Promotion Measures for the Development of a Quantum Ecosystem
Outline

May, 2025

Expert Panel on Quantum Technology Innovation,
Government of Japan

Promotion Measures for the Development of a Quantum Ecosystem

- ✓ To lead global quantum technology industrialization, this promotion measure summarizes **the contents necessary for the development of an ecosystem under current government strategy.** (In 2024, promotion measure was issued focusing on international collaboration.)
- ✓ Positioning: **Report on "Measures to strengthen and complement the three existing strategies**" toward the 2030 target.

Research

Quantum Technology and Innovation Strategy
Established in January 2020
Revision of technology roadmap in April 2022
R&D Strategy for Quantum Technology

Vision

Vision of Quantum Future Society
Established in April 2022
Strategy for social transformation
Future vision, targets, etc.

Industry

Strategy of Quantum Future Industry Development
Established in April 2023
Practical application and industrialization strategy of quantum technology

Promotion Measures

Complement to strengthen and add the three strategies

・**This measure: Quantum ecosystem (May, 2025)**

・Globalization
Reported April, 2024

Goals by 2030

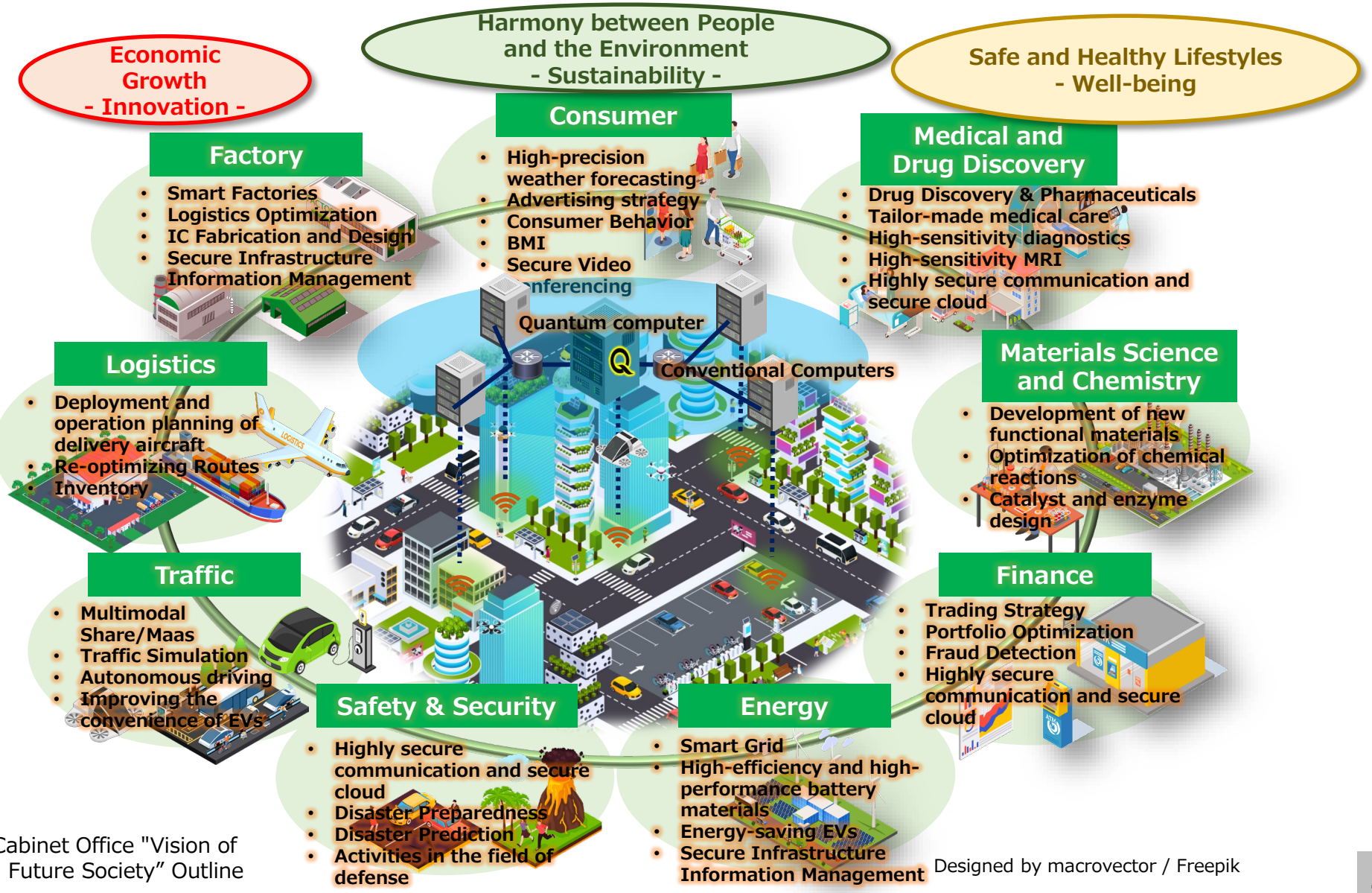
10 million quantum technology users in Japan

Through quantum technology, production to 50 trillion Yen

Fostering quantum unicorn companies to create future markets

Reference: Importance of quantum technology in the future society

- ✓ Quantum technology enables ultra-fast computation as a next-generation industrial foundation.
- ✓ A key enabler of the next industrial revolution, it is vital to human advancement.



Source: Cabinet Office "Vision of Quantum Future Society" Outline

Designed by macrovector / Freepik

Reference: Policy Trends in Quantum Technology in Countries Around the World

America National Quantum Initiative Reauthorization Act (2024.12 Submitted to the Upper House, under deliberation)

Budget: The NQIA, enacted in 2018, was revised, and the total budget size is 2.7 billion dollars (about 405 billion yen) over the five years until 2029

Location: Quantum Sensing and Measurement Center established at NIST, NASA was newly recognized as a quantum institute and the Quantum Research Institute was established under its umbrella.

Priority Measures (Industrialization): Formulated a quantum computing commercialization strategy at the DOE.

Expansion of collaboration with QED-C (Consortium for Quantum Economic Development) to across all government ministries.

United Kingdom National Quantum Strategy (2023.3)

Budget: Invest 2.5 billion pounds (about 475 billion yen) over 10 years from 2024, and attract another 1 billion pounds of private investment

In November, it announced a £500 million budget increase to support the science and technology industry, including quantum

Priority Measures (Industrialization): Implementation of quantum technologies targeting the 2030s in the quantum field Proposed five new missions (budgetary measures, attracting private investment, strengthening human resource development, attracting overseas companies, and regulatory reform)

Germany Quantum technologies action concept (2023.4)

Budget: Announced a cross-ministerial plan for 2023-2026, with a total contribution of approximately EUR 3 billion (JPY 480 billion) over four years

Priority Measures (Industrialization): Efforts to secure international superiority through product development as an action area, priority technology development, and securing future markets

Building ecosystem a strong ecosystem of industrial partnerships

Korea South Korea's Quantum Science and Technology Strategy (2023.6)

Budget: Public-private cooperation to invest at least 3 trillion Korean won (about 330 billion yen) or more in quantum technology by 2035

Priority Measures (Industrialization): Aim for a 10% share of the global market in quantum-related industries and approximately 1,200 companies supplying and utilizing quantum technologies. Increase the number of high-level quantum technology personnel to 2,500 (7 times the current number) and more than 10,000 people engaged in quantum-related businesses.

Japan Quantum Technology and Innovation Strategy (2020.1)

Budget: Quantum-related budget is about 100 billion yen for FY2024, and about 330 billion yen for 5 years (FY2020~2024)

Location: Established QIH. AIST G-QuAT introduces multiple types of quantum computers and prepares a testbed environment in conjunction with HPC

Priority Measures (Industrialization): Formulated three strategies and two promotion measures. Accelerating use case creation and technology development to build a quantum ecosystem.

Note: Each currency will be converted to Japan yen at the rate as of March 18, 2024 (US dollar: about 150 yen, British pound: about 190 yen, euro: about 21.8 yen, won: about 0.11 yen)

The Need for a Quantum Ecosystem and What It Should Be

[Japan's Past Strengths and Structural Issues]

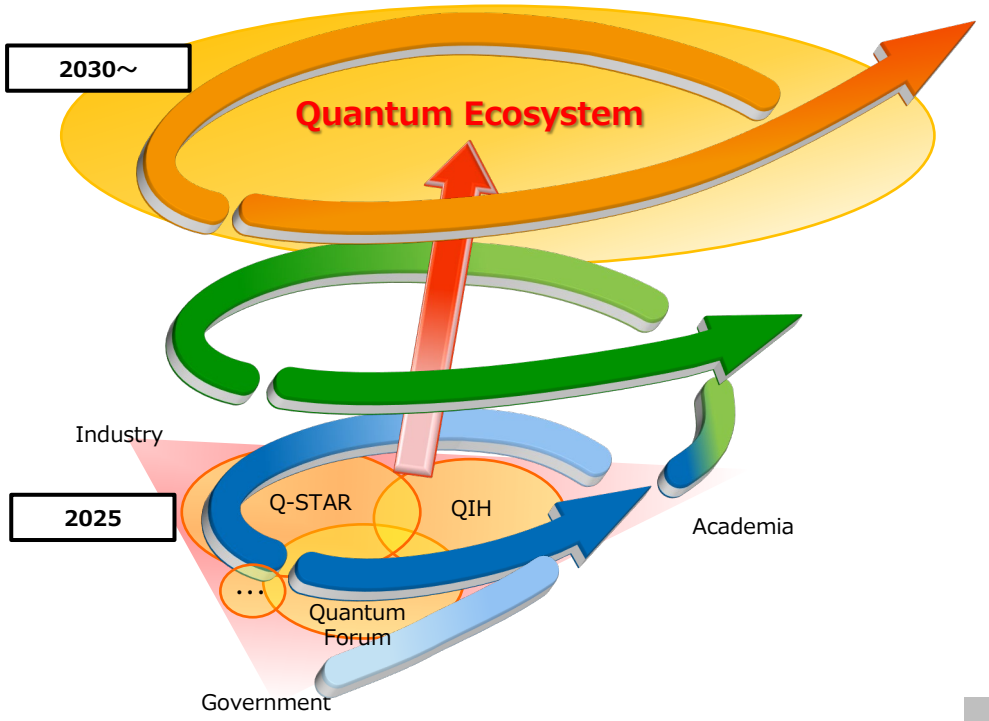
- ✓ Japan has demonstrated its international competitiveness by providing high-performance and high-quality products through a vertically integrated ecosystem (centered on manufacturing)
- ✓ However, in the digital age, the company lags behind in responding to the horizontal division of labor and platform-type ecosystems, and lags behind in international competition

[Domestic status and ecosystem development challenges]

- ✓ Despite a growing number of players, efforts remain fragmented and individual, with no established framework for collaboration and co-evolution.
- ✓ In order for Japan to secure a leading position internationally amid constraints such as human resources, computing infrastructure, and funding, Japan must mutually form a "quantum ecosystem" premised on connection and collaboration.

[The target Quantum Ecosystem]

- ✓ Quantum technology is not a single solution, but is expected to become a multi-layered platform
- ✓ A robust ecosystem is needed, **integrating vertical strengths in hardware and materials with horizontal expansion in software and cloud**.
- ✓ In the future, we aim to build **a self-sustaining network in which** these various entities involved in quantum technology are interrelated and grow naturally



Issues for Building an Ecosystem and the Direction of Responses

✓ In order to build the quantum ecosystem that we are aiming for, **we will increase the predictability of the market**, develop **Human Resources, Physical Assets, and Financial Capital**, and build a system that can develop sustainably.

	Challenges	Strategic direction
Human Resources	• Lack of talent in research, commercialization, and global business development • Challenges in attracting global talent due to limited incentives and concerns over brain drain.	[Expanding the pipeline of quantum talent and strengthening international engagement.] • Expanding the base of human resources through various projects, etc., and improving the educational environment for this purpose • Enhance the global value of the R&D environment and market in Japan, and actively disseminate information overseas
Physical Assets	• Lack of necessary equipment such as test beds • Relying on limited overseas suppliers The presence of important parts of the material • Responding to early international industrialization • Delay in international standardization	[Establishment of a strategic base to support the implementation platform of quantum technology and international competitiveness] • Expanding testbed infrastructure and improving user accessibility • Support for domestic production of important materials, overseas cooperation for stable supply, chokepoint analysis • Advancing both basic and application-oriented R&D, including cost reduction, while promoting collaboration. • Formulation of standardization strategies including human resource development based on roadmaps, etc. Support for activities at ISO/IEC JTC3, ITU-T, etc.
Financial Capital	• Poor business and technical foreseeability • It is a startup with excellent technology despite low corporate value and a difficult fund-raising environment compared to overseas players	[Sustainable funding and market creation strategy for the Quantum Ecosystem] • Creating new use cases through testbed expansion and outreach, and establishing benchmarks to evaluate hardware performance for vendor feedback • Considering support schemes such as quantum incubation and VC-engaged government procurement

ISO/IEC JTC3: International Committee for Standardization of Quantum Technology, ITU-T: International Telecommunication Union Telecommunications Standardization Division, VC: Venture Capital

Specific Initiatives to Be Strengthened (1)

Expanding the base of quantum human resource development and enhancing international deployment capacity (Human Resources)

[Human Resource Development]

- ✓ Support for human resource development and career path formation through projects at NEDO, IPA, NICT, Q-LEAP, etc.
- ✓ Examination of a system to improve the mobility of human resources between academia and industry
- ✓ Enhancing and promoting Japan's R&D and market appeal to attract domestic and international talent
- ✓ Developing expert and interdisciplinary human resources through enhanced education at youth and tertiary levels

Sustainable Fund Circulation and Market Creation Strategies to Support the Quantum Ecosystem (Financial Capital)

[Creation of Use-Cases to increase market predictability]

(Quantum Computer)

- ✓ Creation of new use cases by giving users access to various quantum computers and conducting awareness-raising activities, etc.
- ✓ Establish benchmarks in which technical issues are fed back to vendors, etc.

(Quantum Security/Quantum Network)

- ✓ Further expansion of the number of users through the sophistication and expansion of testbeds, etc.

(Quantum Measurement and Sensing/ Quantum Materials)

- ✓ Strengthen collaboration between research institutes to promote the development of new devices
- ✓ Preparation of testbeds and the realization of use cases through them, etc.

[Improvement of the investment environment]

- ✓ Implementation of a quantum incubation program with the involvement of VCs, including globally
- ✓ Consideration of support measures that contribute to sales, such as government procurement

[Collaboration and Coordination between Academia and Industry]

- ✓ Promote the early use of project results in industry and the reinvestment of profits in academia.

NEDO:New Energy and Industrial Technology Development Organization, Information-technology Promotion Agency, IPA(IPA),
NICT:National Institute of Information and Communications Technology, Q-LEAP:Photonics and Quantum Leap Flagship Program

Specific Initiatives to Be Strengthened (2)

Strategic hub for quantum implementation and global competitiveness (Physical Asset)

[Place]

- ✓ Expansion of testbed environments such as AIST G-QuAT, RIKEN, QST, NICT, etc., and establishment of a system for using them, etc.

[Parts and Supply Chain]

(Quantum Computer)

- ✓ Accelerating next-generation system development, with focused support for Japan's strengths in components and materials, complemented by collaboration with overseas suppliers
- ✓ Supply chain mapping and chokepoint analysis through international frameworks and other frameworks
- ✓ In order to realize next-generation machines that can be used in industry, we support the development of parts and materials and hardware systems through collaboration between hardware vendors and suppliers.
- ✓ Development of common platform software, applications that are used as de facto standards, etc.

[Standardization]

- ✓ Support for international standardization activities in IEC/ISO JTC3, ITU-T, etc., and the establishment of a framework for certification, etc.
- ✓ Enhancing global competitiveness and international outreach through intergovernmental dialogue

(Quantum Security/Quantum Network)

- ✓ R&D for domestic production of key components
- ✓ Promote R&D and technology verification to maintain world-class technological capabilities such as QKD
- ✓ Development of integrated technology for data communication networks and QKD networks
- ✓ Development of a quantum-secure cloud platform for confidential data processing
- ✓ Development of elemental technologies for the realization of the quantum Internet
- ✓ Development of satellite quantum cryptography communication technology, etc.

(Quantum Measurement and Sensing/ Quantum Materials)

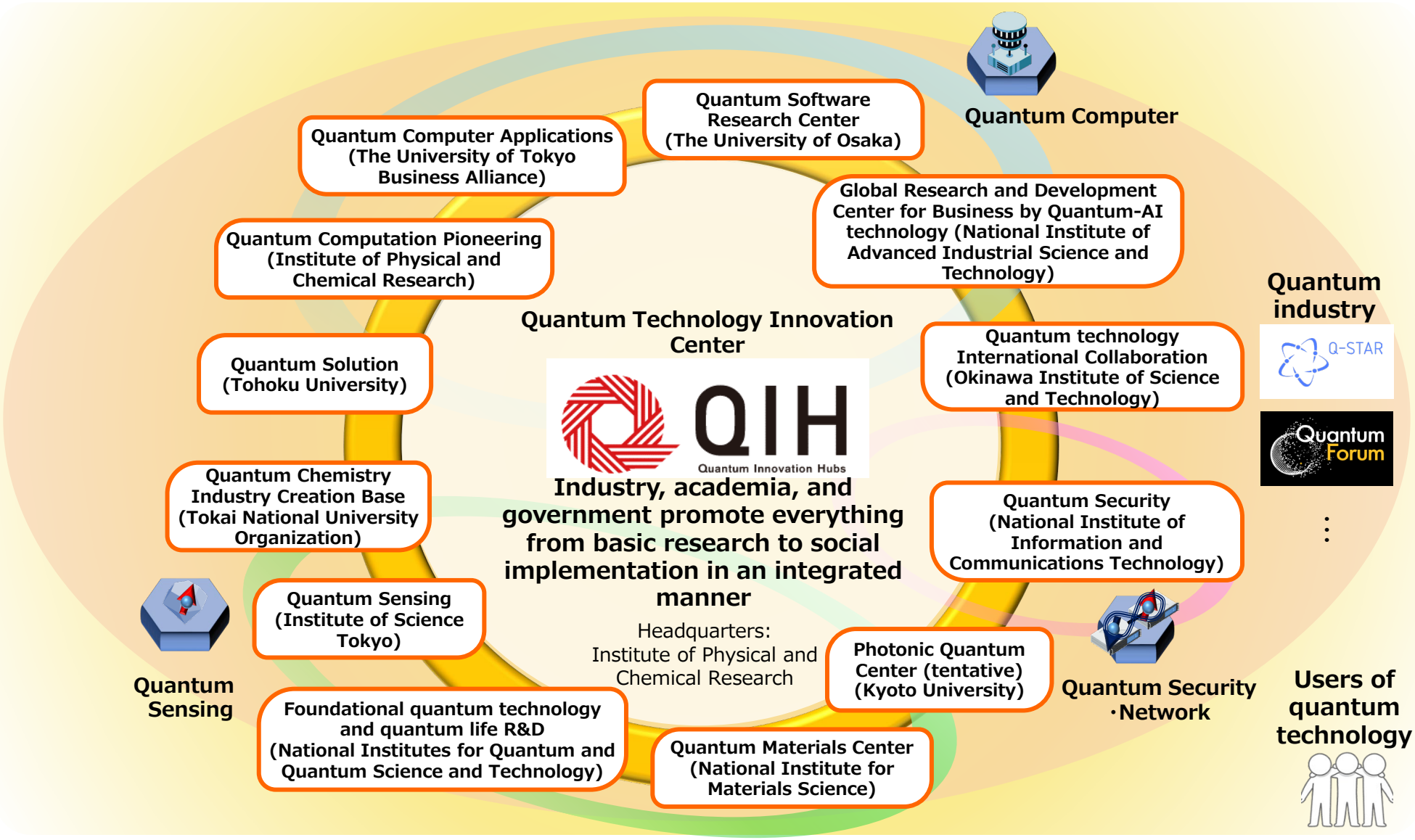
- ✓ Ensuring a stable supply of materials for critical parts
- ✓ Assessment of supply chains under geopolitical risks and strategic measures for resilience
- ✓ Advancing high-performance and miniaturized sensing technologies for current, magnetic field, and time
- ✓ Continuous support for the development of materials such as topological materials, etc.
- ✓ Formulation of standardization strategies based on development roadmaps, etc., and support for the development of young standardization human resources in each layer, etc.

G-QuAT: Global Research Center for Business Development of Quantum-AI Convergence Technology, QST: National Institutes for Quantum and Quantum Science and Technology, QKD: Quantum Key Distribution

Strengthening Collaboration with the Quantum Technology Innovation Center (QIH)

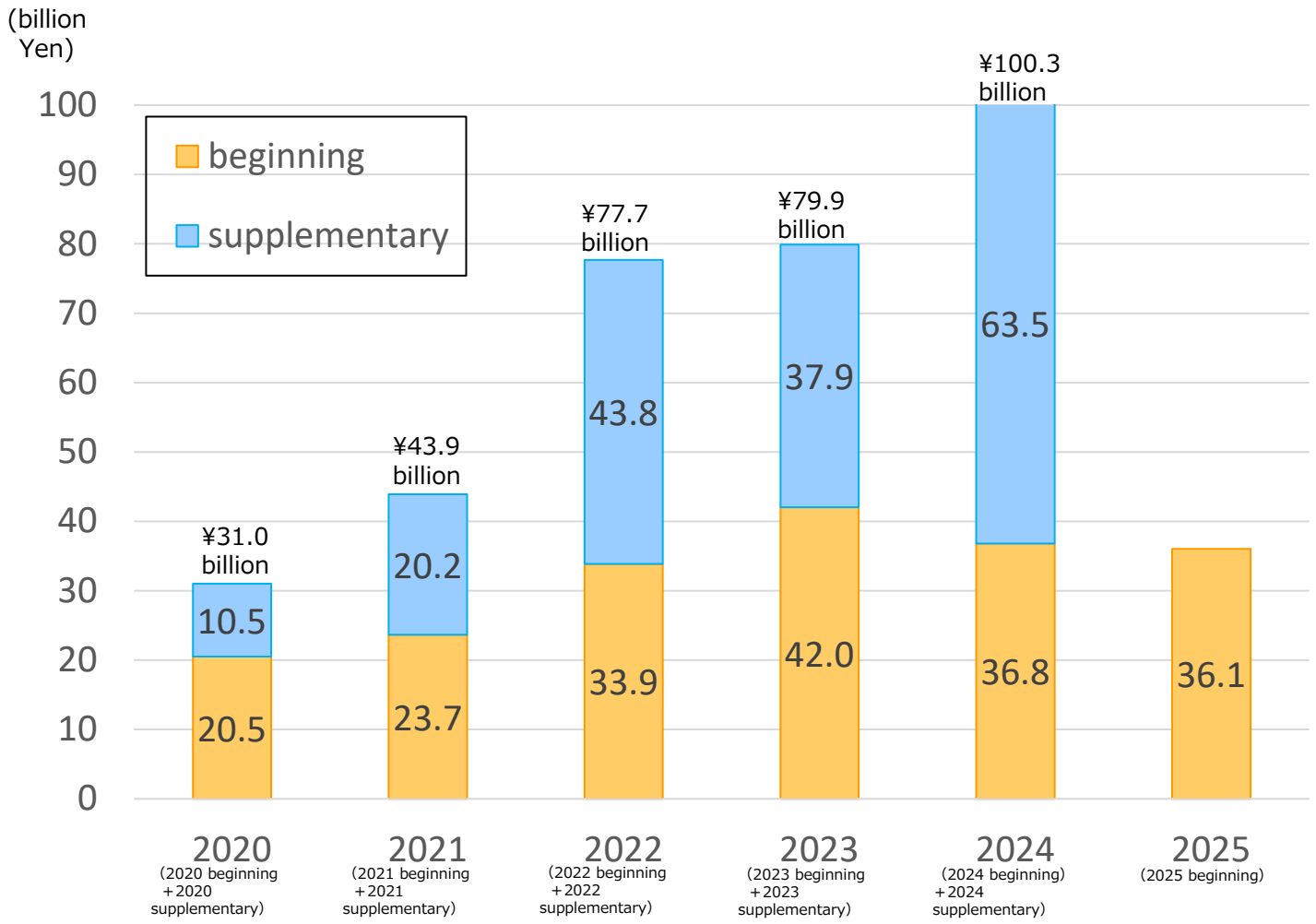
Leading nations, the United States, the United Kingdom and Europe, are rapidly enhancing their R&D and industrialization frameworks.

⇒ ・Collaborate with QIH to advance Japan's competitiveness via R&D and strategic partnerships.
・Develop activities based on the strengths of each base and make use of their respective autonomy and self-reliance



Reference: Quantum-related Budget (FY 2020~FY 2025)

Total for 5 years of 2020 year ~ 2024 year: 332.8 billion yen



Example) 2022 years = 2022 years beginning + 2022 years supplementary