

Responsible Quantum Computing

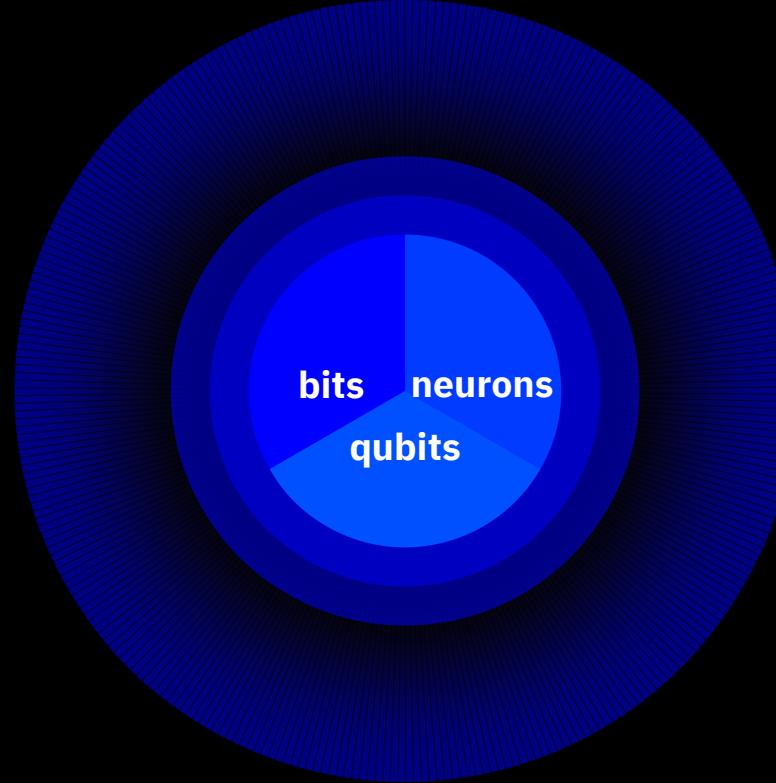
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Responsible Quantum Computing Research

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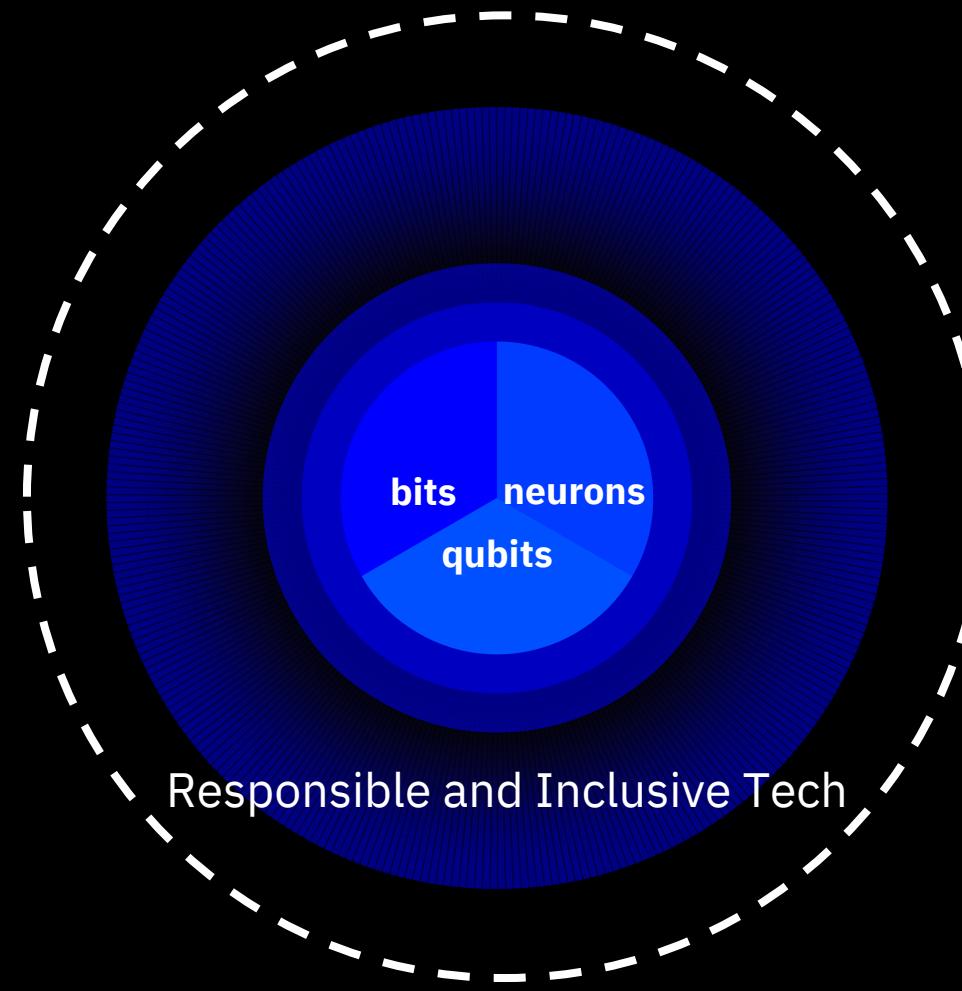
The future of computing

A combination of bits, neurons and qubits



The future of **responsible** computing

Aim: ensures that technologies and solutions are proactively inclusive and accountable

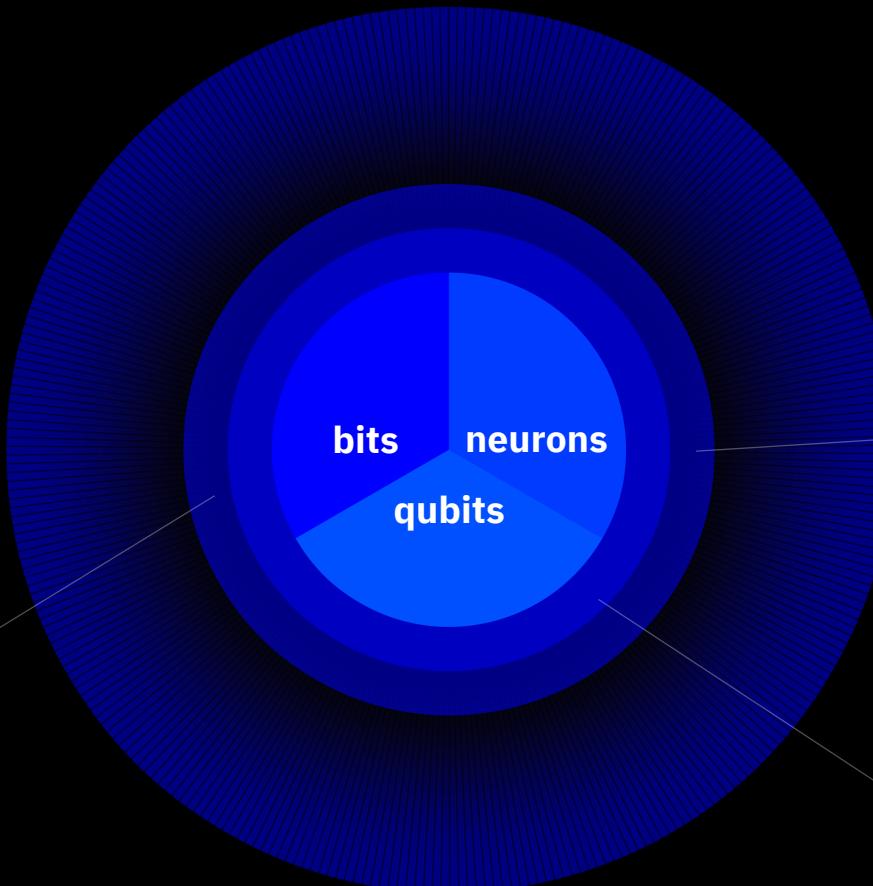


Responsible and Inclusive Tech Research

A few of our current efforts



Mitigation of Harmful
Tech Impacts



Responsible Tech
Frameworks, Methods and Tools



Inclusive
Language
Technologies



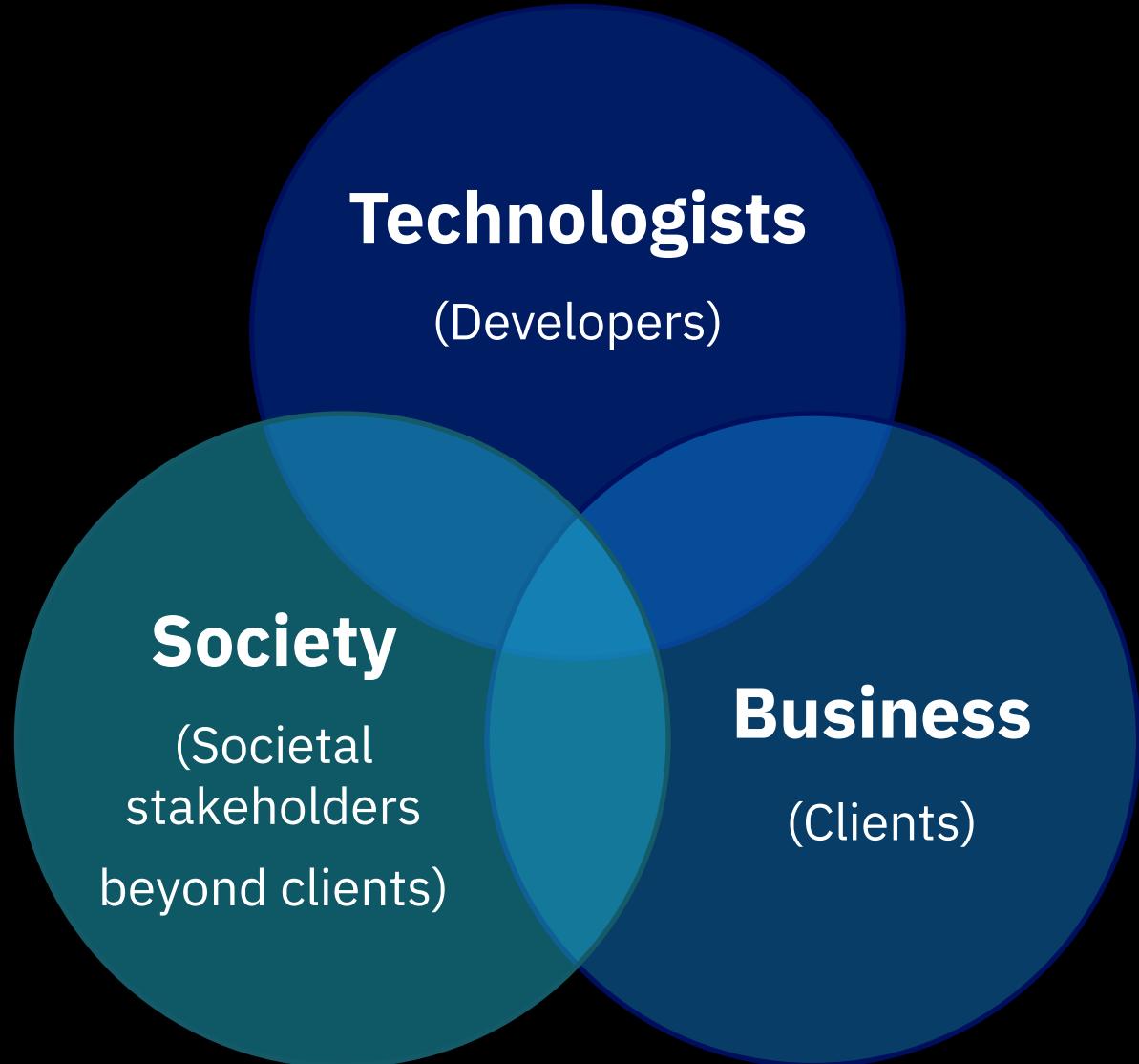
Neuroethics



Responsible Quantum
Computing

Scope of the research

Research spans across three key dimensions



Responsible Quantum Computing

IBM Quantum



**Responsible Quantum
Computing is understood as
Quantum Computing that is
aware its effects.**

Why Responsible Quantum Computing

1.

**Quantum Computing is
an emerging
technology with most
of its impact unknown**

→ avoid for devices and
applications to be used
for nefarious purposes.

2.

**Quantum Computing
offers distinct
opportunities but also
distinct challenges**

→ principles and
paradigms for
responsible computing.

3.

**It is high time to be
pro-active**

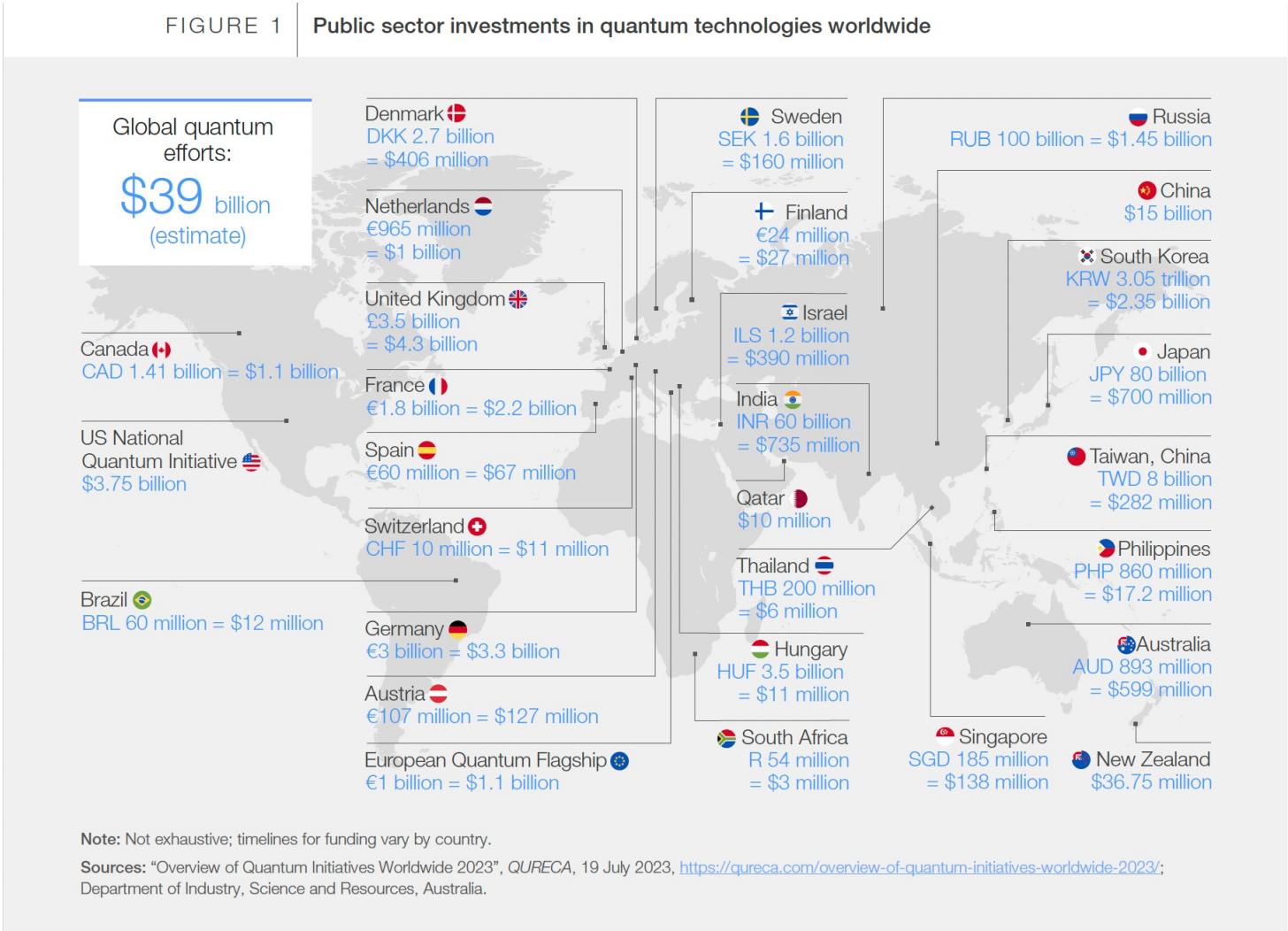
→ avoid this discussion
after the fact and hence
develop principles now.

Why Responsible Quantum Computing

- Current investments into QT inequally spread globally
→ Risk of a digital divide
 - Possible Negative Implications for
 - Education
 - Workforce development
 - Research & Development
 - Industry development
 - Quantum Ecosystems
 - Environment
- Pro-active approach necessary

FIGURE 1

Public sector investments in quantum technologies worldwide



Responsible QC Initiatives

Responsible Quantum Computing Research: *Discussing and using responsible innovation methods in the context of QC*

- [Responsible Quantum Computing Principles](#) (2024)
 - Quantum Dialogues – Multistakeholder research project, Uds (2023-2026)
 - [The societal impact of the emerging quantum technologies](#) (2017)
 - [Reading the road: challenges and opportunities on the path to responsible innovation in quantum computing](#) (2021)
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Multilateral, multistakeholder initiatives aimed at policy-makers and C-level

- CERN/GESDA
[Open Quantum Institute](#) launched March 2024, tying QC research to the UN Sustainable Development Goals
 - World Economic Forum
[Quantum Computing Governance Principles](#) (2022)
[Quantum Economy Blueprint](#) (2024)
[Quantum Security for the Financial Sector: Informing Global Regulatory Approaches](#) (2024)
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Standardization Efforts

- IEEE
- DIN
- NIST (for quantum-safe cryptography)

WEF Quantum Computing Governance Principles, 2022

Core Values

Giving the governance principles normative underpinnings

- Transparency
- Common good
- Accessibility
- Non-maleficence
- Equitability
- Inclusiveness
- Accountability

Core Themes

Governance focus areas

- Sustainability
- Transformative capabilities
- Standardization
- Privacy
- Cybersecurity
- Workforce development
- Creating awareness
- Open innovation
- Access to Hardware infrastructure
- Transformative capabilities

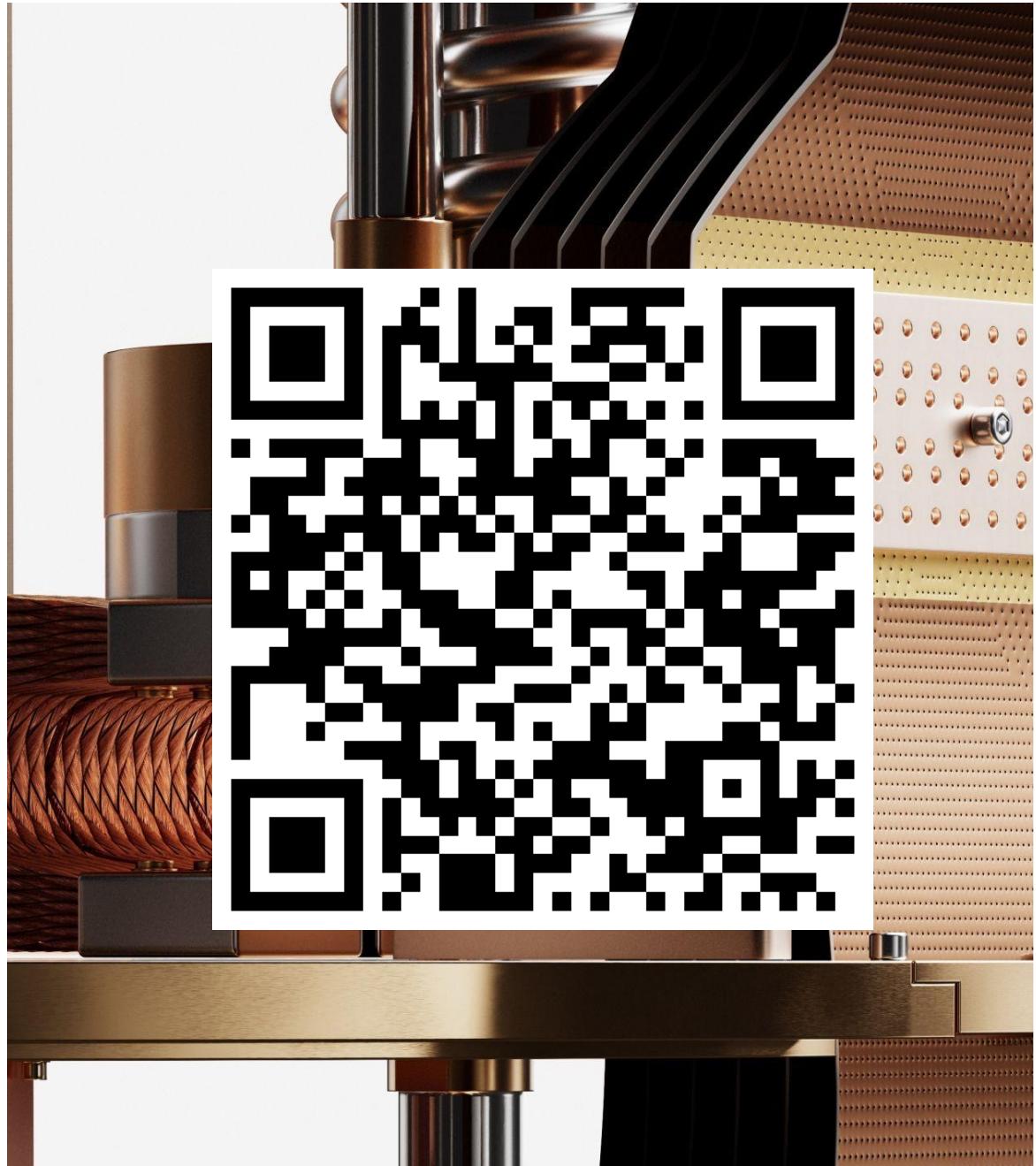
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Source:



Responsible Quantum Computing at IBM

- Research into the societal implications of quantum computing, and our role as a quantum computing provider in mitigating potentially undesired consequences of the technology.
- Contract language defining acceptable and responsible use
- Responsible Quantum Principles
- IBM Quantum Safe
- [IBM Research blog](#) (Jan 24) for details





Technology

Quantum Safe Explorer

Quantum Safe Posture Management

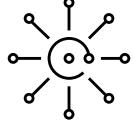
Quantum Safe Remediator



Open-source projects

Open Quantum Safe (OQS)

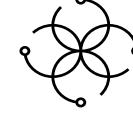
Contributing to the open-source development and prototyping of quantum-safe algorithms and protocols



Centers of excellence

NIST National Cybersecurity Center of Excellence (NCCoE)

Providing expertise to drive the next generation of quantum-safe cryptography standards



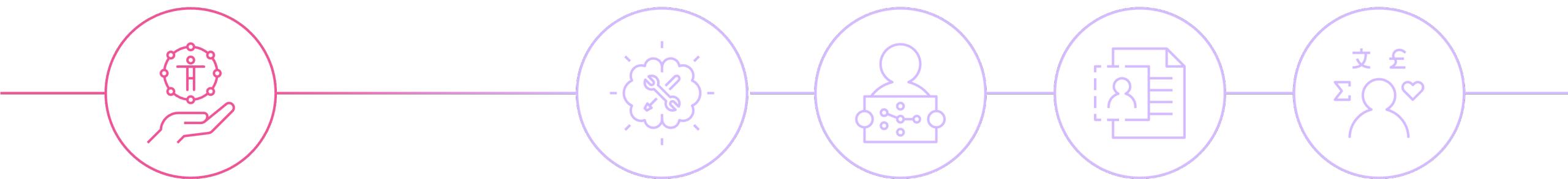
Industry consortia

GSMA Post-Quantum Telco Network Taskforce

First telco taskforce for quantum-safe communications

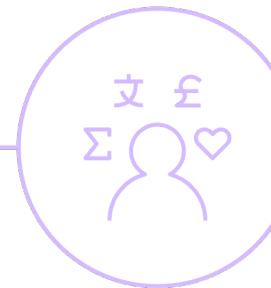
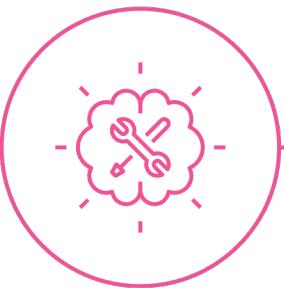
MITRE Post-Quantum Cryptography Coalition

Cross-industry consortium facilitating adoption of quantum-safe cryptography



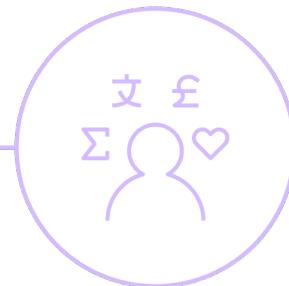
Make a positive societal impact

We are developing a new form of technology. We are doing so because IBM is the catalyst to make the world work better. Therefore, quantum computing, too, should make the world work better by prioritizing use cases that make a positive societal impact.



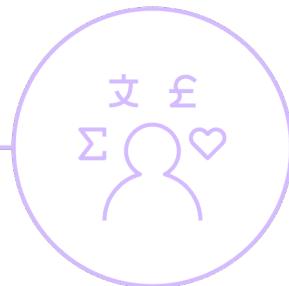
Explore use cases with foresight

Developing a new technology means we may unlock use cases or algorithms that never existed before. We must be prepared for unintended impacts to use cases that seem positive.



Promote our products accurately

As innovators, it is our responsibility to ensure that our audiences are aware of quantum's promise, its limitations, and the expected development timeline.



Make consistent and transparent principled decisions

It is the responsibility of IBM Quantum employees and IBM Quantum leadership alike to uphold these principles. Where decisions come in conflict with these principles, it is the responsibility of leadership to make decisions consistently and transparently.



Build a diverse and inclusive quantum community.

IBM Quantum is building a global quantum computing ecosystem. It is our responsibility that this ecosystem represents the diversity of the world at large, and be inclusive of people of all backgrounds, experiences, and abilities.

Stakeholder mapping

- 1. Identify stakeholders.** *Who's making decisions about the technology that results from the research? Who's using it? Who's impacted by it?*
- 2. Specify stakeholders.** *Who are the key stakeholders? Who are under-considered stakeholders? Who has benefitted or harmed from similar technology before?*
- 3. Identify impacts.** *What are the exciting or positive impacts for the stakeholders? What are the concerning or negative impacts?*
- 4. Specify the impacts.** *Which of these impacts are direct impacts? Which are indirect? What is the timeline of each impact?*
- 5. Review.** *Do you need to anticipate any processes or oversight to reduce potential harms? Do you need to add specificity to your research goals to maximize potential benefits?*



It is high time to be **pro-active**

We want to avoid this discussion after the fact and hence think about responsible computing **now**, before it is even more widely deployed and available.



As a community, we should **lead the way** in developing and using quantum computing responsibly.



We have a moral responsibility to **consider the wider societal impact** of the development and use of technology and should collaborate in acting upon it.

IBM Quantum