



CRDS Center for Research and Development Strategy
Japan Science and Technology Agency

The 12th International Symposium on Human Survivability
"The Challenges of Transdisciplinary Education and Research:
What Can Japanese Universities Learn from the European Experience"

Transformative Science, Technology and Innovation Policy, and its implications for Transdisciplinary Research

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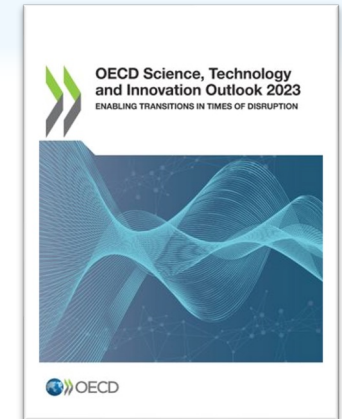
Items

1. Transformative STI policy in times of disruptive changes
2. Mission-oriented innovation policy: a specific approach towards a social transformation
3. Emerging technology governance
4. Implications for transdisciplinary research and education

1. Transformative STI policy in times of disruptive changes

Enabling transitions in times of disruption

OECD Science, Technology and Innovation Outlook 2023



1. STI policy in times of **global crises**

Covid-19 pandemic, Russia's war of aggression against Ukraine, and "securitisation" of STI policy

2. STI policy in times of **strategic competition**

Strategic competition, strategic autonomy & international alliance ("like-minded" countries)

3. STI policy for **Sustainable Transitions**

More directive and multilevel policy approach

4. **Mobilising science in times of crises: Lessons learned from COVID-19***

Mobilisation of the components of the scientific system: open science, research infrastructure, industry-academia collaboration, research funding, scientific advice, and communication

5. **Reaching Net zero: Do mission-oriented innovation policies deliver on their promises?***

Systemic policy experimentation, Pit-falls ("STI-only" trap, orientation trap and policy trap)

6. **Emerging technology governance: Towards an anticipatory framework***

Anticipatory framework, responsible innovation, strategic intelligence, stakeholder and public engagement, and etc..

Accelerating the transformation towards a sustainable and resilient society

- ✓ **Long-term efforts are needed**
Example: Carbon neutral ~2050
- ✓ **Multifaceted efforts are needed**

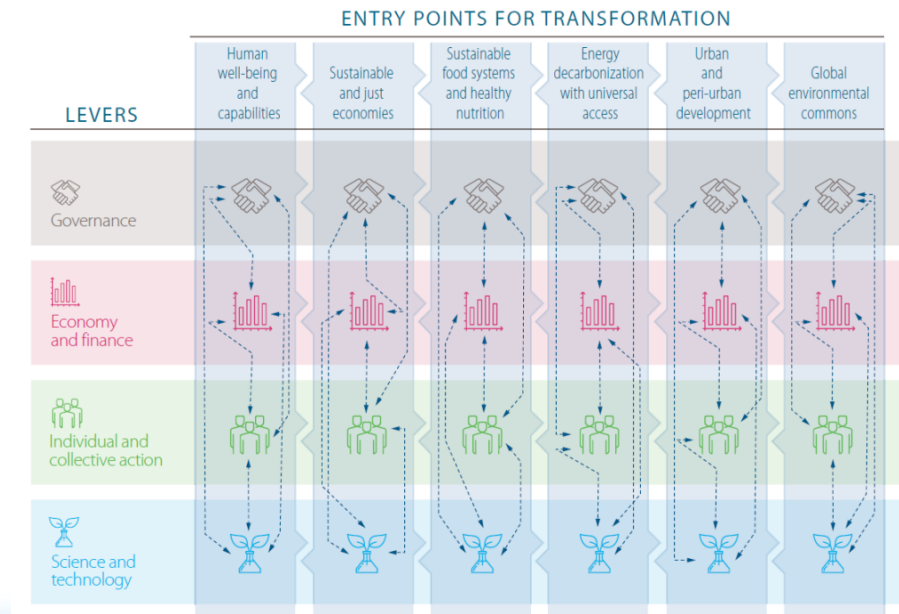
Science and Technology + Government (Governance) + Economy (Market/Finance) + Individual and Collective Behaviors

Transformative Innovation
 "Innovation aimed at social change in order to respond to complex and wide-ranging social issues such as global environmental issues."
 (Government of Japan, 6th STI Basic Plan,)

Six Transformation required by 2050 (IIASA, 2020)



Entry points and levers for change



Source: IIASA, *The World in 2050* (2020)

Source: United Nations, *GSDR2019* (2019)

Opportunities and risks of emerging technologies

AI, quantum computing, synthetic biology, neurotechnology, etc...

- Growing Impacts of Emerging Technologies
 - Economic Impact
 - Environmental Impact
 - Safety and Security, and etc..
- Critical for transition towards sustainable and resilient society
- Also need to ensure divergent values and well-beings
 - Democracy, human rights, equity and inclusiveness, etc..
- *Collingridge dilemma*
- Need for Anticipatory Governance for Responsible Innovation



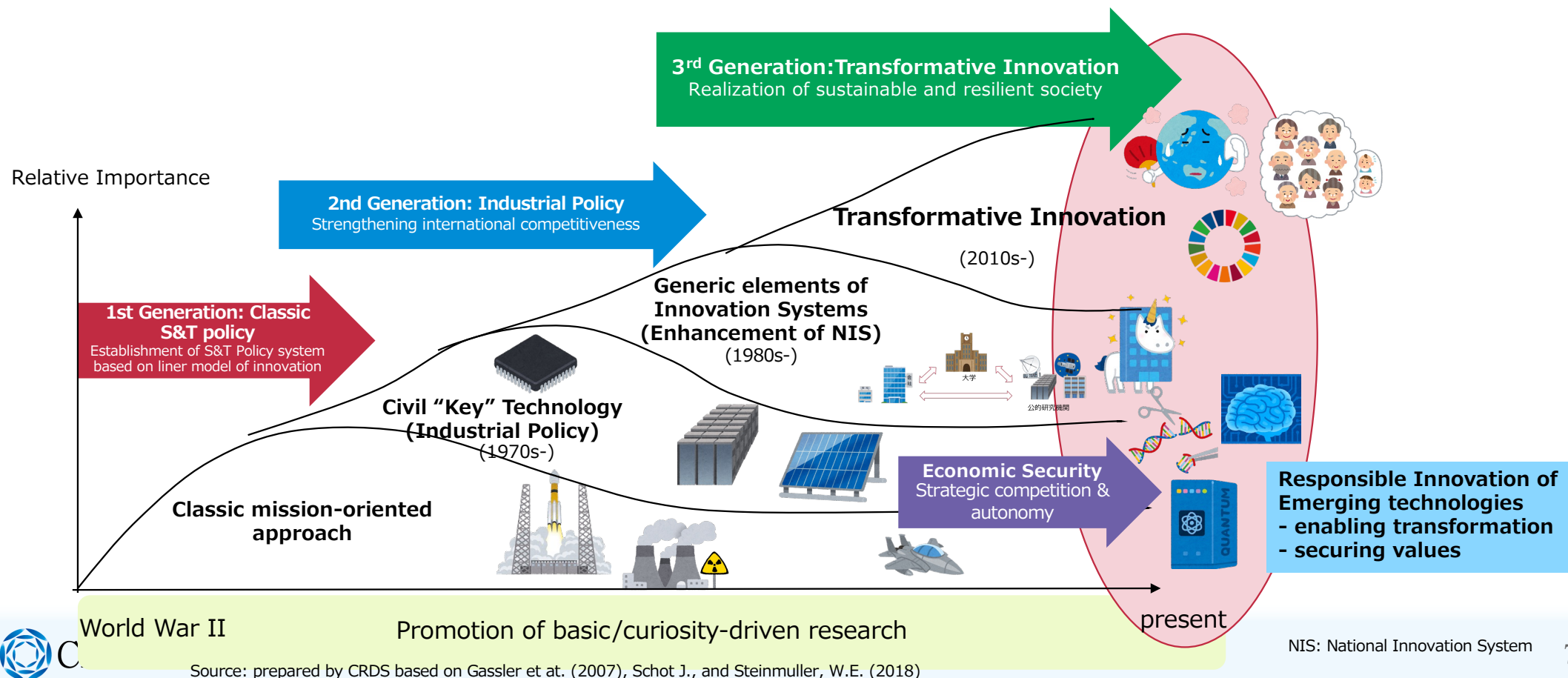
OECD established Global Forum on Technology as a international forum to share views on opportunities and risks presented by emerging technologies

Source:

<https://www.oecd.org/digital/global-forum-on-technology/>

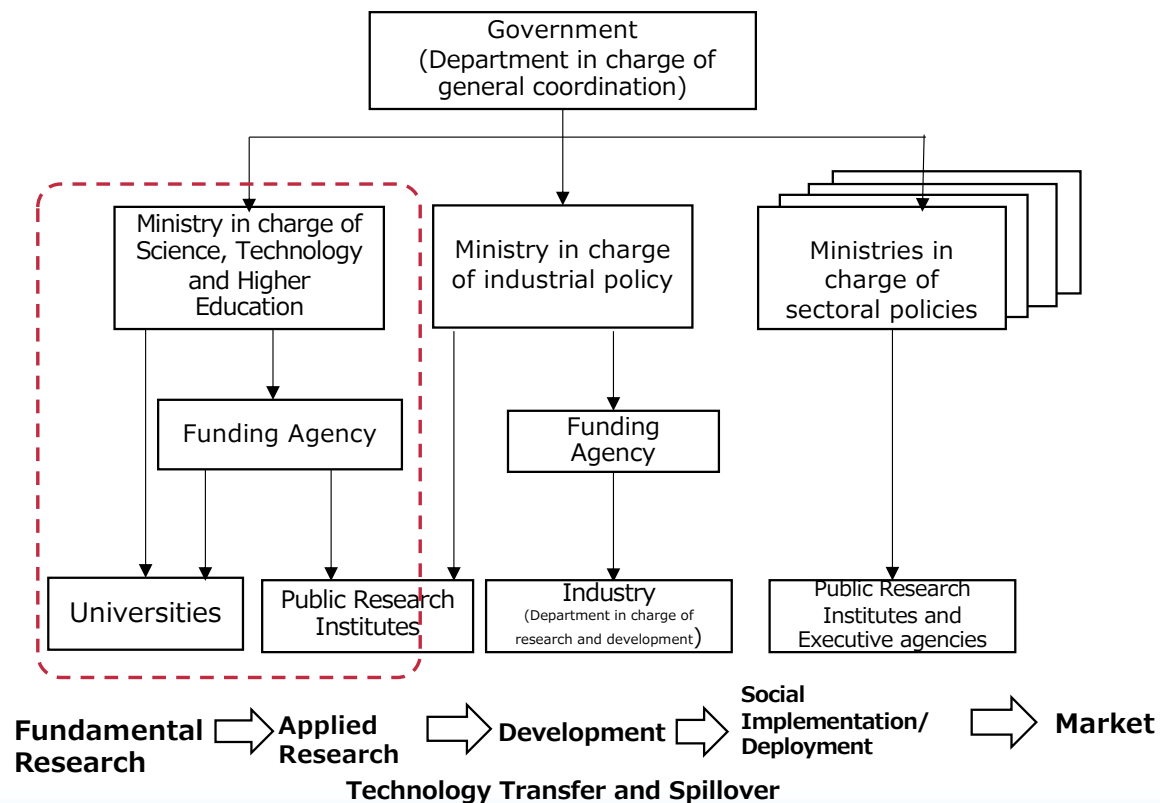
Expansion of Science, Technology and Innovation Policy Framework

- Historically, the **STI policy framework has expanded cumulatively** in response to socioeconomic and technological changes
- Policy targets, instruments, and systems change** accordingly.



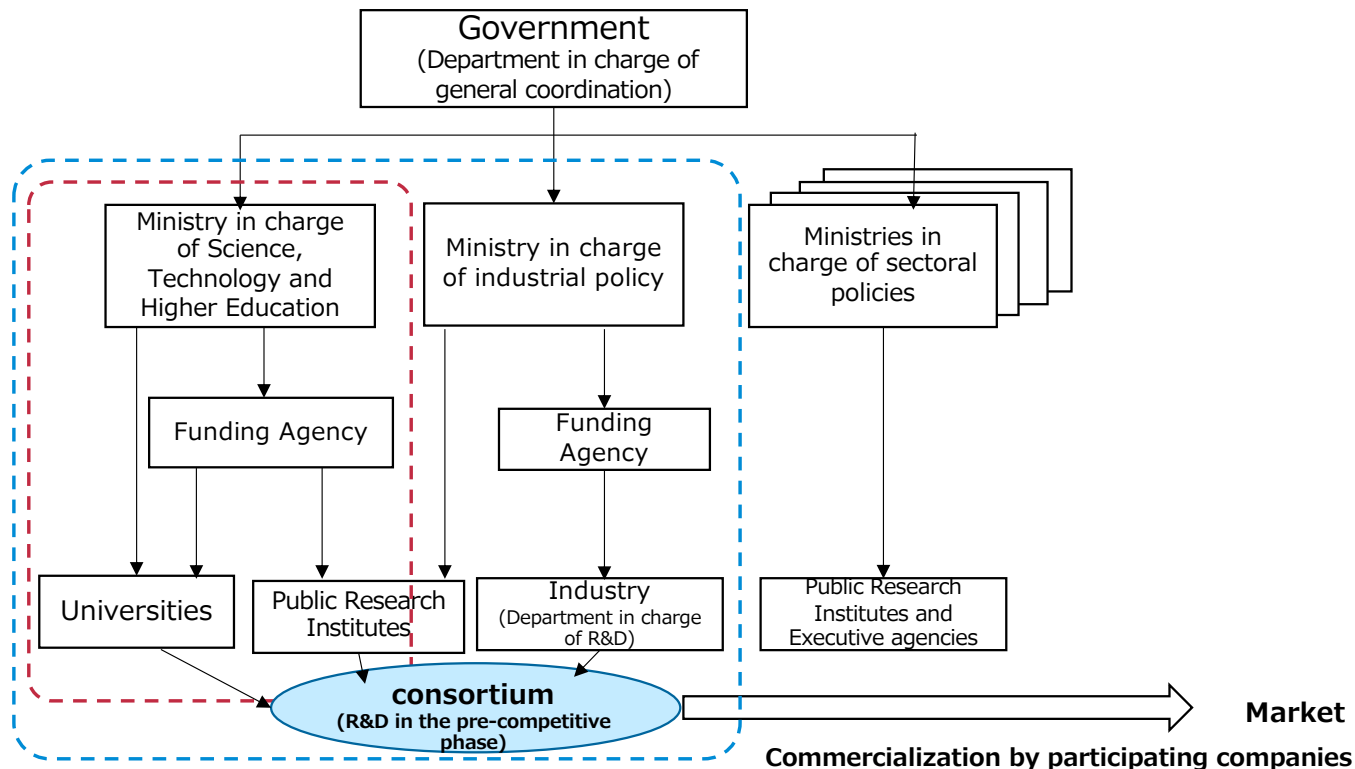
1st Generation: Classic S&T Policy (based on liner model)

- **Clear division of roles** based on knowledge and technology spillover
- Centered on ministries in charge of science and technology policy, public research institutions, etc.



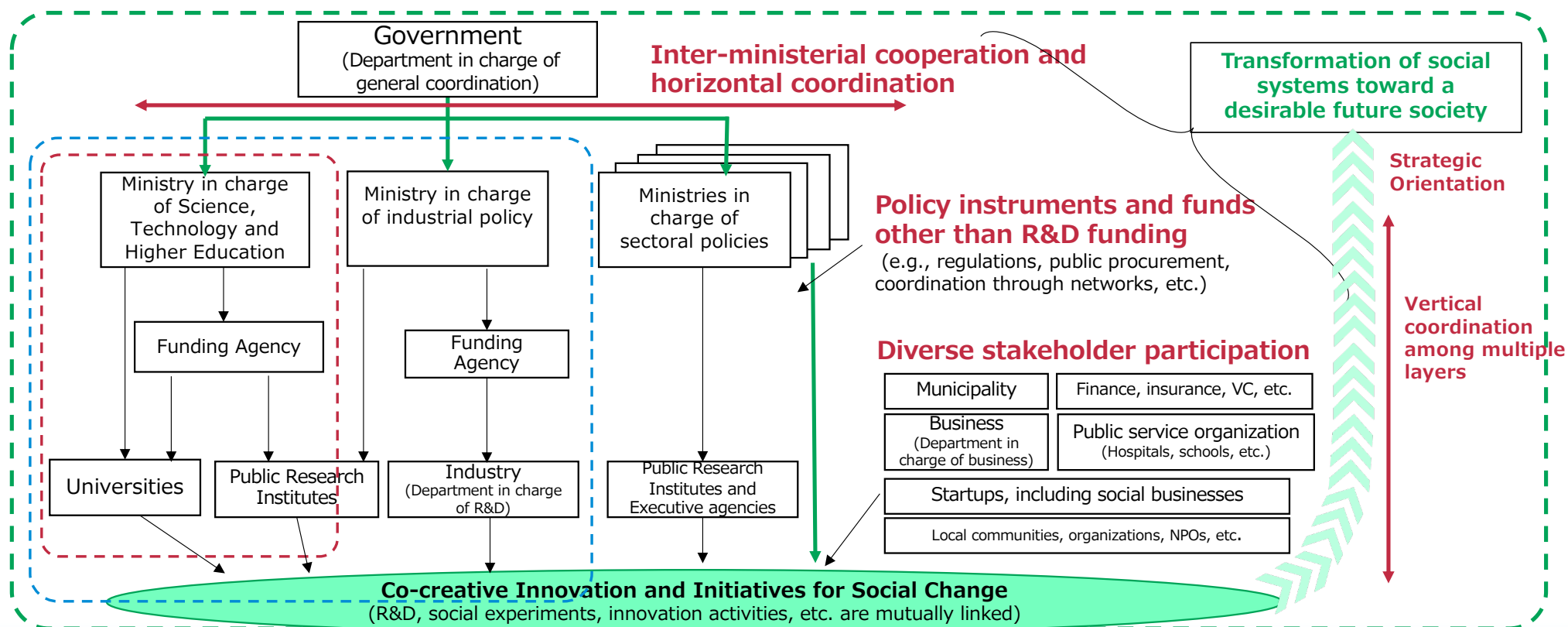
2nd Generation: Industrial Policy

- Collaborative R&D in the pre-competitive stage by industry-academia-government consortium and marketization by participating companies
- Strengthen the innovation system through industry-academia collaboration, strengthening of intellectual property rights, and support for start-ups



3rd Generation: Transformative Innovation Policy

- **Inter-ministerial collaboration**, including sectoral ministries, and **co-creation with various stakeholders**
- In addition to research and development, **use a variety of policy instruments and funds**



OECD S&T Policy 2025 Initiative

Requirements for a next-generation STI policy (Transformative STI policy) that responds to new social demands

NEW MODES OF INNOVATION

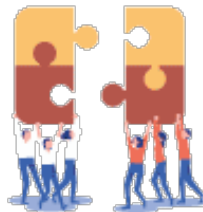


How to spur and deepen **STI cooperation** between firms, the public research system, governments, and non-profit sectors for transition?



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



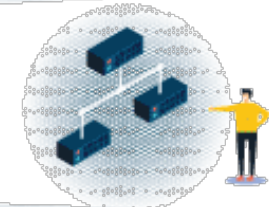
How to direct **private financing and public funding** to support transitions?

How to gear **infrastructures and enabling technologies** towards delivering transitions?



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

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



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

2. Mission-oriented innovation policy: a specific approach towards a social transformation

Mission-oriented Innovation Policy (MOIP) as a Policy Approach for the Realization of Transformative Innovation

Toward the realization of *Transformative Innovation*, science, technology and innovation (STI) policy needs to expand its framework.

- Comprehensive and complex approaches including policy measures of the sectoral ministries (goal setting, planning, and implementation)
- Connecting and coordinating numerous measures and projects of multiple ministries under a common goal



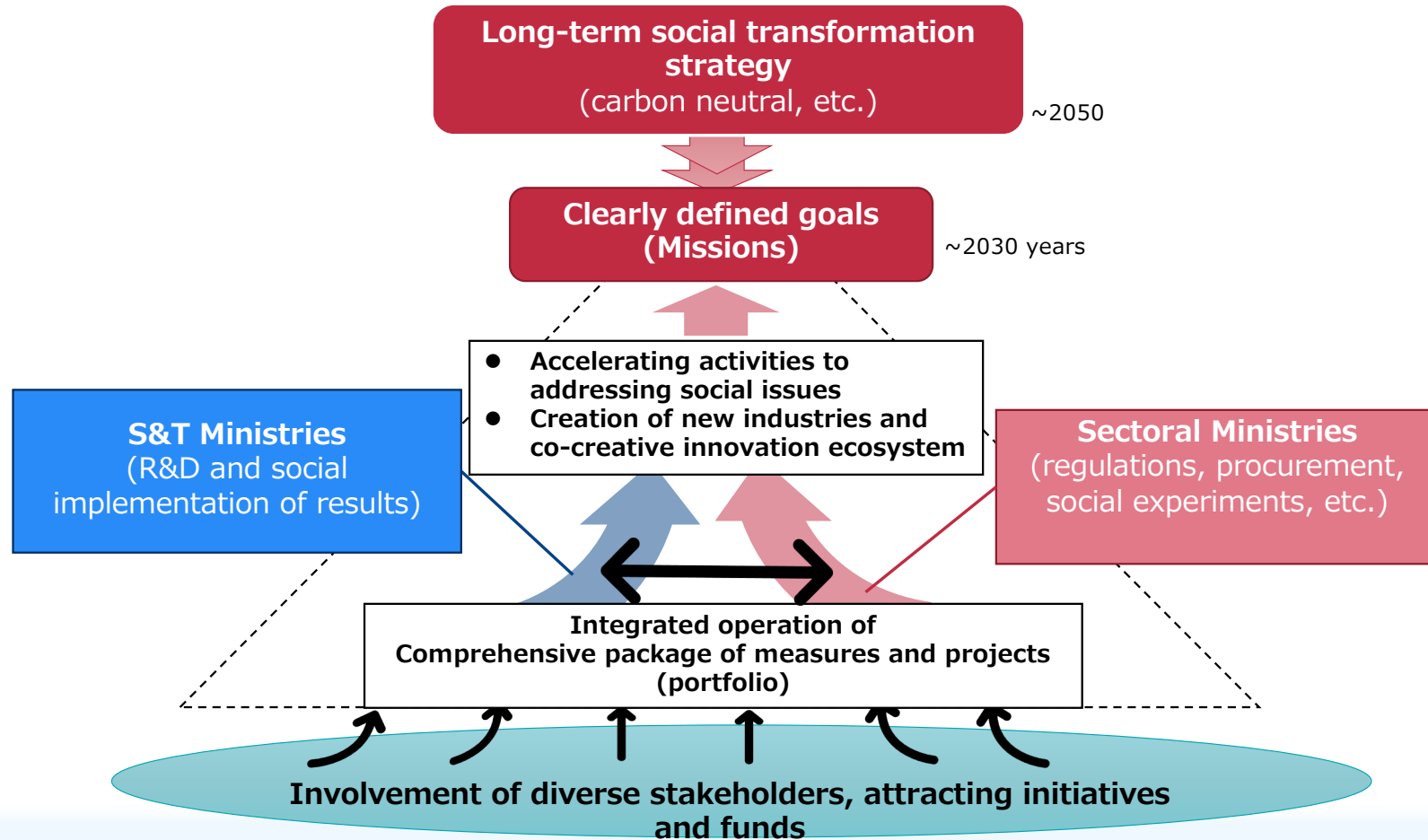
“Mission Orientation” as a specific policy approach for Transformative Innovation

- Setting clear achievement targets (missions) with timeframes for the realization of long-term strategies involving social transformation
- Integrated operation of a comprehensive package (portfolio) of diverse measures and projects
- Driving R&D results and innovation
- Involvement of diverse stakeholders and attraction of initiatives and funds

OECD's Definition of MOIP

“MOIP is a co-ordinated package of policy and regulatory measures tailored specifically to mobilise science, technology and innovation in order to address well-defined objectives related to a societal challenge, in a defined timeframe.” (Larrue, 2021,p.8)

Image of Mission-oriented Innovation Policy



MOIP Initiatives in Other Countries

Since the 2010s, the growing need for a new approach to social change has led many countries to focus on "mission orientation."

Countries are paying attention to "mission-oriented" approaches. The implementation stage is underway, including pilot initiatives.

- **The European Union (EU)** has set five missions in Horizon Europe (2021-2027)
- Introduced "mission-oriented approach" in STI strategies in European countries.
 - Germany: High-Tech Strategy 2025 (HTS2025)
 - Netherlands: Mission Driven Top Sector Strategy
 - United Kingdom: Mission-orientation in industrial strategy & national innovation strategy (under consideration)
 - Norway, Austria, Australia, etc.
- OECD : MOIPs Project and Cross-Departmental Initiatives

An official website of the European Union | How do you know? | English | Search

Home > Funding > Funding opportunities > Funding programmes and open calls > Horizon Europe > EU Missions in Horizon Europe

EU Missions in Horizon Europe

What missions are, the areas they will focus on, studies and reports that led to this approach, how to get involved and relevant events.

PAGE CONTENTS

- What are EU Missions?
- Making Missions happen
- How to get involved

What are EU Missions?

EU Missions are a new way to bring concrete solutions to some of our greatest challenges. They have ambitious goals and will deliver concrete results by 2030.

They will deliver impact by putting research and innovation into a new role, combined with new forms of governance and collaboration, as well as by engaging citizens.

HIGH-TECH STRATEGY 2025
Talents. Skills. Innovations.



Dutch missions for grand challenges
Mission-driven Top Sector and Innovation Policy



Information in English

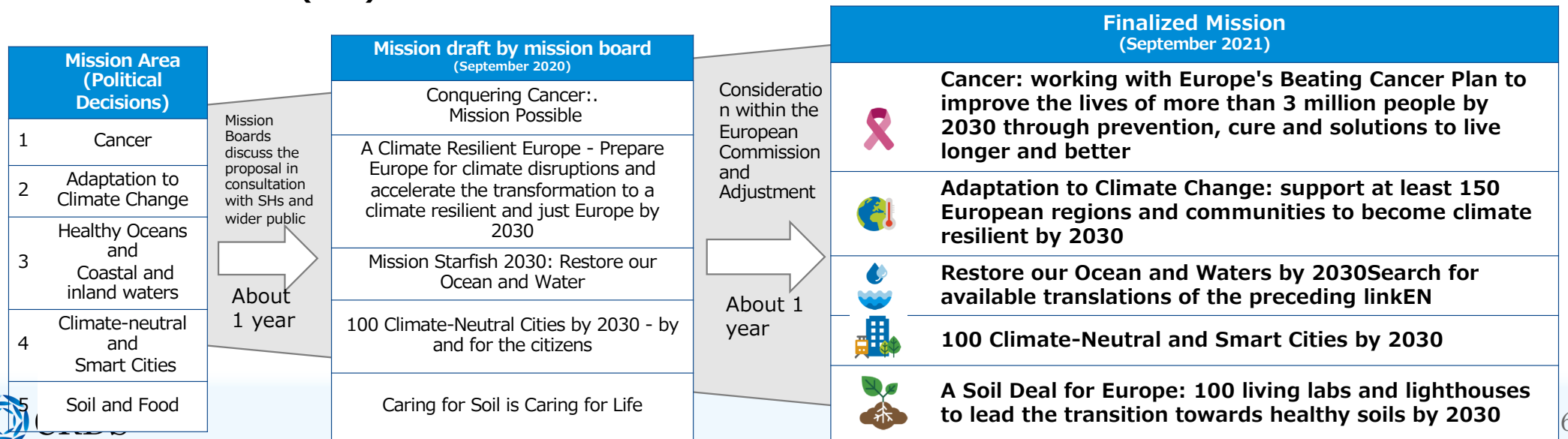
The PILOT-E scheme is a funding scheme for the Norwegian business sector launched as a collaboration between the Research Council, Innovation Norway and Enova SF.

Fast track from concept to market

The objective of the scheme is to promote more rapid development and deployment of new, environment-friendly energy technology products and services to help to reduce emissions levels in Norway and internationally. Calls for proposals under the PILOT-E scheme are targeted towards specific societal challenges, and the scheme is a good fit for larger concepts that address complex challenges ranging from research activity to commercial realisation. PILOT-E is designed to follow up participants throughout the entire technology development pathway - from concept to market.

EU Missions

- **Adoption of the Mission-Oriented Approach** in the **Research and Innovation Framework Program Horizon Europe (2021-2027)**
- **Five Missions to be achieved by 2030** to realize a sustainable social economy
- **Establishment of a cross-directorate structure across the European Commission** to promote research, innovation and solutions to societal challenges in an integrated manner.
- **Positioned as a means to realize a long-term strategy for Europe as a whole**, e.g. "European Green Deal," "Europe Fit for the Digital Age," "Beating Cancer," and "New European Bauhaus"
- **Coordination with the funds and initiatives of each member country, as well as with regional development funds (Cohesion Funds) and the investment and loans of strategies of the European Investment Bank (EIB)**



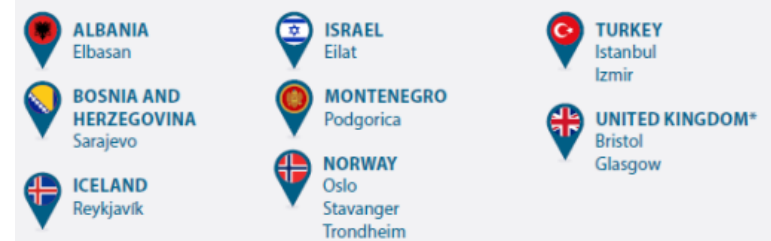
Selected Cities for Carbon Neutral and Smart City Mission

100 cities from EU Member States and 12 cities from Associate Countries were selected

Cities from EU Member States

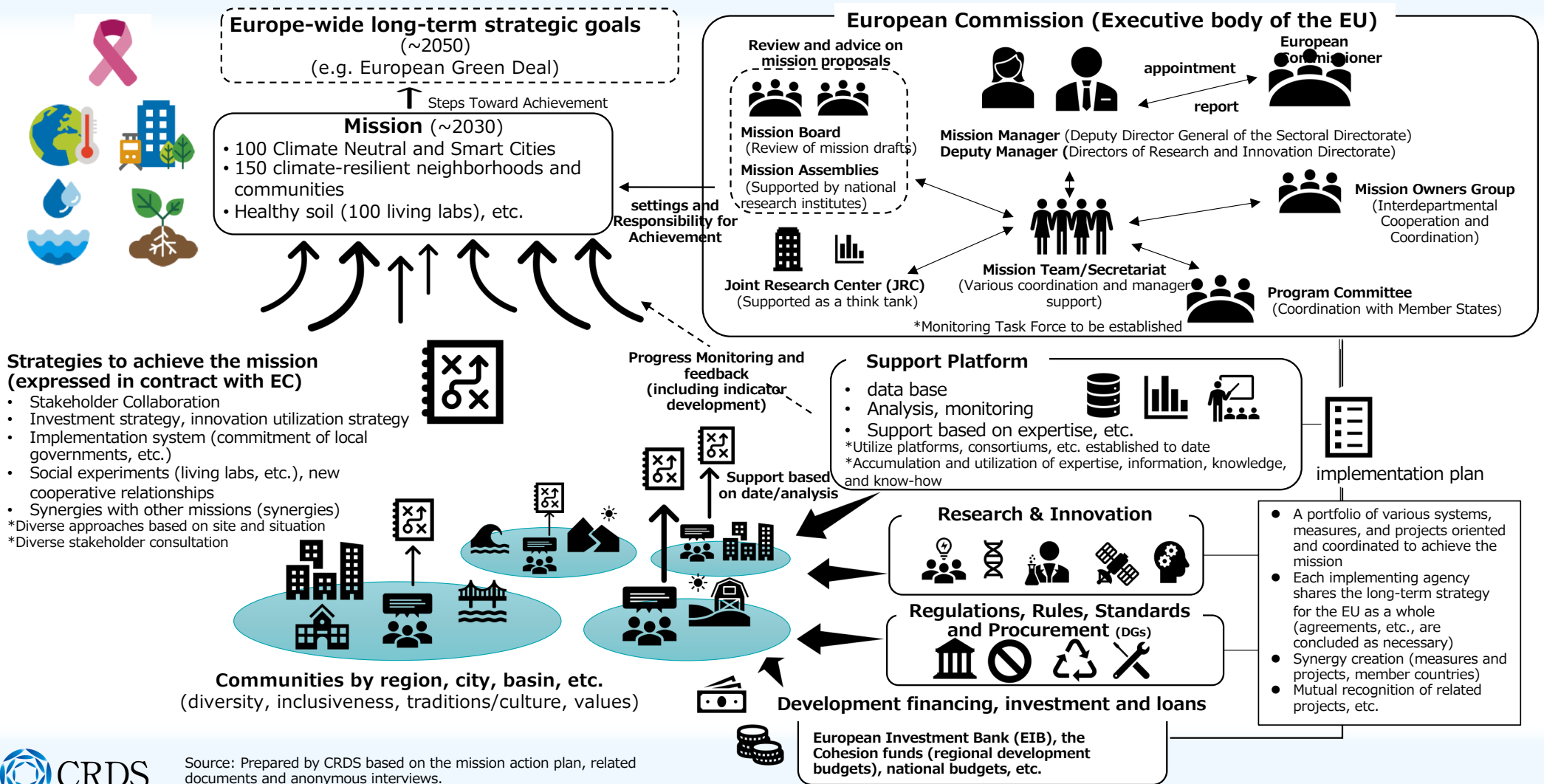


Cities from Associate Countries



Source: European Commission, Directorate-General for Research and Innovation, EU missions : 100 climate-neutral and smart cities, Publications Office of the the European Union, 2022, <https://data.europa.eu/doi/10.2777/191876>

Image of the implementation of the EU Missions



Source: Prepared by CRDS based on the mission action plan, related documents and anonymous interviews.

R&D programs to address social issues and Mission-oriented P&D Programs

Since the 2000s, many R&D programs have been implemented to address social issues

- Budapest Declaration(1999):“Science in Society, Science for Society”
- MEXT
 - [Research Institute of Science and Technology for Society \(RISTEX\)](#), Japan Science and Technology Agency (2001-)
 - [Science and Technology Research Partnership for Sustainable Development \(SATREPS\)](#) (2008-) (in collaboration with MOFA&JICA)
 - [Center of Innovation](#) (COI) (2013-2022)
- **Large R&D program led by the Cabinet Office (Mission-oriented R&D Programs)**
 - [Cross-ministerial Strategic Innovation Promotion Program](#) (SIP) (2014-)
 - [Moonshot R&D Program](#) (2019-)

[Case] Inter-ministerial and public-private partnerships and governance in the public-private ITS concept and roadmap and SIP automated driving systems (SIP-adus).

It is assumed that the following factors have contributed to the cooperation of the ministries in charge of the sector and the collaboration between the various stakeholders.

- **Changes in the international competitive environment** and the **sense of crisis among** car companies and related industries.
- **Need for change in regional transport systems** due to **depopulation, ageing population, etc.**, etc.

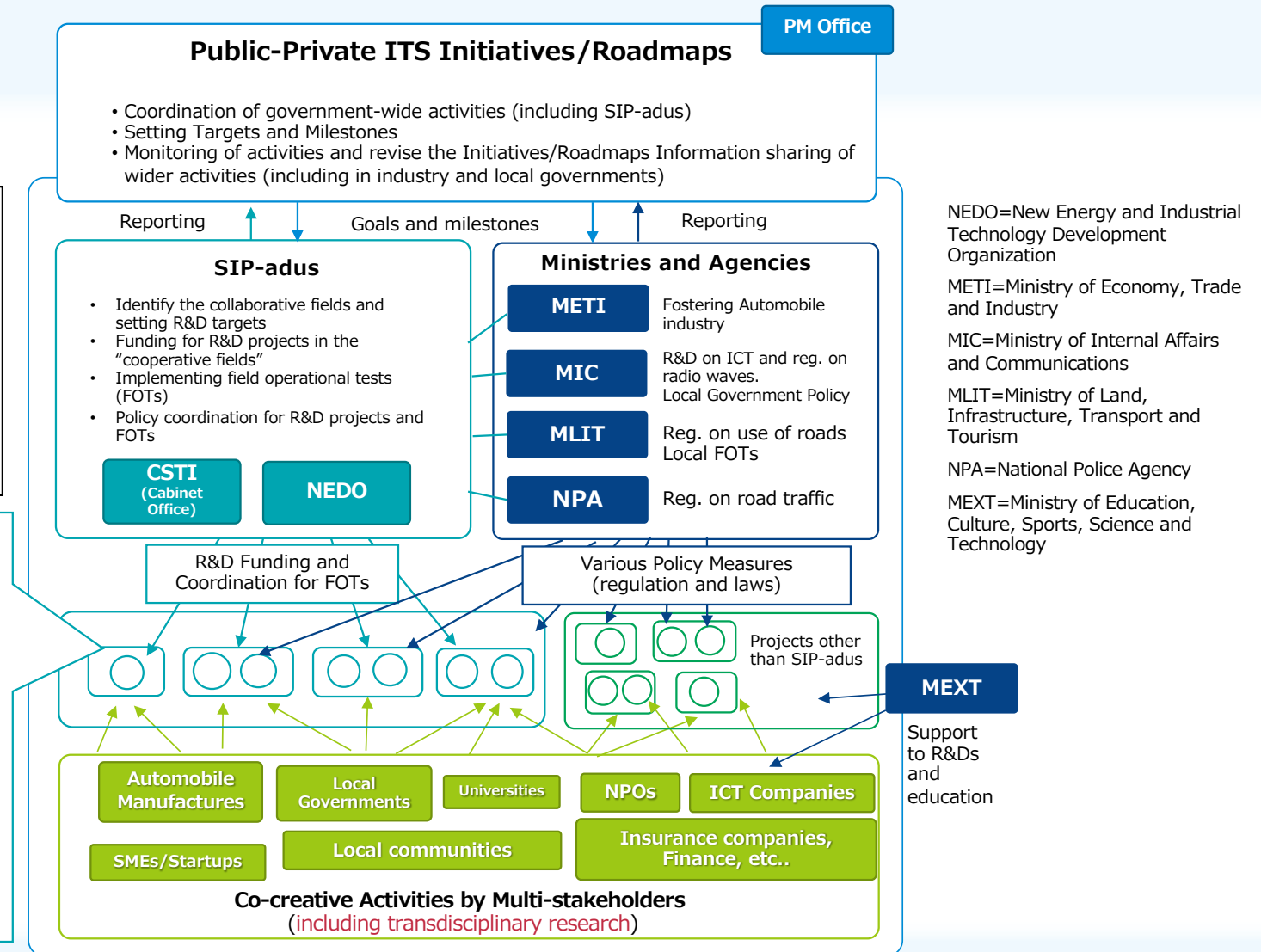
- **Can it generate similar movements?**
- **in the way it was intended.**
- **In other areas/issues.**

SIP implementation projects <Cooperation area>

Joint research and development
Demonstration test.

Themes

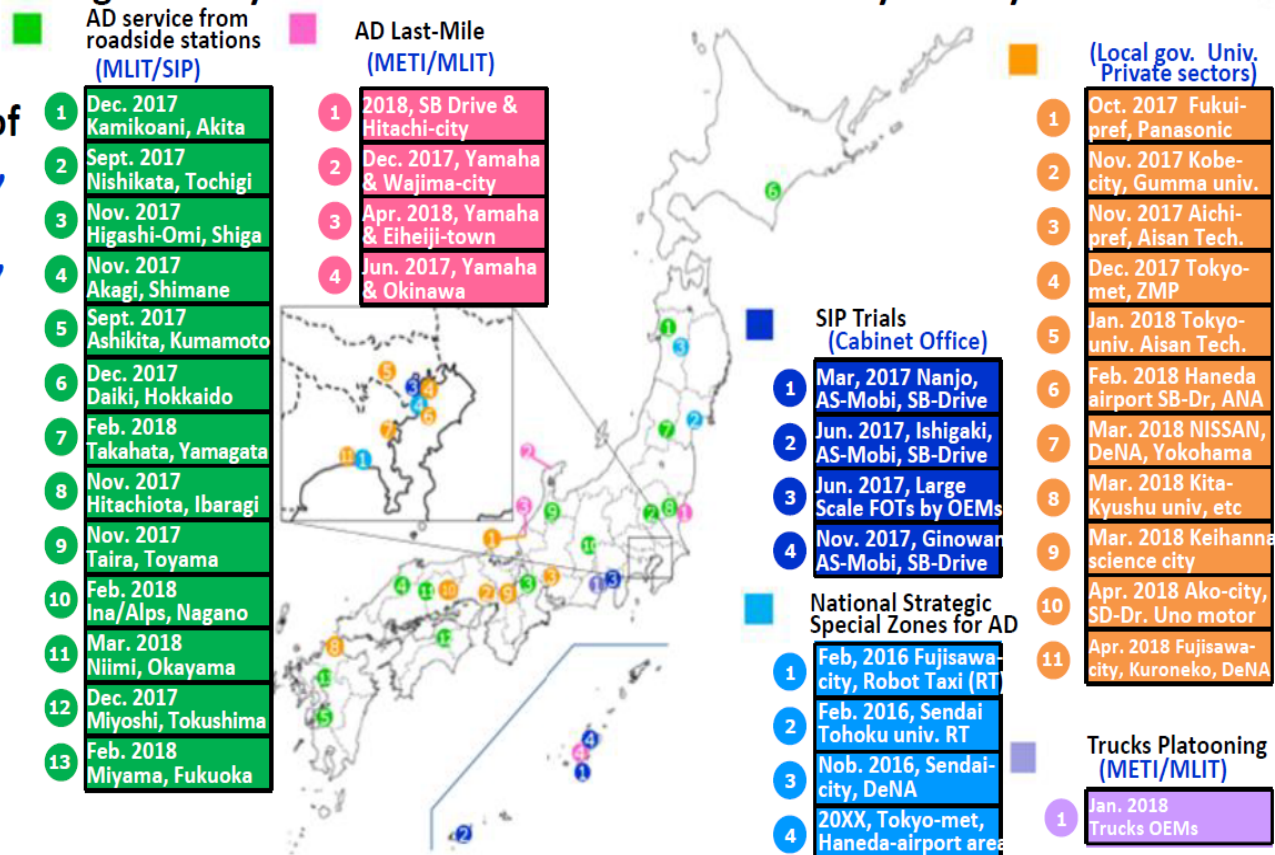
- ✓ Dynamic map
- ✓ Human Machine Interface
- ✓ information security
- ✓ Pedestrian accident reduction
- ✓ Next generation urban transport
- ✓ Safety assessment technologies in virtual spaces.
- ✓ Architecture construction for geographical data
- ✓ social demand fostering



Automated Driving System Field Operational Tests (FOTs) across Japan on going

➤ Automated Driving Mobility tests to create “Local Smart Mobility Society”.

by
collaboration of
-Government,
-Local
government,
-Academia
-Private
sectors.



3. Emerging technology governance

Emerging Technology Governance and Challenges to Japan

Emerging Technology Governance

- From the early stages (upstream) of the research and innovation cycle of technology,
- Envisioning the actual social application of the technology and the future society that it will bring about,
- In addition to research and development, various policy measures such as norms (values), regulations and rule-making, stakeholder participation and discussion, etc., should be coordinated and utilized,
- Promote research and innovation activities in a responsible manner

OECD technology governance framework

Process and measurers for Responsible Innovation

A framework in three layers

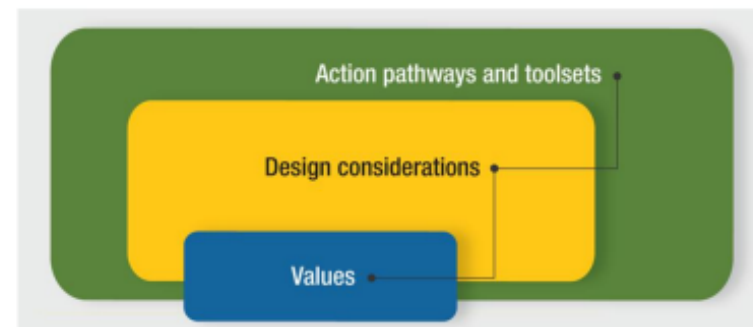
I. **Layer 1: Values** (2 types: foundational and tech-specific)

II. **Layer 2: Design considerations**

- I. Alignment
- II. Anticipation
- III. Agility
- IV. Engagement of stakeholders and society
- V. International cooperation

III. **Layer 3: Action pathways and toolsets** (annex)

- I. Deepening strategic intelligence
- II. Embedding values upstream in the innovation process
- III. Engaging society and stakeholders
- IV. Developing guidelines and regulation

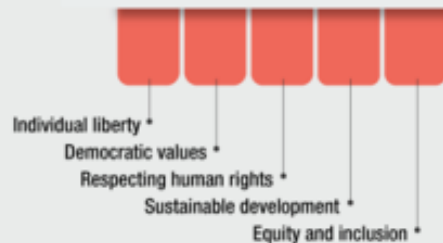


OECD technology governance framework: Values

Values layer: anchoring the framework

Foundational values

- express **shared commitments** to certain ideals of ethical, political, economic or cultural importance
- **“shared values” of the OECD community**, found in collective public declarations of the OECD



Context-specific values

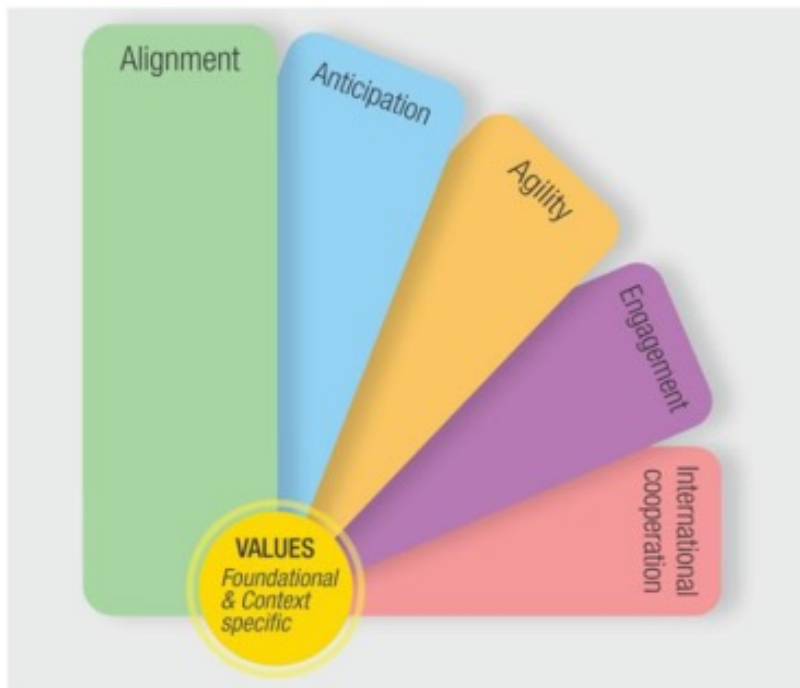
- derived from **existing OECD Recommendations**
- intended to **guide policy decisions** at specific points in time.
- provide a **moral and political basis** for the priorities and trade-offs that are a feature of all technology governance decisions.



OECD technology governance framework: Design Considerations



Layer 2: Design considerations for technology governance systems



Alignment

align tech development with institutional and social **values** to maximise benefits of innovation & produce more support among stakeholders and in society.

Anticipation

anticipatory approaches and **strategic intelligence** enable the **upstream** identification of desirable future outcomes, potential risks, risk-benefit trade-offs and dilemmas.

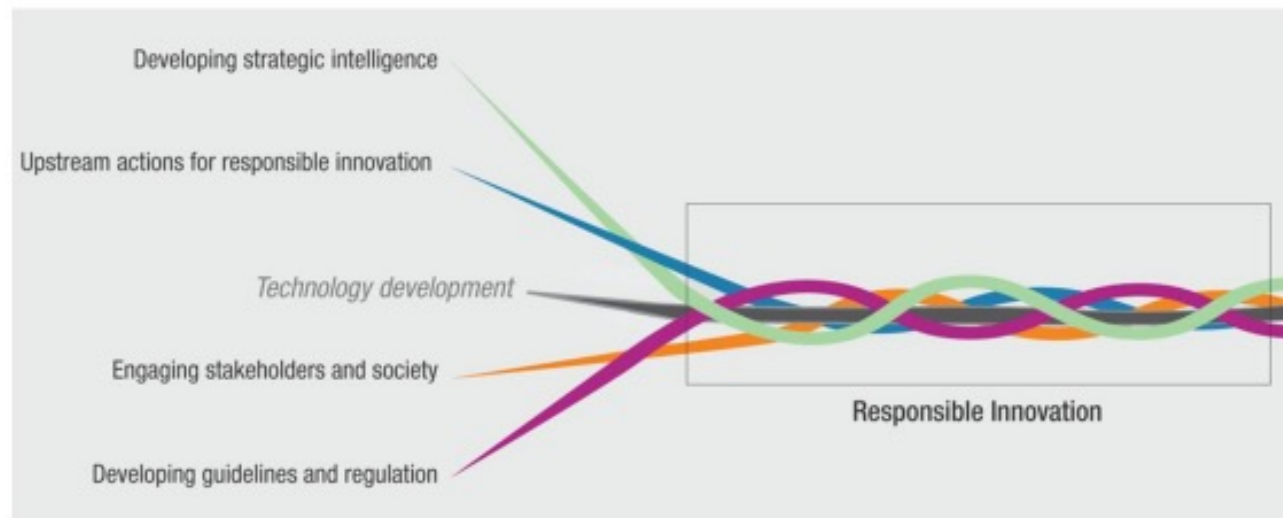
Agility

Involves adaptivity, innovation-friendly approaches like **continuous learning**, **iterative evaluation** and **experimental** tools.

OECD technology governance framework: Pathways



Layer 3: Interconnected action pathways and toolsets



- **Sequences of policy action** to guide innovation actors to apply and implement the design considerations that help advance the process of developing technology responsibly (annex)

Cases in Japan

While it is possible to establish a policy framework for promoting initiatives that are consistent with key strategies in Japan, there are also cases where this is not the case

- **AI**
 - In collaboration with the OECD, launched the AI Principles and the [Global Partnership on AI \(GPAI\)](#).
 - Also proactively promoting rule making, such as the [Hiroshima Process](#).
 - In Japan, the AI Strategy Council has been established and a framework for collaboration among ministries is in place.
- **Synthetic Biology/Engineering Biology**
 - Coordination structure and policy community among Cabinet Office and ministry departments also exist in the context of "bio-manufacturing" and "bio-economy".
- **Neurotechnology**
 - There are academic association organizations and consortiums of private companies. On the other hand, coordination structure within government organizations are unclear at this time.
 - Example: Moonshot R&D Goal 1: Internet of Brain Project "[NeuroTech Guidebook](#)" and "[NeuroTech Evidence Book](#)" were created and published.
- **Quantum technology**
 - The stage is just beginning. [Leading initiative](#) of ELSI Center, Osaka University. Future plans include efforts under Moonshot Goal 6.
 - Overseas, the [World Economic Forum](#) and other organizations have published reports.

Emerging Technology Governance and Challenges to Japan

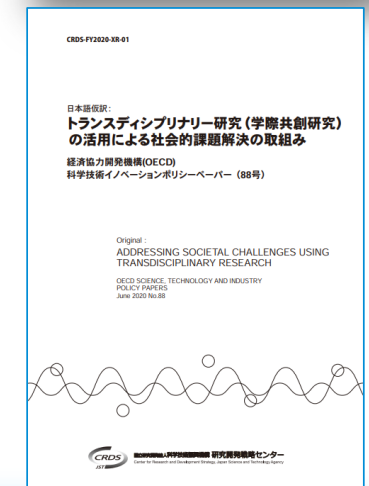
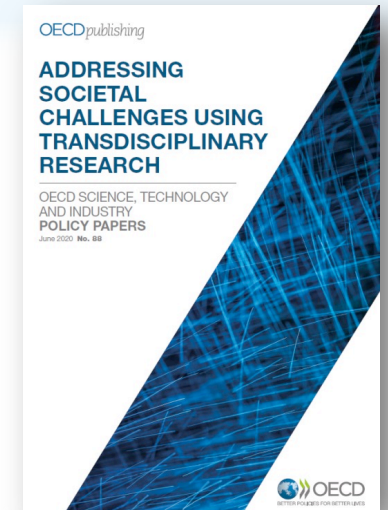
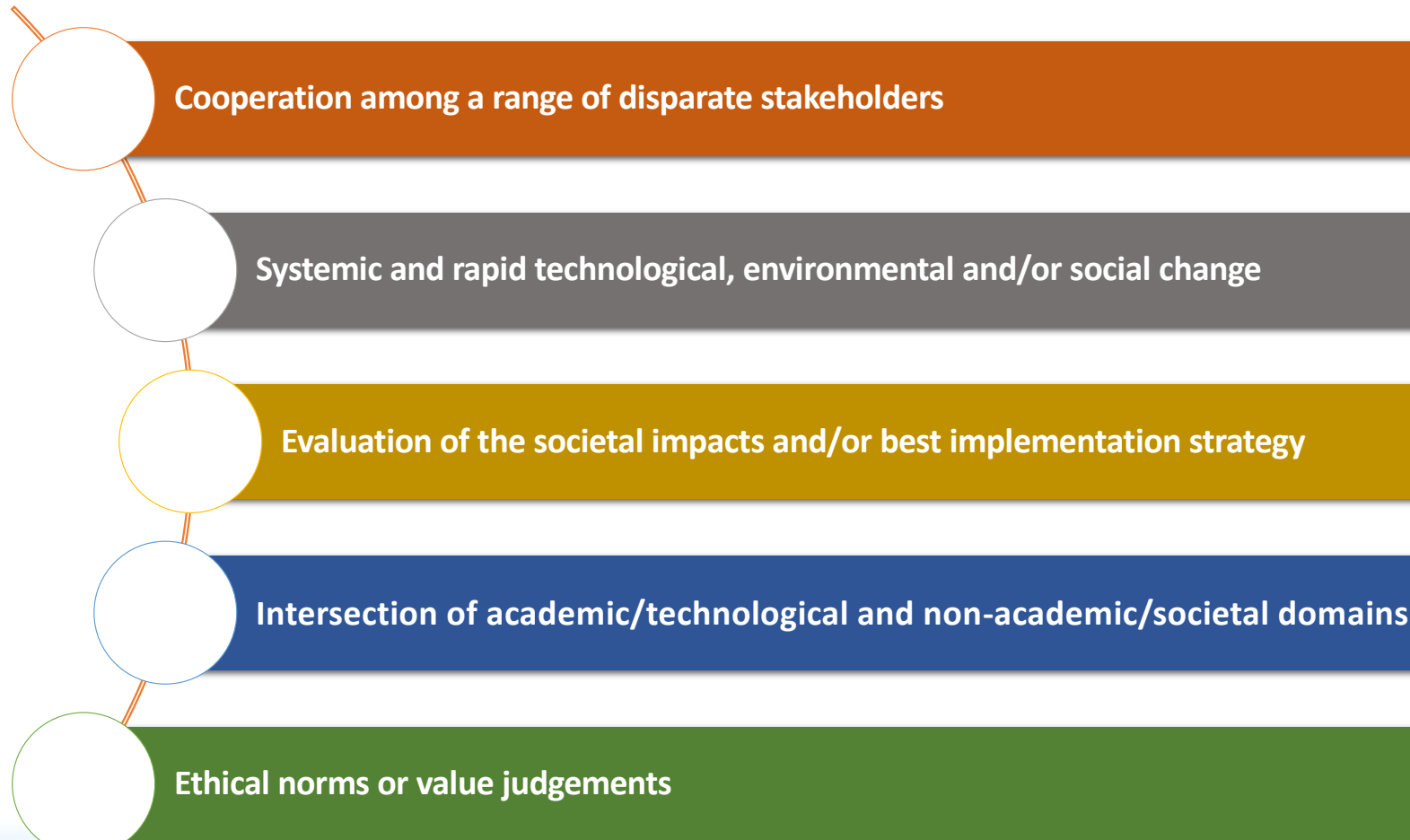
Issues in Japan's context

- Necessity to tackle problems proactively before they become apparent
- Closely related to international norms and standards, and directly linked to the international competitiveness of the industry
- Importance of norms and values
- Whole-of-government approach
- Collaboration and engagement with various stakeholders and citizens (transdisciplinary activity)

4. Implications for transdisciplinary research and education

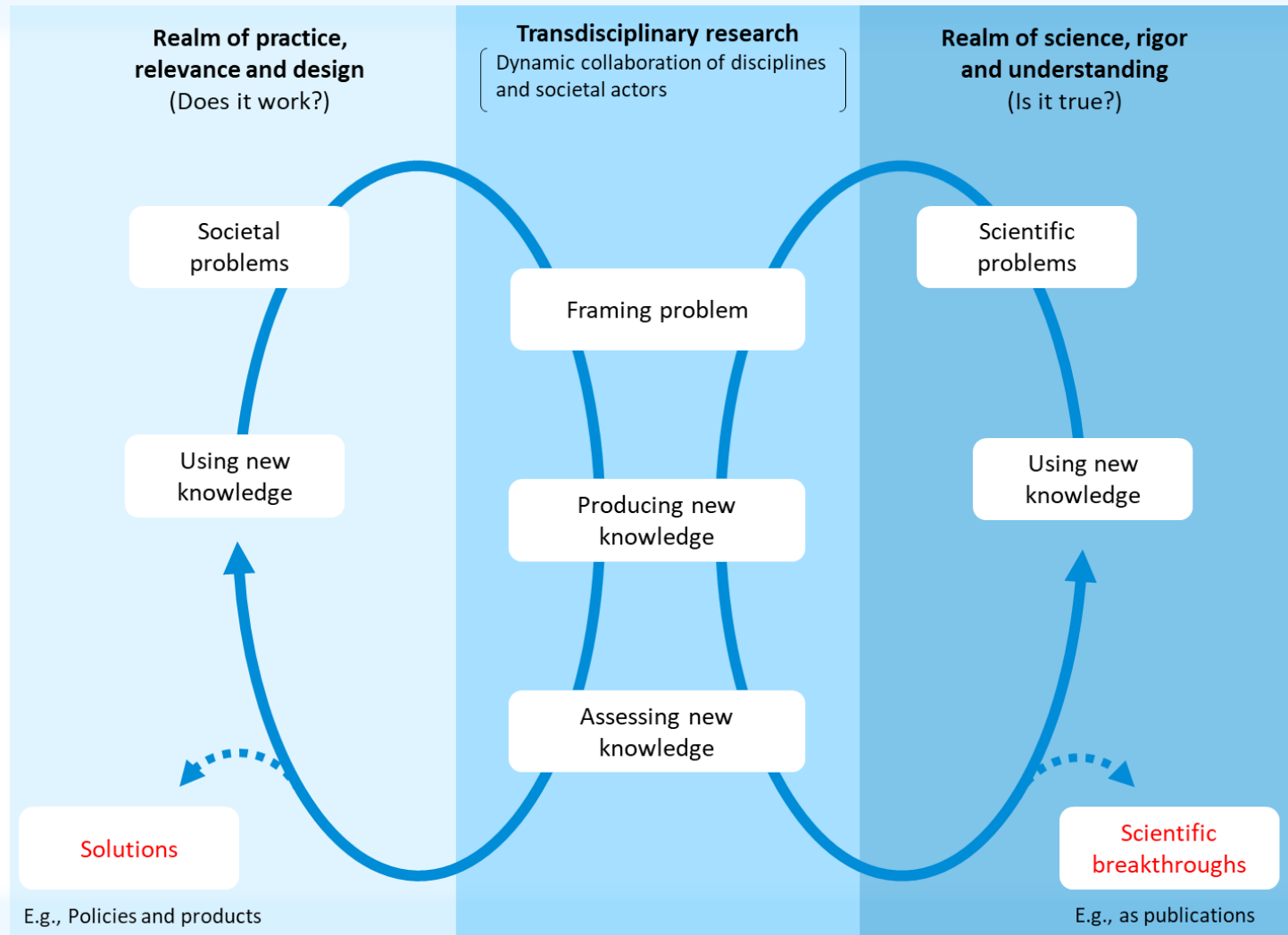
Issues need for transdisciplinary approach

(OECD, [Addressing societal challenges using transdisciplinary research](#), 2019)



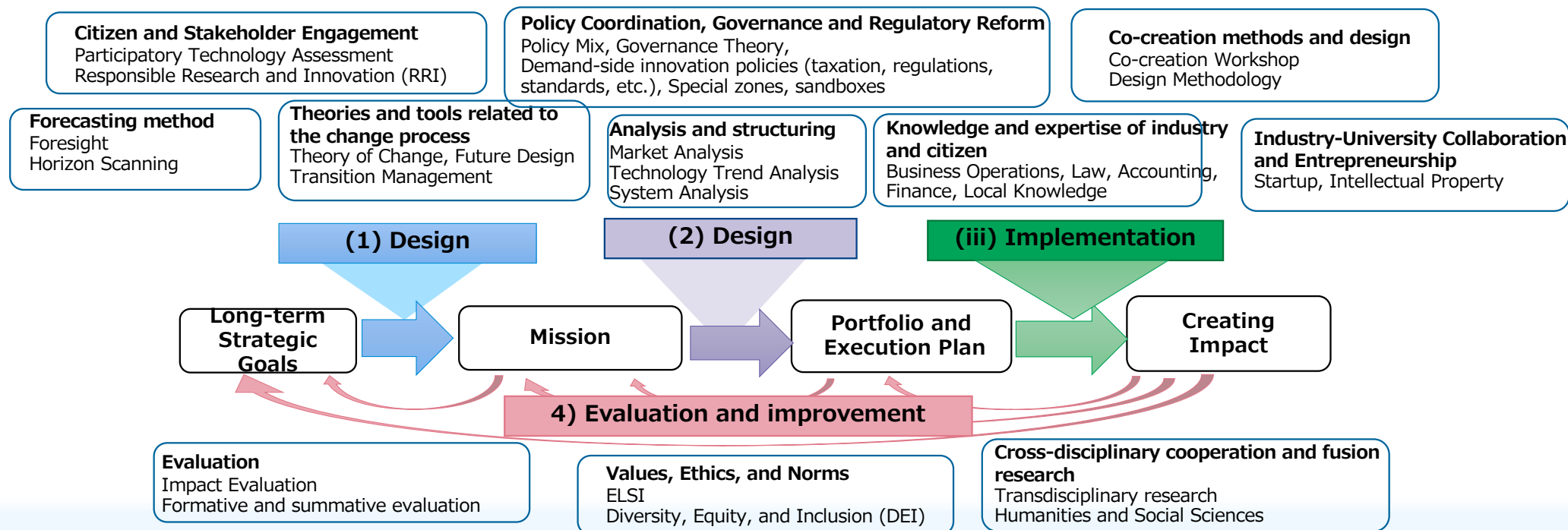
[Japanese translation](#)

Cycle of Transdisciplinary research (OECD, 2019)

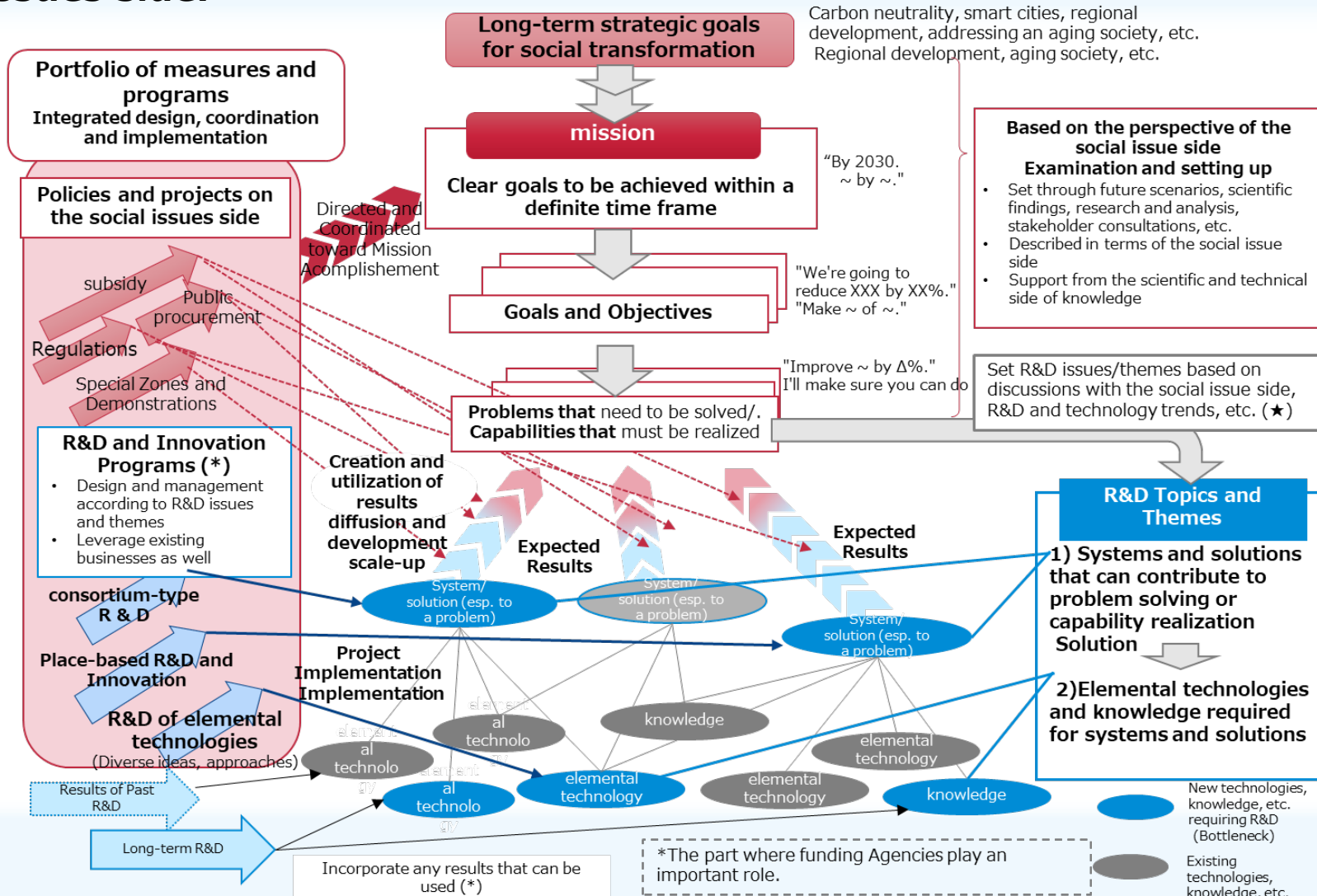


Expertise, knowledge and tools involved in promoting mission-oriented STI policies.

- **Design and implementation of mission-oriented STI policy** requires **bringing together the various knowledge and methods related to STI policy to date**
- Use of knowledge from the **humanities and social sciences, new knowledge** and **development of methodologies and tools are also needed** (e.g., the EU framework plan supports the development of various methodologies and tools, which may be used in the next plan)
- **Research institutes and expert groups** support the process of implementing EU and national missions



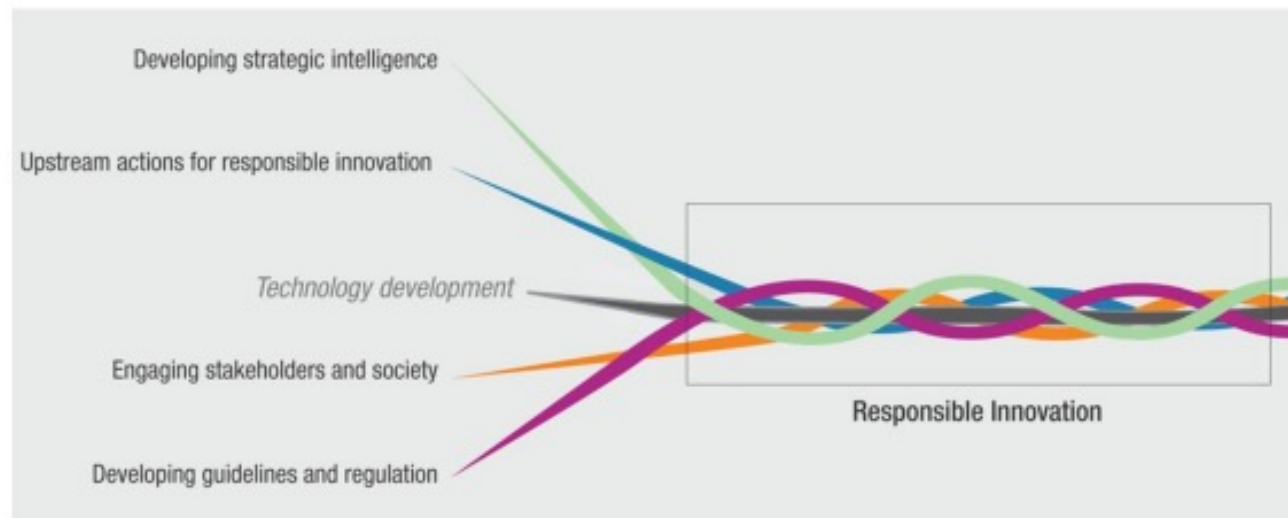
Research and development in mission-oriented STI policy: approaches from the societal issues side.



OECD technology governance framework: Pathways



Layer 3: Interconnected action pathways and toolsets



- **Sequences of policy action** to guide innovation actors to apply and implement the design considerations that help advance the process of developing technology responsibly (annex)

Implications for transdisciplinary research and education

- Expansion of the framework to a transformative STI policy requires new governance mechanisms and styles of research and innovation activities
- As shown in the MOIP and technology governance cases, the following matters are of particular importance;
 - ✓ Collaboration among a wide range of stakeholders and the establishment of common goals,
 - ✓ Collaboration across disciplines and organizational boundaries,
 - ✓ Reflecting diverse values in activities,
 - ✓ Learning through practice, and etc..
- These are exactly in line with the requirements for transdisciplinary research and human resource development for such research