institutions capable of taking the long view. Basic research alone does not automatically become national strength. It has to move through a discovery-to-commercialization process that includes research institutions, skilled workers, capital investments, manufacturing capacity, procurement, standards, and customers. American genius is at its best when public investment expands the realm of what's possible and private enterprise turns possibility into products, companies, jobs, and strategic capability.

FAS is grounded in a similar spirit of *policy* entrepreneurship: the belief that scientific ideas must be translated into democratic action and public benefit. As Congress considers legislation that empowers America to compete in AI, quantum, biotechnology, semiconductors, robotics, and advanced manufacturing, it needs that same spirit of policy entrepreneurship to build a coherent governance and commercialization system that ensures American discoveries do not stall between the laboratory and the marketplace.

Technology Competition has Changed

The United States remains a global science and technology superpower, but the competition has changed. According to AAAS's 2026 global R&D update, China now leads across all major aggregate indicators of R&D capacity: dollars invested, researchers active in their fields, scientific publications, and global patent applications. According to ASPI, there has been a "…stunning shift in research leadership over the past two decades towards large economies in the Indo-Pacific, led by China's exceptional gains. The US led in 60 of 64 technologies in the five years from 2003 to 2007, but in the most recent five years (2019–2023) is leading in seven. China led in just three of 64 technologies in 2003–2007 but is now the lead country in 57 of 64 technologies in 2019–2023, increasing its lead from our rankings last year (2018–2022), where it was leading in 52 technologies." The U.S. is no longer the undisputed leader of science and technology. We have moved from an era of assumed leadership to an era where leadership must be actively rebuilt. We have to tend our garden.

In many domains, technology competition is far more than who sells the final product. Global tech leadership is won by who trains the workforce, who owns the equipment, who sets the standards, who controls the supply chain, and who can translate discovery into deployment most effectively. This is a feedback loop the U.S. invented. Yet for decades, sharpening global competition has laid bare growing gaps in the U.S. system that undermine the assumption that what is invented here will be built into a source of economic advantage here. The specific technologies contemplated by these bills are symptomatic of gaps in our commercialization pipeline, and domestic capacity for de-risking and financing strategic new technologies. Government has a significant role in addressing these gaps, and FAS commends Congress's leadership on massive efforts to address them like with *CHIPS and Science*, but the patchwork of programmatic responses to date are not up to the scale of the challenge.That's where this committee comes in.

Semiconductors are a good example that show all these aspects of leadership at work. A modern semiconductor depends on a chain of capabilities, and when any one layer becomes concentrated abroad, U.S. leadership becomes vulnerable. National Science Board data show that in 2024, just over half of global value-added semiconductor production occurred in China and Taiwan combined, while the United States accounted for 19 percent. Congress has already responded with significant investments through the *CHIPS and Science Act,* but we cannot depend on behemoth, once-in-a-generation legislative efforts like that to secure every critical technology sector; although such strategic investment is welcomed. In semiconductors, as in the other technologies before this committee, the final product is only the visible harvest. As the CHIPS story demonstrates, it is also far more expensive to attempt to rebuild lost capacity than to sustain that which still exists. I commend the committee for acting on this insight across many of the key technologies this package would address.

And while China is the central pacing challenge, this is not only a China story. The global playing field has changed around us. Europe is competing through standards, industrial policy, and regulatory influence. The United Kingdom is seeking to define itself as a hub for AI governance, life sciences, and frontier technology. India is dramatically scaling its digital infrastructure, STEM talent, space, semiconductors, and advanced manufacturing. Japan, South Korea, Taiwan, and other partners hold critical positions in chips, batteries, robotics, advanced materials, and defense-relevant technologies. The United States is no longer competing in a world where others wait for American invention and then follow. We are competing in a world where many nations are deliberately organizing capital, talent, infrastructure, and policy around the next generation of strategic technologies.

American Technology Leadership Legislation under Consideration

Congress should evaluate these bills by more than the technology domain they name, but also by whether they support the underlying system that allows the United States to lead in that domain. A commission, study, or procurement guidelines can be useful if it produces actionable recommendations and follow-through. All could be bolstered by adequately resourcing the full R&D development lifecycle.

The *PROTECT USA Act* raises a different kind of competitiveness question. The bill is framed as a response to foreign regulatory overreach, particularly the European Union's Corporate Sustainability Due Diligence Directive, and there is an understandable concern that American companies should not be subject to unpredictable or extraterritorial foreign mandates that conflict with U.S. law. Regulatory certainty matters for competitiveness. But this proposal also illustrates the danger of solving one uncertainty by creating another. If a U.S. company operating globally is told that it may face risk abroad for failing to comply with foreign law and risk at home for complying with it, that company is not more competitive; it is caught in a legal and commercial trap. A stronger approach would engage in meaningful diplomatic dialogue to protect U.S. sovereignty while preserving the ability of American firms to compete globally, engage allied markets, and operate with clear rules. In a technology competition, we should be careful not to make global scale-up itself feel like a liability for American companies.

Robotics competitiveness is about robots, yes, but before that it is about sensors, actuators, software, AI, manufacturing integration, safety standards, and workers who know how to deploy and maintain systems on factory floors, farms, warehouses, hospitals, and disaster sites. The National Commission on Robotics Act is a useful strategy-building vehicle because it recognizes that robotics leadership cuts across workforce, supply chains, commercial adoption, and national competitiveness, but the strategy must be connected to resources that can address those needs. In the meantime, this committee could consider additional hearings on this topic, requests for information from the public or standing up a special subcommittee to begin gathering insight.

Immersive technology, that is Augmented Reality, Virtual Reality, and Extended Reality, are more than simply consumer devices. They are training tools for surgeons, pilots, manufacturers, first responders, service members, and students. The *United States Leadership in Immersive Technology Act* would help create a federal focal point for understanding the state of this industry and identifying what is needed to sustain U.S. leadership. That is a sensible first step, but the advisory structure should be connected to the people and infrastructure that make the field possible: optical engineers, computer vision experts, human-computer interaction researchers, semiconductor designers, technicians, standards bodies, and privacy and safety experts.

Semiconductor competitiveness presents a case with much to observe. The *CHIPS and Science Act* was a historic investment in fabrication capacity, but fabs depend on specialized manufacturing equipment, advanced materials, skilled technicians, and scientific disciplines such as precision optics, plasma physics, metrology, and materials science. The *Chip EQUIP Act* identifies a real strategic vulnerability by bracing against U.S. public investment being used to deepen dependence on equipment from foreign entities of concern. But procurement guardrails like this must be paired with upstream investments in the science and workforce needed for the next generation of equipment.

Open-source and open-weight AI require similarly careful thinking. Open models can accelerate research, competition, small-business adoption, and scientific discovery. They can also create misuse risks, including cyber and biosecurity risks when capabilities diffuse faster than institutions can respond. The status quo should go beyond the binary of open versus closed. The goal should be a policy architecture that preserves American openness and innovation while investing in evaluation, incident response, secure deployment, and technical measurement capacity. The *Open-Source AI Leadership Act* is valuable because of the clarity it can bring to the Department of Commerce's important role within this architecture that will only serve the researchers, startups, companies at the forefront of AI development.

Quantum technology is another domain where the endpoint is easy to overstate and the foundations are easy to underinvest in. Quantum sensing, communications, computing, and cryptography have significant implications for national security, economic competitiveness, and scientific discovery. Congress has shown leadership here already with passage of the *National Quantum Initiative Act*, including its work on the upcoming reauthorization in 2026, which would allow for consultation with the National Quantum Coordination Office in the White House Office of Science & Technology Policy, and the Subcommittee on the Economic and Security Implications of Quantum Science under the National Science and Technology Council. The *American Quantum Competitiveness Act* builds on that foundation by focusing on commercialization, trusted supply chains, critical components, and private-sector scaling. That is the right next phase, but quantum leadership will still depend on long-term investment in condensed matter physics, engineering, materials science, cryogenics, photonics, standards, and a specialized workforce.

Biomanufacturing and biosecurity show why competitiveness and safety must be designed together. The United States should lead the bioeconomy, but we should not repeat the mistake of letting governance lag decades behind capability. *The Biosecurity Modernization and Innovation Act* is important because it not only addresses today's screening gap in gene synthesis; it begins to ask how the United States can build an adaptive biosecurity system that identifies concerns, tests governance tools, and updates oversight as the technology changes. *The BEDROCK Act* addresses the need to complement the safety and security of biotechnology with a focus on ensuring that American companies can remain globally competitive. These proposals and many in this domain have been produced and catalyzed by the policy thought leadership of the National Security Commission on Emerging Biotechnology. The successful uptake of their recommendations is strong evidence that national commissions like this can be effective, and a model to emulate, if followed by sustained legislative progress.

Autonomous vehicles are another example of how technology competition now reaches deep into ordinary products. A modern vehicle is more than a mechanical method of conveyance.

It is a software-driven, sensor-rich, connected operating system that depends on semiconductors, batteries, communications equipment, data flows, mapping technologies, human-machine interfaces, cybersecurity, and advanced manufacturing. That makes the automotive sector a legitimate national and economic security domain. The *Automotive National and Economic Security Act* is a meaningful area for congressional attention, but the policy objective should not stop at identifying exposure. The United States also needs to build the trusted domestic and allied capacity that gives companies real alternatives: secure components, resilient supply chains, strong cybersecurity standards, modern manufacturing talent, and the ability to innovate in the next generation of vehicles here at home.

Every bill before this Committee is, at its heart, a bet on the American S&T workforce ecosystem who will actually build, run, and improve these technologies. As outlined, that workforce is under pressure right now, and the pathways feeding into these specific fields is narrower and more obscure than the ambition of this legislation requires. The question Congress should ask of each proposal today is not only whether it addresses a technology gap but whether it also strengthens the people and institutions that make closing that gap possible. This is not an abstract concern from scientists cheering for their own team. A 2025 ASTC national survey of more than 1,000 U.S. adults found that 9 in 10 Americans across party lines believe federal investment in STEM education is important for future economic prosperity, and nearly 7 in 10 are concerned about federal policy changes that affect the nation's ability to attract and retain top scientists. The American public has already arrived at this conclusion. The legislation before this committee is an opportunity for government institutions to catch up.

Congress has shown it can act when competitiveness is treated as a national priority. The *CHIPS and Science Act,* infrastructure investments, energy manufacturing incentives, ARPA-H, regional innovation efforts, and bipartisan work on biosecurity, quantum, robotics, and supply chains are evidence that Congress can make lasting, meaningful progress when it wants to. Those successes and prioritizations are the building blocks of a next generation American tech competitiveness agenda. The next step is to make those pieces durable, fully implemented, and connected to the research and workforce base.

Conclusion

The United States boasts scientific ingenuity, entrepreneurial talent, capital, and motivated workers. What we too often lack is a coherent system for connecting them towards a common goal. Congress can help build that system by aligning research, talent, standards, supply chains, public finance, procurement, and government capacity around clear national objectives. That is the work required to turn American discovery into American products, American companies, American jobs, and American strategic advantage.

I commend the Committee's focus on technology leadership. The next step is to make sure each proposal is empowering and leveraging the foundations of that leadership - science, talent, and government capacity. That is how the United States can compete with confidence, protect its values, and deliver technological progress that benefits all of America for the next 250 years.