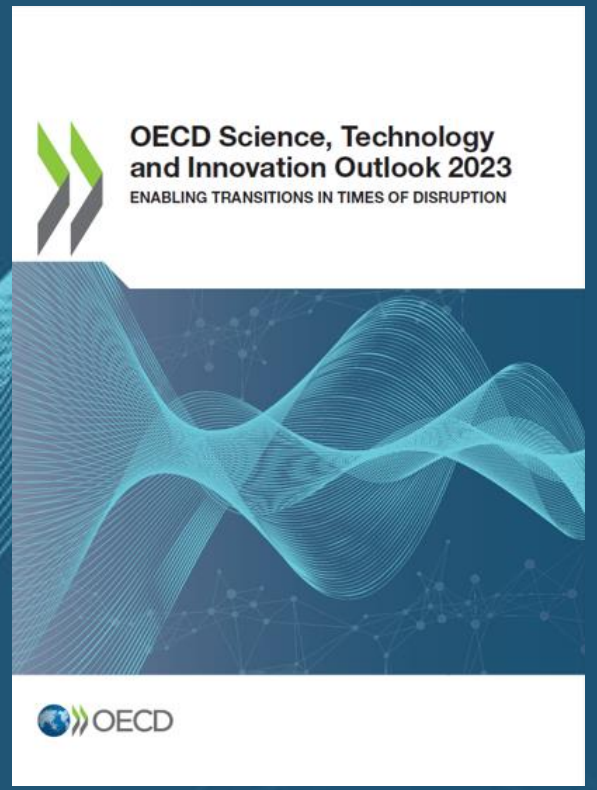
STI policies for transitions in times of disruption

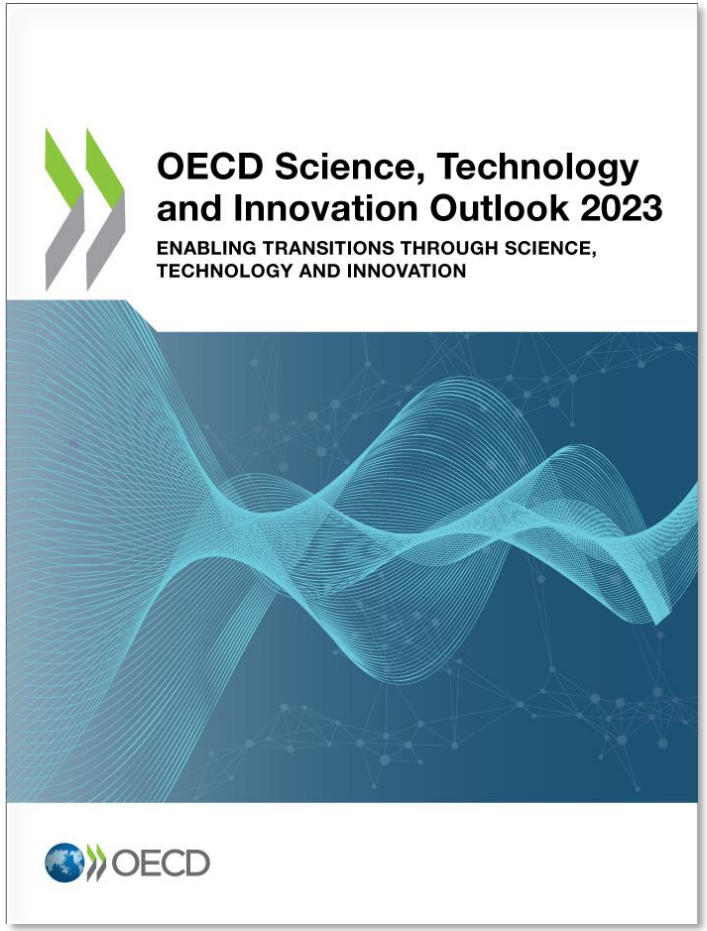
and the role of technology governance



Andrew Wyckoff, Director, OECD Directorate for Science, Technology and Innovation

STI Outlook 2023

- An OECD flagship publication, most widely read STI output
- Published every 2 years, since the mid-1990s
- Asks: “What’s new in the field of science, technology and innovation policy?”
- The 2023 edition focuses on STI for sustainability transitions in an age of disruptive change
- Provides an international review based on latest policy information and indicators
  - Based on the work of the Committee for Scientific and Technology Policy (CSTP) and its working parties
  - Draws extensively upon OECD STI statistical and qualitative data infrastructures



STI in an age of disruptive change

- Disruptive shocks and crises and a greater emphasis on the resilience function of STI
- Climate change and the need for greater directionality in STI policy and international cooperation
- Strategic competition and the growing securitisation of STI policy

OECD Science, technology and Innovation OUTLOOK 2023
Enabling transitions in times of disruption

1- STI policy in times of global crises

2- STI policy in times of strategic competition

3- STI policy for sustainability transitions

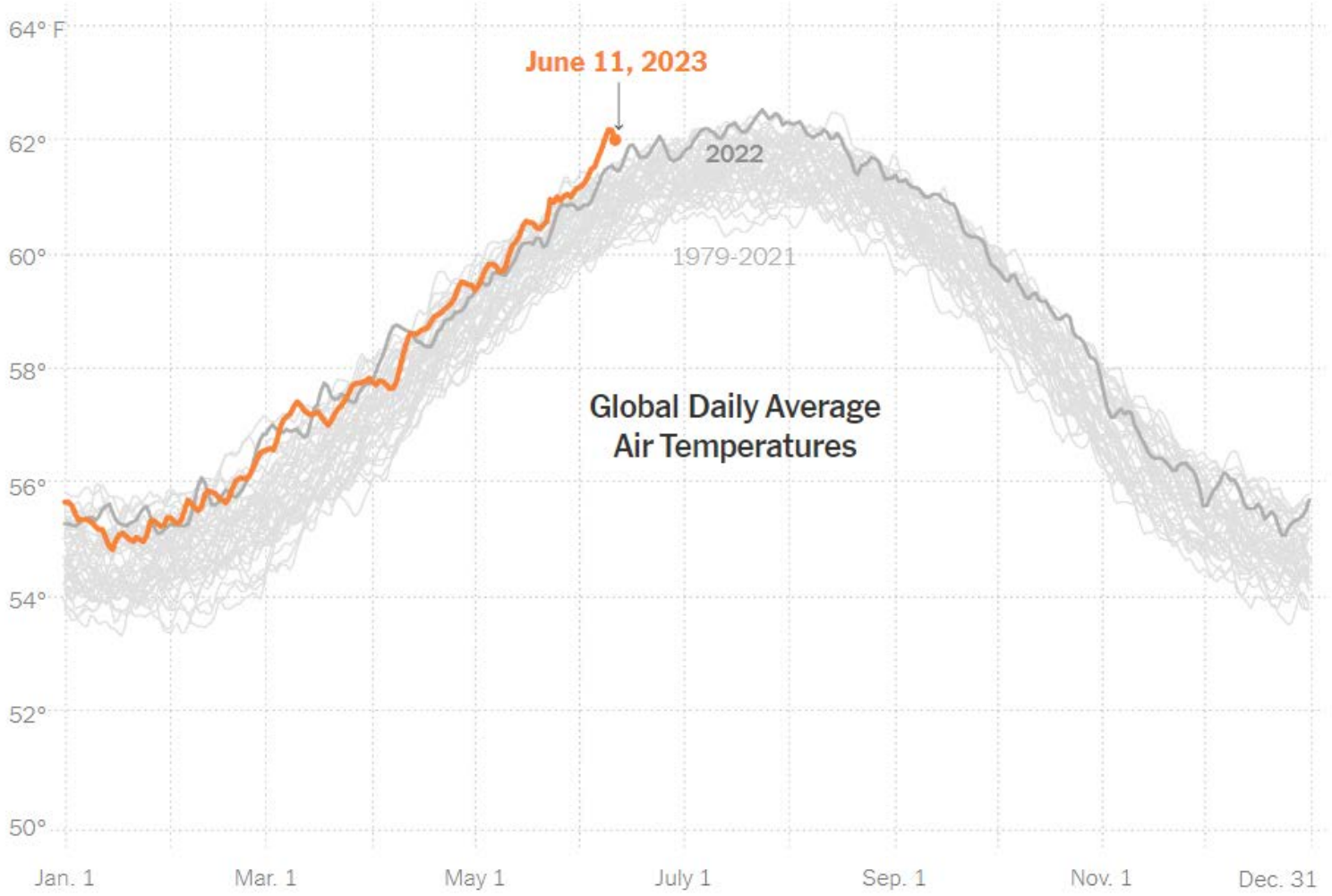
4- Mobilising science in times of crisis: Lessons learned from COVID-19

5- Reaching Net zero: Do mission-oriented policies deliver on their many promises?

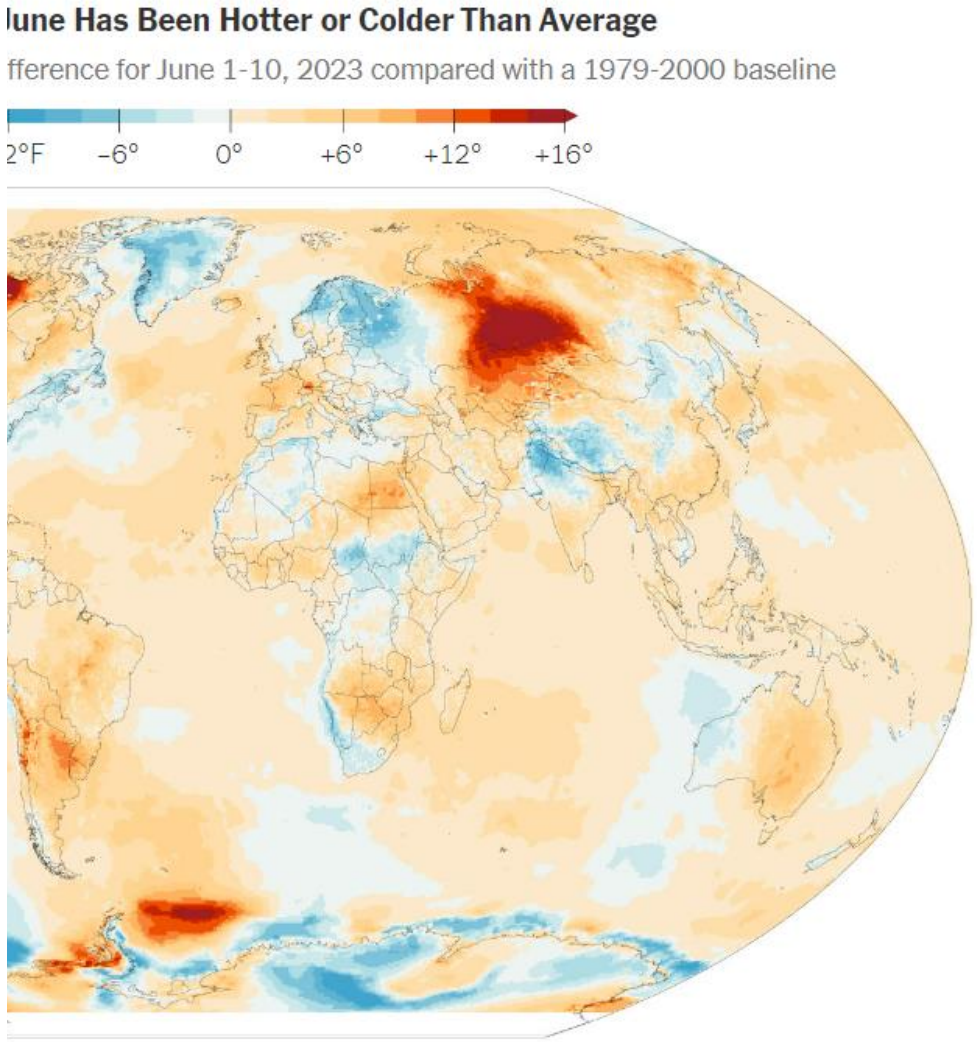
6- Emerging technology governance: Towards an anticipatory framework

1. Climate neutrality requires massive socio-technical change

Climate change is upon us.

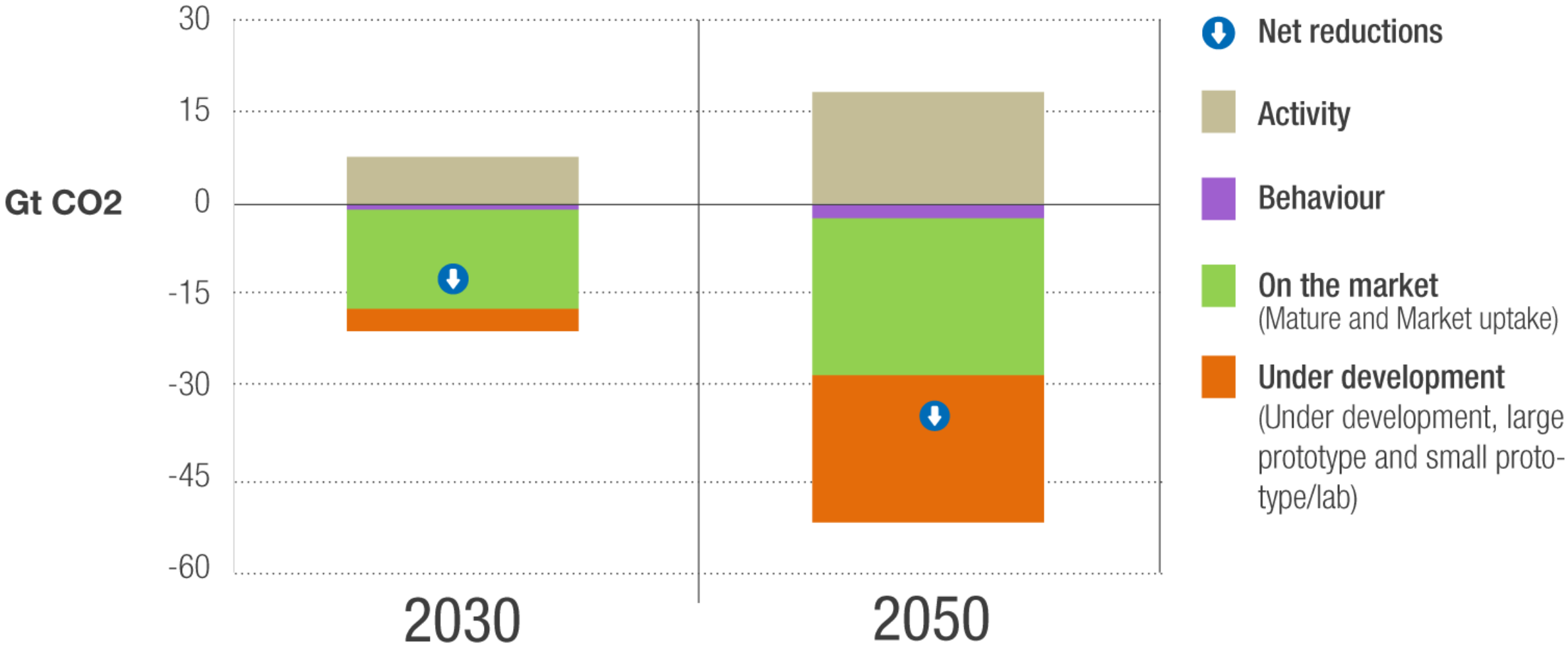


Source: Climate Reanalyzer, Climate Change Institute at the University of Maine, based on data from the National Centers for Environmental Prediction Climate Forecast System | Note: Forecast models are available from 1979.



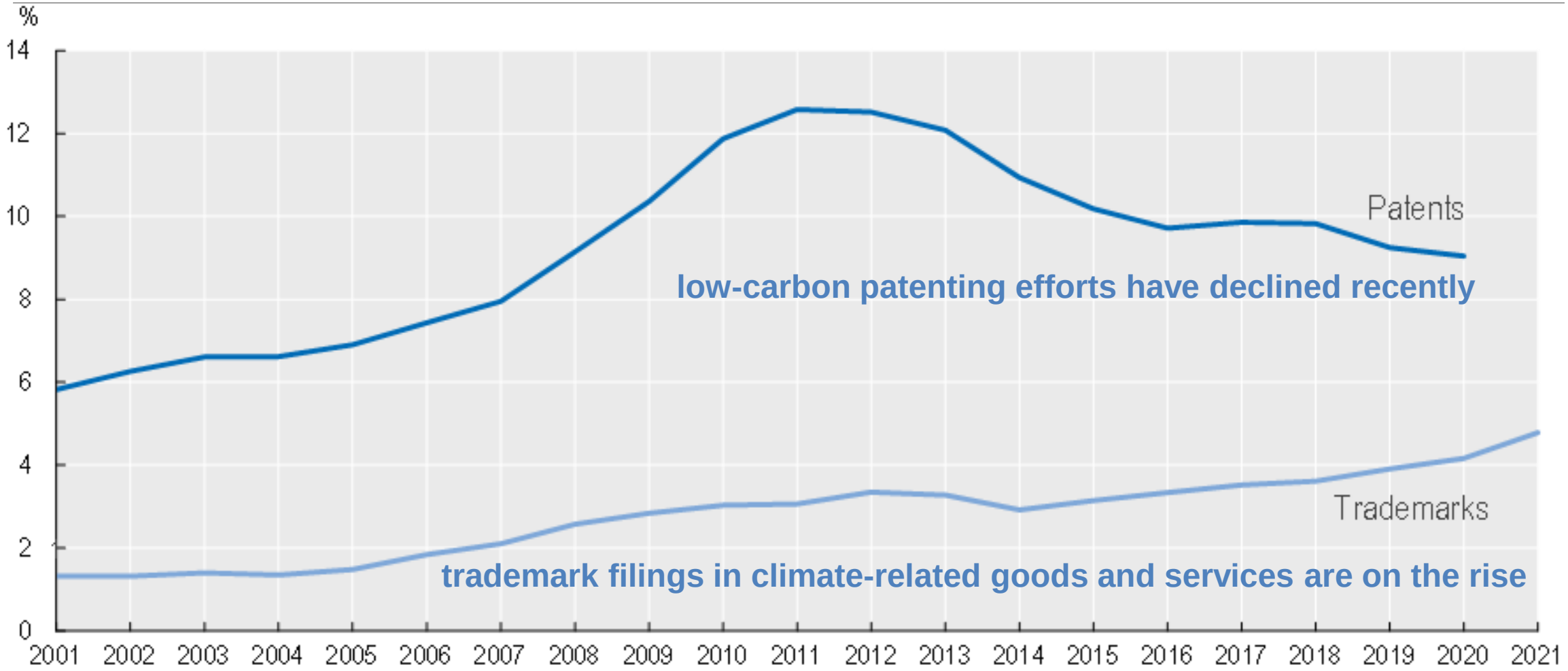
limate Change Institute at the University of Maine, based on data from the
ental Prediction Climate Forecast System

The IEA estimates that 50% of emissions reductions will come from technologies that are not yet in the market . . .



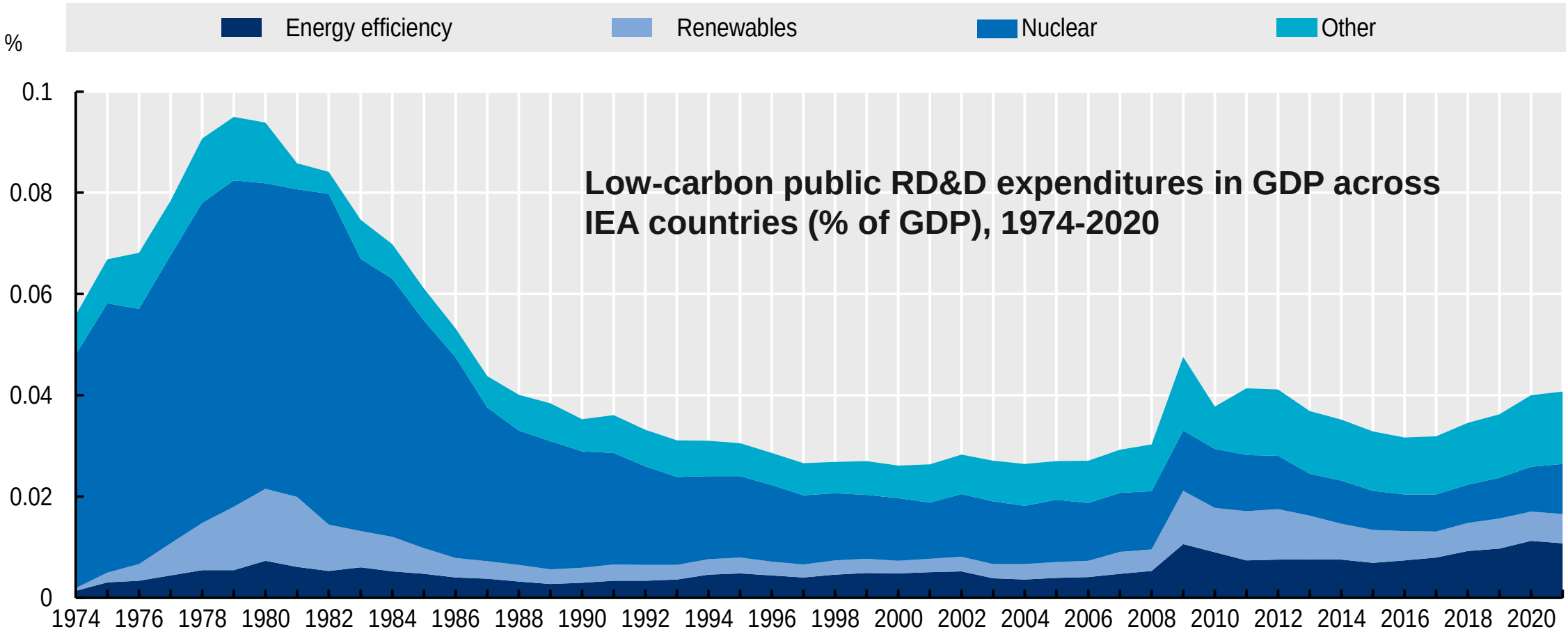
Source: IEA (2021), Net-Zero by 2050

… but business' efforts focus on deployment of existing technologies …



Note: Patent data refer to families of patent applications filed under the Patent Cooperation Treaty (PCT), by earliest filing date. Trademark filings are from the European Patent Office, the United States Patent and Trademark Office and the Japan Patent Office.
Source: OECD, STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats, February 2023.

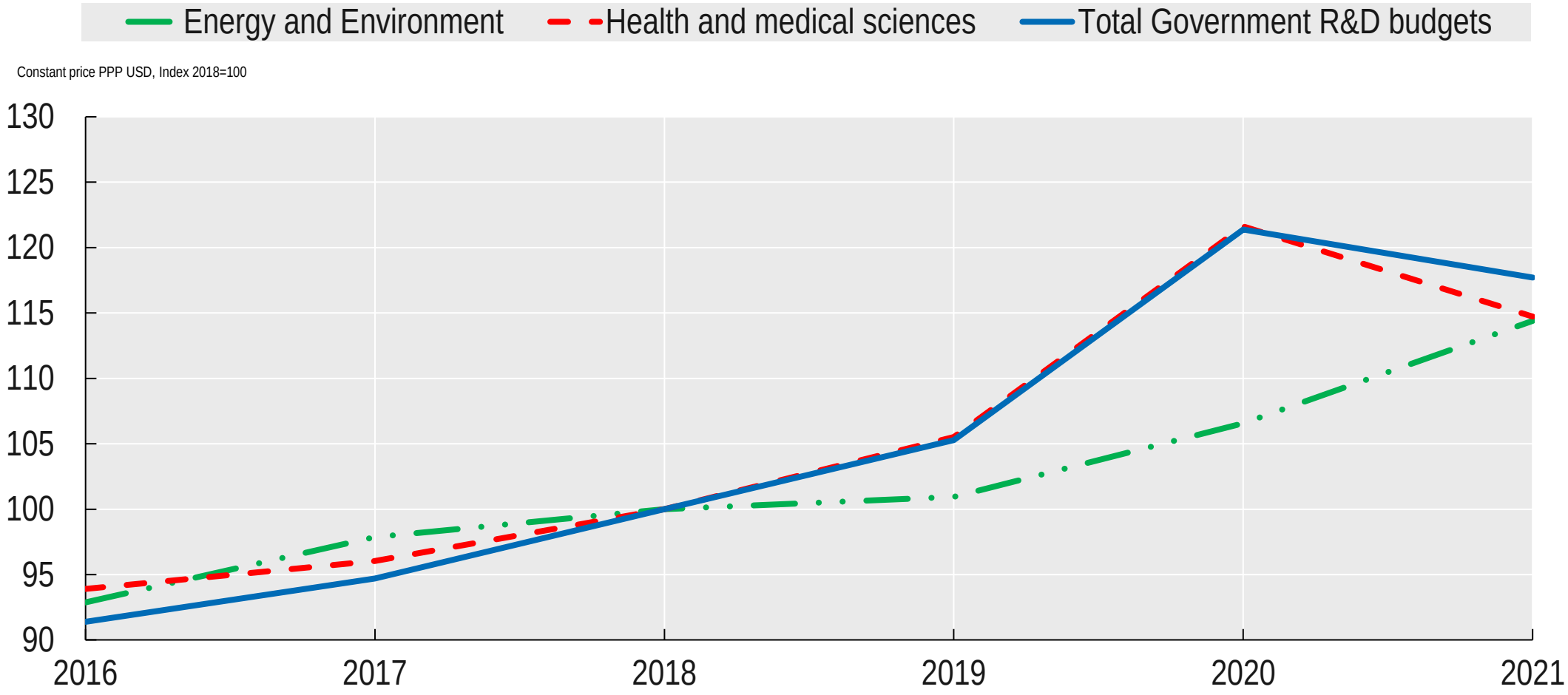
… while public expenditures on low carbon R&D and demonstration remain relatively low



Note: The "Others" category includes Carbon capture and storage, Hydrogen and fuel cells, Other power and storage technologies, and Other cross-cutting technologies and research. See https://www.iea.org/data-and-statistics/data-product/energy-technology-rd-and-d-budget-database-2 .
Source: IEA Energy Technology RD&D Budgets database, December 2022.

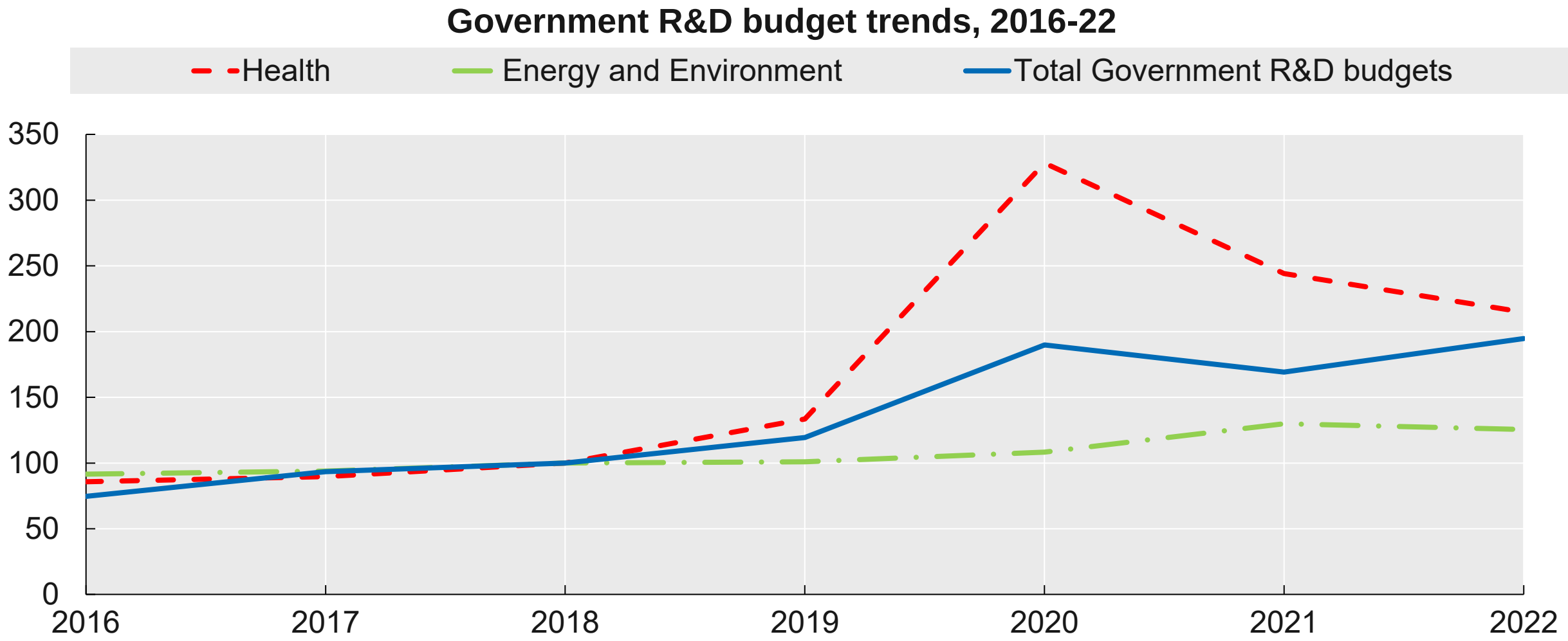
Govt R&D spending rose sharply to meet the health crisis, while spending on energy and environment continue to rise

Government R&D budget trends, 2016-21



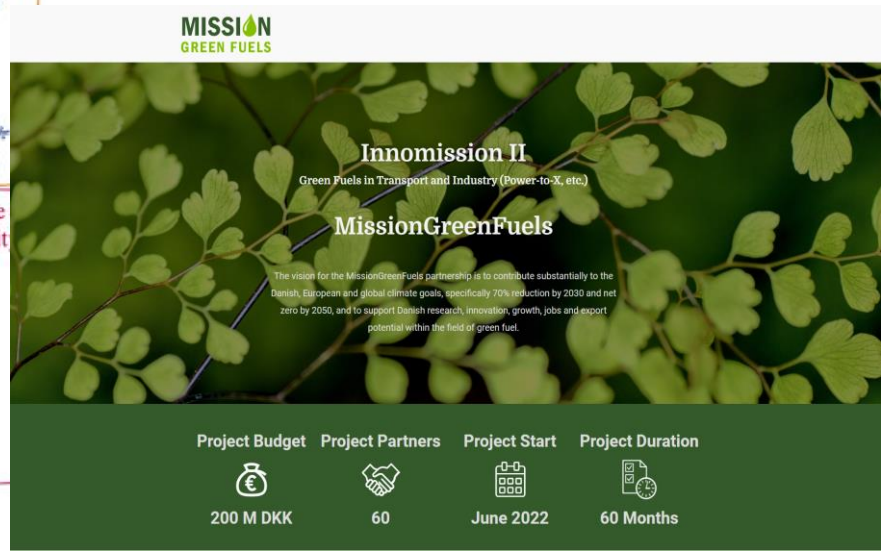
Source: OECD R&D statistics, September 2022.

The pattern in Japan is somewhat similar, though with less growth in energy and environment than the OECD average



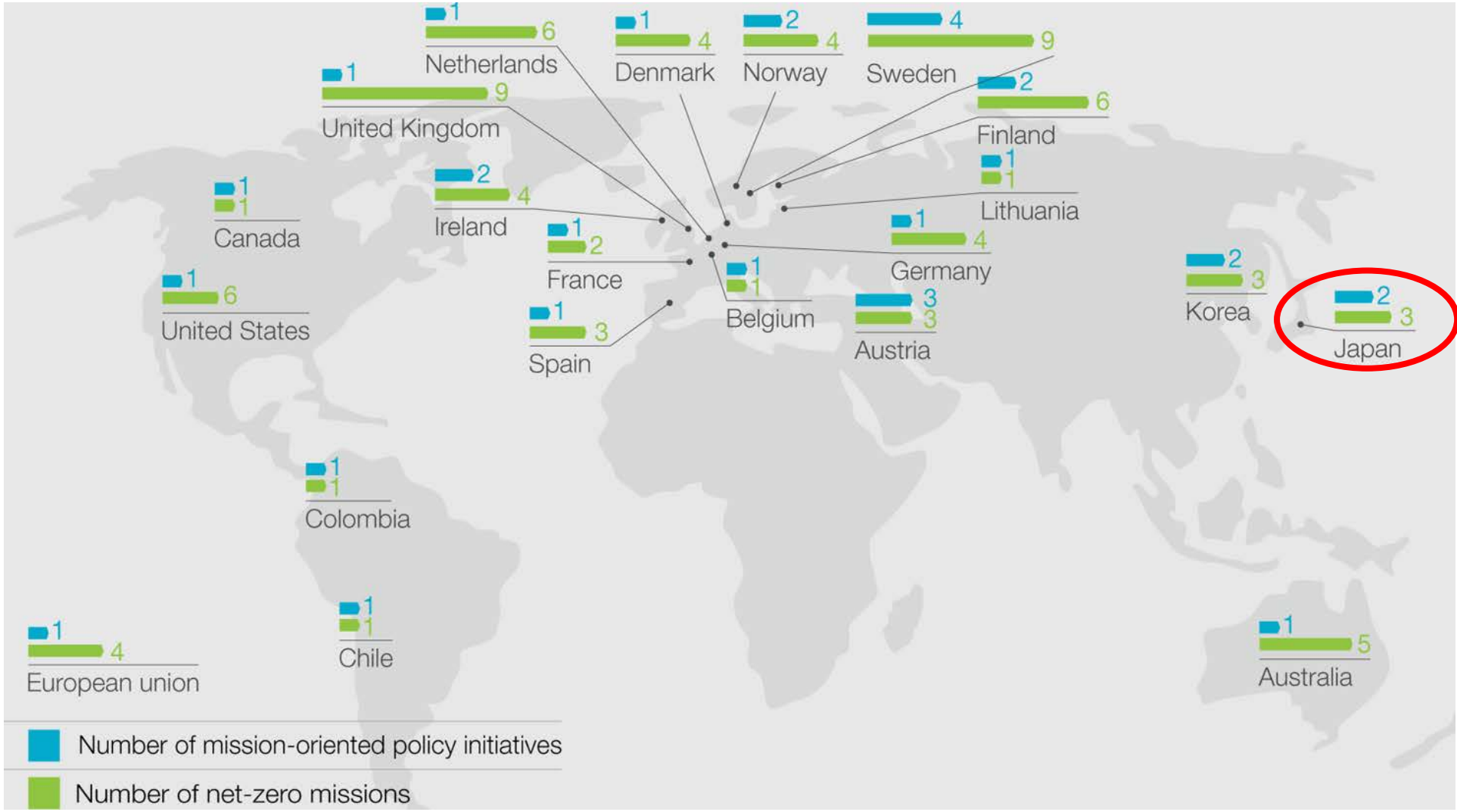
Source: OECD R&D statistics, June 2023

Many see the need for moonshot types of programmes



The net-zero mission database

- An institutional space for collective action to address complex and systemic challenges
- Most ‘net zero’ missions are still in their infancy
- Steep learning curve, strong need for reflexivity…



Main findings of database and case studies analysis

- Most net-zero missions produce some of their expected results
- They represent in most cases a marked improvement relative to traditional STI policy mixes
- Net-zero missions are not yet well suited to bring about the needed transformative changes to achieve the goal of net-zero
- Their success in this will depend on their ability to:
  - **expand beyond STI programmes and budgets**
  - **move from co-developed strategic agendas to joined up action**
- But it's only the beginning…

'STI' trap

Many Net Zero missions remain techno-focused, led by STI authorities, financed from STI budgets

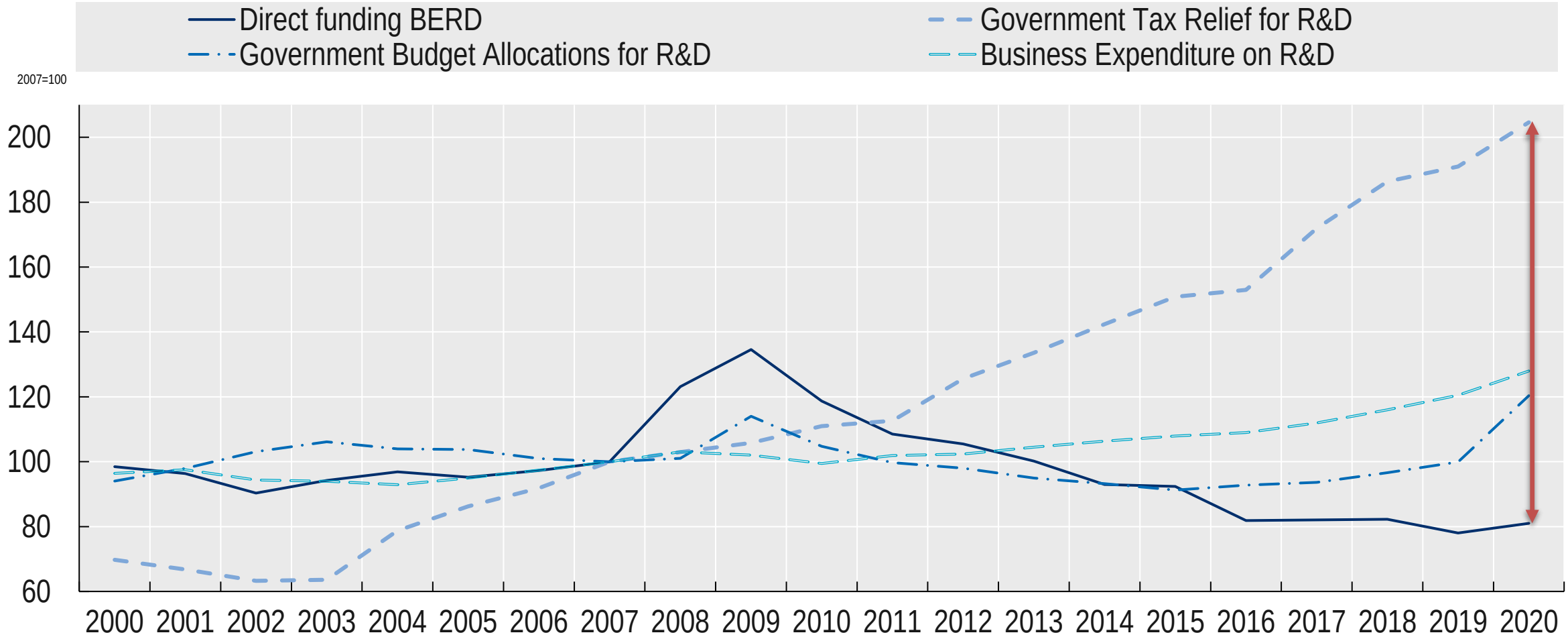
'Orientation' trap

Many Net Zero missions remain focused on the development and monitoring of strategic agenda, with still too little focus on implementation

Setting targets implies reorienting policy portfolios, for example, in the tools used to support business R&D

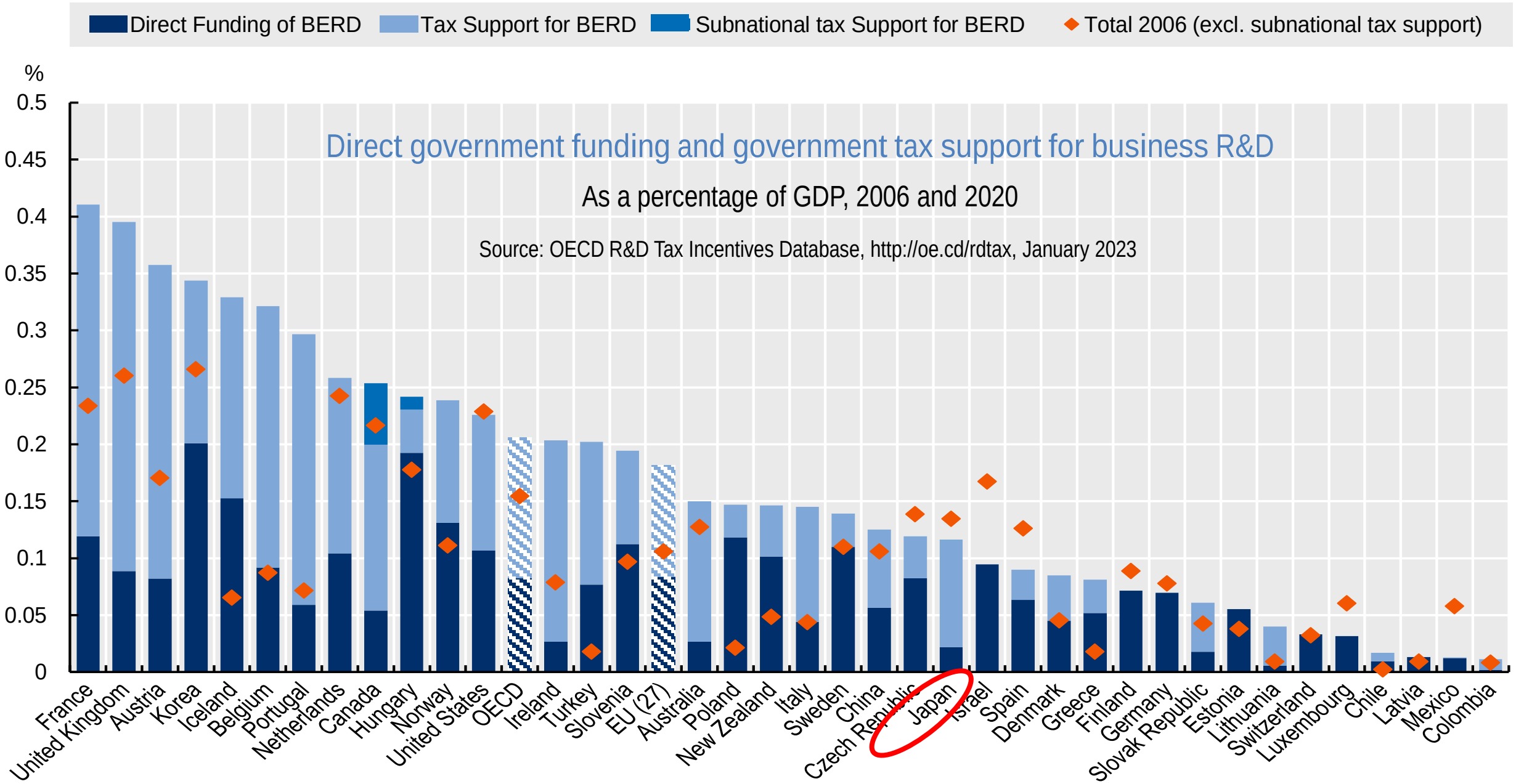
Shift in government policy support mix for business R&D, 2000-2020

Government funding of R&D in the OECD area, indexed values for key figures normalised by GDP, 2007=1



Source: OECD, *Science, Technology and Innovation Outlook 2023*, calculations based on OECD *R&D Tax Incentives Database*, http://oe.cd/rdtax, April 2022.

Japan's policy mix makes extensive use of R&D tax support



Beyond investments to tackle systemic change

Larger investments and greater directionality in research and innovation activities are needed, but these should coincide with a reappraisal of STI systems and their supporting STI policies to ensure they are “fit-for-purpose” to contribute to sustainability transitions

This requires reforms of STI itself

S&T POLICY 2025
Enabling Transitions through Science, Technology and Innovation

NEW MODES OF PARTNERSHIP

How to spur and deepen **STI cooperation** between firms, the public research system, governments, and non-profit sectors for transition?

How to **engage society in STI** to further transitions?

How to promote **cross-government coherence** on STI-enabled transitions that depend on several government bodies cooperating?

How to leverage **international STI cooperation** in the interest of transitions?

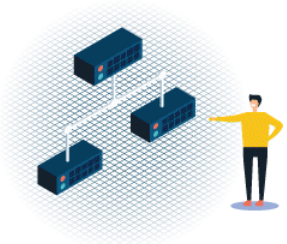
INNOVATION ENABLERS

How to direct **private financing and public funding** to support transitions?

How to **develop and implement emerging technologies** to enable just transitions?

How to **gear research and technical infrastructures** towards transitions?

How to nuture the **skills and capabilities** required for STI-enabled transitions?



How to ensure various **framework conditions** for STI are conductive to supporting transitions?

How to develop and use **knowledge and evidence** that support transitions?

2. STI in times of strategic competition

Context

- Technological leadership has long underpinned the economic prosperity and security of OECD countries and has typically involved some measure of protection of technologies from strategic competitors.

- The growing ascendancy of China in frontier technologies has ushered in a new era of intensified strategic competition, particular in critical technologies that will underpin future economic competitiveness and national security.

China's growing ascendancy raises three main areas of concern for liberal market economies

1. **Rising competition in critical technologies**

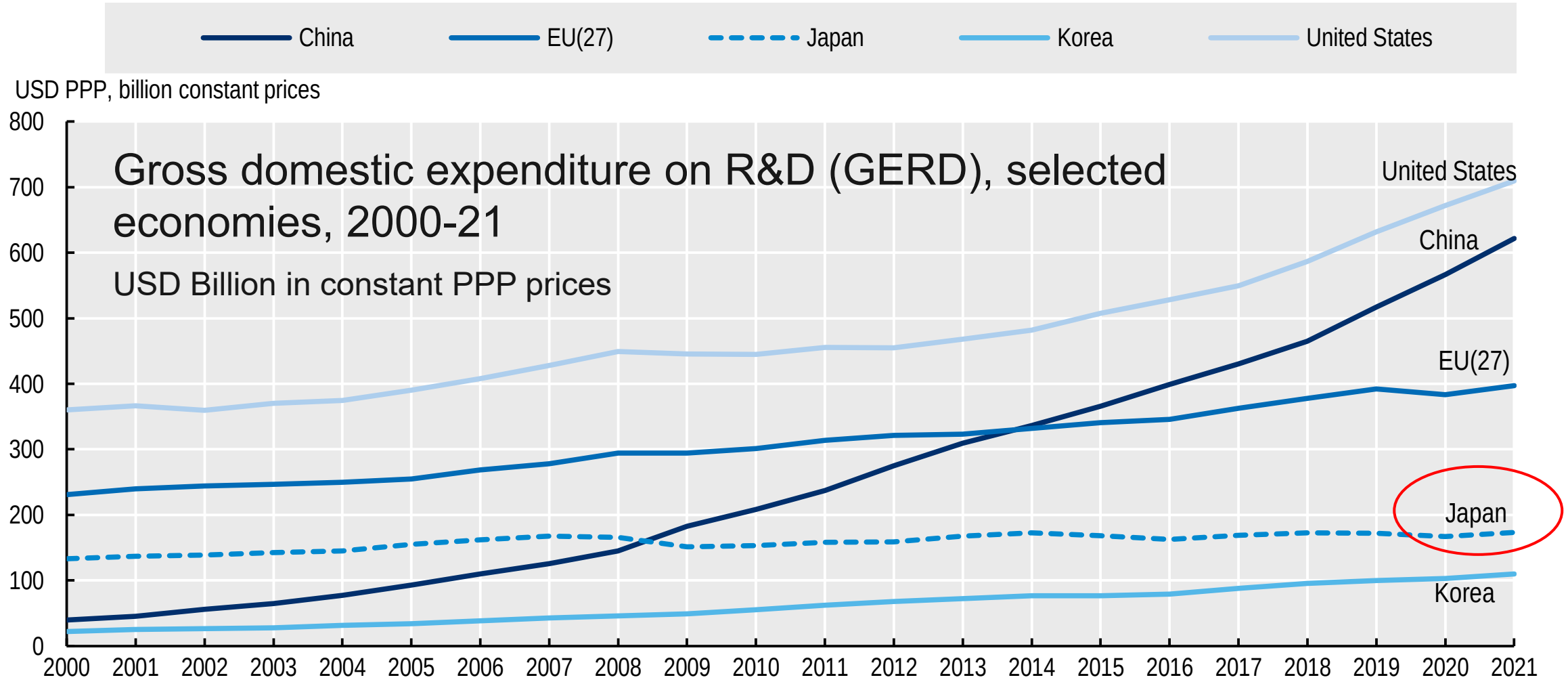
2. **Diverging values and interests**

3. **Increasingly vulnerable tech supply chains and interdependencies**

A ‘new’ framing for STI policy?

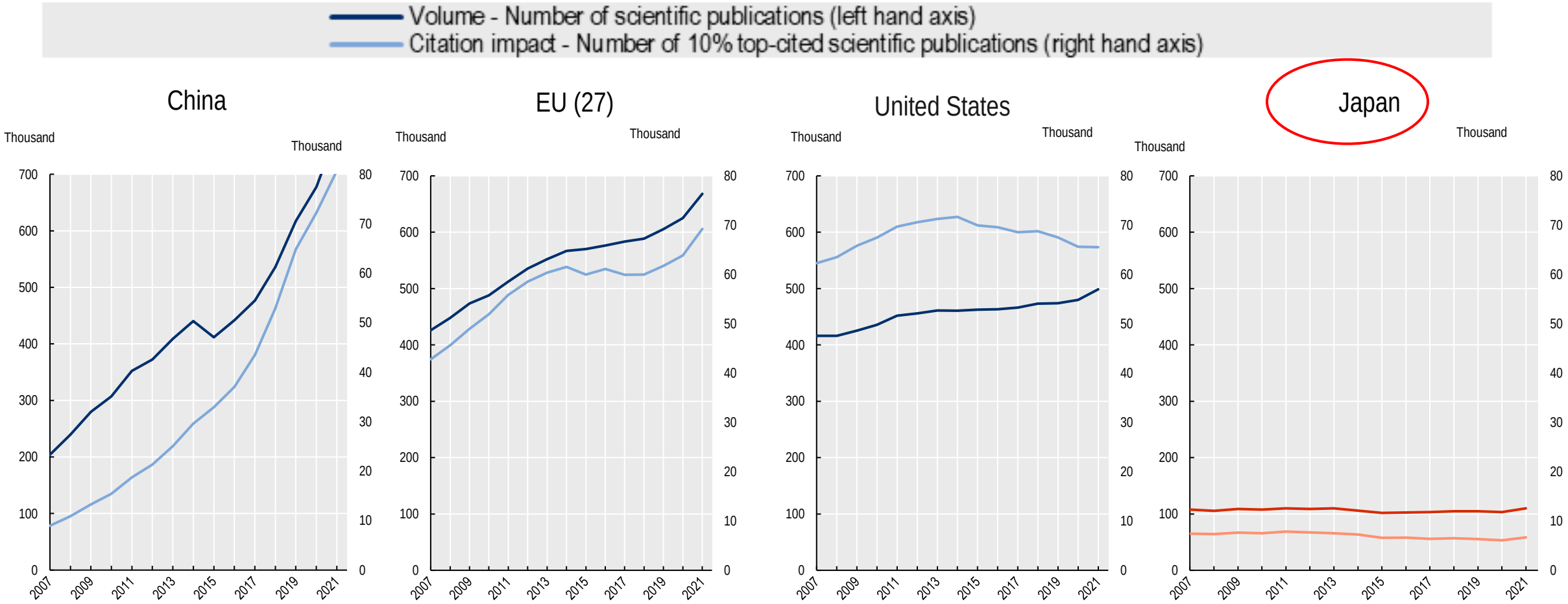
- Concepts like “**technology sovereignty**” and “**strategic autonomy**” have emerged as frames for STI policy.
- This framing could – and is indeed intended to – **disrupt** existing technology ecosystems. It could also have unintended effects – for example, on co-operation in basic science.
- The STI Outlook maps out the landscape on growing strategic competition, outlining the main issues and the initiatives of the ‘**Big 3**’, who account for about 70% of global R&D.

The rise of China: R&D investments



Source: OECD, *Science, Technology and Innovation Outlook 2023,* calculations based on OECD Main Science and Technology Indicators Database, February 2023, http://oe.cd/msti.

The rise of China: quantity and top-cited scientific publications

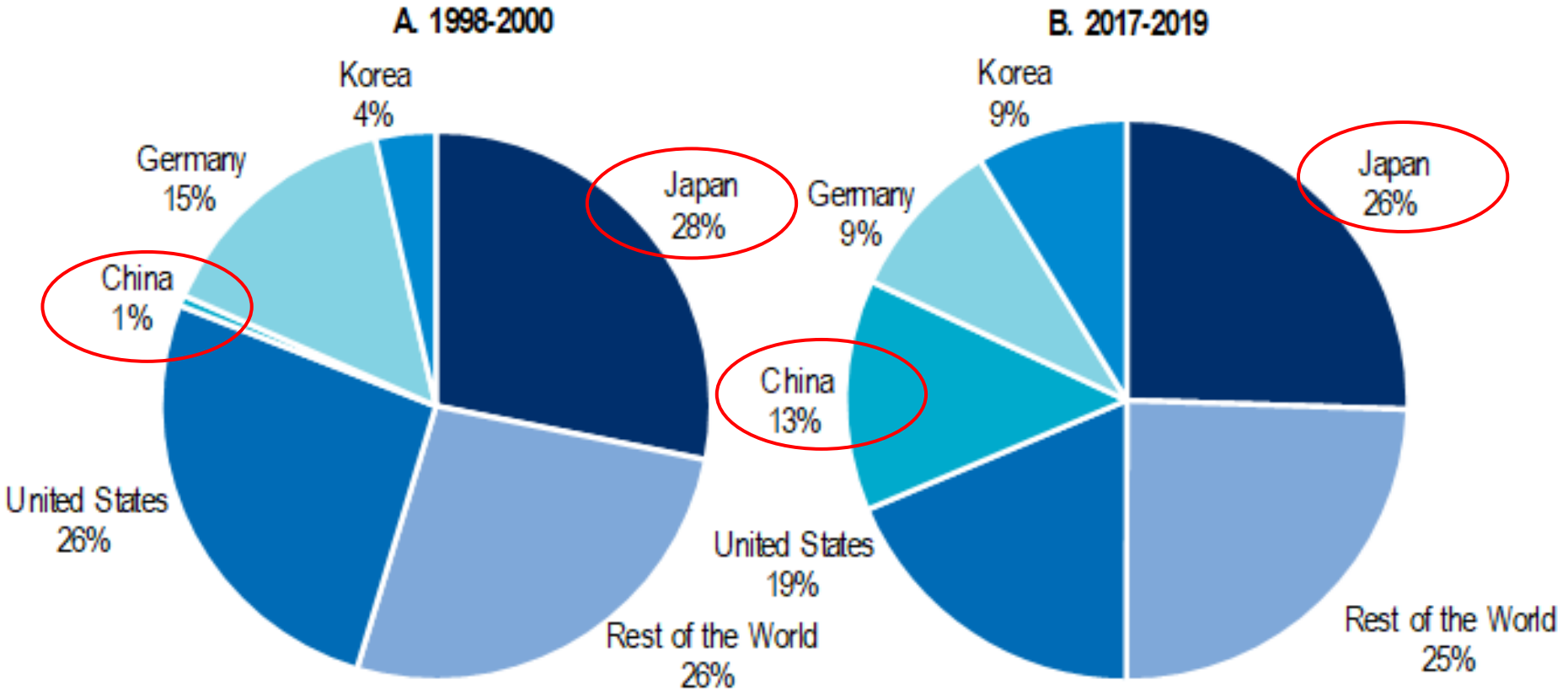


Source: OECD, *Science, Technology and Innovation Outlook 2023,* calculations based on Scopus Custom Data, Elsevier, Version 6.2022

The rise of China: patenting

Distribution of IP5 Patent families for selected countries and the rest of the world

Percentage of IP5 patent families accounted for by different countries and regions that make up the total



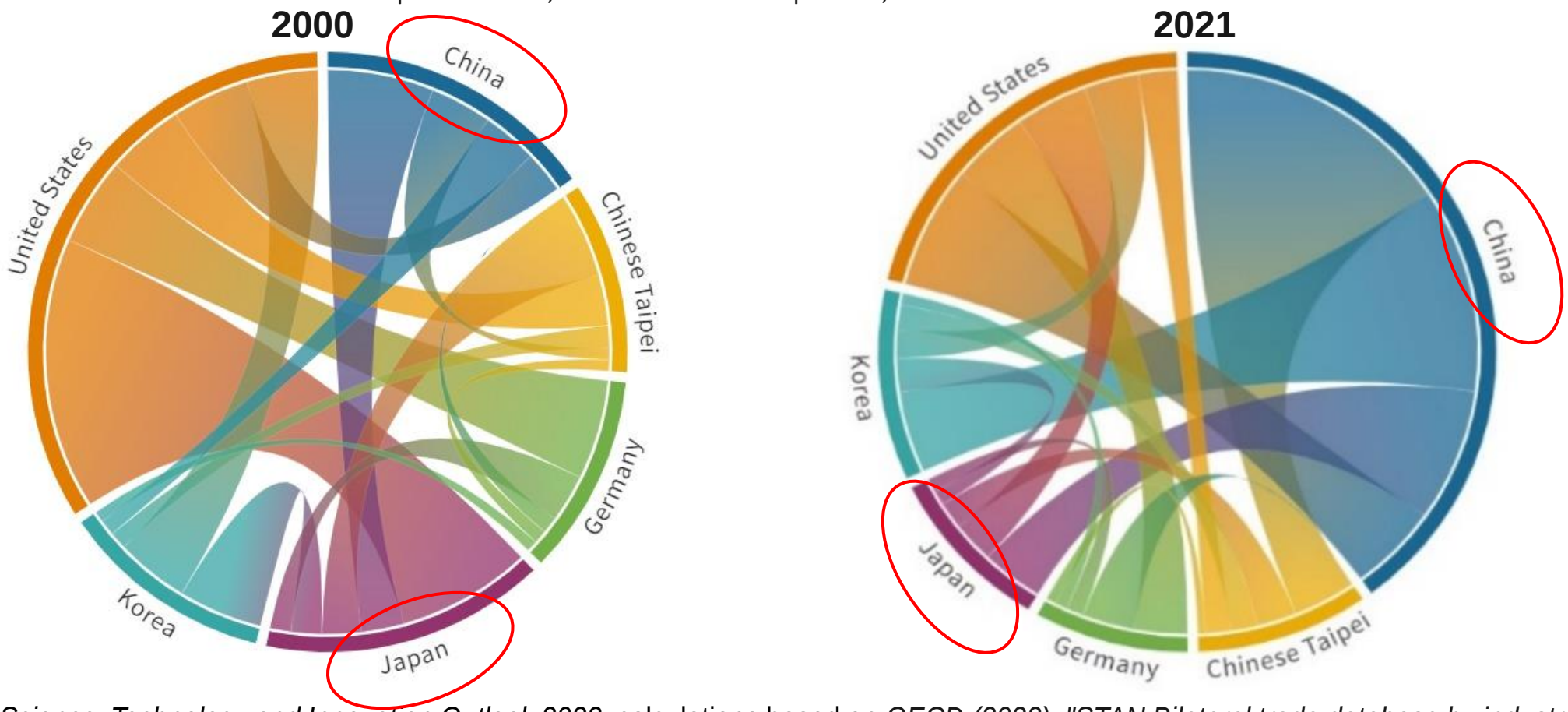
Note: Data refer to families of patent applications filed within the Five IP offices (IP5), by earliest filing date, according to the applicant's location.

Source: OECD, *Science, Technology and Innovation Outlook 2023, forthcoming*, calculations based on STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats (accessed 9 February 2023).

Interdependencies: Trade in high R&D-intensive sectors

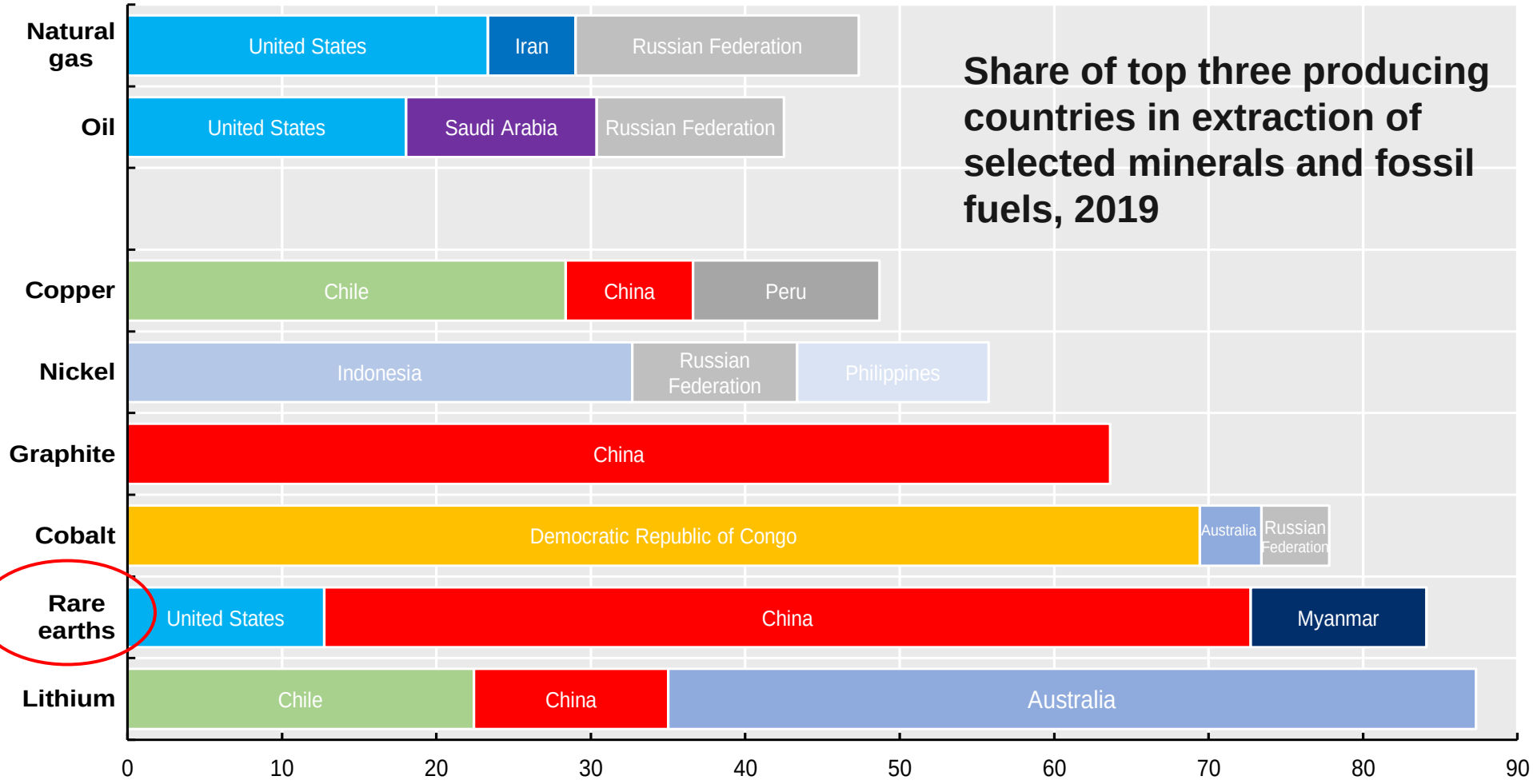
R&D-intensive intermediate goods

Import flows, in USD current prices, selected economies



Source: OECD, *Science, Technology and Innovation Outlook 2023*, calculations based on *OECD (2022), "STAN Bilateral trade database by industry and end-use category, ISIC Rev. 4", STAN: OECD Structural Analysis Statistics (database), https://doi.org/10.1787/data-00691-en, October 2022.*

The current production of many green minerals also display strong dependencies

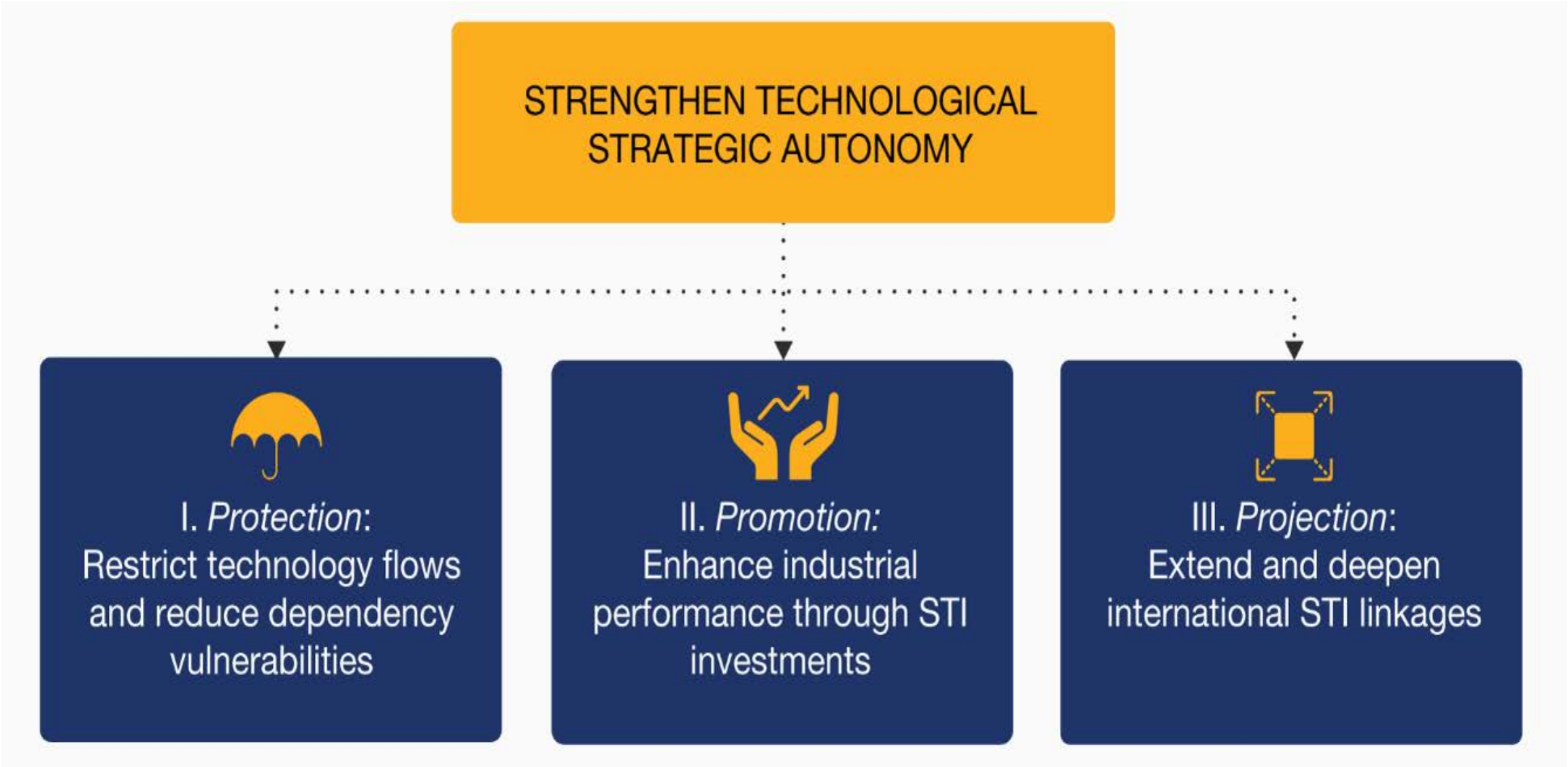


China's embargo on rare-earth exports to Japan in 2010-11 raised supply concerns, yet separation and refining of rare-earth oxides continue to be predominantly performed in China

STI have potentially vital roles to play in developing substitutes, improving recycling, and increasing efficiency

Source: IEA, Paris https://www.iea.org/data-and-statistics/charts/share-of-top-three-producing-countries-in-extraction-of-selected-minerals-and-fossil-fuels-2019

Governments are strengthening their technological strategic autonomy

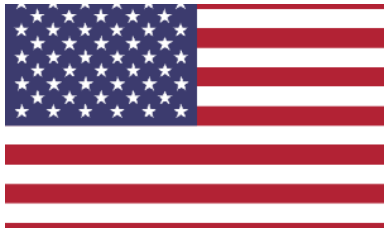


Recent policy initiatives reveal growing security anxieties and strategic competition

Selected examples of policy initiatives in China, the EU and the United States

Made in China 2025; 14th Five Year Plan; Dual Circulation Strategy; Military-Civil Fusion; Government Guidance Funds; China Standards 2035; Belt and Road Initiative

NextGenerationEU; New Industrial Strategy for Europe; New European Innovation Agenda; Important Projects of Common European Interest; Chips Act for Europe; EU-US Trade and Technology Council



CHIPS and Science Act; Inflation Reduction Act; Infrastructure Investment and Jobs Act; Quad; Indo-Pacific Economic Framework for Prosperity; G7 Partnership for Global Infrastructure and Investment

What's happening in Japan?

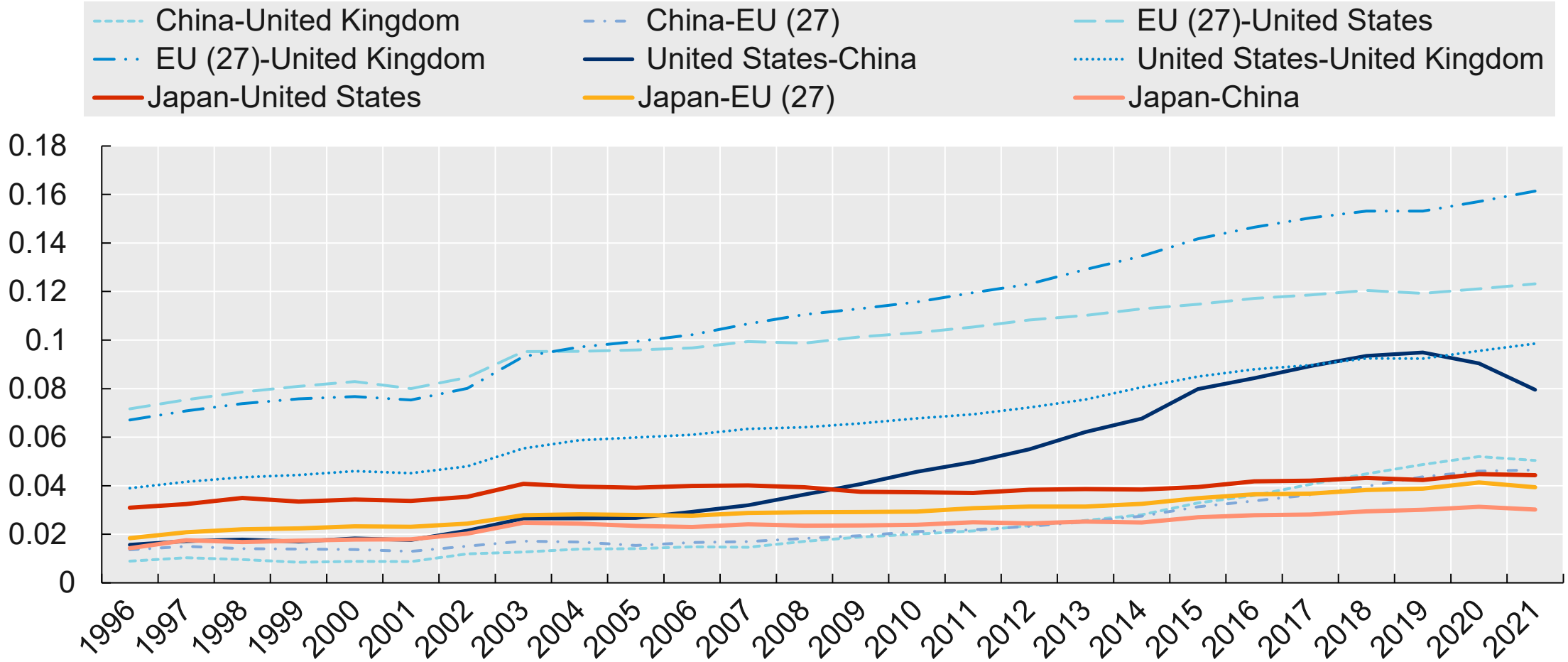
- Protection
  - New export controls on semiconductors (c.f. US and NL)
  - Research security measures
- Promotion
  - Green Innovation Fund
  - Moonshot
- Projection
  - Japan specific programmes, e.g. JST's international activities
  - G7 and G20 initiatives
  - Quad and Indo-Pacific Economic Framework for Prosperity

STI policies in times of strategic competition

1. Policies promoting strategic autonomy could sacrifice some of the gains from specialisation, economies of scale and the diffusion of information and know-how.
2. They could also undermine future co-operation on global grand challenges.
3. Excessively risk-averse policies could trigger a more abrupt and extensive intellectual decoupling and disengagement.
4. A major test for multilateralism will be to reconcile growing strategic competition with the need to address global challenges like climate change.

Weak signal of change: research collaboration

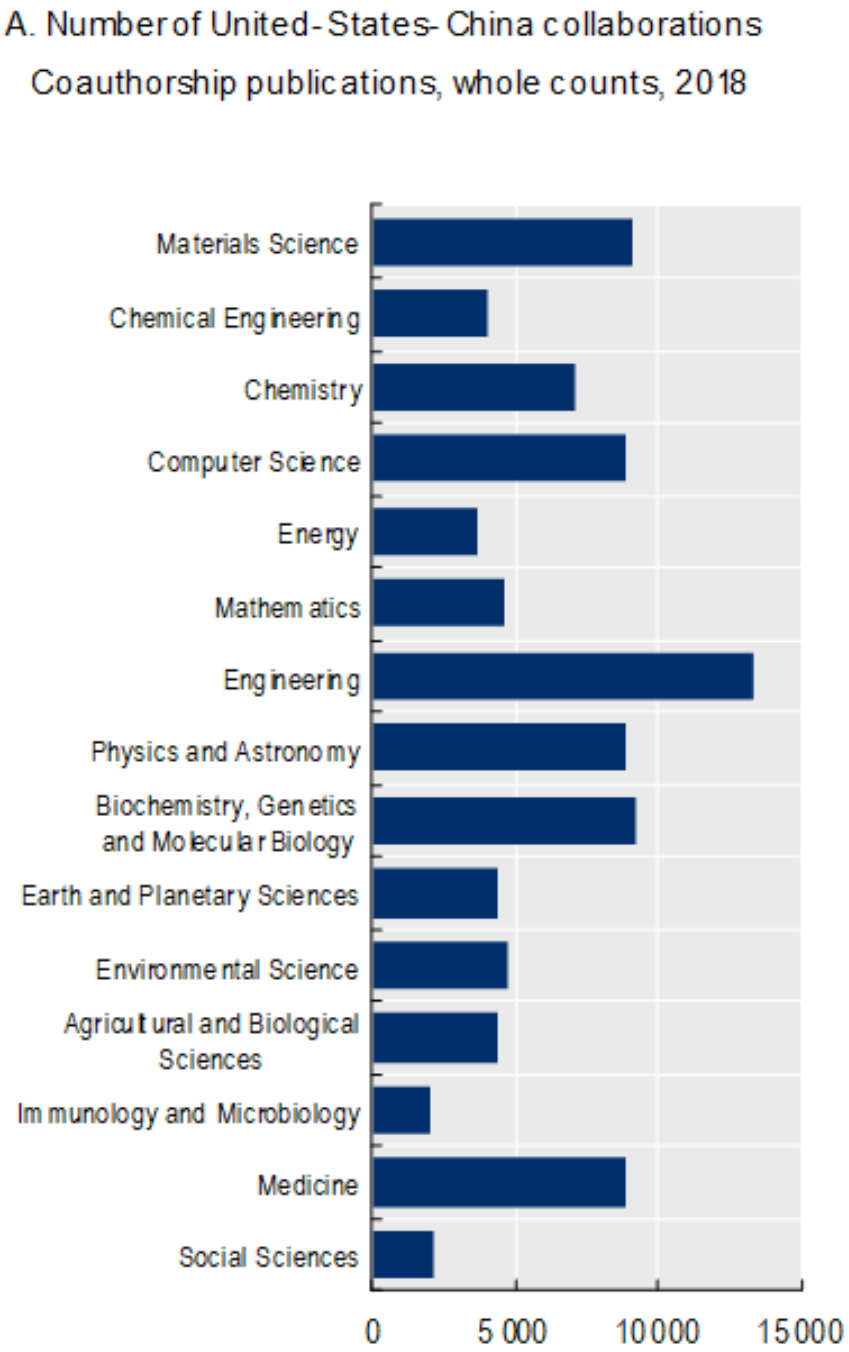
Bilateral collaboration intensity trends in scientific publications, 1996-2021

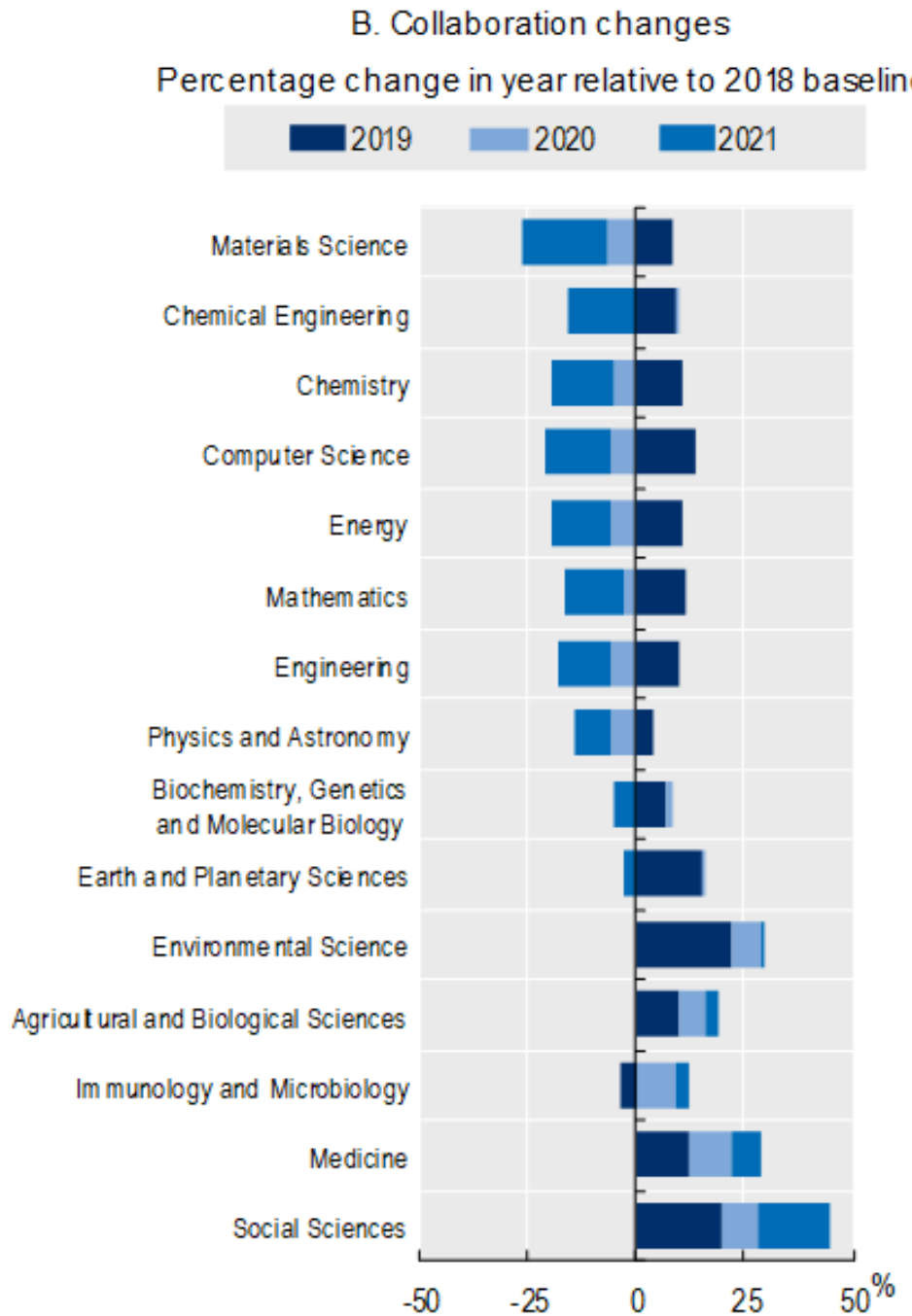


Note: Whole counts of internationally co-authored documents; Source: OECD, *Science, Technology and Innovation Outlook 2023, forthcoming*, calculations based on Scopus Custom Data, Elsevier, Version 6.2022.

Top 15 fields of collaboration between the United States and China

Declining US-China collaboration in engineering and natural sciences





Source: OECD, *Science, Technology and Innovation Outlook 2023*, calculations based on Scopus Custom Data, Elsevier, Version 6.2022, February 2023.

What should governments do?

- These are complex, cross-cutting issues, where there's considerable uncertainty and turbulence. The Outlook offers four pieces of advice:
  1. Governments need to treat this as a **cross-departmental** issue and co-ordinate accordingly. Competitiveness, security and sustainability are related goals.
  2. There is a lot of **variety** on the nature and levels of interdependency vulnerabilities and national security risks across sectors, technologies and countries. So governments should avoid blanket measures and consider strategic competition on a case-by-case basis, weighing up their options and implementing measured responses.
  3. Governments are going to need '**strategic intelligence**' – including horizon scanning, foresight, technology assessment, and evaluations – to make informed decisions in a turbulent and uncertain environment.
  4. It is also going to be important like-minded governments co-ordinate in their responses, to avoid things like inefficient '**subsidy races**' from emerging.

3. Technology governance is an important consideration at the intersection of sustainability transitions and strategic competition

Key messages on technology governance

Key messages

Actors at country and international levels seek guidance and agreement on how to **embed foundational values in technology** to make innovation more **responsible and responsive to societal needs.**

Innovators and societal stakeholders (funders, researchers, tech developers, associations etc) need to be brought in the **technology governance process.** This should occur at both the **national and international levels.**

General and anticipatory framework for the governance of emerging technologies is needed, to **use common tools and learning** to help address many recurrent policy issues and dilemmas.

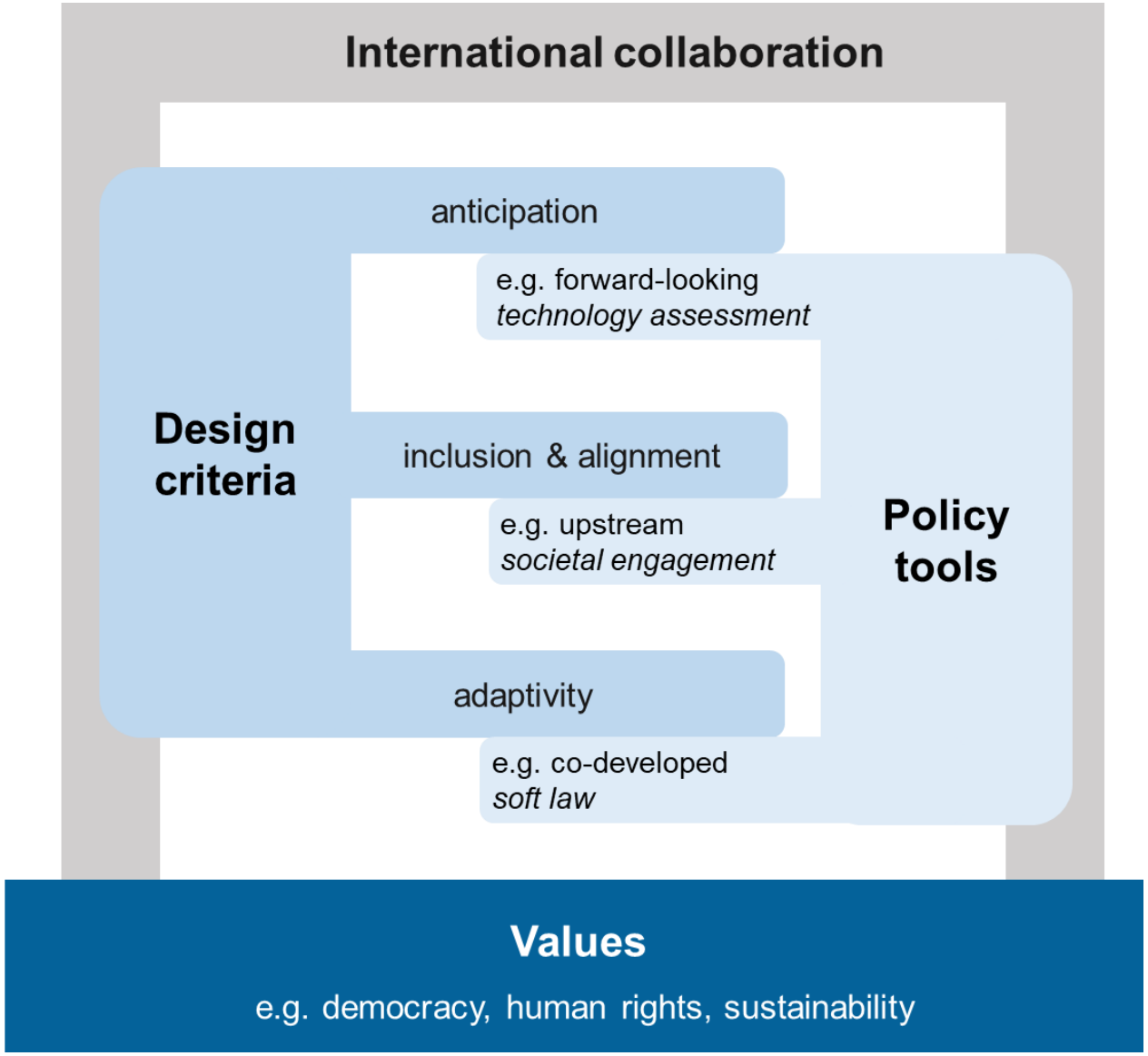
The framework as a whole could act as a **force for technological cooperation** at the international level by reinforcing the commonality and commitment of these values and tools.

Emerging technology governance framework: key elements

Three-tiered structure

- **Values** provide the orientation of governance systems as a whole
- **Design criteria** could guide the development of emerging technology governance at both the national and international levels
- **Tools** for countries to operationalise design criteria

The framework can apply both to national and international governance of emerging technologies, and international collaboration should be a goal for work at both levels



Global Forum on Technology

OECD
Global Forum
on Technology

OECD

#GFTech

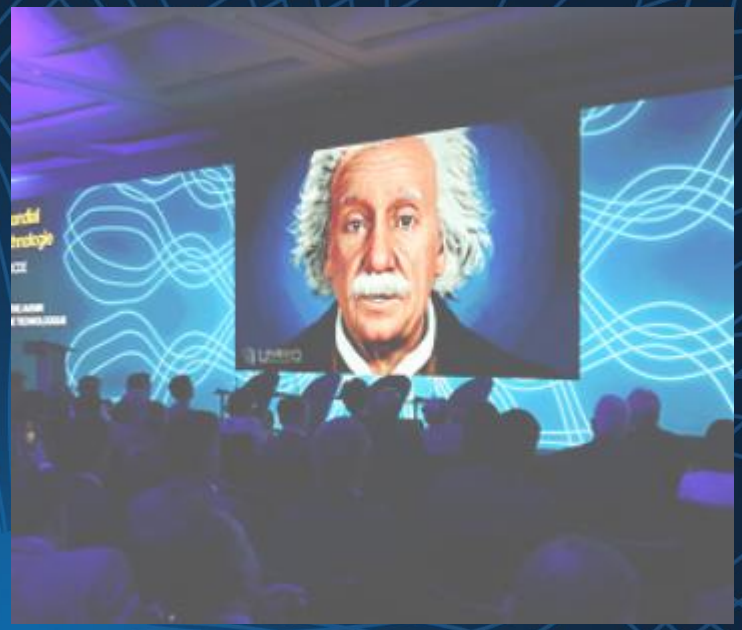
Setting up the OECD Global Forum on Technology (GFT)

Announced at the OECD Digital Economy Ministerial in December 2022, the Forum will host in-depth, inclusive and values-driven discussions to foresee and get ahead of the long-term benefits and risks presented by technology.

Informal advisory group established and met 3 times culminating in the proposed concept note that has benefited from direct CSTP consultation and has been discussed at CDEP last May.

GFT is supported by team members from across the two divisions (Digital Economy Policy and Science and Technology Policy); The team has established an initial website and a visual identity for the forum.

OECD
Global Forum
on Technology



Inaugural event 6 June

OECD
Global Forum on Technology

Criteria for technology selection

Two tracks and three cross-cutting themes

Track 1: technologies ripe for immediate work

Sustainable development and resilient societies

Responsible, values-based and rights-oriented technology

Bridging digital and technology divides

Promote coherence and explore interplay across technologies, facilitate outreach and high-level policy discussion

Track 2: horizon-scanning

Identify technologies for future work and provide forward look

OECD Global Forum on Technology

Technologies proposed

Synthetic biology

Immersive technologies

Quantum technologies

Additional topics for future work:

Human augmentation

Internet of Things (IoT), with a focus on territorial management

Engagement efforts & participants

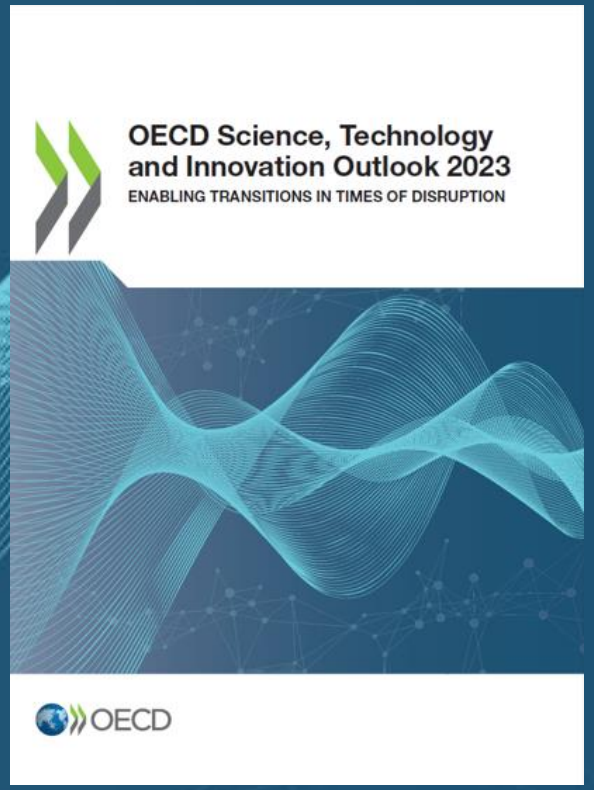
2023 forum activities

6 June Inaugural event alongside the OECD Ministerial Council Meeting in Paris, Chaired by the UK

Workshops on specific technologies and community building with experts including OECD Members, non-Members and stakeholders

GFT event in Israel alongside CDEP meeting in November 2023.

Thank you!



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https://www.oecd.org/sti/science-technology-innovation-outlook/