Tentative Translation

# Promotion Measures for the Development of Quantum Industries

## Outline

**April, 2024**

Expert Panel on Quantum Technology Innovation,
Government of Japan

# Introduction（Background）

- ✓ Japan has so far formulated the strategy that describes the vision and goals that should be realized through quantum technology(QT), as well as policies and implementation plans for the practical and industrialization of quantum technology to achieve these goals.
- ✓ On the other hand, against the background of the remarkable progress in quantum technology, the situation surrounding Japan has been changing drastically, with each country formulating national strategies and international collaboration becoming more active, and we need to respond quickly.

**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**

**Situation Changed!**

**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**

# Promotion Measures for the Development of Quantum Industries

- ✓ These promotion measures summarize contents that should be strengthened and added as soon as possible under the current government strategy to quickly respond to the progress of quantum technology, the strategies of each country, and changes in the situation of practical application and industrialization in Japan and overseas.
- ✓ This is a report of measures to strengthen and complement the three strategies toward the 2030 goals.

**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**
Reported in April 2024
**Complement to strengthen and add the three strategies**

## 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**

# A new perspective “Globalization”

Adding “Globalization” to the three perspectives of practical application and industrialization of quantum technology and strengthening our efforts in an integrated manner, to further strengthen efforts regarding international collaboration in the “Strategy of Quantum Future Industry Development“

## Collaboration

Participation, collaboration, and co-creation of diverse industries, global cooperation, industry-academia-government collaboration

**Global collaboration, expansion, and market acquisition by industry-academia-government**

**Cooperation with overseas companies**
**Market formation**

## Incubation

Aggressive support of startup/venture and new business creation

**Expansion and growth into overseas markets by startups/ventures**

## Accessibility

Realization of an environment for the use of quantum technology open to industry

Strengthening perspective

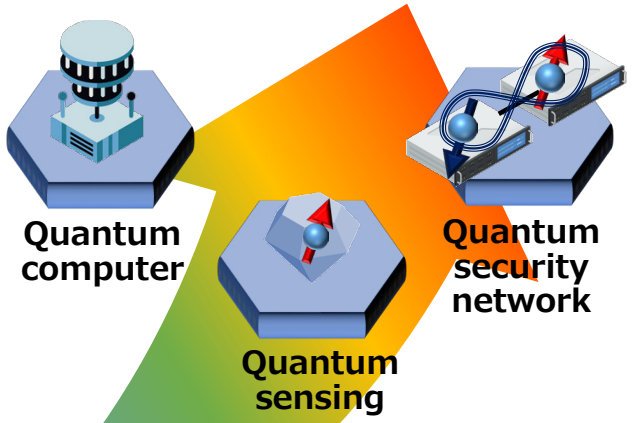
## Globalization

International collaboration between industry, academia and government, overseas expansion, and implementation of research that attracts attention from around the world

**Collaboration with like-minded countries**
**Improving visibility from around the world**

## Goals by 2030

- 10 million quantum technology users in Japan
- Through quantum technology, production to 50 trillion Yen
- Fostering quantum unicorn companies




Quantum/Classical **Hybridization**
(HPC, AI, Semiconductors, Optics, etc.)
**Gradual replacement** with quantum technology

# Issues and direction of response

- International collaboration with like-minded countries is the key to further development as we reach the stage of utilizing quantum technology
- Sorting out the various issues currently faced as further promoting for international collaboration in the quantum field
- Clarifying points that need to be strengthened in response to various issues

| | The various issues | The points to be strengthened |
|---|---|---|
| **Expansion into the global market** | ・**Lack of local information and networks** necessary for overseas expansion<br>・**In emerging markets, it is risky** for private companies **to expand overseas** alone<br>・Lack of **support for startup creation and growth** | ・**Creating opportunities for global expansion and collaboration** between industry and academia through intergovernmental collaboration, etc.<br>・Support for building **an indispensable global supply chain** among like-minded countries<br>・**Strengthening the environment for the use** of quantum technology<br>・Strengthening **support for the creation and growth of startups and accelerating ecosystem construction**<br>・Participation in **international standardization activities, etc.**<br>・Continuous support for **basic fundamental research**<br>・Promoting **domestic production of key technologies** in the supply chain |
| **Promoting research that attracts attention from around the world** | ・**Risk of reduced visibility in the global quantum community**<br>・Continuously securing **cutting-edge technology with an international presence in our country**<br>・**Risk of losing access** to advanced technology and equipment overseas | |
| **Developing and securing quantum human resources in industry and academia** | ・Lack of **specialized human resources and global human resources** responsible for industrialization<br>・Lack of **world-class research talent** | ・Enhancing opportunities for **young people** to come into contact with and learn about quantum technology<br>・Sending **doctoral students and young researchers** overseas and creating an environment that attracts overseas human resources |

# Specific efforts to be strengthened (1)

## International collaboration/Efforts to strengthen expansion into the global market

【Understanding and developing global research trends】

- ✓ Proactively **exchanging information on research and technology trends and industrial needs** with academia-industry collaboration to understand areas of cooperation and competition based on overseas technology trends and identify "winners"
- ✓ **Actively utilizing frameworks with like-minded countries such as multilateral dialogues and MOCs and MOUs** regarding quantum technology

【Developing and securing domestic technology】

- ✓ **Creating excellent technology that attracts attention from around the world** by strengthening fundamental research that will support next-generation quantum technology
- ✓ Promoting industrial participation by **clarifying technical specifications and formulating roadmaps necessary for large-scale and industrialization** of parts, materials, devices, etc. that are essential for the practical application of quantum technology

## Efforts to promote technological development in Japan

【Quantum computer】

- ✓ **Developing user-friendly testbeds**, including a hybrid computing environment, which are focused on the advancement of parts materials and peripheral equipment, supplier development, and creation of use cases in line with industrialization
- ✓ **Identification of killer use cases** in which quantum computers play a decisive role through collaboration with other fields, etc.
- ✓ Participating in **international standardization activities** in response to the accelerating movement toward international standardization of quantum technology worldwide
- ✓ **To aim for social implementation and knowledge accumulation of annealing and quantum inspired technologies**, supporting the identification of issues based on practical use, industrialization, and expansion into overseas markets
- ✓ **Flexible review of national project goals and portfolios** based on global development trends

【Quantum security networks】

- ✓ **R&D toward the early social implementation of quantum cryptographic communication** and **demonstration tests on an agile basis** to **achieve social implementation by 2030**.
- ✓ **Promoting research and development of quantum relay technology, etc.,** which is essential for realizing quantum internet, etc.
- ✓ **Promoting international standardization such as CV-QKD and TF-QKD**
- ✓ **Promoting the compilation of evaluation standards and evaluation methods** necessary for the creation of an international certification system for QKD equipment

【Quantum measurement and sensing/materials】

- ✓ Promoting environment **creation such as building a testbed** that simulates the real environment and **establishing a user point of contact**
- ✓ **Promoting the development of quantum materials with novel physical properties** in addition to working to improve the quality of diamonds, etc.

# Specific efforts to be strengthened (2)

## Efforts related to human resource development

【Strengthening efforts for doctoral students and young researchers】

- ✓ **Sending doctoral students and young researchers from industry and academia overseas** and inviting overseas researchers and supporting **students' participation in international academic conferences and overseas summer schools**
- ✓ Holding **a summer camp open to all doctoral students** studying quantum technology
- ✓ Developing and securing quantum human resources through **reforming in graduate school education, such as establishing courses and majors**, mainly at universities of Quantum Technology Innovation Hubs

【Strengthening efforts for young people】

- ✓ **Considering a standard curriculum targeting technical college and university students** who support the industrialization of quantum technology
- ✓ **Creating an environment where elementary, junior high, and high school students**, who will be the next generation, **become familiar with quantum science**

【Strengthening efforts to connect industry, academia, and domestic and international connections】

- ✓ **Strengthening efforts such as workshops and training with the participation of individual researchers within companies in mind**
- ✓ **Developing human resources who can oversee the entire system integration** of quantum technology by industry and academia
- ✓ Promoting human resources exchanges, recruitment and retention with like-minded countries and the Global South

## Efforts to strengthen innovation infrastructure

【Creation and scale expansion of startups/venture companies/new businesses】

- ✓ **Promoting timely dispatch of information** in collaboration with existing provision functions regarding legal systems, regulations, government strategies, budgets, etc. **related to quantum technology in each country**
- ✓ **Promoting participation in service demonstrations with the premise of overseas expansion** through collaboration between the public and private sectors and **supporting the construction of global supply chains** centered on like-minded countries
- ✓ **Supporting national and local government events and trade fairs** that are expected to attract many participants from overseas
- ✓ To support the establishment of startups, etc., considering **systems that allow businesses to develop products using facilities and equipment owned by national research institutes, as well as expansion of available facilities**
- ✓ To create new markets by startups, etc., **as public institutions etc. are early adopters, quickly procuring products and supporting initial demand stimulation and business expansion**

【Collaboration with other strategic areas/economic security】

- ✓ **Collaborating** with quantum technology innovation measures and **strategies related to cutting-edge important technologies such as AI, semiconductors, biotechnology, materials, and information and communications** to foster and secure technologies essential to our country and create industries

# Collaboration and Strengthening of Quantum Hubs

## 【Strengthening collaboration between hubs】

- ✓ Moving forward with the practical application and industrialization of quantum technology, **strengthening the collaboration system between hubs, such as sharing common roles between national research institutes and universities, such as industrial support, human resource development, international collaboration, and intellectual property management**
- ✓ **Promoting interaction among researchers by holding joint workshops at multiple quantum hubs and supporting collaborative research projects between hubs**, since there are opinions that collaboration between each bub is insufficient at the level of researchers in the field

## 【Strengthening individual hubs】

- ✓ Against the backdrop of the rapid progress of quantum technology, and based on the formulation of each country's quantum strategy and the movement of international cooperation, **strengthening Quantum Technology Innovation Hubs strongly to support the overseas expansion of industry and academia and to create excellent technologies that attract attention from around the world**

Enhance

**Global Research and Development Hub for Business by Quantum-AI Technology**
(National Institute of Advanced Industrial Science and Technology)

Aiming to **Build a global business ecosystem** by solving social issues and creating new markets by **building a hybrid computing environment and an environment for developing and evaluating next-generation quantum computer components and peripherals, and contributing to international standardization, etc.**

Enhance

**Quantum Computation Pioneering Hub** (RIKEN)

**Proceeding with the development of core technology that utilizes actual domestic quantum computers and Promoting scientific research to connect multiple types of quantum systems** such as superconductivity, light, and cold atoms for aiming to develop highly scalable and cutting-edge quantum computers

Enhance

**Quantum Security**
(National Institute of Information and Communications Technology)

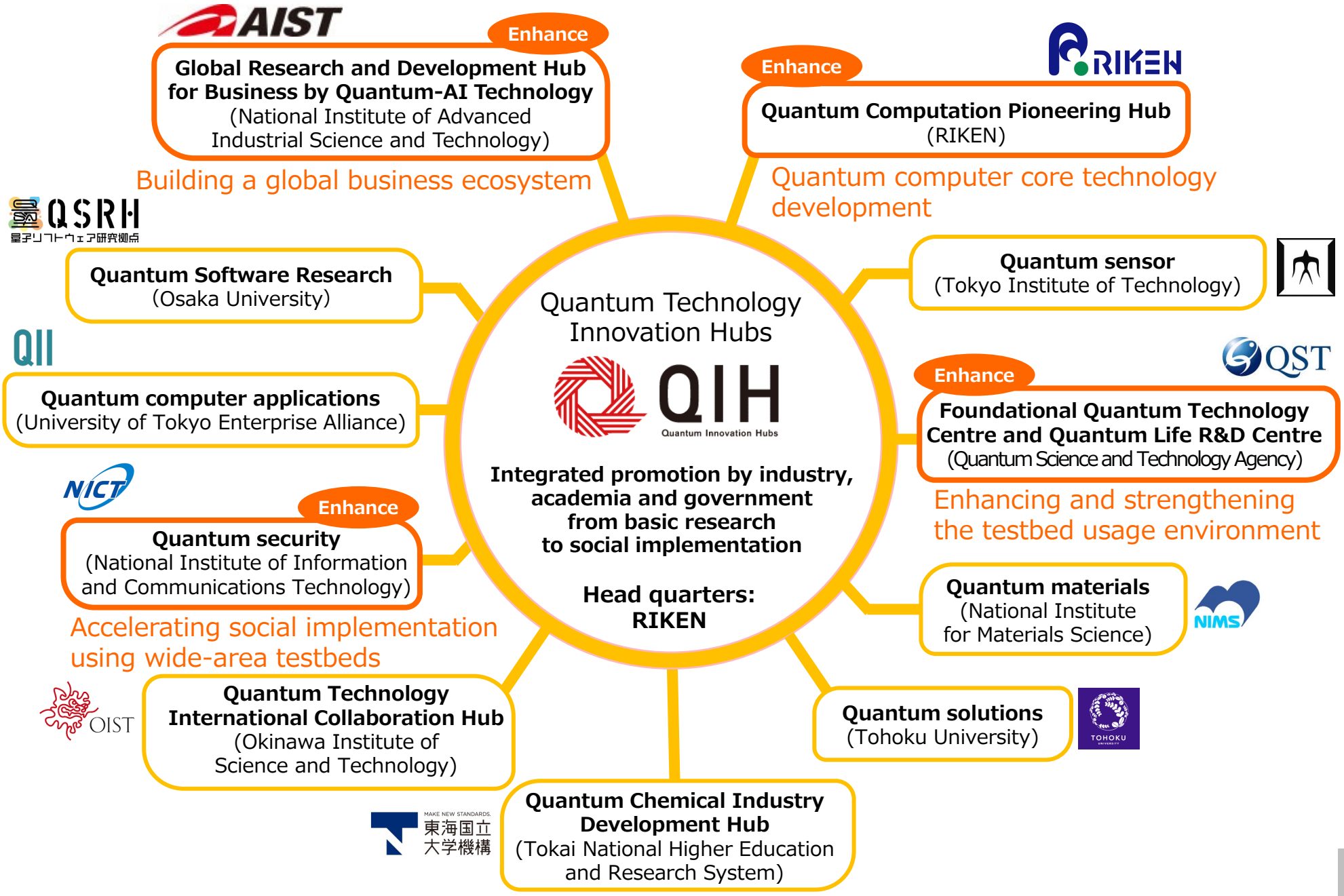
**Clarifying the issues and establishing use cases for the social implementation** of quantum cryptographic communication, **promoting its use among early adopters**, and **contributing to consider aiming to create an international certification system**, by utilizing the wide-area testbed, which will be expanded by the end of March 2024

Enhance

**Foundational Quantum Technology Centre and Quantum Life R&D Centre**
(National Institute for Quantum Science and Technology)

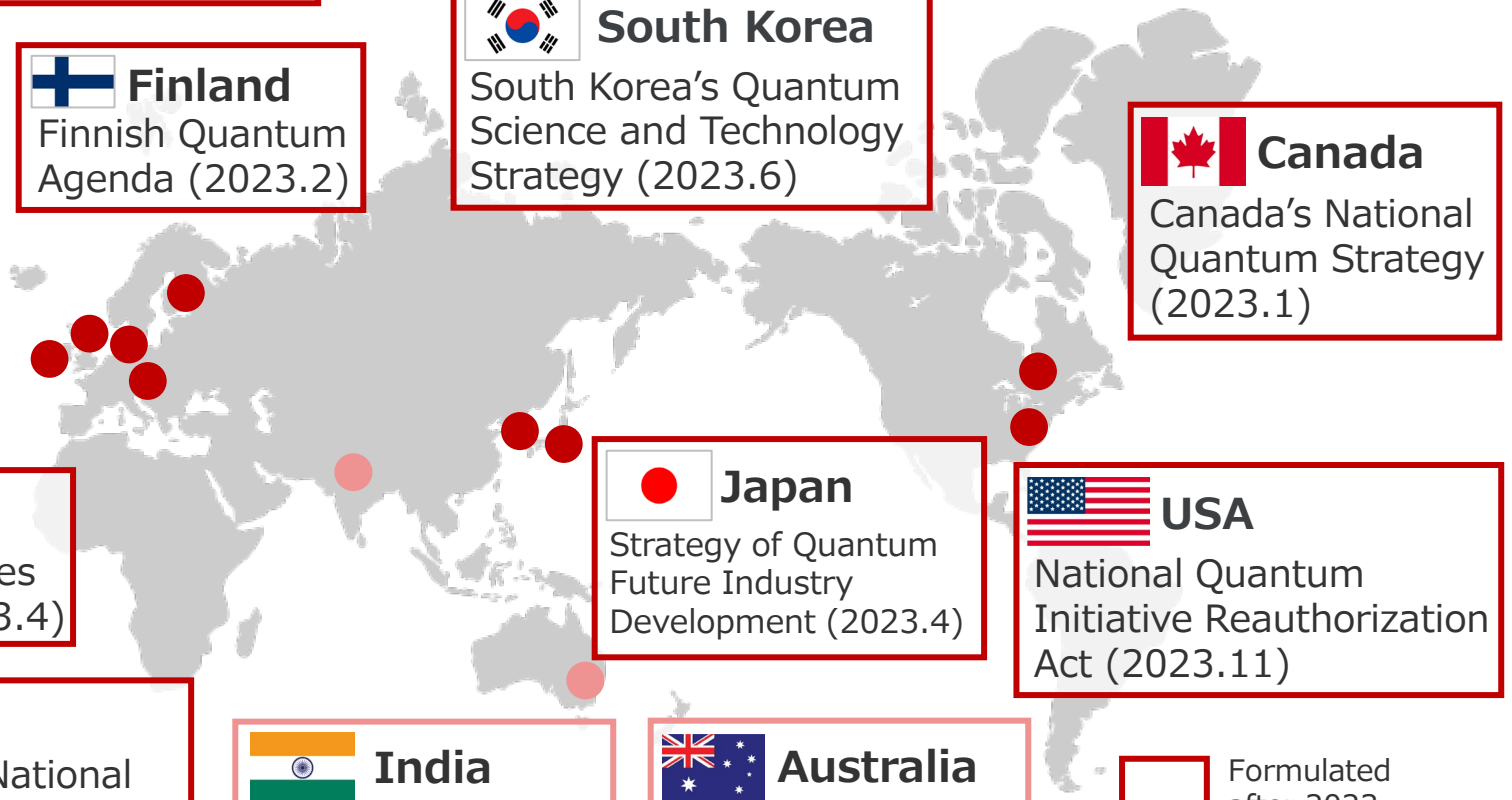
**Enriching and strengthening the test bed usage environment** to promote the use of quantum sensors in a wide range of fields, and **developing new seeds research that will contribute to Japan's economic security**, such as the development of quantum sensors that can be used even in extreme environments

# Overall Quantum Technology Innovation Hubs



# Policy trends in QT in countries around the world

In 2023, international interest in quantum technology will increase significantly, with countries around the world formulating national strategies.



**EU**
Horizon Europe (2021~)

**NATO**
Quantum Strategy (2023.11)

**UK**
National Quantum Strategy (2023.3)

**Finland**
Finnish Quantum Agenda (2023.2)

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

**Canada**
Canada's National Quantum Strategy (2023.1)

**Denmark**
National quantum strategy (2023.9)

**Germany**
Quantum technologies action concept (2023.4)

**Japan**
Strategy of Quantum Future Industry Development (2023.4)

**USA**
National Quantum Initiative Reauthorization Act (2023.11)

**Ireland**
Quantum 2030 - A National Quantum Technologies Strategy for Ireland (2023.11)

**India**
National Quantum Mission (2022.4)

**Australia**
National Quantum Strategy (2022.4)

Formulated after 2023

Formulated before 2022