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# AN OVERVIEW OF NATIONAL STRATEGIES AND POLICIES FOR QUANTUM TECHNOLOGIES

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# Disclaimers

# Abstract

This paper takes stock of the ambitious national strategies and policy instruments countries are introducing to support the development and uptake of quantum technologies. It reviews the timelines, motivations, scope, goals, assessment and governance mechanisms characteristic of national quantum strategies. The paper also identifies the main policy objectives of frequently used instruments, including institutional funding and project-based grants for public research, grants for business research and development, public procurement, and equity financing.

**Keywords:** quantum technologies, national strategies and plans, policy mix, government support for research and development, technology co-operation, international collaboration.

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# Executive summary

Governments worldwide are investing in quantum science and technology in pursuit of their anticipated economic and societal benefits and to achieve key strategic objectives, from technological leadership to national security. Quantum technologies, including sensing, computing and communication, aim to offer capabilities beyond the reach of existing digital technologies. They have the potential to contribute breakthroughs for problems that are currently intractable across several sectors, for example by enabling earlier and more accurate medical diagnoses and accelerating drug discovery, designing new materials and cleaner chemical processes, optimising energy grids and logistics planning, and supporting the development of energy technologies. Over time, they might also help to achieve progress on complex societal challenges, such as food security and access to clean water.

At the same time, quantum technologies vary in their degree of maturity, with most not yet widely commercialised and long and uncertain technological timelines often presenting significant risks for private investors. Quantum technologies also pose significant digital security and privacy risks, in addition to concerns about potential dual-use applications. In this context, governments are introducing ambitious national strategies and policies to shape their domestic quantum ecosystems and monitor developments in this rapidly evolving field. This paper describes the emerging policy landscape supporting the development and uptake of quantum technologies.

Many countries have allocated substantial public funds to support quantum science and technology. As of October 2025, an estimated USD 55.7 billion has been committed to quantum science and technology by governments worldwide since 2013 (Qureca, 2025[1]). By November 2025, 18 OECD Member countries, plus the European Union, have adopted formal strategies. These strategies address technological development priorities, management of risk, stakeholder involvement and desired outcomes.

In countries where significant public funding for quantum science and technology predates the adoption of formal strategies, the introduction of a strategy has helped coordinate existing funding activities. Mission-oriented innovation policies, which organise multiple initiatives and programmes around one or more high-level objectives, have also been used to support such coordination. Public consultations, and a range of foresight exercises, have informed strategy design, but scope exists in many countries to broaden stakeholder participation. Most national plans highlight international partnerships as key to success and in some cases formal quantum co-operation agreements exist. Most strategies also underscore the importance of engaging in global standards-setting efforts, such as those for post-quantum cryptography.

Governance structures for quantum strategies vary significantly. In some cases, national strategies are embedded within broader science and technology agendas, while in others they stand alone, supported by dedicated legislation or specialised councils. France, Japan and the United States have placed quantum strategy governance at the highest level of the executive branch. To guide policy and monitor progress, countries often set measurable goals, and these also vary widely, from specific measures for technological performance benchmarks (e.g. numbers of qubits) to targeted shares of global markets.

To implement quantum strategies and achieve strategic goals, countries are introducing various types of policy initiatives focusing on quantum technologies. Five key instruments form the backbone of these efforts: (i) institutional funding for public research; (ii) project grants for public research; (iii) grants for business research and development (R&D); (iv) public procurement; and (v) equity financing. These instruments serve distinct purposes in shaping and supporting quantum technology ecosystems:

- Governments allocate institutional funding and award grants to universities and research centres, often in partnership with businesses, hosting dedicated basic and applied research programmes in quantum technologies. Institutional funding is also used to build and maintain research and technology infrastructures, such as testbeds and quantum computing clouds, to facilitate rapid prototyping and application testing. Public research organisations often support skills and talent development, as part of tertiary education programmes and through workforce upskilling initiatives.
- In addition to public research funding, financial support for the private sector incentivises firms' investment in the commercialisation of quantum technologies. More specifically, governments issue competitive grant calls to support industry-led R&D and innovation activities and use public procurement to help stimulate demand for pre-commercial technology applications.
- Equity financing further supports early-stage quantum start-ups by lowering investment risk and attracting complementary private capital. Financial support for private sector actors tends to target domestic firms. In some cases, however, international companies with advanced technological capabilities may also receive funding, which is typically tied to collaboration with local stakeholders.

Many policies encourage cross-disciplinary collaboration, spanning science, industry and international partnerships, to leverage complementary knowledge and expertise across scientific fields, business sectors and regions. However, the intensity of international collaboration may be slowing, with rates of cross-country co-authorship falling from approximately 33% to below 30% between 2019 and 2022. Collectively, policies have the overarching goal of strengthening national public research and industry actors by supporting basic science and helping translate quantum research discoveries into commercial applications.

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# 1 National quantum strategies: From vision to implementation

## 1.1 From developing a vision to setting concrete objectives

Many countries have committed substantial public funding to support the development and uptake of quantum technologies. As of November 2025, 18 OECD Members plus the European Union have adopted dedicated national strategies. These strategies reflect underlying technological development priorities, management of risks, stakeholder inclusion and desired outcomes. A selection of notable policy milestones and strategies illustrates the growing activity of policymakers in the field (Figure 1).

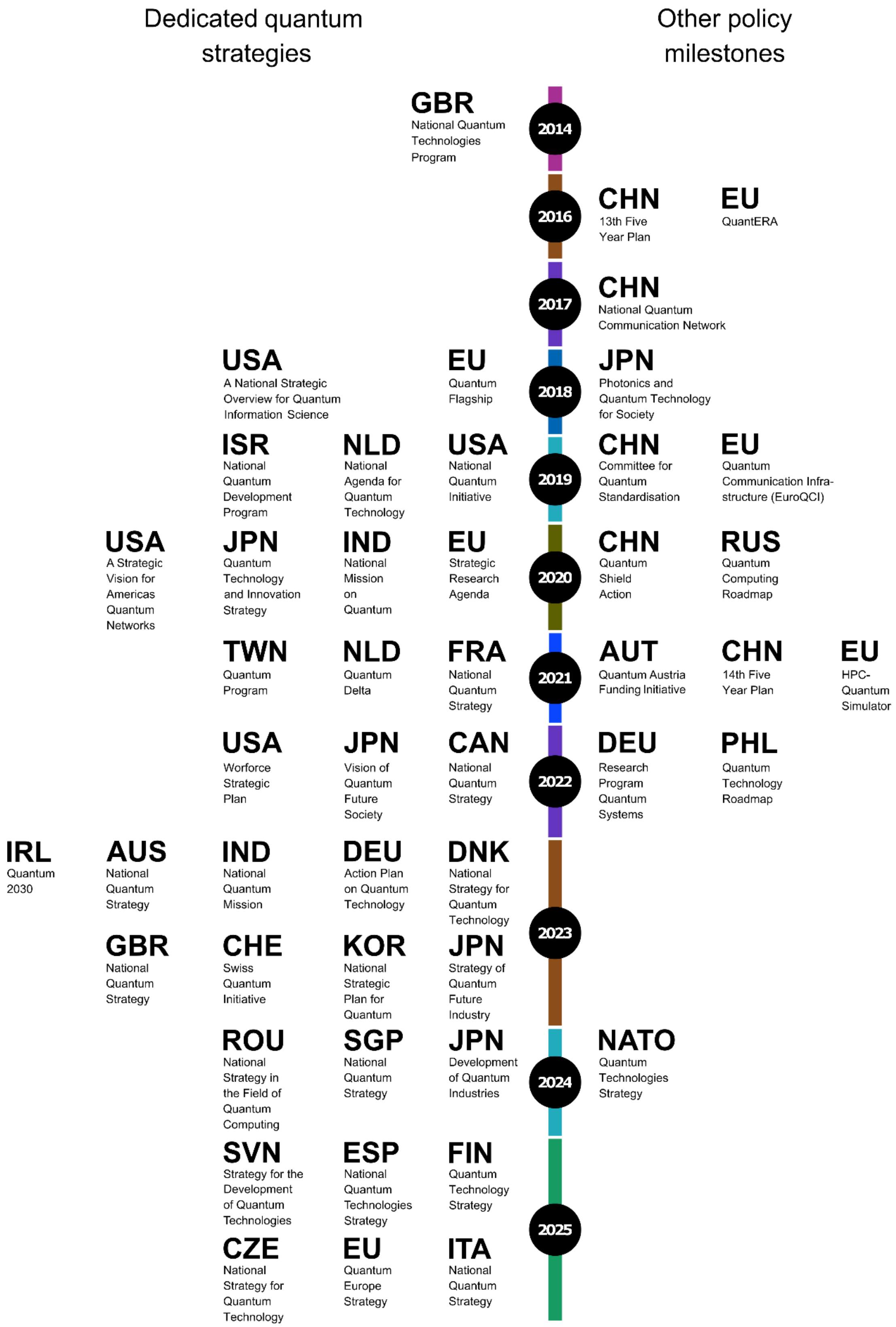
This section presents a synthetic overview of the elaboration, implementation and monitoring of national strategies, as well as further considerations in the context of international relations. These elements build upon the *OECD's Quantum Technologies Policy Primer* (OECD, 2025[2]) and provide the necessary broader context for examining the detail of the policy initiatives presented in Section 2.

### *1.1.1 National strategies' framing: Economic imperatives and national security considerations*

Governments are investing in basic and applied research, as well as in the commercialisation of quantum technologies, in recognition of their potential in a wide range of business applications across various sectors (OECD, 2025[2]). In healthcare, for example, quantum sensors could help monitor the effects of medication at the cellular level. Quantum computers could also contribute to drug discovery by simulating molecular structures and interactions. Meanwhile, industries such as finance, energy and communications are exploring quantum solutions to enhance portfolio optimisation, resource exploration and digital security. Furthermore, considerations around potential digital security and privacy risks, as well as dual-use applications, are motivating countries to increase their domestic capabilities in these technologies. By investing in quantum research and development, many governments aim to secure technological leadership and protect national security while monitoring advances with economic or strategic risks (Box 1).

The Covid-19 pandemic fundamentally reshaped the context for quantum strategy development, as it heightened concerns about technological resilience and supply chain vulnerabilities. The pandemic also led to a wave of government investment in support of the economy, some of which was dedicated to quantum science and technology, allowing some European countries to start formalising their own national quantum policy (see Box 2). Concurrently, in the United States, the CHIPS and Science Act of 2022 extended the dedicated budgets and provisions of the National Quantum Initiative. As described in the OECD Science, Technology and Innovation Outlook 2023 (OECD, 2023[3]), the global STI landscape entered "an era of strategic competition, particularly in critical technologies, driven by concerns surrounding supply chain vulnerabilities, strategic dependencies and geopolitical tensions."

## Figure 1. The timeline of national and supranational quantum strategies




Note: This timeline presents the main policy developments in the global elevation of quantum technologies. It is not comprehensive and accounts for initiatives that are not dedicated quantum strategies yet remain important for contextual awareness.

## Box 1. Potential benefits and risks of quantum technologies

### Potential technology benefits

Once sufficiently mature, quantum technologies could become a source of productivity gains and a competitive advantage across many business activities and sectors. Research is still needed to verify the applications of quantum technologies, but interest in the following areas is widespread:

- **Medicine and healthcare**: Quantum sensors promise improved medical imaging that could detect tumours and track drug effects at the cellular level, enabling earlier and more accurate diagnoses. Quantum computing could accelerate DNA sequencing and drug discovery.
- **Materials science**: Quantum sensors could reveal microscopic defects and thermal stresses in materials before cracks appear, boosting safety and cutting quality inspection time. Quantum computers could help develop stronger, lighter and more efficiently manufactured materials.
- **Energy and extractive industries**: Quantum sensors could help locate geological resources and identify equipment faults early, reducing exploration costs, production downtime and environmental risks. Quantum simulation and optimisation may help deliver improved carbon-capture processes and energy grid operations.
- **Chemistry**: By simulating molecular reactions, quantum computers could unlock low-energy routes to manufacturing ammonia and other chemicals, dramatically lowering carbon emissions. Quantum simulations are likely to aid in understanding how molecules interact with light, thereby deepening our understanding of biological processes such as photosynthesis and vision.
- **Finance**: Atomic clocks already timestamp trades with microsecond precision, aiding market transparency and regulatory compliance. Quantum algorithms could expand capabilities in areas such as risk analysis, portfolio optimisation, transaction settlement and crash forecasting.
- **Transportation and logistics**: Quantum sensors could improve battery-health diagnostics and enable civil engineers to conduct deeper surveys of subsoils. Quantum computing could aid in designing next-generation batteries and solving vast routing and scheduling problems.
- **Communications**: Quantum networks are being tested to strengthen the security of data links for critical infrastructure applications and to enable new modalities of distributed quantum sensing and computing.

Many applications might also help tackle some of today’s most pressing societal challenges, for example boosting food security through precision agriculture, and improved access to clean water on account of subterranean monitoring and next-generation purification materials. The integration of quantum technologies with classical computing and networks is expected to augment these benefits.

### Potential technology risks

Although these technologies offer great potential, they also present considerable risks, especially concerning digital security and privacy. Quantum computers have the capability to compromise commonly used encryption methods, putting financial information, sensitive data and critical infrastructure at risk. Post-quantum cryptography standards have been developed, with adoption and integration into existing systems to follow. Additionally, the advanced capabilities of quantum sensors raise concerns about arbitrary or unlawful surveillance and potential privacy infringements. Applications in cryptanalysis, intelligence gathering and weapons development, among others, pose national security risks that are prompting countries to build domestic quantum capabilities.

Source: OECD (2025[2]).

### Box 2. The Covid-19 crisis led to European Union funding allocations for quantum technologies

The Covid-19 pandemic led to important economic stimulus packages in the European Union (EU), with Member States mobilising recovery funds to stabilise economies and support strategic sectors, including quantum technologies. The EU established NextGenerationEU as its primary financial mechanism for post-pandemic recovery. With a total budget exceeding EUR 800 billion, this mechanism was designed to strengthen economic resilience and support green and digital transitions, the latter including emerging fields such as quantum technologies. The Recovery and Resilience Facility (RRF), the core component of NextGenerationEU, allocated a total EUR 723.8 billion in grants and loans to Member States. Each EU country was required to develop a National Recovery and Resilience Plan.

This funding was instrumental in the formalisation of quantum strategies in countries such as Germany, Italy and the Netherlands. Germany leveraged its Economic Stimulus Package to support quantum technologies as part of a broader research and innovation framework: A total of EUR 2 billion from the package was allocated to quantum technologies specifically.

Austria allocated EUR 107 million to quantum technologies from its national recovery funds under the RRF. The Czech Republic's National Recovery Plan helped fund the QuantERA II 2023 call for transnational research projects in quantum science and technologies. Spain integrated quantum technologies into its national recovery and resilience plans. Italy utilised recovery funds to support quantum computing infrastructure and research hubs.

## 1.2 Process for developing strategies: Strategic intelligence, public consultation and development of roadmaps

Quantum science and technology is a complex field. The underlying physical phenomena can be difficult to communicate, and the potential socioeconomic consequences of quantum technologies remain highly uncertain. In this context, governments have used various tools to inform the development of their policies and set strategic objectives:

- **Public consultation exercises** have varied in scope and frequency. For example, France and Korea essentially sought inputs from domain specialists, while Australia, for example, released a public "National Quantum Strategy Issues Paper" for general consultation and feedback, and Canada consulted citizens widely through virtual roundtables and online surveys. Table 1 compares stakeholder engagement in the development of national quantum strategies across multiple countries.
- **Technology assessment** aims to evaluate a technology's potential and associated risks. The United States Government Accountability Office (GAO) conducted a thorough assessment of quantum computing and communications, identifying critical opportunities and policy considerations for federal decision makers (GAO, 2022[4]). Since 2022, Korea has supported the annual publication of a "Quantum Information Technology White Paper" covering technology trends, markets and statistics.

## Table 1. Stakeholders' involvement in quantum strategy development, selected countries

Comparative overview of participation methods and key actors

| Country | Methods used | Notes |
|---|---|---|
| Australia (DISR, 2022[5]) | Workshops, consultations, advisory boards, programmes | The CSIRO Quantum Technology Roadmap was specifically developed to initiate a dialogue between government, researchers and industry on the benefits of quantum technology for Australian industry and the potential for long-term economic growth. The development of this Roadmap involved extensive consultation with over 80 stakeholders from more than 40 organisations spanning the quantum technology industry. This included representatives from university research groups, publicly funded research agencies, industry players, end-users, government entities and private investors. In April 2022, DISER released the "National Quantum Strategy Issues Paper" for public consultation. This paper aimed to gather diverse perspectives on the potential opportunities and challenges of quantum technologies in Australia, informing the development of the strategy. |
| Canada (ISED, 2022[6]) | Roundtables, surveys, road-mapping | To inform the development of its national strategy, the Government of Canada undertook broad consultations with academia, industry and not-for-profit organisations. These consultations focused on key areas including research, talent development, commercialisation and security. In 2021, over 200 experts and stakeholders, representing academia, industry and government, were consulted to understand Canada's needs in quantum science, identify opportunities and define priorities. The methods employed for these consultations included virtual roundtables, an online survey and a dedicated email address to facilitate input from a wide range of participants. |
| France (Forteza Paula, 2020[7]) | Auditions in the context of a report | The Forteza report was commissioned by the French Prime Minister and led by members of the Parliament. The report involved gathering insights from experts, including academics, large industrial groups, start-ups and public institutions. |
| Korea (Ministry of Science and ICT, 2023[8]) | Collaborative platform, review and advisory | In 2025, the Korean government launched the Quantum Strategy Committee and a working-level committee comprising government officials, academics, researchers, industry representatives and others. These committees work to establish policies and investment strategies that promote quantum science and technology, as well as the quantum industry. The Quantum Strategy Committee will review and approve a comprehensive quantum plan covering research and development, industrialisation, human resource development, infrastructure development, and international co-operation strategies in the quantum field in Korea. |
| Netherlands (Quantum Delta, 2019[9]) | National open day, consultation group | A national open day was held in April 2019 to gather input from the public. A broad-based consultation group was formed, comprising fifty representatives from the scientific, business and governmental communities. |
| Spain (Red.es, 2025[10]) | Public consultation, inter-ministerial coordination | To inform the development of its National Strategy on Quantum Technologies (2025-2030), Spain launched a public consultation to assess the needs of its national quantum ecosystem. The consultation focused on identifying priorities for deploying quantum initiatives, including infrastructures, use cases, incubators and testbeds, which will be supported by resources from the European Regional Development Fund managed by Red.es until 2029. Based on the findings, the Spanish government approved the strategy in 2025 as a coordinated framework between the Ministry of Science, Innovation and Universities and the Ministry for Digital Transformation and Public Function. |
| United Kingdom (Lucy Williams, 2024[11]) (EPSRC, 2018[12]) | Public and experts, workshop, advisory boards, parliamentary inquiry | The Engineering and Physical Sciences Research Council commissioned a public dialogue to understand public perceptions of quantum technologies. This involved workshops in four locations (Oxford, Glasgow, Birmingham and York) with 77 participants. The workshops were held between September and November 2017. A stakeholder workshop was held in March 2017 involving academics, representatives from technology companies and policymakers. The Government Office for Science enlisted a panel of academics and industrialists to provide the evidence base for its report on quantum technologies. The Science and Technology Committee of the House of Commons conducted an inquiry into quantum technologies, gathering written and oral evidence from various stakeholders. |
| United States (NQCO, 2020[13]) | Workshops, expert reports | Since 2014, the National Science Foundation and the Department of Energy have organised several workshops on specific topics on quantum technologies, inviting academia, industry and policymakers. Since 2018, the White House has also convened summits with the same type of actors. |

Source: OECD elaboration based on various national reports and strategy documents.

- **Horizon scanning** identifies emerging trends and opportunities in each technology. Innovate UK actively engages in horizon scanning with its 2023 "50 Emerging Technologies" report, which includes quantum technologies, to guide strategic investment and policymaking. The United Kingdom's Digital Regulation Cooperation Forum (DRCF) produced a "Quantum Technologies Insight Paper", engaging regulatory bodies like Ofcom, the Financial Conduct Authority and the

Information Commissioner’s Office, facilitating discussions about potential regulatory implications and broader societal impacts of quantum technologies (DRCF, 2023[14]).

- **Technology road-mapping** involves developing strategic guidelines to direct a given technology’s long-term development. The roadmaps developed for quantum technologies differ significantly across countries, shaped by distinct creation processes and strategic priorities. For example, Canada employs a structured approach, establishing specialised working groups to develop dedicated roadmaps for each domain of quantum technology (computing, sensing and communication). In contrast, the United States adopts a decentralised approach, with agencies like the Department of Energy (DoE) producing a "Quantum Information Science Applications Roadmap", detailing their directions in quantum research and development (DoE, 2024[15]). Table 2 illustrates various methods and strategic exercises used by governments to inform their actions in the field of quantum technology, while Table 3 presents examples of common objectives in quantum roadmaps.

## Table 2. Examples of governmental exercises informing quantum technology strategies

| Country | Roadmap | Technology forecasting | Foresight | Horizon scanning | Technology assessment |
|---|---|---|---|---|---|
| Canada | National Quantum Strategy with roadmaps for sensing and computing | Economic forecasting within National Quantum Strategy | Integrated into National Quantum Strategy | Consultative approach for the development of the National Quantum Strategy | Council of Canadian Academies report on responsible adoption, cybersecurity considerations in the National Quantum Strategy |
| France | National Quantum Strategy, France 2030 plan, PROQCIMA | Forteza report | Integrated into National Quantum Strategy and the France 2030 plan | | MetriQs-France programme |
| Korea | National Quantum Strategy | Three-Phase Development Strategies for Transitioning to Quantum Economy | Integrated into National Quantum Strategy | Ongoing through Quantum Strategy Committee | Quantum Information Technology White Paper |
| United Kingdom | 2015 NQTP, 2023 National Strategy, NQCC Roadmap | DRCF Insight Paper, MoD Global Strategic Trends | GO Science | Innovate UK's 50 Emerging Technologies, IoP Vision for Quantum Technologies | TechUK Report on Quantum Resilience |

Note: This table provides illustrative examples rather than an exhaustive review of all governmental activities.

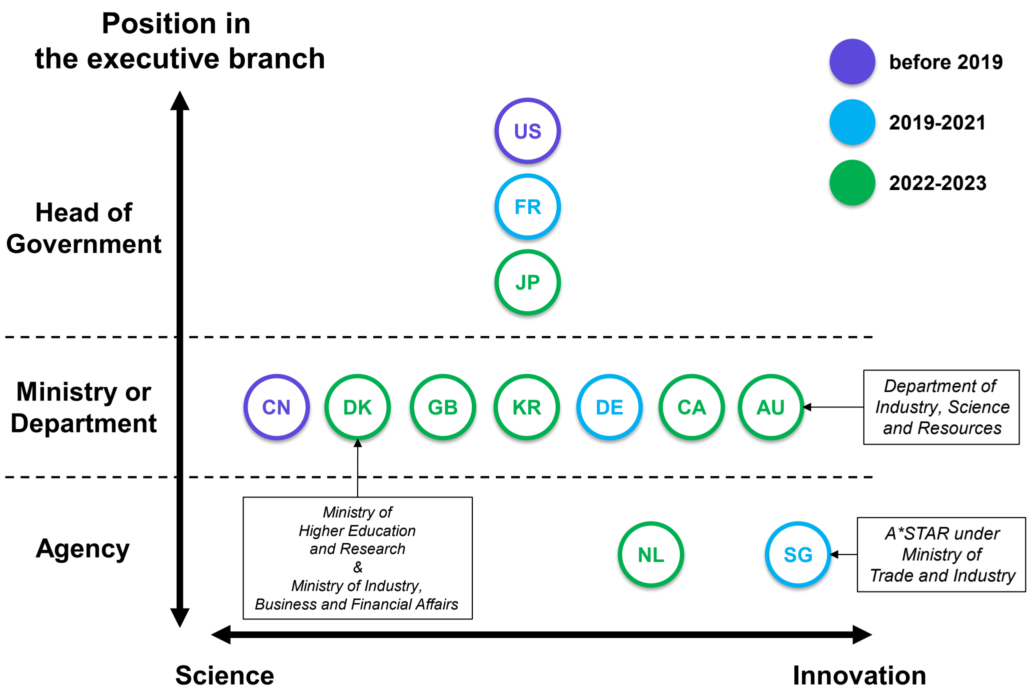
## 1.3 Governance of strategies: Involvement of stakeholders, interministerial alignment and mission-oriented innovation policies

Governance structures for quantum strategies vary significantly across countries, reflecting differences in national priorities, organisational frameworks and levels of governmental commitment. This diversity illustrates how each country tailors its approach to advancing quantum technologies. In some cases, national quantum strategies are embedded within broader science and technology agendas, while in others, they stand alone, supported by dedicated laws or specific governance bodies. Figure 2 shows the executive authorities responsible for quantum strategies in a selection of countries.

## Table 3. Examples of common objectives in quantum roadmaps

| Objective | Description | Examples |
|---|---|---|
| **Technological** | Many countries articulate clear, measurable targets in terms of qubit counts and performance metrics regarding quantum computing capabilities. | The European Union, through its Quantum Flagship initiative, initially targeted the achievement of quantum advantage using NISQ (Noisy Intermediate-Scale Quantum) processors of around 50 qubits with low error rates by 2023, subsequently aiming for scalable architectures of up to 1 000 qubits by the end of the decade (European Commission, 2024[16]).<br>Similarly, Germany's 2022 roadmap outlines precise numerical milestones, seeking an internationally competitive quantum computer with at least 100 qubits by 2026. That computer would need to be scalable up to 500 qubits, with Germany ultimately developing fully fault-tolerant, universal quantum computing systems within fifteen years (Bundesministerium für Bildung und Forschung, 2022[17]). |
| **Economic** | Strategies typically highlight market competitiveness, commercialisation pathways and investment attraction. | The United Kingdom explicitly aims to capture 15% of the global quantum technology market share by 2033 (Department for Science, Innovation & Technology, 2023[18]), emphasising private equity growth and robust industrial engagement.<br>Japan has set ambitious economic goals, aiming for a value of quantum technology production of approximately JPY 50 trillion by 2030, with a clear focus on immediate industrial applications and societal integration (Cabinet Office, 2024[19]). |
| **Social** | This includes workforce development, education and public awareness, which play a vital role in quantum roadmaps and reflect a consensus that technological progress in the field is contingent upon societal readiness. | The European Union has developed comprehensive targets, including the creation of 180 validated open-source quantum education modules, hosting 100 outreach events by 2030 and actively promoting diversity within the quantum technology workforce (European Commission, 2024[16]).<br>Korea prioritises a significant expansion of its specialised quantum workforce, increasing from fewer than 400 experts in 2022 to over 2 500 by 2035, through dedicated graduate programmes and international collaborations (Ministry of Science and ICT, 2023[8]). |

## Figure 2. Positioning of executive authorities governing quantum strategies in selected countries




Note: The horizontal axis represents the spectrum of institutions responsible for quantum strategies in countries. Ministries of science and research are on the left (CN, DK), while ministries of economy, technology and innovation are on the right (AU,SG). At the centre lie authorities with both attributions or those for which this distinction is not applicable.

The governance of quantum strategies in France, Japan and the United States is under the responsibility of the highest level of the executive branch. In the United States, for example, the White House's Office of Science and Technology Policy oversees the national quantum strategy, coordinating federal efforts to accelerate the development of quantum technologies. Similarly, Japan's Cabinet Office plays a central role in managing national science and technology policies, ensuring that quantum initiatives are embedded within the country's broader innovation agenda.

In some countries, independent bodies have been specifically created to oversee quantum initiatives. The United Kingdom, for example, coordinates its national quantum policy through the Office for Quantum, which is housed within the Department for Science, Innovation and Technology. This specialised office focuses solely on quantum technologies, providing a dedicated channel for policy implementation, coordination and monitoring. The United States also established the National Quantum Coordination Office, designed to ensure cross-departmental collaboration and strategic alignment in the execution of quantum policies. Singapore follows a similar approach, with its National Quantum Office tasked with driving the implementation of the country's national quantum strategy, ensuring that quantum research and development are closely aligned with national economic goals and industrial needs.

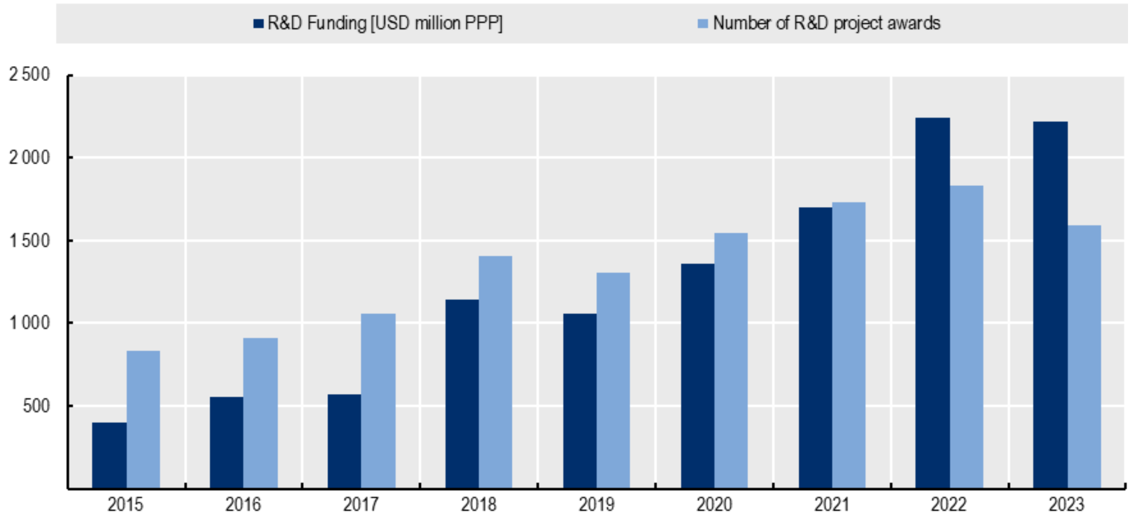
In most countries, expert advisory groups play a vital role in shaping national quantum strategies by providing well-informed, specialised guidance to government bodies. Countries like Australia and Korea have established advisory groups composed of leading experts in quantum science and technology, helping to ensure that national policies are grounded in scientific excellence and practical feasibility. In Australia, the National Committee on Quantum brings together experts to advise the government on quantum policies, making sure that scientific developments align with industry needs and public policy objectives. Similarly, Korea's Quantum Strategy Committee offers strategic guidance to the government, helping to steer national efforts in quantum technologies and ensure that the country's quantum ambitions are effectively integrated into its broader technological and industrial strategies.

### *1.3.1 Strategies help the coordination and amplification of quantum initiatives*

As of October 2025, an estimated USD 55.7 billion has been committed to quantum science and technology by governments worldwide since 2013 (Qureca, 2025[1]). Yet, it is important to note that these estimates are based on public announcements of government investments and should be interpreted with care. They often represent the overall expected budget of programmes, which may include legacy allocations for quantum technologies made before the strategy was established. They may also include funding from non-governmental sources such as the private sector.

Achieving a complete thematic breakdown of public expenditures on quantum science and technology is not possible at present. However, the OECD Fundstat infrastructure provides a decentralised database and a set of analytical tools capable of estimating quantum-specific R&D funding allocations at a project level for 19 OECD Member countries and the EU-EC programme, representing a weighted average percentage of 58% of total Government Budget Allocations for R&D (GBARD) in 2021. Ongoing OECD work provides a detailed description of the methodology, limitations and country comparisons (Yamashita et al., 2021[20]; Aristodemou et al., 2023[21]; Aristodemou et al., 2025[22]). While the coverage is only partial, the ongoing work offers valuable insights into quantum-related funding trends and identifies a total of USD 11 billion (in Purchasing Power Parity – PPP terms) in R&D project awards since 2015. The OECD Fundstat resource is a flexible infrastructure comprising a database on government project-level R&D funding and analytical tools. Figure 3 details estimated quantum-related R&D funding allocations across 19 OECD Members and the European Commission (EC) programmes, for the years 2015-2023. During this reference period, a total of 12 209 quantum-oriented R&D projects received funding awards, amounting to approximately USD 11 235 million (in purchasing power parity terms (PPP)). The average implied quantum project award size stood at USD 0.92 million (PPP), surpassing the implied average project size across all R&D fields (USD 0.75 million in PPP terms), reflecting a major interest in quantum technologies.

### Figure 3. Estimated annual quantum R&D funding in the OECD Fundstat database, 2015-23




Note: The OECD Fundstat database comprises R&D funding project award data from 19 OECD Member countries (AUS, AUT, BEL, CAN, CHE, CZE, DEU, EST, FIN, FRA, GBR, IRL, JPN, LTU, LVA, NOR, PRT, SWE, USA) and the European Union (EU) - European Commission (EC) programmes. Over the reference period, 2015-23, during which data coverage is stable, the OECD Fundstat database covers approximately 51% of the Government Budget Allocation for R&D (GBARD) in these 19 OECD Members (excluding General University Funds), as reported in the Main Science and Technology Indicators (MSTI) Database, www.oecd.org/sti/msti.htm. R&D funding award data reflect authorisations rather than actual commitments or expenditure. Analysis performed on R&D project awards with available funding information.
Source: OECD calculations based on data from the OECD Fundstat database (v.2024), accessed in September 2025.

Figure 3 shows the results of an analysis of the annual distribution of public quantum-related R&D funding and project awards, expressed as proportions of the total cumulative quantum-related R&D funding recorded between 2015 and 2023. The analysis reveals funding increases after 2019, with particularly high investment activity occurring in 2022 and 2023, together accounting for over one-third of total quantum R&D funding during this timeframe. While quantum-related R&D project awards also increased, their trajectory followed a steadier growth pattern, with a decrease in 2023 to a level comparable to that of 2020 rather than sharp peaks.

This progressive rise illustrates how, before the establishment of formal national strategies, funding for quantum technologies was already increasing, even if doing so in a fragmented manner across different institutional channels. For example, in the years leading up to the National Quantum Initiative Act, the United States government was already funding research in quantum science and technology through dedicated programmes in the National Institute of Standards and Technology, the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the Department of War and the Department of Homeland Security (National Science & Technology Council, 2021[23]).

To coordinate efforts across ministries and initiatives, mission-oriented innovation policies are being used in several national quantum strategies. These can help to provide innovators with more direction, for instance in better understanding application areas where demand is likely to rise. Mission-oriented innovation policies can also help to set the conditions necessary for coordination and joined-up actions. Mission-oriented innovation policies are coordinated packages of policy and regulatory measures tailored to mobilise science, technology and innovation to address well-defined objectives related to specific societal challenges within a defined timeframe. Mission-oriented innovation policies often span several stages of the innovation cycle, from research to demonstration and market deployment (Larrue, 2021[24]).

The most striking example of mission-oriented innovation policies serving to structure a national strategy is with the United Kingdom's 2023 National Quantum Strategy, which is built around five explicit missions. These missions aim to address specific challenges, such as secure communication, healthcare diagnostics and infrastructure resilience, and have measurable targets set for 2030-2035. The "missions" themselves were co-designed by government, academia and industry to ensure coordinated efforts across sectors. Emphasis was placed on end-users of quantum technologies within government (e.g., related to uses in health, defence and transport). The National Quantum Strategy also includes investments in testbeds and pilot projects to support the transition of quantum technologies from research to practical application.

## 1.4 Monitoring progress in quantum strategies: Key performance indicators

To direct policy and monitor progress in quantum technology, countries often set goals and aim to measure progress within their strategies. This helps countries to position themselves in the global quantum sector, benchmarking against other countries to identify weaknesses and strengths. The key performance indicators (KPIs) used in national strategies range from specific targets for technological performance and readiness levels, to ecosystem metrics such as skills and workforce development, adoption and preparedness, numbers of quantum start-ups and spin-offs, as well as attained market shares, levels of private investment, intellectual property produced, supply chain autonomy and international collaboration.

Some countries, notably the United States and, to a lesser extent, France, have opted for broader, less defined and more flexible objectives in their quantum strategies. For example, quantum strategy documents in the United States generally do not specify quantitative metrics or targets, but instead outline strategic goals and directions. In contrast, strategies from the European Union (Strategic Advisory Board of the European Quantum Flagship, 2024[25]), Korea (Ministry of Science and ICT, 2023[8]) and the United Kingdom (DSIT, 2023[26]), feature detailed metrics and publicly available methodologies. However, it is important to note that even among those countries with more precise metrics, there is a shared recognition that these goals and measurements are part of an ongoing process of definition (Strategic Advisory Board of the European Quantum Flagship, 2024[25]).

An attempt at standardising quantum KPIs was recently presented by the German Quantum Technology and Application Consortium (Quantum Technology and Application Consortium – QUTAC, 2024[27]). The QUTAC framework addresses critical challenges such as inconsistencies in current KPI definitions, measurement methodologies and data comparability across countries. It highlights the need for standardised KPIs to enable meaningful international benchmarking and informed policymaking. However, the QUTAC work also acknowledges several limitations. One is the inherent difficulty of capturing nuances in national priorities within a uniform framework. In addition, practical challenges relate to data availability, quality and harmonisation across countries with different capacities and resources.

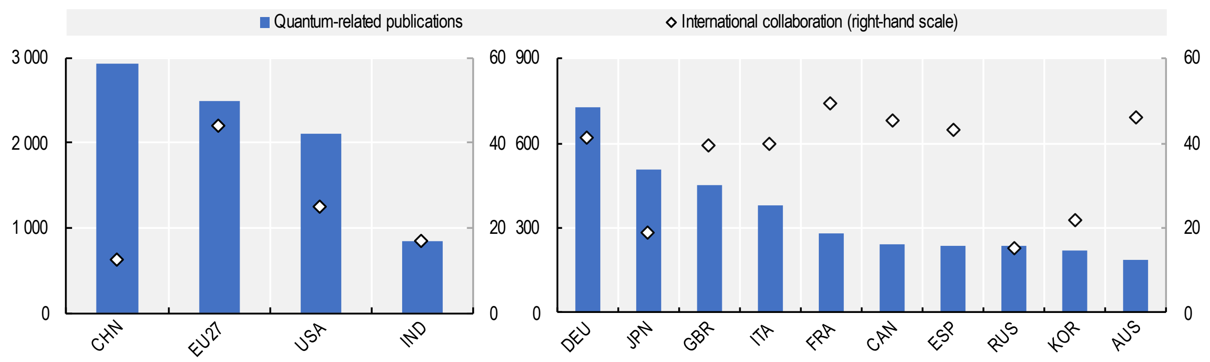
## 1.5 The international dimension: Collaboration, standardisation and safeguard measures

International relations in quantum science and technology are increasingly influenced by strategic considerations. National quantum strategies typically include an international dimension. For instance, one of the KPIs used by the United Kingdom for its national strategy is the number of countries that universities in the United Kingdom have partnered with. Korea sets explicit funding targets for international collaboration. France reviews the extent of foreign investments in quantum businesses as a protection measure in its national strategy. The United States has a dedicated strategic document specifically on international engagement and partnerships. Moreover, shaping formal international standards for quantum technologies also emerges as a common strategic priority across countries.

Figure 4 presents a comparative analysis of quantum research output volume juxtaposed with data on international collaboration intensity across leading national quantum ecosystems. This is an experimental indicator that measures the number of documents related to quantum technologies, identified using a list of search queries developed from a review of existing literature (Scheidsteger et al., 2021[28]). The substantial rates of international collaboration observed across European quantum research ecosystems—with France, Germany, Italy, Spain and Switzerland all exhibiting collaboration intensities around 40%—reflect the structural impact of general European research integration mechanisms and of the Quantum Flagship in particular.

### Figure 4. Top countries with quantum-related publications and their international scientific collaboration intensity, based on fractional counts, 2023

The number of publications is represented in blue bars (left-hand scale in absolute numbers, fractional count). Juxtaposed is the share of publications of that country involving international co-authors (right-hand scale, in percentage)



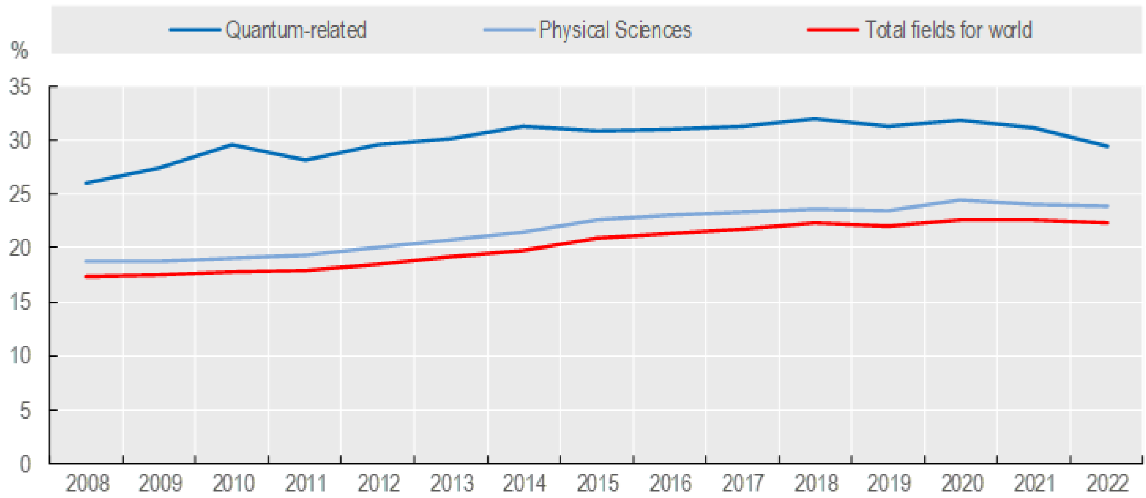

Note: A fractional count means that a share of a publication is attributed as a fraction of 1 to each participating country, if multiple countries are involved.
Source: OECD calculations based on Scopus Custom Data, Elsevier, Version 1.2025, accessed in September 2025.

The growing strategic importance of quantum science and technology is illustrated by shifting trends in the intensity of international collaboration, which have historically been particularly high. Figure 5 presents longitudinal data on international collaboration intensity across three categories: quantum research, physical sciences and all scientific fields. This temporal perspective reveals that quantum research had a consistently higher level of internationalisation than the two other categories throughout the 2008-2022 period. However, collaboration intensity in quantum science and technology began to plateau and subsequently decline, with international co-authorship rates falling from approximately 33% to below 30% from 2019 to 2022. Collaboration intensity[1] in quantum technologies between the United States and EU Member States declined by 15% between 2018 and 2022. This overall decrease reflects broader global trends, possibly influenced by security-related policies impacting co-operation, even among like-minded partners.

This recent deceleration could signal a shift in the international quantum research landscape. The timing corresponds to several interrelated developments: heightened geopolitical tensions regarding technological leadership, increased policy emphasis on scientific security and technology transfer restrictions, expansion of export control regimes to encompass quantum technologies and national-level strategic prioritisation of quantum capabilities development.

**Figure 5. International collaboration intensity for publications in quantum, physical sciences and all fields, based on fractional counts, 2008-2022**

Percentage rates of international co-authorship




Source: OECD calculations based on Scopus Custom Data, Elsevier, Version 1.2024, accessed in November 2024

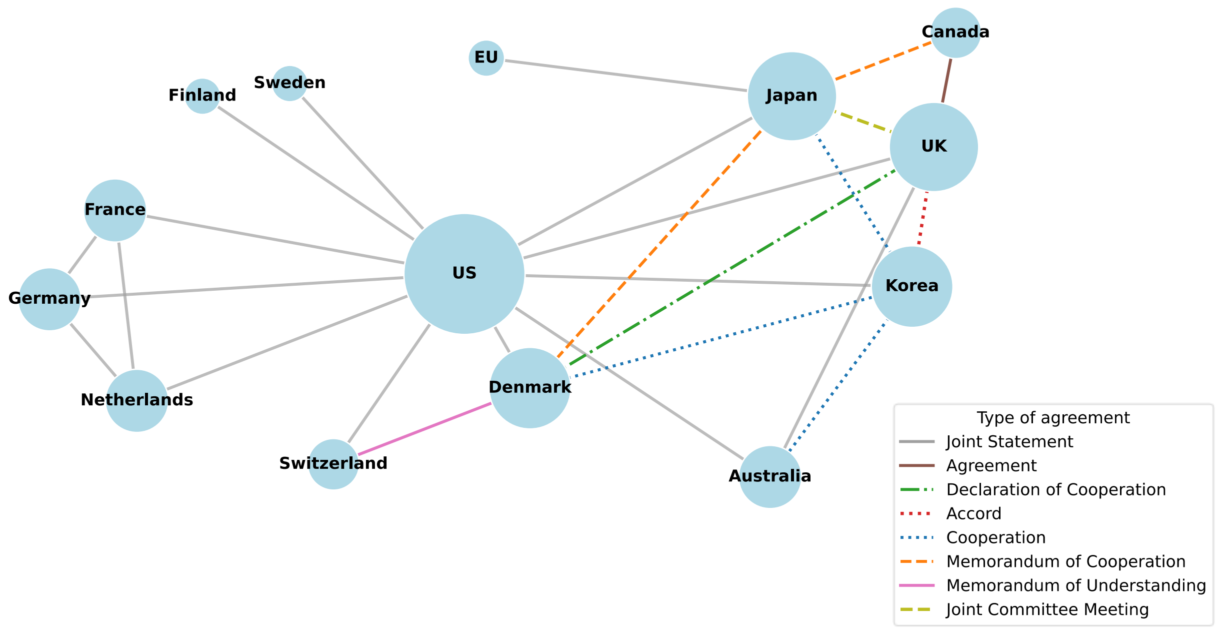
### *1.5.1 The growing incidence of measures to protect quantum technologies*

Countries seeking to strengthen their technological and strategic autonomy often rely on three main policy interventions: protection, promotion and projection (OECD, 2023[3]). Promotion focuses on industrial policies to enhance domestic capabilities and reduce reliance on foreign suppliers, while projection aims to expand technological influence abroad. Protection measures seek to restrict knowledge flows and mitigate potential risks associated with technological interdependencies. Among these, export controls have become a key tool for restricting the transfer of sensitive technologies. Countries that have announced export controls related to quantum technologies and materials include Australia, Canada, the People's Republic of China (hereafter "China"), Denmark, Finland, France, Germany, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Spain, the United Kingdom and the United States.

### *1.5.2 Bilateral collaboration*

Bilateral agreements are formal arrangements between two countries to collaborate on shared priorities. In the areas of science, technology and innovation, these provide structured frameworks for establishing partnerships for collaborative research, knowledge sharing and technology development. They are also used as tools for addressing geopolitical and economic challenges, aiming to ensure countries maintain technological competitiveness in emerging fields. The United States, for example, has formalised bilateral agreements on quantum technologies with at least ten countries. Similarly, the United Kingdom has formalised agreements with at least six countries. Illustrating their proliferation, Figure 6 provides a graphic representation of over 20 bilateral agreements across OECD Member countries.

**Figure 6. A representation of over 20 bilateral agreements related to quantum science and technology**




Note: Each node represents a country and the lines between countries represent bilateral agreements. The size of the node corresponds to the number of bilateral co-operation statements, accords, memoranda or declarations related to the country.

### *1.5.3 Standardisation*

Most national quantum strategies prioritise the development of standards and participation in standards-setting activities. Several quantum standardisation activities are taking place globally. Standards support interoperability, which can in turn accelerate commercialisation (OECD, 2025[2]). Standards can also serve to assert technological leadership. As shown in Table 4, several organisations are actively engaged in developing standards for quantum technologies, each with a specific focus and approach.

The appropriateness of the timing of current standards-setting processes in quantum technologies is debated. Early standardisation in many fields of technology can help to provide direction and prevent future fragmentation. However, setting technical standards too early risks locking in technologies that may later prove sub-optimal. As the IEC points out in a 2021 White Paper on quantum technologies, "Initiating and promoting standards activities before the science has matured can lead to standards that lock in inferior technologies or give an unfair advantage to those quickest to take leadership" (IEC, 2021[29]).

Nevertheless, some types of standardisation and best practices could reduce fragmentation in research and development. Establishing basic standards related to terminology and measurement can support quantum technologies that are still at the early stages of development without precluding further directions of progress (van Deventer et al., 2022[30]). These standards can help provide ecosystem actors (whether from research, industry or government) with a clear and shared understanding of the technology. It may also be valuable to establish standardised processes and benchmarks for evaluating the performance of quantum technologies, not least to support decision making by investors and research funders (RHC, 2024[31]). Standardisation efforts also need to be co-developed with industry actors to ensure that standards support, rather than obstruct, industry efforts.

## Table 4. Stakeholders of international quantum technology standardisation

| Organisation or consortium | Primary focus area | Key standardisation activities or initiatives |
|---|---|---|
| IEEE Standards Association (IEEE SA) | Broad quantum technologies | P1913 (Software-Defined Quantum Communication), P1943 (Post-Quantum Network Security), P2995 (Quantum Algorithm Design), P3120 (Quantum Computing Architecture), P3172 (Post-Quantum Cryptography Migration), P3185 (Hybrid Quantum-Classical Computing), P3329 (Quantum Computing Energy Efficiency), P7130 (Quantum Technologies Definitions), P7131 (Quantum Computing Performance Metrics) |
| IEC/ISO Joint Technical Committee 3 (JTC 3) | Broad quantum technologies | Developing standards for quantum computing, simulation, sources, metrology, detectors, communications; |
| CEN-CENELEC Joint Technical Committee 22 (JTC 22) | European market-focused quantum technologies | WG 1 (Strategic Advisory), WG 2 (Quantum Metrology, Sensing, Enabling Technologies), WG 3 (Quantum Computing and Simulation - Layer Model), WG 4 (Quantum Communication and Cryptography) |
| National Institute of Standards and Technology (NIST) | U.S.-focused, focus on PQC | Post-Quantum Cryptography (PQC) standardisation (ML-KEM, ML-DSA, SLH-DSA, HQC, FALCON), quantum measurement standards, support for QED-C |
| International Telecommunication Union (ITU) | Quantum communication, particularly Quantum Key Distribution (QKD) | ITU-T X.1713 (QKD Node Security), Framework for QKD Protocols, Y.3800 (QKD Network Overview), Y.3801 (QKD Network Requirements) |

Source: OECD elaboration based on ISO (2025[32]), ITU-T Focus Group on Quantum Information Technology for Networks (2022[33]), Department of Commerce (2024[34]) and IEC (2021[29]).

### *1.5.4 Risks of a fragmented technology landscape*

Some business and research leaders have voiced concerns that export controls could stifle innovation in quantum technologies. Small firms may struggle with the reporting requirements tied to export licence applications (Zhang, Clare, 2024[35]). Several countries have prohibited the export of quantum computers with 34 or more qubits, yet it is unclear to academic and industry experts why this threshold presents a meaningful national security risk (Sparkes, 2024[36]). Concerns are also raised about national interests potentially influencing the development and adoption of standards, particularly in the context of increasing competition between countries in the race for quantum supremacy (OECD, 2025[2]). This issue is made more visible by the increased involvement of governments in standardisation processes in spaces that were traditionally left to the private sector (NIST, 2024[37]).

Any re-division of the world into blocs will likely sacrifice some of the gains from specialisation, from economies of scale, and from the diffusion of information and know-how (OECD, 2022[38]). It could also lead to competition in ways that might undermine future co-operation on global grand challenges. Such risks are further described in the *OECD's Quantum Technologies Policy Primer* (OECD, 2025[2]).

# 2 Policy instruments supporting the development and uptake of quantum technologies

To realise the strategic visions outlined in the previous section, governments are designing and implementing a mix of policy initiatives. The OECD's Quantum Technologies Policy Database collects information on close to 250 policies across 40 countries and the European Union.[2] This section identifies the main objectives of policies included in the database. It is structured around the five main instruments governments use to support the development and uptake of quantum technologies: institutional funding for public research, project grants for public research, grants for business R&D, public procurement, and equity financing. Table 5 provides a description of each instrument and summarises their key objectives. The following sections elaborate on these objectives, providing several examples from the database.

## 2.1 Institutional funding for public research

### *2.1.1 Addressing fundamental challenges in science and engineering*

Governments often provide public research actors with sustained financial support to develop foundational research capabilities in quantum technologies. Universities and other research centres host foundational research activities to advance the scientific understanding of quantum mechanics and its phenomena, forming the basis for future technological developments. Applied research seeks to translate fundamental quantum physics discoveries into practical, deployable technologies that can benefit various sectors. For example:

- The Danish National Research Foundation has allocated around USD 40 million from 2012-2027 to establish and support three **Quantum Research Centres of Excellence**. These centres focus on various aspects of quantum science and aim to develop foundational technologies that could transform fields such as computing, secure communication and ultra-sensitive measurement.
- Since 2019, the United States' National Science Foundation has allocated USD 148 million for its **Quantum Leap Challenge Institutes** programme. This initiative supports higher education institutions in pushing the boundaries of research in areas including quantum networking, computation, simulation and sensing. Beneficiary institutions lead collaborative efforts, integrating a range of approaches to achieve targeted scientific, technological and educational objectives in cutting-edge fields. These efforts involve partnerships across multiple institutions and disciplines, addressing the complex challenges at the intersection of science and engineering. **Expanding Capacity in Quantum Information Science and Engineering** is another National Science Foundation programme spanning 2024-2029, designed to create a diversified investment portfolio in research and education leading to scientific, engineering and technological breakthroughs. Among its goals, the programme helps build capacity and infrastructure across eligible United

States higher education institutions seeking to engage significantly in quantum information science and engineering.

- Switzerland's **National Centre of Competence in Research: Quantum Science and Technology**, funded by the National Research Foundation with around USD 200 million during 2011-2022, brings together over 40 research groups from across the country to explore the frontiers of quantum science and practical applications in areas such as quantum computation, cryptography, communication, sensing and simulation.
- Singapore's Ministry of Education and National Research Foundation provided over USD 200 million between 2007 and 2023 for the country's **Centre for Quantum Technologies**, aiming to build national research capacity in the field. The centre brings together physicists, computer scientists and engineers to conduct basic research and to build quantum devices.

## Table 5. Main policy instruments supporting the development and use of quantum technologies

<table>
<tr><th>Policy instrument</th><th>Description</th><th colspan="2">Objectives</th></tr>
<tr><td rowspan="3">Institutional funding for public research</td><td rowspan="3">Financial support to public research actors, including universities, research centres, and research and technology organisations.</td><td>Address fundamental challenges in science and engineering</td><td>• Advance the understanding of quantum mechanics and its phenomena, which serve as the basis for future technological developments.<br>• Translate fundamental quantum physics discoveries into practical, deployable technologies.<br>• Develop international scientific partnerships.<br>• Invest in laboratories, equipment and other facilities that expand research capabilities and promote collaboration among public research actors.</td></tr>
<tr><td>Support the commercialisation of quantum technologies</td><td>• Combine the resources and expertise of public research organisations and industry partners.<br>• Establish or maintain research and technology infrastructures that researchers and companies can use to develop and test quantum technologies.<br>• Create testbeds and demonstration facilities dedicated to rapid experimentation, iteration and benchmarking of quantum technologies.</td></tr>
<tr><td>Skills and talent development</td><td>• Mobilise public research organisations to support tertiary education and workforce development.<br>• Collaborate with industry actors to strengthen skills development, linking educational programmes with business needs.<br>• Raise awareness of career opportunities and promote participation in the quantum workforce.</td></tr>
<tr><td>Project grants for public research</td><td>Competitive grants with calls for proposals for research projects in quantum technologies.</td><td colspan="2">• Promote foundational research to achieve scientific breakthroughs and demonstrate the capabilities of quantum technologies.<br>• Support cross-disciplinary research that integrates different kinds of scientific fields.<br>• Promote international collaboration to leverage global expertise and facilitate research exchanges.<br>• Support the transition from fundamental research to market-ready applications, e.g. by incentivising industry partnerships and fostering entrepreneurial initiatives.</td></tr>
<tr><td>Grants for business R&D</td><td>Competitive grants with calls for proposals for business R&D activities.</td><td colspan="2">• Fund industry-led projects and partnerships to demonstrate commercial viability and cultivate demand for quantum technology products and services.<br>• Target business sector challenges, supporting high-impact projects for example in sustainability and security, healthcare and energy.</td></tr>
<tr><td>Public procurement</td><td>Government commissioning of R&D and innovation services from firms.</td><td colspan="2">• Support investment in R&D, contributing to advancing technology readiness levels and helping businesses develop innovative solutions that they can later sell to other ecosystem actors.<br>• Foster international collaboration and technology transfer.</td></tr>
<tr><td>Equity financing</td><td>Public investments in shares of private or publicly-owned firms, i.e. giving an ownership stake.</td><td colspan="2">• Support the development of quantum start-ups and young small- and medium-sized companies.</td></tr>
</table>

Institutional funding for universities and research centres often aims to develop international partnerships. For instance, New Zealand's Tertiary Education Commission has supported the **Dodd-Walls Center** with around USD 45 million between 2021 and 2028 to weave international partnerships and strengthen domestic expertise in photonic and quantum technologies. Norway's **QuSpin**, a centre of excellence awarded around USD 30 million by the Norwegian Research Council over 2017-2027, has recruited fifty researchers from eleven countries to develop quantum technologies that reduce power consumption and heat generation in electronics. The Quantum Leap Challenge Institutes programme mentioned above also underscores the importance of fostering collaboration with international research organisations as a key objective.

Besides funding universities and public research centres, governments are strategically mobilising research and technology infrastructures to address fundamental challenges in quantum science and engineering. They are investing in laboratories, equipment and other facilities that help link various public research actors and contribute to expanding quantum research capabilities. For example:

- Australia's **National Quantum Strategy Investment** (Department of Industry, Science and Resources, 2023-2024) allocates around USD 650 million from the National Reconstruction Fund to quantum technology, a portion of which will be dedicated to building and enhancing research facilities.
- In 2017, China started building its **National Laboratory of Quantum Information Science** in Hefei, a collaborative effort between the Chinese government, the Chinese Academy of Sciences and other regional entities, with investments from the Bank of China and Shenzhen Capital. While actual investment expenditures have not been reported, the government has announced up to USD 15 billion to develop the laboratory. It is envisioned as a leading platform for quantum information research.
- Qatar launched the **Centre for Quantum Computing** in 2024, the first centre of its kind in the country. It was specifically built to support fundamental research in quantum communication, computing and sensing, providing infrastructure and expertise for basic science. The centre aims to build national capacity and collaborate with global academic and industry partners, thus fostering an environment conducive to long-term research.

### *2.1.2 Supporting the commercialisation of quantum technologies*

Institutional funding initiatives mapped in the OECD's Quantum Technologies Policy Database are more often oriented towards developing technology applications than towards advancing basic science. Governments thereby seek the dual goal of strengthening the research base while fostering innovation and technological breakthroughs. To this end, policies often seek to combine the resources and expertise of public research organisations with those of industry partners. In this way, researchers can tackle more ambitious projects collaboratively than in isolation, while industry participants can guide research activities toward practical use cases. For instance:

- In Italy, the **National Quantum Science and Technology Institute** (Ministry of University and Research, 2023-2026) is funded with about USD 120 million to establish a consortium of 20 Italian research centres to promote competitive research and facilitate industrial innovation. The Institute's activities range from basic research to prototype development. It emphasises bridging gaps between academia and industry, including through the creation of academic spin-offs and start-ups.
- The Australian Research Council's **Centres of Excellence for Engineered Quantum Systems** is a national initiative of USD 90 million operating from 2021 to 2028 that seeks to bridge the gap between theoretical quantum physics and practical engineering, enabling the translation of quantum science into usable technologies. It operates as a collaboration hub, bringing together expertise from various research institutions, government agencies, industry partners and

international centres. This multi-stakeholder model enables large-scale research projects that would be challenging for individual actors to undertake alone.

- Sweden's **Wallenberg Centre for Quantum Technology** (Swedish Research Council and Wallenberg Foundation, 2018-2028) is a USD 150 million national research initiative focused on developing quantum technologies, including quantum computers, sensors, simulators and communications systems. The centre aims to strengthen business competitiveness in quantum technology. It promotes industrial partnerships by supporting companies in identifying and investigating use cases, particularly with industrial PhD projects. The centre also fosters the creation of academic spin-offs, hosts industry workshops and supports the commercialisation of research via patenting and licensing.
- In the United States, the **National Quantum Information Science Research Centres** (Department of Energy, 2020-ongoing) aim to address some of the most complex challenges in science and technology by advancing quantum computing, communication, sensing and materials science. The five centres integrate the expertise of over 1 500 professionals from 115 academic, industrial and governmental institutions across the United States, with partners elsewhere in North America and Europe. Each centre employs a co-design approach, coupling research and innovation with practical applications. They foster a quantum ecosystem that supports technology transfer, workforce development and the rapid deployment of quantum applications.
- Germany's **Quantum Computing Initiative** (Federal Ministry for Economic Affairs and Climate Action, 2021-2025) represents close to USD 1 billion in support of practical quantum applications. The largest proportion of the funding (about USD 800 million) is allocated to Germany's Aerospace Centre (DLR), which has worked closely with large corporations and start-ups to establish two innovation centres in Hamburg and Ulm. These centres provide industry partners access to cleanrooms, laboratories and office space for research collaborations and technology transfer. They serve as hubs for research and development, bringing together DLR's projects, industry stakeholders, start-ups and potential end-users of quantum computing technology.
- **Quantum Science Austria** is an ambitious research initiative (2023-2029) that aims to build a cluster of excellence led by the University of Innsbruck in collaboration with other Austrian public research actors. The initiative emphasises a collaborative, interdisciplinary approach that pools the resources, expertise and methodologies of Austria's leading institutions. Additionally, Quantum Science Austria includes an outreach and technology transfer programme designed to share insights and innovations with society and industry. This integration facilitates tackling advanced research questions that surpass the capacity of individual research programmes or conventional funding structures.
- With an investment of over USD 110 million, the United Kingdom's **Quantum Technology Hubs** (UK Research and Innovation, 2019-ongoing) seek to translate the country's quantum research efforts into practical, innovative technologies across various fields such as healthcare, security, critical infrastructure and computing. Five Quantum Technology Hubs are based at universities with distinct focus areas, including computing and simulation, communication and sensing (biomedical, metrology, and position, navigation and timing). The hubs are implemented through partnerships with industry actors, which provide financial contributions and in-kind support to help align research with commercial needs.
- Brazil's **Competence Centre for Quantum Technologies**, supported with about USD 10 million by the Brazilian Research and Industrial Innovation Enterprise during 2022-2027, supports market-driven research and development activities in quantum technologies. The programme seeks to create an open innovation environment for the creation and attraction of start-ups, involving national and international partnerships and associated companies.

Policies also seek to establish and maintain research and technology infrastructures that researchers and companies can use to develop and test quantum technologies. These include scientific facilities, lab equipment, demonstration and testing facilities, and digital environments providing computing and networking services. These infrastructures often support knowledge transfer, helping transition lab-scale breakthroughs into commercial technologies and applications. They also help ensure that knowledge sharing is both voluntary and occurs on mutually agreed terms, protecting intellectual property holders from forced, coerced or inadvertent transfers of technology. They can offer prototyping facilities, propose technology transfer and extension services, strengthen domestic supply chains and support the creation of spin-outs. A main objective of Sweden's Wallenberg Center for Quantum Technology mentioned above is to create a Swedish-built quantum computer. Other examples of policies are described below.

- Israel's **National Quantum Initiative** (Israel Innovation Authority, 2018-ongoing) developed a quantum computing centre with an initial investment of around USD 30 million, offering unprecedented possibilities for R&D across all layers of quantum hardware and software. This centre, which supports three core quantum processing technologies (superconducting qubits, cold ions and optical computing), serves Israel's industry and academic sectors. It provides access to a complete quantum computing stack, with potential future expansions including cloud accessibility.
- Japan has allocated about USD 425 million to support the establishment of the **Global Research and Development Center for Business by Quantum-AI Technology** (Ministry of Economy, Trade and Industry, 2023-ongoing) at the National Institute of Advanced Industrial Science and Technology. The centre is developing several unique testbeds to support R&D for industrialising quantum technology. Key initiatives include creating use cases, developing the supply chain and building the business ecosystem, among others. In addition, Japan has supported the development of a **Quantum Computing Cloud Platform** (Ministry of Economy, Trade and Industry, 2023-ongoing), providing industry stakeholders with access to a 127-qubit IBM quantum computer located at the University of Tokyo. Through this initiative, the Ministry aims to stimulate cross-industry collaboration and drive innovation in areas such as autonomous vehicles, pharmaceuticals, materials science and finance. In parallel, the **RIKEN quantum computing cloud service** (Ministry of Education, Culture, Sports, Science and Technology, 2023-ongoing) provides access to the quantum computers produced domestically through Japan's Quantum Leap Flagship Program described in Section 2.2.
- With a budget of nearly USD 100 million, the Finnish Technical Research Centre provides access to **Quantum Computing** via cloud services, hosting a 5-qubit machine since 2022, which was followed by a 20-qubit computer in 2023 and a 50-qubit machine in 2025. As a limited liability company wholly owned by the Finnish state, the Finnish Technical Research Centre operates under the direction of the Ministry of Economic Affairs and Employment. It also provides foresight and business advisory services to help companies identify use cases and develop and implement quantum algorithms.
- Korea's **Quantum Computing Infrastructure Development Project** (Ministry of Science and ICT, 2022-2026) seeks to develop the country's first independently built 50-qubit superconducting quantum computer with an accompanying cloud service for remote access and computational applications. The project aims to provide cloud services for research and educational purposes.
- The Netherlands hosts several research centres that aim to advance quantum technologies and collaborate with industry to develop real-world applications. **QuTech**, established in 2013 at Delft University of Technology, focuses on quantum computing and quantum networks. **QuSoft**, launched in 2015 at the University of Amsterdam, concentrates on quantum software and multidisciplinary applications. In 2018, the **Centre for Quantum Materials and Technology Eindhoven** was founded at Eindhoven University of Technology to work on areas including quantum simulation, hybrid quantum computing, quantum communication and quantum materials

and devices. More recently, the **Centre for Quantum Nanotechnology Twente** was established in 2020 at the University of Twente, specialising in quantum photonics and materials research.

- In the European Union, **Qu-Pilot** (2023-2026, USD 20 million) aims to strengthen Europe's quantum sensing, computing and communication production facilities to meet the rising demand for pilot-scale production services among quantum technology providers. The programme seeks to deliver initial experimental production capabilities and set the groundwork for industrial-scale manufacturing environments. Qu-Pilot's goal is to promote the development of European standards in quantum technology, fostering a resilient European supply chain and ensuring that critical intellectual property remains within the European Union.

Several initiatives integrate quantum computers with classical high-performance computing (HPC) environments to leverage the different strengths of both in solving complex problems more effectively. This hybrid approach allows problems to be divided into parts that are best suited for quantum computers and others that are better handled by classical computers (OECD, 2025[2]). For example, **Quantum Spain** (Ministry for Economic Affairs and Digital Transformation, 2021-ongoing) has invested around USD 20 million to build a complete quantum computing infrastructure for Spain. The project supports the research and technology ecosystem, particularly with an interest in exploring artificial intelligence applications. The infrastructure is integrated with the Barcelona Supercomputing Centre and will be accessible through cloud services. France's **Hybrid HPC-quantum programme** (Alternative Energies and Atomic Energy Commission, 2022-2027) allocates around USD 75 million to combine several quantum technologies with classical supercomputing. The initiative is part of a research programme that spans both academic and industrial domains, providing actors with free access to integrated computing resources. Its main goals are to promote the dissemination of use cases and to foster open scientific exploration. Quantum Spain, France's Hybrid HPC-quantum programme and other European initiatives have also received support from the European Union's **EuroHPC Joint Undertaking** (European Commission, DG CONNECT, 2021-ongoing), which has allocated USD 106 million to host and operate six quantum computers across multiple European sites. These have been designed to be integrated with other existing HPC systems across Europe, including in the Czech Republic, France, Germany, Italy, Poland and Spain. These infrastructures will support research and innovation activities for various end-users, including the scientific community, industry players and the public sector.

Two large infrastructure initiatives sampled in the database are dedicated to quantum communication. With a budget of nearly USD 100 million, the **European Quantum Communication Infrastructure (EuroQCI)** (European Commission, DG CONNECT, 2021-2027), involves all 27 EU Member States and the European Space Agency to design, develop and deploy a terrestrial segment relying on fibre communication networks linking strategic sites within and across countries and a satellite-based space segment. To form the basis of the terrestrial segment, EU Member States are leading parallel projects domestically to develop quantum communication networks (OECD, 2025[2]). Since 2017, China has been developing an **Integrated Quantum Communication Network** (Led by the Ministry of Science and Technology), combining over 700 optical fibres on the ground with two ground-to-satellite links to achieve quantum key distribution (QKD, see Box 3) over a total distance of 4 600 km for users across the country. The terrestrial segment includes a 2 000 km optical fibre network connecting Beijing and Shanghai, and the network serves over 150 industrial users, including state and local banks, municipal power grids, and e-government platforms.

### Box 3. What is quantum key distribution?

Today's cryptographic methods use classical bits both for the transmission of secret keys and encrypted data. Their security relies on mathematical problems such as integer factorisation, which are practically impossible to solve using classical computers. However, in the future, a sufficiently powerful quantum computer could solve such problems.

Quantum key distribution (QKD) is an application of quantum communication technology that creates secret keys encoded in qubits and sent through a quantum network, aiming to strengthen security. Unlike traditional cryptographic methods relying on mathematical calculations, QKD seeks to secure communication based on nature's physical (quantum) laws. As qubits are highly sensitive to observation, any attempt to intercept them causes them to decohere and introduce detectable errors. These errors render the eavesdropped information unusable. In practice, however, the security of practical QKD systems is highly implementation-dependent. QKD devices can introduce vulnerabilities that attackers may exploit, meaning that actual security depends on hardware and protocol implementations rather than physics alone. Moreover, QKD provides only a partial cryptographic solution, as it does not supply source authentication and therefore still requires classical cryptographic mechanisms. Given these challenges, cybersecurity agencies do not recommend the use of QKD or other forms of quantum cryptography unless their technical and operational limitations are resolved, a goal that continues to drive active research and development.

Source: OECD (2024[39]) and OECD (2025[2]).

Several initiatives supporting research and technical infrastructures aim to create environments dedicated to rapid experimentation, iteration and the benchmarking of different quantum technologies. These include dedicated testbeds and demonstration facilities that enable firms to build capabilities in quantum technologies and to develop and test prototypes. These programmes lower the barriers for researchers and firms to experiment with new devices and methods, aiming to quickly distinguish between breakthroughs that could be scaled up and less viable approaches. For instance:

- Germany's **Quantum Computing Demonstration Setups** (Federal Ministry of Education and Research, 2021-2026) promote the domestic development and demonstration of a quantum computer with at least 100 individually controllable qubits within 5 years, scalable to at least 500 qubits. The initiative seeks to raise national capabilities, thereby reducing reliance on non-European quantum computing providers. It encourages various German scientific, industrial and economic stakeholders to engage with quantum computing technologies. The initiative also aims to integrate these systems with existing IT infrastructure, making them widely accessible to researchers and industries through cloud-based solutions.
- The United States' **Enabling Quantum Leap: Convergent Accelerated Discovery Foundries for Quantum Materials Science, Engineering and Information** programme (National Science Foundation, 2019-2025) supports foundries equipped with mid-scale infrastructure to rapidly prototype and develop advanced quantum materials and devices that enable breakthroughs in quantum sensing, communication and computing systems. The programme fosters a collaborative network among academia, industry and national laboratories, seeking to expedite technology transfer and contributing to the rapid deployment of quantum innovations into practical applications.
- In the Netherlands, Quantum Delta NL supports three **Quantum Sensing Testbeds** (2021-ongoing): the Ultracold Quantum Sensing Testbed, focusing on compact optical clocks and atom interferometers using ultracold strontium atoms for precise timekeeping and navigation; the Quantum Sensing Spin Testbed, an open-access platform using nitrogen-vacancy centres for

magnetometry and other sensor development; and the Quantum Mechanical Testbed, which benchmarks ultra-coherent mechanical sensors for various applications under real-world conditions. Each testbed fosters collaboration across academia, industry and government to accelerate innovation and commercialisation.

- The United Kingdom's **Quantum Testbed Competition** (funded by UK Research and Innovation and implemented through the National Quantum Computing Centre, 2024-ongoing) finances prototype testbeds for companies to run and refine quantum algorithms. Its "competition" model bridges theoretical research with hardware engineering and fosters faster uptake by industry end-users. The initiative aims to identify the optimal types of quantum computing systems for different classes of problems, laying the groundwork for developing scalable and large-scale quantum computers.
- In the European Union, several programmes are developing and supporting testbeds and demonstration facilities. **Qu-Test** (2023-2026, USD 20 million) brings together infrastructures and expertise across Europe to offer testing and validation services for quantum devices, including chips, components and systems. The initiative fosters a trusted quantum technology supply chain, ensuring that devices meet quality and reliability standards. Meanwhile, **OpenQKD** (2019-2023, USD 15 million) is building a large-scale testbed and demonstrator network for QKD across 12 European countries, including cross-border links and free-space trials, leveraging the existing fibre infrastructure. The programme seeks to demonstrate the broad application of QKD-enabled security solutions through industry collaboration, develop hands-on use cases and establish standardised interfaces that support interoperability. More recently, and moving towards industrialisation, the **Quantum Chip Technology Stability Pilots** programme (2026-2030, EUR 300 million) has been announced to develop stable pilot-scale fabrication capabilities for quantum chip production. The initiative aims to accelerate innovation and meet the needs of the European quantum industry over the coming decade, with a particular focus on supporting start-ups and SMEs. The six Pilots are implemented under the Chips Joint Undertaking and are co-funded by the European Commission and the respective participating countries.
- Singapore's three **National Quantum Platforms** (National Research Foundation, 2022-2025) received around USD 15 million to promote collaboration between research institutions, industry partners and government agencies in developing practical quantum technologies. The National Quantum Computing Hub is advancing quantum hardware, middleware and algorithms while working with industries such as finance, supply chain management and chemistry to explore real-world applications. The National Quantum Fabless Foundry supports the fabrication of quantum devices, ensuring that research breakthroughs translate into manufacturable and scalable technologies. Meanwhile, the National Quantum-Safe Network is conducting nationwide trials of quantum-safe communication technologies to enhance cybersecurity infrastructure for businesses and government entities.

### *2.1.3 Skills and talent development*

Policies providing financial support to public research actors tend to include an educational or training component. The United Kingdom's **Training and Skills Hubs in Quantum Systems Engineering** (UK Research and Innovation, 2016-ongoing) emphasise interdisciplinary doctoral training, ensuring that emerging scientists and engineers receive both the theoretical knowledge and the practical engineering skills required for the field. Latvia's **Quantum Initiative** (Ministry of Education and Science, 2022-ongoing) fosters interdisciplinary training by uniting top scientists, educators and industry stakeholders to develop advanced curricula and hands-on research opportunities, thereby creating a national pipeline of experts who are versed in both fundamental science and real-world technology applications. Sweden's Wallenberg Center for Quantum Technology, for example, organises a dedicated graduate school and postdoctoral programme focusing on quantum technology, providing early-career researchers with hands-on experience in cutting-edge quantum research. Quantum Science Austria also includes a strong commitment to training and mentoring young scientists. The Quantum Leap Challenge Institutes link a range of universities, national labs and industry players in the United States under common research themes. These networks often involve joint courses, cross-lab research projects and large-scale workshops that expose students to broad and complementary expertise across disciplines. Expanding Capacity in Quantum Information Science and Engineering, which operates through competitive calls, requires applicants to outline education and workforce development plans.

Support for public research organisations often promotes collaboration with industry actors to strengthen skills development. It encourages linking formal educational programmes with business needs, helping graduates transition into the workforce and ensuring that their expertise matches the evolving demands of the quantum marketplace. For example, Australia's **Sydney Quantum Academy**, established by the Government of New South Wales in 2019 with a USD 11 million investment, unites four universities to train future scientists and engineers while facilitating internships in industry, ensuring that those receiving specialised training also gain industry-relevant experience. The United States' National Quantum Information Science Research Centres partner with industrial stakeholders to channel specialised knowledge and best practices from commercial settings into academic training. In addition, higher education institutions often offer scholarships and fellowships dedicated to quantum technology to attract talent and develop a skilled quantum workforce, while also supporting the Department of Energy National Laboratories.

Policies supporting research and technology infrastructures often integrate state-of-the-art facilities and equipment into tertiary education or through specialised short courses and workshops for individuals already in the workforce. Programmes providing cloud-based access to quantum computing often seek to provide researchers, students and industry professionals with hands-on experience in using and developing applications for such systems. Quantum Spain's TalentQ programme, for instance, runs workshops, seminars and training courses explicitly designed to create a pipeline of professionals prepared to work on Spain's first quantum computer. Germany's Quantum Computing Initiative highlights collaborations with large corporations and start-ups to create a talent-friendly environment, ensuring that the next generation of quantum specialists has access to both foundational research opportunities and commercial R&D settings. With a broader scope, Brazil's Competence Centre for Quantum Technologies aims not only to support industrial innovation but also to bridge the country's existing skill gap in quantum research and applications. The European Union's OpenQKD supports the career development of junior staff members from project-associated industrial partners. It also includes capacity-building measures to external stakeholders that foster know-how on QKD deployment and operation, including staff training and end-user workshops.

Prior studies, job board data and other sources indicate talent shortages in quantum fields (OECD, 2025[2]). Some institutional funding policies seek to raise awareness of career opportunities and promote participation in the quantum workforce. The United States' Expanding Capacity in Quantum Information Science and Engineering programme, for example, emphasises funding institutions that have traditionally lower capacities in quantum technologies. Likewise, Australia's **Centre of Excellence in Quantum Biotechnology** (Australian Research Council, 2024-2031) features commitments to inclusive hiring practices and reducing barriers for underrepresented groups in STEM fields. Switzerland's National Centre of Competence in Research: Quantum Science and Technology has aimed to cultivate a new generation of quantum researchers and has prioritised gender balance, targeting measurable increases in young female scientists.

## 2.2 Project grants for public research

Governments issue competitive grants with calls for research proposals, inviting researchers and public research organisations to submit research project proposals aligned with national priorities in quantum technologies. These grants promote foundational research to achieve scientific breakthroughs and demonstrate applications. As this requires expertise across multiple scientific fields, including physics, mathematics, engineering and computer science, among others, project grant schemes often support research collaborations that encourage the formation of cross-disciplinary teams. For example:

- France's USD 170 million **Quantum Priority Research Program and Equipment** (National Centre for Scientific Research, Alternative Energies and Atomic Energy Commission and National Institute for Research in Digital Science and Technology, 2022-2027) represents the upstream part of the national acceleration strategy dedicated to quantum technologies. The programme promotes research efforts ranging from fundamental research to proofs of concept. It supports research consortia carrying out 10 complementary projects, including quantum error correction, superconducting qubits, gravity sensors and quantum communication within operational networks.
- New Zealand's USD 7 million **Quantum Technologies Aotearoa Research Program** (Ministry of Business, Innovation and Employment, 2023-2028) is designed to promote multi-institutional collaboration through the Dodd-Walls Centre, integrating the country's existing quantum research resources and promoting cross-institutional knowledge sharing.
- Canada's **Quantum Alliance** (Natural Sciences and Engineering Research Council of Canada, 2023-2028) provides grants tackling quantum science challenges, inviting projects to explore interdisciplinary applications and linking quantum technologies with other fields in natural sciences and engineering. The programme actively tracks proposal success rates and seeks to support inclusive career development within funded projects.
- The United States' **Quantum Sensing Challenges for Transformational Advances in Quantum Systems Program** (National Science Foundation, 2023-2025) is a USD 29 million initiative that aimed to (i) achieve proof of principle for new concepts, platforms or approaches through experimental tests, and (ii) demonstrate tangible advantages for targeted applications by leveraging quantum phenomena. Grant applications required interdisciplinary collaboration, with teams led by at least three investigators from diverse domains such as engineering, computer science, mathematics, physical sciences, biology or geosciences.
- China's **Construction and Control of Second-Generation Quantum Systems Major Research Plan** (National Natural Science Foundation, 2021-2029) is a nearly USD 30 million initiative supporting fundamental research in quantum information science. The research plan promotes interdisciplinary collaboration among mathematics, information science, engineering, materials science and chemistry. It facilitates collaborative research networks where equipment, resources and knowledge are shared among participants.
- India's USD 8 million **Quantum Information Science and Technology** programme (Department of Science and Technology, 2019-2022) aims to develop the country's capabilities in quantum information science. It fosters the development and demonstration of quantum computers, secure quantum communication methods, quantum-enhanced and quantum-inspired technologies, and quantum algorithms. To this end, the programme supports collaborations through centralised research facilities established at key locations across India.
- The **Convergent Quantum Research Alliance in Telecommunications** programme (2024-2026) is a USD 2.2 million initiative funded under the US-Ireland R&D Partnership Centre-to-Centre programme. It is a joint initiative between Ireland (Research Ireland), Northern Ireland (Department for the Economy) and the United States (National Science Foundation) aiming to develop foundational technologies for quantum networks. The programme focuses on converging quantum

and classical networking methodologies to address the complex challenges associated with long-distance quantum communication.

Governments also use research grants to promote international collaboration to leverage global expertise, facilitate research exchanges and strengthen domestic quantum technology capabilities. Canada's Quantum Alliance and the United States' Quantum Sensing Challenges for Transformational Advances in Quantum Systems Program, for example, have promoted global academic partnerships, whereas New Zealand's Aotearoa Research Program seeks to establish and strengthen collaborations with key partner countries, including the United Kingdom, Japan, Singapore, the United States, Germany and Australia.

Public research grants can also support the transition from fundamental research to market-ready applications. Several of these policies incentivise industry partnerships and foster entrepreneurial initiatives. Examples include:

- Germany's **Application Network for Quantum Computing** (Federal Ministry of Education and Research, 2021-2026) funds projects aiming to demonstrate practical applications of quantum computing in industry or science. Industry stakeholders and research institutions are encouraged to collaborate on developing practical quantum computing solutions, evaluating the technology's potential within their respective sectors. The initiative is structured around two funding modules: the "Consortium" and "Network" modules, each with specific objectives and deliverables. In the Consortium module, pre-competitive research projects target the development of quantum algorithms and quantum machine learning models to address industry-specific problems. The Network module will support individual and joint projects that foster interoperability, shareable resources and open access to quantum computing hardware and software, thereby reducing barriers to entry, especially for small and medium-sized enterprises.
- The **Finnish Quantum Flagship** (funded by the Research Council of Finland, 2024-ongoing) is a USD 14 million initiative to establish a consortium coordinated by Aalto University and gathering other national actors, including universities, research centres and businesses. The flagship aims to support research collaborations that support the development of the country's quantum technology ecosystem.
- In the European Union, the USD 120 million **QuantERA** programme (funded by Horizon Europe, 2016-ongoing) supports high-impact quantum technology research through coordinated funding calls. The initiative fosters cross-border collaboration and integrates national and regional research efforts. It encourages knowledge transfer and commercialisation by aligning research with industry needs and public policy priorities.
- With a budget of USD 12 million, the United States' **Quantum Testbed Pathfinder** initiative (Department of Energy, 2023-ongoing) supports research projects that advance understanding of how quantum computing might advance computational science. More specifically, the programme aims to (i) investigate the fundamental physical limits of quantum processors to delineate their capabilities and constraints; (ii) harness Noisy Intermediate-Scale Quantum devices (see Box 4) to gain insights into the practical utility of quantum computing in solving complex problems; and, (iii) develop robust methodologies to evaluate the utility of both existing and hypothetical quantum processors.
- In 2015 and 2016, the **Canada First Research Excellence Fund** provided around USD 120 million to three university-led, seven-year research programmes in quantum technologies. Those hosted at Sherbrooke and British Columbia universities focus on quantum materials, involving industrial partners and spin-off companies in developing applications that generate social, environmental and economic impacts. The Transformative Quantum Technologies programme led by the University of Waterloo works with ecosystem actors to develop and commercialise products focusing on three grand challenges: universal quantum computing, quantum sensing and long-distance quantum communication.

- Singapore's USD 85 million **Quantum Engineering Program** (National Research Foundation and Agency for Science, Technology and Research, 2018-2026) supports applied research focusing on industry challenges and initiatives nurturing the quantum ecosystem. The initiative's deliverables include (i) engagement of industry and user-agencies, with cash and in-kind contributions to projects; (ii) talent development through training of researchers and engineers; and (iii) evidence of intellectual property and industrial outcomes.

Several research programmes have defined specific milestones for quantum computing. For example, India's Quantum Information Science and Technology programme targeted the design and assembly of a 4-qubit quantum computer. Japan's **Moonshot Research and Development Programme** (2020-2030), led by the Cabinet Office, the Ministry of Education, Culture, Sports, Science and Technology and the Japan Science and Technology Agency, aims to develop a functional NISQ computer and a demonstration of effective error correction by 2030. In parallel, Japan's **Quantum Leap Flagship Program** (Ministry of Education, Culture, Sports, Science and Technology, 2018-2028) is supporting targeted research projects (e.g. on quantum algorithms and noise reduction) leading to the near-term use of NISQ devices as an intermediate milestone in the path to fault-tolerant quantum computers. The programme seeks to develop quantum computing systems with 100 to 1 000 qubits in the near term, ultimately striving for systems with 1 million qubits. In addition, Japan's Ministry of Economy, Trade and Industry plans to allocate USD 330 million between 2025-2027 to support investments in the development of systems and components necessary for the industrialisation of next-generation quantum computers. Together with the testbed environment hosted at the Global Research and Development Center for Business by Quantum-AI Technology, this funding aims to contribute to establishing a quantum computing supply chain at an industrial scale.

### Box 4. What are noisy intermediate-scale quantum computers (NISQs)?

Noisy intermediate-scale quantum computers (NISQs) are the most advanced quantum computers currently available. They are considered intermediate in size and capability compared to the quantum computers envisioned for the future. Quantum computing requires the management of extremely fragile quantum effects. These effects are susceptible to the smallest disturbances observed in nature, including thermal fluctuations and electromagnetic interference. Such disturbances, or "quantum noise", cause qubits to "decohere" (i.e. to lose their quantum properties), resulting in information loss and computation errors. Today's NISQs experience errors every 100 or 1 000 operations, corresponding to error rates between 1% and 0.1%.

By contrast, fault-tolerant quantum computers are the theorised large-scale and stable devices capable of reliably managing quantum noise and performing computations over extended periods. Manufacturers aim to reduce error rates by three orders of magnitude, to about one every million operations or 0.0001%, a threshold at which fault-tolerant quantum computers become more viable.

Source: OECD (2025[2]).

Most programmes fund research projects through flexible or standard competitive calls (e.g., Canada's Quantum Alliance, the United States' Quantum Testbed Pathfinder and New Zealand's Quantum Technologies Aotearoa). While these can encourage collaboration, whether by requiring private-sector partners, offering higher funding caps for multi-institution projects or allowing international expenses, they primarily function through traditional grant mechanisms, allowing researchers to apply individually or in teams without the necessity of a formalised research partnership. By contrast, some programmes fund large, coordinated research initiatives structured around formalised partnerships, often involving shared facilities and mandated multi-institutional collaboration (e.g., India's Quantum Information Science and

Technology, and Ireland's Convergent Quantum Research Alliance in Telecommunications). These support research consortia where multiple actors share data, facilities and other resources.

## 2.3 Grants for business research and development (R&D)

As most quantum technologies have yet to reach maturity and have lengthy and uncertain timelines, private investment involves substantial risks (OECD, 2025[2]). Recognising their potential for commercial application and strategic implications, governments are also investing to supplement the role of the private sector in quantum technology ecosystems. Grants provide financial support that helps de-risk business investments in R&D and innovation activities, including staff costs and building or acquiring equipment and intellectual property, among other expenses. These grants fund industry-led projects and partnerships to demonstrate commercial viability and cultivate demand for quantum technologies. For example:

- The United States' **Quantum Benchmarking Initiative** (Defense Advanced Research Projects Agency and Department of Energy, 2024-ongoing) aims to determine the feasibility of building an industrially useful quantum computer by 2033. The programme rigorously assesses proposed approaches through an interagency team of quantum scientists and engineers. Companies start by submitting written proposals and delivering oral presentations, after which selected teams receive six-month contracts to detail their quantum computing vision and its practical applications. Those that move forward undergo a year-long scrutiny of their R&D plans, including technical aspects like error correction and economic scalability. Firms that clear this scrutiny will work with DARPA to validate their quantum computing concept.
- In the United Kingdom, the **Commercialising Quantum Technologies Challenge** (UK Research and Innovation, 2019-2025) is a nearly USD 200 million initiative that aims to accelerate the development and commercialisation of quantum-enabled products that can drive productivity, technological competitiveness and economic growth. The primary objectives of the initiative are to foster industry collaboration, encourage innovation in quantum products and services, and create a thriving supply chain for quantum technologies within the country. The initiative also seeks to make the country an attractive destination for international companies.
- Finland's **Quantum Technologies Industrial Project** (partly funded by Business Finland with about USD 10 million, 2021-2024) supports a 12-partner consortium comprising nine companies, two universities and one research organisation. The consortium collectively spans the entire value chain from materials and hardware to software and system-level solutions. The initiative focuses on collaborative R&D to address the complex hardware and software requirements of quantum computing, quantum communication and quantum sensing.
- The Israel Innovation Authority introduced a **Quantum Technologies Consortium** (2023-2026) supported with around USD 35 million to develop two quantum processor technologies (trapped ions and superconductors) alongside quantum software development. The consortium structure encourages active collaboration between government, academia and the private sector to foster innovative solutions in quantum technology. Members submit clear objectives and detailed project plans, with the Innovation Authority providing 65% of the funding based on developmental milestones.
- The European Innovation Council's **Accelerator Challenges: Enabling the Smart Edge and Quantum Technology Components** (2011-ongoing) and **Emerging Semiconductor or Quantum Technology Components** (2018-ongoing) offer funding and mentorship to innovative start-ups and SMEs working on disruptive quantum hardware and software. By emphasising the transition from research prototypes to full-scale market solutions, these programmes help small enterprises secure capital, refine their technologies and position themselves for commercial success.

Some business grants target specific sectors, supporting high-impact projects in sustainability and security, healthcare and energy, among other sectors. For instance:

- The United States' **Small Business Funding for Quantum Sensing in Biomedical Applications** (National Institutes of Health, 2020-ongoing) supports technological innovation in quantum sensing that addresses critical biomedical research needs and facilitate clinical applications in disease prevention, monitoring and diagnosis. The initiative aims to bridge the gap between laboratory research and real-world clinical implementation, fostering collaboration between quantum sensing experts and biomedical professionals. It supports the development of low-cost, highly sensitive miniaturised devices that help increase access to advanced diagnostics and improve patient care.
- Australia's USD 25 million **Critical Technologies Challenge Program** (Department of Industry, Science and Resources, 2023-ongoing) supports the development of quantum technology solutions for market-driven challenges of national significance. These challenges span four critical areas: optimising energy networks for sustainability and security, advancing medical imaging and sensor technologies, enhancing autonomous communication systems, and minimising the environmental impact of resource exploration and processing. The programme aims to accelerate commercialisation by helping early-stage ventures demonstrate the viability of quantum solutions and move them towards broader market deployment.
- Spain launched the programme **Development of Use Cases for the Application of Quantum Technologies in Strategic Productive Sectors** (Red.es, 2025-ongoing) with a total budget of USD 11.6 million to stimulate the deployment of quantum technologies across key industrial sectors, including aerospace, defence, energy, finance, logistics and telecommunications. The initiative promotes collaboration between companies, research centres and industry associations to develop and test use cases that demonstrate the technological and economic potential of quantum solutions. Complementing this initiative, Spain allocated an additional USD 11.6 million to establish a **Quantum Communications Hub** (Ministry for Digital Transformation and Public Function, 2025-ongoing) to accelerate the deployment of quantum-secure communication technologies, particularly for critical infrastructure and public services.

## 2.4 Public procurement

Besides business grant schemes, governments use public procurement to strategically invest in quantum start-ups and young firms to support the commercialisation of quantum technologies. Governments use public procurement to build and operate many of the research and technology facilities described above. This includes, for example, several initiatives described in Section 2.1, such as the Finnish Technical Research Centre's Quantum Computing initiative and Israel's National Quantum Initiative, both of which have awarded contracts to domestic players, as well as the European Union's EuroHPC Joint Undertaking, which has supported EU ecosystem actors. Procurement generally supports domestic ecosystem actors, particularly businesses, helping these build capabilities in technologies that are not ready for broader commercialisation. Pre-commercial procurement also fosters investment in R&D, contributing to advancing technology readiness levels and helping businesses develop innovative solutions that they can later sell to others.

Public procurement can also foster international collaboration and technology transfer. In Australia, a **Partnership with the US-based company PsiQuantum** (2024-ongoing) aims to construct and operate a utility-scale fault-tolerant quantum computer in Brisbane. This nearly USD 1 billion investment includes setting up PsiQuantum's Asia-Pacific headquarters, establishing partnerships with the local quantum industry and advanced manufacturing clusters. As part of the investment, the Australian government also expects to develop digital and advanced technology supply chains, as well as to support university and research collaborations, including through doctorate-level positions, mentoring and internship opportunities. The **Quantum Accelerated Mining Exploration (QUANIMEX)** project is a 2024-2025 joint initiative between the United Kingdom (UK Research and Innovation) and Canada (National Research Council Canada) that seeks to accelerate the detection and analysis of critical mineral deposits through the integration of quantum sensing technologies. The primary objective is to develop and deploy a drone-based sensor system that combines magnetic and gravimetric measurements to streamline the identification and 3D mapping of mineral-rich zones. The initiative is particularly relevant for locating strategic minerals such as cobalt, lithium, nickel, copper and rare earth elements essential for clean energy applications.

Procurement initiatives can also aim to address technology risks and strengthen national security. The digital security provided by quantum networks is a key motivation behind the European Union's EuroQCI and China's Integrated Quantum Communication Network initiatives described in Section 2.1. Other examples include:

- France's **PROQCIMA** programme (Ministry of the Armed Forces, 2024-ongoing) is devoting more than USD 500 million to develop two universal quantum computing prototypes for defence applications by 2032. Inspired by historical cryptographic breakthroughs like the British ULTRA project, PROQCIMA aims to develop a fault-tolerant quantum computer with 128 and 2048 logical qubits by 2032 and 2035, respectively. This initiative seeks to reinforce France's strategic technological edge in national security while addressing the significant scientific and industrial challenges.
- Canada's **Quantum Encryption and Science Satellite** initiative (Canadian Space Agency, 2019) seeks to deploy QKD technology via a Low-Earth Orbit satellite. The project is part of Canada's commitment to securing national and global communication infrastructures, ensuring resilience against future quantum cyber threats.
- In the United Kingdom, the **Space Photon Entanglement Quantum Technology Readiness Experiment** project (led by the Science and Technology Facilities Council, 2024-ongoing) also aims to advance space-based QKD, focusing on entangled photon transmission to secure communication links. The project's goal is to lay the foundation for the country's future quantum-secure space communications infrastructure. Following this initiative, the UK Quantum Communications Hub plans a follow-up **Satellite Platform for Optical Quantum Communications** mission to further develop space-based QKD.

## 2.5 Equity financing

Some governments provide equity financing to support the development of quantum start-ups and young companies. In addition to the challenge of securing private investment in technologies with lengthy and uncertain timelines, these firms also have more limited capacity to generate revenue compared to established large companies. Governments can de-risk investments by buying shares of ownership of such firms, making it more attractive for private investors to follow suit. For example:

- In 2019, the Austrian Research Promotion Agency acquired shares of ownership in Alpine Quantum Technologies, a spin-off from the University of Innsbruck, amounting to over USD 5 million. Meanwhile, Austria's Wirtschaftsservice provided pre-seed funding of around USD 0.2 million, which helped bridge the initial phase of operation. The non-dilutive investment is accompanied by support services, including intellectual property training.
- Business Finland provided USD 3 million in 2020 to support the establishment of IQM Quantum Computers, a spin-off collaboration between the Technical Research Centre of Finland and Aalto University. IQM is the company building the computers that the Centre makes accessible via its Quantum Computing programme (mentioned in Section 2.1).

- In 2021, China's Internet Investment Fund secured USD 14 million for Origin Quantum's Series A round to bolster the company's investments in quantum chips, measurement and control systems, and quantum computing platforms. Multiple domestic investors have supplemented the government's equity financing.
- The United Kingdom's British Business Bank invested USD 2 million in Oxford Ionics in 2023. The company, working in trapped-ion quantum computing, received this funding through the UK's National Security Strategic Investment Fund. The government considered supporting Oxford Ionics' work advancing its Electronic Qubit Control system to be strategic for British national security interests.
- In 2024, Denmark's Export and Investment Fund invested around USD 10 million in the US-based Atom Computing. Following this announcement, the company decided to locate its European headquarters in Denmark as part of a strategic partnership to support the country's quantum research actors and engage with quantum computing customers in Europe.
- The Spanish Ministry for Digital Transformation and Civil Service announced in 2025 an investment of around USD 70 million in Multiverse Computing through the Spanish Society for Technological Transformation, the country's high-tech investment company. Based in San Sebastian, Multiverse Computing is a quantum computing software company that has developed AI applications inspired by quantum algorithms.

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# Notes

[1] The indicator of bilateral collaboration intensity between two economies is calculated by dividing the number of scientific publications by authors with affiliations in both economies (whole counts) by the square root of the product of the publications for each of the two economies (whole counts). This indicator is therefore normalised for publication output. Publications refer to all citable publications, namely, articles, reviews and conference proceedings based on Scopus Custom Data, Elsevier, Version 1.2024, November 2024.

[2] The database was developed in two main stages. First, the OECD Secretariat acquired a database on government funding announcements in quantum technologies from The Quantum Insider (https://thequantuminsider.com/), a market intelligence company. The Secretariat reviewed, curated and extended the information (relying on data from official government sources available online) to meet OECD's standards for a policy database. In a second step, the information contained in the database was validated by experts participating in the GFTech focus group on quantum technologies, as well as delegates to the Digital Policy Committee and the Committee for Scientific and Technological Policy. Experts and delegates reviewed and complemented the policy data for their country.