

National Quantum Initiative Advisory Committee

May 19, 2023



Agenda

Time (pm EST)	Topic
1:00 – 1:05 (5 min)	<i>Opening Remarks</i> <ul style="list-style-type: none">• Kathryn Ann Moler and Charlies Tahan, NQIAC Co-Chairs
1:05 – 1:30 (25 min)	<i>NQIAC Findings: Presentation and Deliberation</i> <ul style="list-style-type: none">• Kathryn Ann Moler and Charlies Tahan, NQIAC Co-Chairs
1:30 – 2:20 (50 min)	<i>NQIAC Overarching Recommendations: Presentation and Deliberation</i> <ul style="list-style-type: none">• Kathryn Ann Moler and Charlies Tahan, NQIAC Co-Chairs
2:20 – 2:30 (10 min)	<i>Break</i>
2:30 – 3:50 (1 hour 20 min)	<i>NQIAC Detailed Recommendations: Presentation and Deliberation</i> <ul style="list-style-type: none">• Kathryn Ann Moler and Charlies Tahan, NQIAC Co-Chairs
3:50 – 4:00 (10 min)	<i>Approval and Closing Remarks</i> <ul style="list-style-type: none">• Kathryn Ann Moler and Charlies Tahan, NQIAC Co-Chairs



Findings

1. In its first 5 years, the NQI has increased the United States' capacity in quantum information science and technology R&D.
2. The development of QIST is critical to U.S. economic and national security.
3. Key scientific, engineering, and systems integration challenges remain and must be solved for the U.S. to realize the full economic impacts and benefits of QIST.



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Overarching Recommendations

- A. To ensure U.S. leadership in QIST, the NQI Act should be reauthorized and expanded. All authorized QIST programs in the NQI Act, the CHIPS and Science Act, and other relevant legislation should be **funded at the authorized levels**.
- B. To ensure that the United States leads in QIST discovery, innovation, and impact, efforts should be increased to **attract, educate, and develop** U.S. scientists and engineers in QIST-related fields, improve and accelerate pathways for foreign QIST talent to live and work in the United States, and increase support for research collaboration with partner nations.
- C. To safeguard the security and competitiveness of U.S. advances in QIST, the United States should develop policies that thoughtfully promote and protect U.S. leadership in QIST; expand domestic center-scale and single principal investigator QIST research activities and infrastructure; and evaluate and improve the reliability of global supply chains for QIST.
- D. To realize the potential of QIST for society, the NQI must accelerate the development of valuable technologies. This goal will require new programs in engineering research and systems integration that will **enable a virtuous cycle of maturation and scaling of** quantum systems to useful applications through multisector partnerships and engagement with ~~potential~~ end-users.



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Detailed Recommendations

➤ Summary:

1. Reauthorize and appropriate the NQI Act
2. **Expand** research
3. Fund industry-led partnerships
4. Invest in **equipment and** infrastructure
5. Promote international cooperation
6. **Promote and protect** U.S. QIST R&D
7. Strengthen supply chains
8. **Attract and retain** foreign talent
9. Develop domestic talent



Detailed Recommendations

- RECOMMENDATION 1: The United States should renew the NQI to support U.S. quantum information science, technology, and engineering, and signal intent to extend the NQI beyond its initial ten-year **authorization**.
 - Recommendation 1A: Authorization for NQI centers should be renewed for at least 5 years, with existing Centers charged to review and refresh their R&D goals, and all authorized funds should be appropriated.
 - Recommendation 1B: CHIPS and Science Act-authorized funding for QIST should be appropriated, and semiconductor **research and** manufacturing capabilities should be leveraged for QIST.



Detailed Recommendations

- RECOMMENDATION 2: The United States should expand the NQI to increase support of fundamental research in quantum information science and engineering.
 - Recommendation 2A: Federal agencies should be authorized to establish additional **nimble and focused** NQI Centers, **as needed**, to address newly emerging scientific questions. ~~and to continue to seed new multidisciplinary collaborations over time.~~
 - Recommendation 2B: In addition to the NQI Centers, agency programs to fund QIS research activities led by a single principal investigator or only a few principal investigators should be authorized and appropriated.
 - Recommendation 2C: The NQI should increase support for fundamental research in engineering to accelerate the development of quantum technologies for future scientific and commercial applications, including by establishing QIST Centers that focus on engineering of integrated and scaled systems for a variety of quantum platforms and technologies.
 - Recommendation 2D: Federal agencies should increase investment in R&D for quantum computer science and software engineering, including in quantum algorithms, applications, software and software development tools, and error correction.



Detailed Recommendations

- RECOMMENDATION 3: New Federal programs should help fund industry-led partnerships to develop and advance scaled-up, integrated quantum systems for mission- and commercial-grade technologies, and new mechanisms to fund such programs should be defined and authorized as needed.
- RECOMMENDATION 4: Agencies should expand investment in small- and mid-scale infrastructure in support of Federally-funded research that includes support for staff, **equipment**, maintenance, and operating costs, to ensure that facilities meet the needs of QIST projects.
- RECOMMENDATION 5: The U.S. Government should provide new dedicated ~~research~~ funding to ensure that international cooperation statements result in productive, collaborative ~~research~~ activities between participating nations.



Detailed Recommendations

- RECOMMENDATION 6: The Nation must simultaneously accelerate progress in QIST and protect quantum technology from malign actors.
 - Recommendation 6A: Governmental entities should implement only protective measures that are clear, appropriately targeted, and compatible with the goal of facilitating progress in QIST for the benefit of the Nation and the world.
 - Recommendation 6B: U.S. Government entities should frequently reassess the efficacy of protective measures as QIST advances. This review process should entail thorough consideration of the balance between managing risk and impeding progress.
 - Recommendation 6C: The U.S. Government should work with partner nations to establish shared measures for ensuring supply chain resilience and for protecting QIST. It should avoid unilateral controls when they impede the ability of U.S. industry to compete in the global marketplace.
 - Recommendation 6D: Once the new post-quantum cryptography (PQC) standards are published, the United States should proceed expeditiously with migration to PQC in the public and private sectors. The U.S. Government should provide appropriate resources to accomplish this task effectively, thoroughly, and efficiently.



Detailed Recommendations

- RECOMMENDATION 7: The U.S. Government should facilitate efforts to strengthen, diversify and secure QIST supply chains domestically and in collaboration with partner-nations. As QIST progresses, measures to de-risk and secure international supply chains should be continually updated.
 - Recommendation 7A: The Department of Commerce, in coordination with industry, should develop and maintain a QIST supply chain risk analysis and a plan for strengthening, diversifying, and securing supply chains for key QIS technologies.
 - Recommendation 7B: The U.S. Government should follow and potentially expand the DOE roadmap for addressing critical isotope and rare element needs for QIS R&D to ensure future supplies, as some isotope production requires substantial lead time.
 - Recommendation 7C: Federal agencies should actively support **the development of** QIST-enabling technologies ~~as part of efforts~~ to **help de-risk** the **domestic** supply chain.



Detailed Recommendations

- RECOMMENDATION 8: Domestic talent in QIST should be expanded through educational and training programs at all levels.
 - Recommendation 8A: ~~NSF and other~~ Federal agencies should create additional fellowships and traineeships for U.S. citizens and permanent residents pursuing QIST-related degrees with a focus on broadening participation.
 - Recommendation 8B: All previously authorized QIST education and training programs should be appropriated.
 - Recommendation 8C: NSF should fund the development of a consolidated set of outreach programs, allowing QIST principal investigators to tap into these programs for their “broader impacts” on federally-funded work for more cohesive and scalable impact.
 - Recommendation 8D: NSF should lead a holistic, systematic study of quantum workforce needs, trends, and education capacity should be conducted and monitored biennially for the duration of the NQI to ensure U.S. leadership in QIST and competitiveness in the burgeoning quantum industry.
- RECOMMENDATION 9: Employment of foreign talent in the U.S. QIST workforce should be facilitated and expedited through revised immigration policies and processes, thereby enhancing U.S. economic competitiveness and national security.



Recommendation 9

RECOMMENDATION 9: Employment of foreign talent in the U.S. QIST workforce should be facilitated and expedited through revised immigration policies and processes, thereby enhancing U.S. economic competitiveness and national security.

U.S. graduate schools attract talented students from all over the world to study in QIST and related disciplines. More than half of all recent PhD recipients in QIST-relevant fields were temporary U.S. residents. Yet, after graduation, U.S. immigration policy makes it difficult for these individuals to stay and work in the United States even though many wish to do so. At the same time, U.S. companies, universities, and laboratories are facing an acute shortage of trained QIST talent. **The United States could significantly expand the QIST workforce by easing restrictions on staying to work in the United States by, among other measures,**

- Expanding the number of employment-based visas for QIST positions.
- Increasing the number of slots for permanent residency based on educational qualifications (i.e., creating a STEM PhD Green Card classification).
- Relaxing country-specific quotas for Green Cards for QIST talent.
- Expedite immigration applications and petitions for QIST talent.

For example, agencies should ensure that existing policies, such as those that could allow QIST workers to apply for a national interest waiver, are effective by improving training for adjudicators and ensuring timely adjudications are made.

- Permit graduate students and postdoctoral fellows to apply for permanent residency early in their terms.

Companies and U.S. Government laboratories seek applicants who can work on export-controlled QIST technologies. This requirement excludes hiring students lacking citizenship or permanent residency status, and this would help address this problem.

Such policies would also benefit the economic and national security of the United States by avoiding the loss of STEM talent to foreign competitors or adversaries. We feel that these changes could significantly enhance the number of foreign graduate students and postdoctoral fellows who would choose U.S. citizenship over other options.

