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Committee for Scientific and Technological Policy

# OECD STI Outlook 2025 (work in progress): international cooperation and competition in science and technology and the geopolitical context

Japan Science and Technology Agency, Tokyo, Japan, 22 January 2025

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# Outline

- Introduction to the STI Outlook and outline of the 2025 edition
- Why focus on international STI cooperation in the current geopolitical context?
- Recalling STI Outlook 2023 and its main framework and messages on strategic competition in STI
- Some of the related topics in STI Outlook 2025 that I'll cover today:
  1. Research security developments and practices
  2. International co-operation on emerging technologies
  3. Science diplomacy in international relations
  4. Strategic intelligence for evidence-informed policies
- Guiding questions for the panel discussion that follows

# STI Outlook 2025

Work in progress – tentative publication date June 2025

- An OECD flagship publication, published every two years since the mid-1990s
- Asks: “What’s new in the field of science, technology and innovation policy?”
- Provides an international review based on latest policy information and indicators
- Main themes of the 2025 edition are derived from the CSTP Ministerial Declaration:
  1. Implementing transformative STI policies
  2. Reinforcing shared values in international cooperation and technology governance
  3. Making STI more inclusive
  4. Strengthening the evidence base for STI policy

# STI Outlook 2025: chapter structure (working titles)

Designing and implementing transformative STI policies

*applied to*

- Science policy → Ch4: The implications of a transformative agenda for science policy
- Technology policy → Ch5: How technology convergence is shaping the future
- Industrial policy → Ch6: Transforming industrial ecosystems for sustainability transitions

Designing and implementing transformative STI policies → Ch1: Implementing transformative STI policies

Reinforcing shared values in int'nl co-op and tech governance → Ch2: International co-operation, resilience, and competition

Making STI more inclusive → Ch3: Advancing green, inclusive and just transitions through innovation

Strengthening the evidence base for STI policy → Ch7: Building capacities for policy experimentation and strategic intel.

# The growing ascendancy of China in frontier technologies has ushered in a new era of intensified strategic competition

- This raises concerns for liberal market economies:
  1. Rising competition in critical technologies
  2. Diverging values and interests
  3. Increasingly vulnerable tech supply chains and interdependencies

**Figure 2.2. Gross domestic expenditure on R&D (GERD), selected economies, 2000-21**

US dollar (USD) billion in constant purchasing power parity (PPP) prices

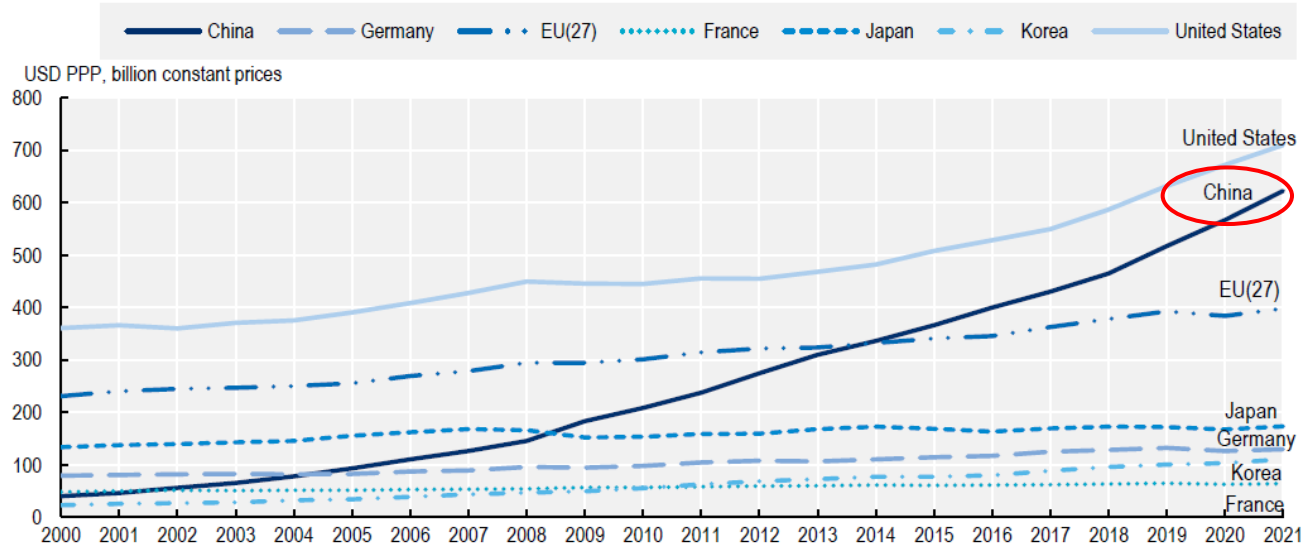
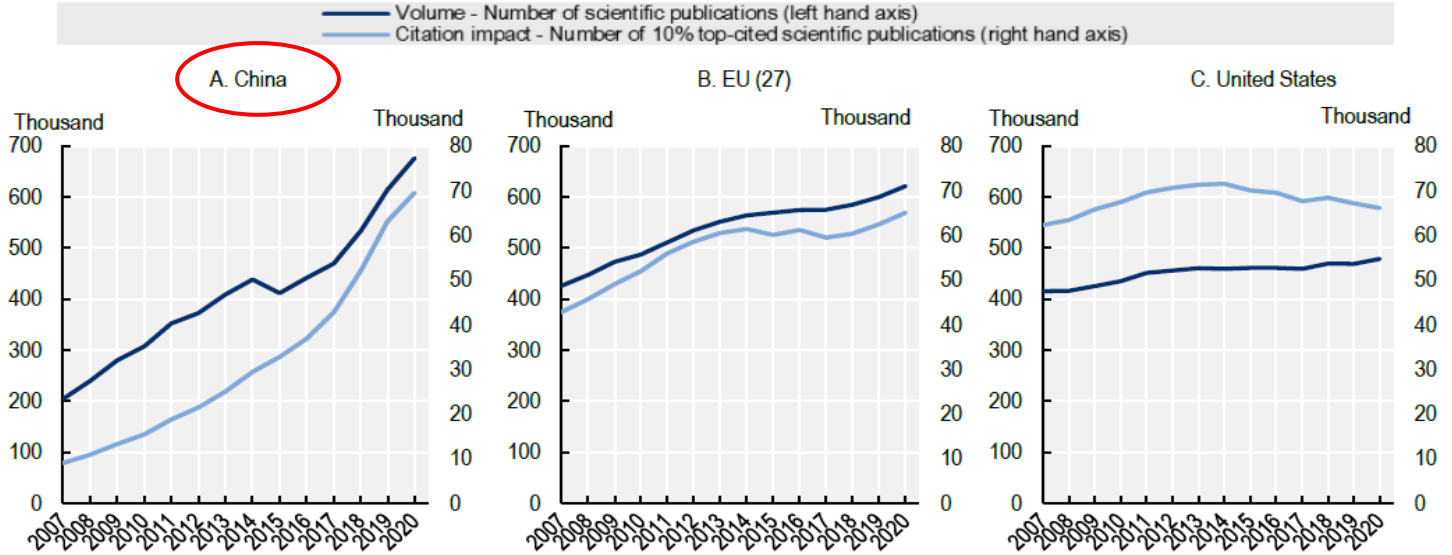



**Figure 2.4. Trends in volume and citation impact of scientific publications, selected economies**

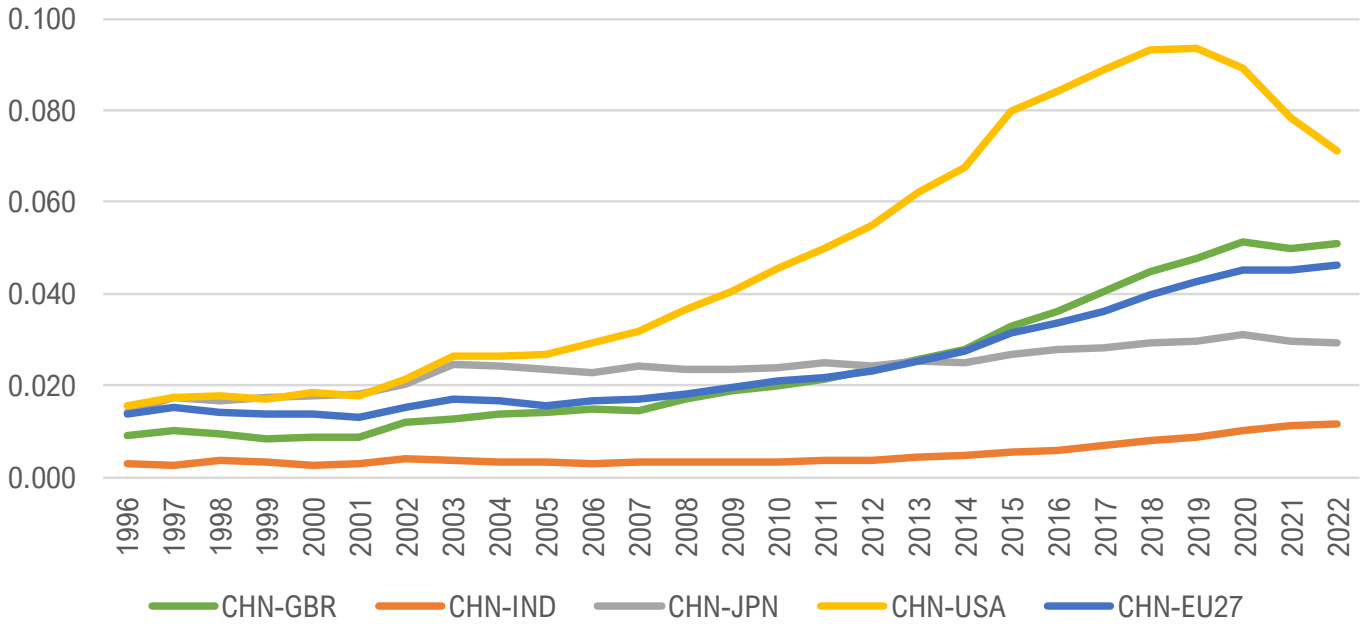


# These concerns translate into major disruptions to the international STI system

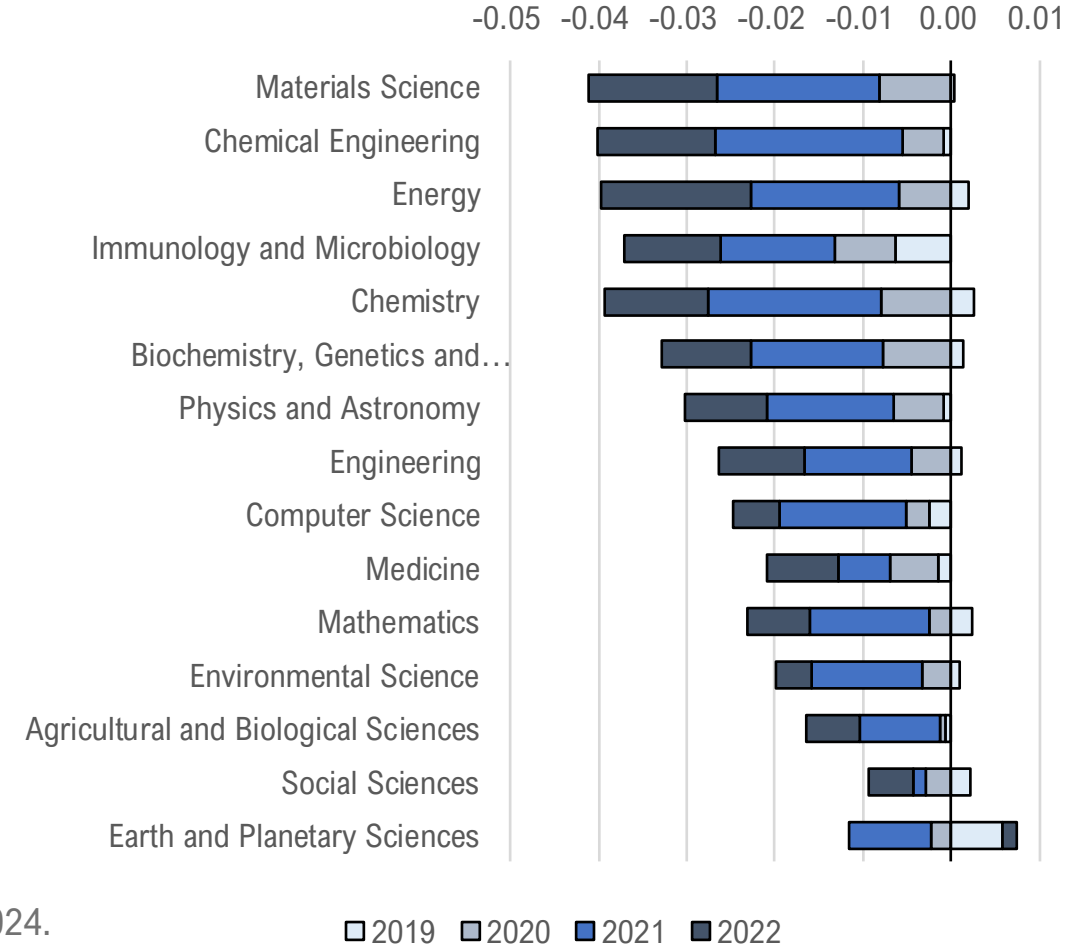
- Concepts like “technology sovereignty” and “strategic autonomy” have emerged as frames for STI policy.
- This framing could – and is indeed intended to – disrupt existing technology ecosystems.
- It could also have unintended effects – for example, on international co-operation in basic science.

# There is already evidence of decline in research cooperation between China and the United States

Bilateral collaboration intensity trends in scientific publications, 1996-2022 (CHN)



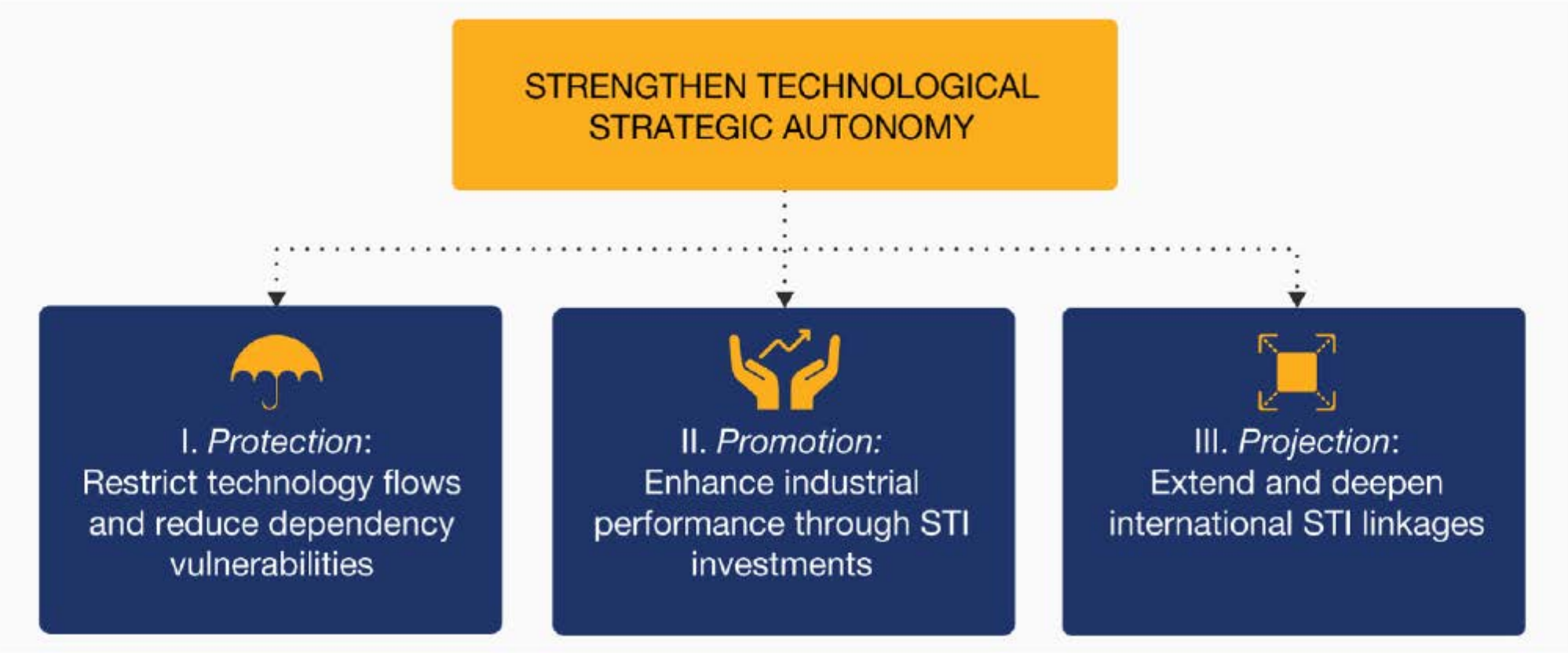

The normalized coauthorship indicator changes from the previous year: CHN-USA




Source: OECD calculations based on Scopus Custom Data, Elsevier, Version 1.2024, April 2024.

# STI Outlook 2023 advanced the '3Ps' framework to describe the emerging securitisation of STI policies

Figure 2.1. Three types of policy intervention to strengthen technological strategic autonomy




Source, OECD 2023, Science, Technology and Innovation Outlook

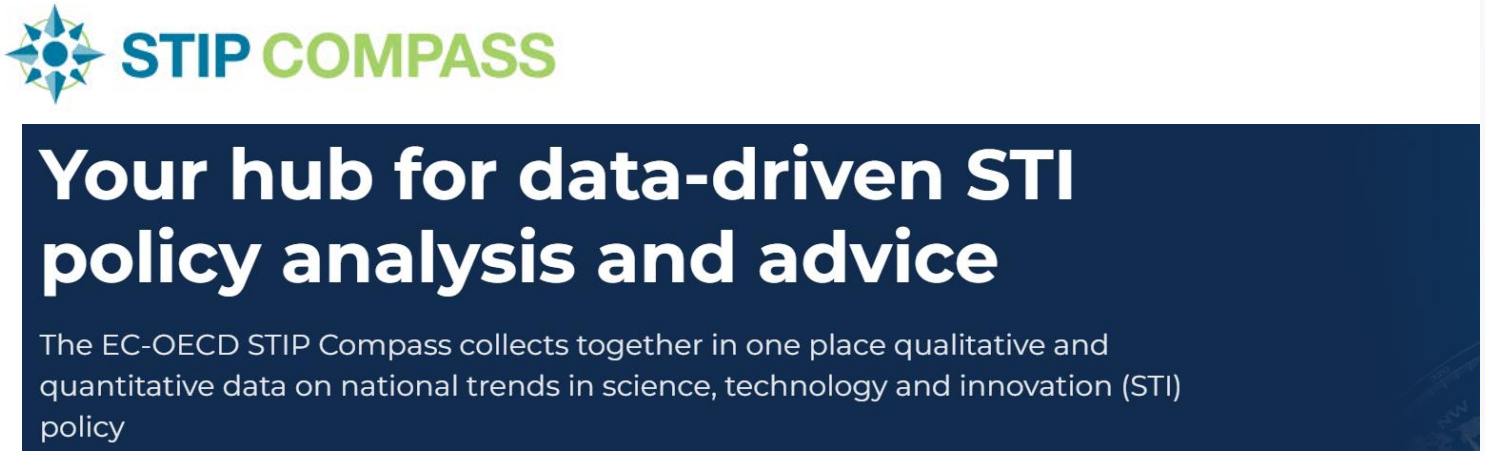
# Co-operation, competition and the implications for science and emerging technologies

- The 2025 edition of the STI Outlook builds on frameworks and evidence presented in the 2023 edition, but extends its analysis to a broader range of countries, incl. Japan
- STI securitisation is an increasingly broad topic, so the chapter's focus is mostly 'upstream', i.e. on the research system
- Among the topics covered are the following:

1. Research security developments and practices
2. International co-operation on emerging technologies
3. Science diplomacy in international relations
4. Strategic intelligence for evidence-informed policies

# Research security policy is intensifying …

| | 2018 | December 2024 |
|---|---|---|
| No. of research security policy initiatives | 27 | 200 |
| No. of countries with dedicated research security policy initiatives | 12 | 27 |




# … with increased focus on implementation support (guidance, tools, advice bodies)

[Integrity and security in the global research eco-system](), OECD 2022

1. Freedom of scientific research and international collaboration as a key element of the global research ecosystem
2. Integrate research security considerations into national and institutional frameworks for research integrity
3. Promote a proportionate and systematic approach to risk management in research
4. Promote openness and transparency in relation to conflicts of interest or commitment
5. Develop clear guidelines, streamline procedures, and limit unnecessary bureaucracy
6. Work across sectors and institutions to develop more integrated and effective policy

## Dedicated structures

- In line with recommendations from 2022 report, many are establishing structures with specific remit for research security
- Responsibilities include information sharing, research security training, risk assessment, and monitoring
- E.g., new National Science Foundation (NSF) office

## Restrictions on collaboration

- Some jurisdictions banning certain types of collaborations (e.g., Flemish against Seven Sons, Canada 'blacklist')
- Others pursuing a case-by-case approach to identifying sensitive research (e.g., German Research Foundation recommendations on dealing with risks in international cooperation, NSF TRUST policy)

## Reporting and verification

- Many countries encouraging or tightening requirements for international collaborations and reporting such as for conflicts of interest and commitment (e.g., Japan, Netherlands)
- Some governments asking funding institutions to play a stronger role, moving beyond self-regulation by researchers and research institutions alone

# New issues are emerging for policy attention

1. Interpreting **open science** principles within an environment of systemic rivalry and competition
2. Simplifying and **harmonizing** regulations and standards within and across countries
3. **Assessing and managing risks** and trade-offs – what are effective (and less effective) practices
4. Monitoring and assessing the **impact of policies** – intended and unintended consequences

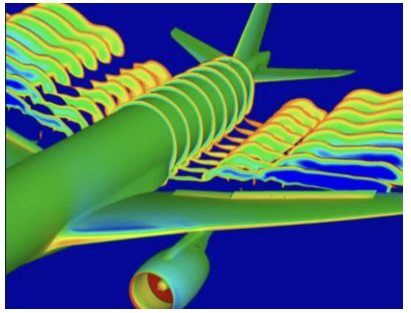
What are your major concerns and priorities in relation to research integrity and security? What roles can international cooperation play?

# International co-operation on emerging technologies has never been more important

- The dual-edged nature of emerging technology requires policies that better anticipate disruptions and enable technology development for economic prosperity, resilience, security and address societal challenges
- Realizing the transformative potential of emerging technologies amidst shared global challenges calls for enhanced co-operation and a collective understanding of risks and opportunities.
- Yet, deepening strategic competition carries the danger of putting downward pressure on the controls that might be necessary to promote accountable and responsible innovation
  - How do we better manage emerging technology in a forward looking and anticipatory manner to make sure we realise the benefits of technology while managing the risks?
  - How can policy steer technological development towards better societal outcomes at the international level?

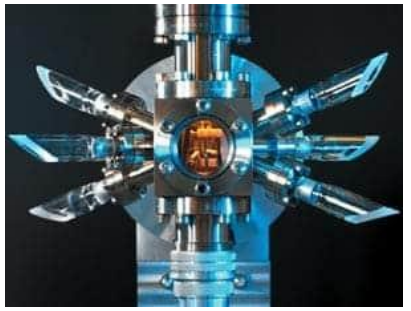
# Consider the example of quantum science and technology

**Quantum computing**: from solving complex optimisation problems, e.g. in logistics and finance, quantum machine learning to identify outliers or anomalies useful for risk analysis, and simulation of computational fluid dynamics and other complex systems which could enable drug discovery and novel materials



*CFD for aviation*

**Quantum sensing**: has the potential to significantly advance measurement capabilities, enabling higher sensitivity and precision. E.g. atomic clocks (measuring time), gravimeters (measuring gravity), magnetometers (measuring magnetic fields).



*Atomic clock*

**Quantum communication**: offers superior security and efficiency compared to classical communications. This is of high importance for uses in finance, government, and defence since it could provide a higher level of security than classical computers.

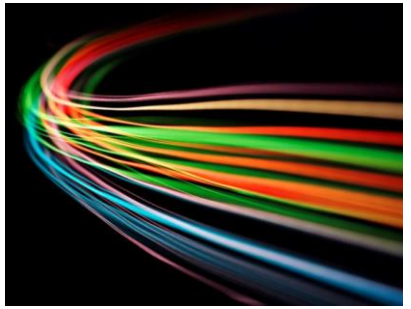


*Illustration of quantum information transmission*

# Why are quantum technologies becoming a strategic priority in the STI agenda?

## A security concern for countries and individuals

The emergence of quantum computing threatens current cryptographic systems (RSA), raises 'harvest now, decrypt later' concerns, quantum sensors could drastically improve surveillance capabilities with potential implications for national security and fundamental rights.

## Economic growth and increased welfare opportunities

Because of its potential impact on infrastructure and at a very fundamental level of the value chain, quantum technologies could have a direct or indirect impact on a very wide array of domains, leading to very important estimates in terms of potential economic and social impact.

## A context of strategic competition and a sense of urgency

Because of its security implications, and the sense of urgency instilled in the formulation of early narratives such as the reference to the physical limit to Moore's Law. Governments have integrated the aspect of race to technological leadership in their policy formulation, while also recognizing the need for international cooperation to advance R&D and set standards.

- ✓ Much progress is still needed
- ✓ Uncertainty as when 'quantum day' will arrive
- ✓ Dominant design in quantum computing is yet to emerge
- ✓ Technologies have different TRLs
- ✓ Companies are still working on identifying market viable use-cases

# The “governance ecosystem” is global

## OECD Framework for Anticipatory Governance of Emerging Technologies: Key actions for pillar 5 on international cooperation

OECD Global Forum on Technology

- ❑ **Engage in forward-looking dialogue** within *inclusive and multilateral fora*
- ❑ **Help develop common analysis and agreed forms of evidence** and evidence-making
- ❑ **Reinforce international co-operation** in science and technology development to *bolster shared approaches to the ethics* of science and technology
- ❑ **Develop international norms** based on shared values


What are the options for international cooperation in quantum science and technology or other emerging technologies that may bring national competitive advantages but also global societal benefits?

# Science diplomacy has emerged as a means to promote global STI cooperation and to further national interests

- As with other concepts and practices in this area, 'science diplomacy' has different meanings and intentions, e.g.
  - Global challenge-oriented diplomacy, e.g. the Paris Agreement on climate change
  - 'Track II diplomacy' involving scientists and other experts, e.g. to maintain co-operation channels between strategic competitor countries on global interests
  - Pursuit of national interests through STI in international fora, mainly with like-minded countries
- These efforts include enhancing STI partnerships with low- and middle-income countries

Research Security for Actionable Science Diplomacy

This perspective explores how research security concerns are changing science diplomacy, and argues that research security is increasingly important for the promotion of international collaboration and actionable science diplomacy.

Kana Asano, Tateo Arimoto

# Considerable efforts are underway to develop comprehensive science diplomacy systems

- 2025 is a big year for science diplomacy, e.g.
  - EC framework on science diplomacy will be published
  - Update of the AAAS / Royal Society framework on science diplomacy
  - UNESCO ministerial meeting on science diplomacy

## EU Science Diplomacy Working Groups

WG1: Using science diplomacy strategically to tackle geopolitical challenges in a fragmented, multipolar world

WG 2: Making European diplomacy more strategic, effective and resilient through scientific evidence and foresight

WG 3: Strengthening science diplomacy in EU and Member States' delegations and embassies and fostering the EU's global science diplomacy outreach

WG 4: Building capacity for European science diplomacy

WG 5: Definition, principles and EU added value of European science diplomacy

How to pursue an international STI relations Agenda that balances national and global interests?

# Demand for strategic intelligence is on the rise

- Proportionality in research security – how to conduct risk assessments that are evidence-based and result in appropriately targeted restrictions under conditions of uncertainty?
- High uncertainty during early stages of technology development – what anticipation tools and capabilities for emerging technology governance and policy are needed in governments?
- Increasing attention to the balance of defence and civil research and development in many countries. Which balance? What specialisations?
- Managing risk and uncertainties – how can strategic intelligence instill greater experimentation and agility in STI policy?

What multilateral efforts and international facilities can support STI global policies? What is the scope for mutual learning on “anticipatory” tools?

# OECD is developing a STI strategic intelligence facility

## Strategic Intelligence

"timely and useable knowledge that supports policy makers in understanding the relevant aspects and scope of the impacts of science, technology and innovation, and their potential future developments"


Technology Assessment

Forecasting & Horizon Scanning

Participatory Foresight

Modelling and statistical benchmarking


Ex Ante & real-time evaluation

Advanced indicators

# Summary of questions to guide the panel discussion

1. *Research security* – What are your major concerns and priorities in relation to research integrity and security? What roles can international cooperation play?
2. *Emerging technologies* – What are the options for international cooperation in quantum science and technology or other emerging technologies that may bring national competitive advantages but also global societal benefits?
3. *Science diplomacy* – How to pursue an international STI relations agenda that balances national and global interests?
4. *Strategic intelligence* – What multilateral efforts and international facilities can support STI global policies? What is the scope for mutual learning on "anticipatory" tools?

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THANK YOU!


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