Testimony of the Quantum Industry Coalition
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Before the Senate Committee on Commerce, Science, and Transportation
Hearing on Securing U.S. Leadership in Emerging Compute Technologies
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The Quantum Industry Coalition (QIC) is a group of companies dedicated to maintaining the United States' leadership in the development and commercialization of quantum technologies. Our members range from start-ups to Fortune 100 companies focusing on a variety of aspects of quantum technology, including hardware, software, and application development. QIC appreciates the opportunity to provide testimony to the Committee about securing U.S. leadership in quantum computing, a key emerging compute technology.

This Committee, along with the House Science, Space, and Technology Committee, took the lead in introducing the National Quantum Initiative Act in 2018. The bipartisan, bicameral bill was signed into law later that year, marking a major strategic investment in next-generation computing technologies. The National Quantum Initiative is slated for reauthorization in the year ahead, and we look forward to working with the Committee to update and expand the National Quantum Initiative.

Quantum computing is the next giant leap in computing capability, with tremendous economic, scientific, and national security implications. A quantum computer uses quantum bits, or qubits, to store information. Qubits are different from classical computer bits in that they store information not only as a "0" or a "1" but as both values - and everything in between. This capability, combined with the phenomenon of entanglement that correlates qubits, enables quantum computers to store and process vastly more information than even the most advanced classical supercomputers. Every usable qubit added to a quantum computer doubles the possible outcomes the computer can consider. With only 300 qubits, a quantum computer could consider more possible outcomes than the total number of particles in the known universe.

For this reason, quantum computers have the potential to solve problems that are currently intractable because of their extreme complexity. Sufficiently advanced quantum computers could model protein folding for medical research, optimize package delivery routes throughout the nation every day to reduce emissions, or help identify and correct hidden weaknesses in our national security supply chains. Many other countries have already begun to look at quantum computing for key public sector initiatives. In Australia, for example, they are looking at quantum computing to optimize their transportation system. In Japan, they have used quantum computing to optimize their waste collection and reducing CO2 emissions by nearly 60% in an area within Tokyo. Canada, the United Kingdom, European Union and others are all looking to utilize today's quantum computing technologies while also supporting R&D advancements of the systems.

Quantum computing will augment and complement classical computing, not supplant it. Users at all levels want answers to their problems, and they do not particularly care what kind of system delivers those answers. Quantum computing will be one tool in a toolkit - albeit an extremely powerful one.

Often, quantum computers will work with classical computers in a back-and-forth collaboration called hybrid quantum computing that uses the strengths of each type of computer. Quantum networks, cloud access, and "Quantum as a Service" models will enable users around the country to access quantum computers much sooner than would otherwise be possible.

As the Committee prepares to reauthorize the National Quantum Initiative Act, you have an opportunity to assess the progress that has been made over five years, and to see what has worked well and what could be improved. We have several recommendations for the Committee's consideration as it charts the National Quantum Initiative's course for the next five years:

Foster commercialization: The National Quantum Initiative was designed in part to encourage the commercialization within the United States of quantum technologies developed here. To date, the Initiative's track record is mixed. The reauthorization should prioritize commercialization and include a focus on what the technology is capable of doing in the near term (1-5 years). Specific actions could include constructing user facilities large enough and advanced enough to facilitate the rapid prototyping needed to bring quantum technology to market; better engagement with small quantum businesses, which are an essential building block of the nation's quantum infrastructure (for example, the Department of Homeland Security requires small business involvement in its procurements); streamlining the SBIR program; and creation of a quantum computing near-term application program where proof-of-concepts and pilots can be built with today's technology to help address key areas of concern.

Advance quantum research and development: Congress should continue to ramp up R&D funding, especially in areas that have near- and medium-term economic and national defense applications. The reauthorization should authorize significant increases in funding, and should promote collaboration and coordination between civil and military R&D efforts.

Encourage a full stack approach: Federal research has focused too much on qubits, and not enough on the rest of the computing stack - from hardware to software and applications. The reauthorization should broaden the scope of research. In addition, there is too little publicly-available data regarding where quantum information science R&D funding has gone, making it difficult to ensure a diverse set of technologies and applications is being adequately funded.

Enable agencies to purchase quantum computers: As quantum computers mature, a wide variety of agencies will need additional on-site hardware to help facilitate expanded access. The reauthorization should authorize additional funding to agencies to purchase, staff, and maintain a variety of quantum computers. In addition, the National Quantum Coordination Office should work with agencies to identify mission-related problems that quantum computers would be well-suited to address, and should help agencies acquire quantum computers or quantum computing services to address those problems.

Promote technology neutrality: Quantum computing architectures vary with qubits being made from super-conducting chips, ion traps, photons, cold/neutral atoms, and more. Quantum systems include gate-model, annealing, and topological systems. It is too early to predict which quantum technologies and architectures that will yield the most value. It will be important for the reauthorization to promote diversity, while recognizing the need to provide additional support to those technologies and architectures that demonstrate the ability to meet technical requirements.

Develop the quantum workforce: The quantum industry urgently needs qualified scientists, engineers, and technicians. Recognizing that it takes a lot of time and effort to produce a qualified quantum worker,

the reauthorization should increase investment in quantum education at the secondary and post-secondary levels, including minority-serving institutions. Funding to help quantum companies alleviate the cost of hiring interns and other temporary workers-in-training would also be welcome.

Promote resilient, domestic supply chains: Quantum computers rely on a variety of highly-specialized components. As part of the broader focus on making the nation's supply chains more robust, the reauthorization should encourage participating agencies to work with the quantum industry to identify, and strengthen the quantum supplier network. Where supply chains can be routed through allies - or, ideally, can be kept within the United States - they should be.

Provide access to quantum infrastructure: Companies and researchers would benefit greatly from increased access to manufacturing facilities, testbeds, and other key infrastructure. The reauthorization should include a plan and funding for quantum infrastructure, distributed throughout the nation.

Promote quantum networking: Quantum networks have the potential to both increase the power of quantum computing and expand access to quantum computing. Building on the quantum networking provisions in the CHIPS and Science Act, the reauthorization should promote the construction of large-scale quantum networks.

Coordinate with national security R&D: The reauthorization should augment coordination between civil and national security quantum information science R&D to the extent possible, including through the Department of Defense and the Intelligence Community.

Enhance cooperation with allies: The reauthorization should continue and enhance ongoing efforts to collaborate with our allies, many of whom are leading in key areas of quantum information science. International collaborations should include commercial as well as academic components.

Ensure continued leadership on international standards: NIST leads the world in standard-setting, which is foundational to emerging technologies like quantum computing. Other countries - especially China - are trying to co-opt international standards bodies in order to gain a structural advantage. The reauthorization should instruct NIST to take appropriate steps to guard against this and to maintain its leadership in such bodies.

Modernize export controls: Export controls are intended to address legitimate national security concerns by protecting American innovation. Unfortunately, they often operate counter to that intent by forcing innovation overseas and making it difficult for Americans to collaborate with allies. The export control regime needs to be updated, and any new quantum-related controls should be undertaken with careful consideration to ensure that they are advancing, rather than harming, national security and international competitiveness.

Promote helpful immigration while limiting IP loss: Immigrants have contributed substantially to many of the nation's greatest scientific breakthroughs. The United States should make it easy and attractive for leaders in quantum information science - the people who would be Principal Investigator in a laboratory or Chief Technology Officer in a quantum startup - to come to the United States. At the same time, it is important to guard against foreign competitors who send people to steal intellectual property and bring it back home to compete unfairly against the United States.

Thank you for your consideration of these recommendations. We look forward to serving as a resource as the Committee prepares to reauthorize the National Quantum Initiative Act.

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