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Aligning smart specialisation with transformative innovation policy

Lessons for implementing challenge-led missions in smart specialisation

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JRC SCIENCE FOR POLICY REPORT

Aligning smart specialisation with transformative innovation policy

Lessons for implementing challenge-led missions in smart specialisation

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2023

TABLE OF

Contents

ABSTRACT

The report provides guidance on applying a mission-oriented approach to smart specialisation strategies (S3) to address societal challenges and achieve the sustainable development goals (SDGs). Challenge-led missions are systemic frameworks that help align S3 with ambitious societal goals, and provide strategic direction to the implementation of policy instruments and projects mobilised through S3. The report focuses on areas relevant to mission implementation, including framing challenge-led missions, designing policy mix for missions, developing concrete practises to support mission implementation, and adapting the monitoring and evaluation system. The authors propose mission-oriented roadmapping framework to improve the coherence and directionality of policy instruments and processes mobilised through missions. The report was prepared in close cooperation with policy makers from the Czech Ministry of Industry and Trade responsible for the Czech national S3 strategy. The publication is aimed at policymakers in Europe and beyond who are responsible for designing and implementing innovation policies that address sustainability challenges and goals such as the SDGs.

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The process benefited from numerous contributions and reflections of many Czech stakeholders involved in shaping and developing the Czech RIS3 strategy. We would like to extend our gratitude to colleagues at the Technology Agency of the Czech Republic (TACR): Eva Brožová (Deputy Director for Strategic Development, formerly leading RIS3 Team), Petr Matolín, Baya Barbora Nuňez, and Zbyněk Růžička. We would also like to thank Michal Pazour and Inka Vaverková at the Technology Centre Prague for their valuable inputs.

We would like to warmly thank colleagues from DRIFT (The Dutch Research Institute for Transitions), Dirk Lorbach, Gijs Diercks and Meno Zahn, for organising and running a series of stakeholder workshops on transition management which introduced the core concepts and tools of transition management to the Czech stakeholders.

We would like to thank participants of the 'Peer-to-peer policy workshop on the implementation of STI for SDGs roadmaps in Czechia, Serbia and Ukraine' held at the Ministry of Industry and Trade of Czechia in Prague on 8 December 2022. The initial findings of the project were presented at the ESPON seminar 'Entrepreneurial regional governance: Territorial cohesion through open innovation' on 7-8 October in Prague.

The collaboration process with the Czech government has benefited from the engagement of JRC colleagues at the Territorial Development Unit, notably Alessandro Rainoldi, Mark Boden, Kateřina Ciampi Stančova (now the OECD), Monika Matusiak, and Angela Sarcina. The report greatly benefited from comments and suggestions provided by JRC colleagues from other Units.

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AUTHORS

Alasdair Reid, Fred Steward, Michal Miedzinsk

FOREWORD BY THE JRC

European countries and regions face unprecedented environmental and social challenges. This requires urgent and concerted responses from policy-makers at all governance levels.

The Joint Research Centre (JRC) plays a unique and vital role within the European Commission, bringing science and policy together to provide a robust foundations for long-term policy strategies and decisions. The JRC has a key role in providing the knowledge for policies and translating it into an evidence base for new generations of policies fit for the ambition of the European Green Deal (EGD) and the UN Sustainable Development Goals (SDGs).

In 2018, the JRC launched a work stream focused on embedding the sustainability dimension and the SDGs in smart specialisation strategies (S3). This new conceptual framework and methodological approach was designed to assist territories in localising sustainability challenges and to provide guidance and concrete examples on how to reorient S3 and other place-based innovation strategies to contribute to green and digital transition across Europe and beyond.

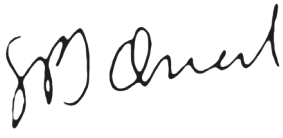
This new approach is at the core of a new policy initiative co-led by the JRC and the Committee of the Regions (CoR): the Partnerships for Regional Innovation (PRI). PRI came as a response to the urgent call of the EGD to address the challenge of climate change. The initiative adopted a broad and systemic framing of innovation and innovation policy to respond to urgent and emerging societal challenges in different territorial contexts across European regions.

In view of our ongoing work, the JRC was honoured to receive a request from the Czech Ministry of Industry and Trade to cooperate with the JRC researchers and experts to embed a mission-oriented approach into their S3. We were delighted to have an opportunity to work closely with the Czech colleagues to provide evidence, examples of existing policy practice and expert advice supporting design and implementation of S3 missions.

The present report is one of the outputs of a yearlong collaboration between JRC researchers and independent experts who engaged in a collaboration with the Czech National S3 Team and stakeholders. The report provides an account of some of the important ongoing policy learning and action research processes, including numerous formal and informal exchanges and discussions involving policy practitioners from Czech Republic and many other European countries and regions.

I hope the report represents a useful contribution for policy makers and analysts across European countries and regions engaged in design and implementation of a challenge-oriented innovation policy.

Stephen Quest
Director-General, Joint Research Centre (JRC)



FOREWORD BY THE CZECH MINISTRY OF INDUSTRY AND TRADE

Mission-oriented approach becomes an integral part of the Czech S3 Strategy

Mission-oriented innovation policy has become an important element in the implementation of the Czech Smart Specialisation Strategy (S3). S3 missions are designed to contribute to addressing major societal challenges and trends through research and innovation, with a strong emphasis on the Sustainable Development Goals (SDGs). The preparation of mission development methodology, however, is a demanding discipline and requires the involvement of domestic and foreign experts.

We are honoured to have been approached by Joint Research Centre (JRC) to participate on the EU pilot project concerning the STI Roadmaps for SDGs. We take it as an acknowledgement of our recent work on the upgrade of the Czech National S3 Strategy 2021+ and its newly highlighted drive towards sustainability and societal challenges.

An important political consensus of cross-ministerial support has been gained for the initial S3 missions 'Improving the material, energy and emissions efficiency of the economy' and 'Strengthening society's resilience to security threats'. We are currently in the phase of implementing the two already defined S3 missions into instruments for financing projects, which are expected to combine synergies and values of technological, systemic, social sciences and humanities solutions. Applying agile approach in our national and regional entrepreneur discovery process (EDP), we work on to improve place-based linkages of S3 missions within specific regions or localities and also to develop the governance, monitoring and evaluation. I perceive the necessity of continuous scanning of the evolution of societal challenges and megatrends and the real-time assessment of their urgency for the Czech Republic and S3, to keep evidence-based approach enabling timely response, possibly indicating further S3 missions.

In 2020, the Ministry of Industry and Trade started to work together with the JRC's Territorial Development Unit on the Smart Specialisation for SDGs approach, now considered as one of the tools for the Regional Partnerships for Innovation (PRI). We highly appreciate the long-term co-operation with JRC. This framework study provides us with a valuable theoretical background for the methodology of mission development. It includes missions framing, addressing sustainability challenges, concrete measures and practices to support mission implementation, adjusting monitoring and evaluation system and proposal for a mission-oriented roadmapping framework as a tool helping to ensure coherence and directionality of policy strategies, instruments and processes supporting S3 missions. We appreciate the examples of relevant international experiences from European countries and regions.

I believe that combining the S3 approach with the mission-oriented approach will result in a path-breaking outcome which could be scaled-up later on and provide an excellent example of best practice also for other EU countries. I appreciate the expertise of colleagues from JRC and invited independent experts. Practical expert knowledge is one of prerequisites of the success of the pilot exercise. Moreover, the whole National S3 team enjoyed the excellent personal communication with the JRC team and experts and we look forward to continuing mutually beneficial and enriching collaboration.

Petr Očko
Deputy Minister for Digitalisation and Innovation,
Ministry of Industry and Trade of the Czech Republic

EXECUTIVE SUMMARY

Countries and regions in Europe increasingly engage in new approaches to research and innovation policies aiming to address societal challenges and ambitious sustainability goals. This is partly in response to the increasing gravity and urgency of these challenges experienced across Europe and partly driven by EU and international policy strategies, notably the European Green Deal (EGD) and the UN 2030 Agenda.

In recent years, smart specialisation strategies (S3) have emerged as an important testing ground for new generations of challenge-oriented research and innovation policies. National and regional governments – including Czechia featured in this report – use smart specialisation as a policy space to experiment with and implement new approaches to support transformative innovation and leverage system change towards sustainability.

In 2018, the Joint Research Centre (JRC) started developing a new challenge-oriented approach to S3 to align it with the ambitions of the EGD and the Sustainable Development Goals (SDGs). Based on the literature review and co-creation with S3 practitioners, JRC proposed a framework for reflection for policymakers on how to embed sustainability goals in the S3 process. The S3 for SDGs approach is now among key approaches supporting the Partnerships for Regional Innovation (PRI) - a new voluntary policy initiative on transformative innovation policy co-led by the JRC and the Committee of the Regions.

Scope of the report

This report focuses on the development and application of a transformative mission-oriented approach to S3 to reorient it towards societal challenges and strengthen its directionality towards the SDGs. Transformative missions are systemic policy instruments that give S3 a stronger strategic direction, and help orchestrate and implement policy instruments and project portfolios mobilised by S3.

The reports draws on the Czech experience in embedding mission-oriented approach to their national S3. The Czech Government requested to cooperate with the JRC on smart specialisation for the SDGs methodology in June 2021 in the context of their newly revamped National RIS3 Strategy 2021+. The Czech S3 emphasised the importance of sustainability challenges in line with the EGD and the UN 2030 agenda and pioneered a mission-oriented approach to strengthen the directionality of the strategy.

The report focuses on the areas relevant for the implementation of missions, including framing challenge-led missions, designing policy mixes for S3 missions, developing concrete practices to support mission implementation, and adjusting monitoring and evaluation system to support transformative S3 missions. It puts forward a proposal for a mission-oriented roadmapping framework as a tool to enhance the coherence and directionality of policy instruments and processes mobilised by S3 missions. The framework is based on a flexible roadmapping approach helping policy makers and stakeholders to co-develop ‘a big picture’ of missions, which can become a navigating tool to support the coordination of relevant actions and gradually improve the coherence and directionality of the policy mix.

The report has been developed in a close collaboration with policy makers from the Czech Ministry of Industry and Trade coordinating and managing the Czech S3 strategy. It is based on the literature review, stakeholder workshops with the Czech S3 stakeholders and an ongoing action research activity with the S3 Team at the Czech Ministry of Industry and Trade. The literature review drew on previous JRC reports, academic sources and technical reports as well as policy and programme documents from selected European countries and regions relevant for the S3 missions.

The publication is a part of the series of JRC reports focused on developing conceptual framework and practical policy guidance to support design and implementation of new challenge-led approaches

to place-based innovation policies addressing sustainability goals. The publication is addressed to policy makers in Europe and beyond responsible for designing and implementing challenge-oriented innovation policies focused on sustainability goals such as the SDGs.

Findings and recommendations

Sustainability-oriented S3 needs to extend its focus from supporting predominantly technological innovation towards a variety of innovations driving wider economic, environmental and social transitions required to achieve the SDGs. However, the conceptual framework and conventional policy articulation of S3 present a number of challenges to full alignment with the transformative ambitions of the EGD and the SDGs:

- Directionality and system-level change towards sustainability are not embedded in the S3 approach;
- S3 governance has limited capacity to orchestrate and mediate alignment and tensions between bottom-up experimental approaches and top-down priorities such as the ambitions and targets set up in the EGD;
- Entrepreneurial discovery process (EDP) is not equipped to foster 'alternative pathway thinking' on variety of ways innovation can contribute to sustainability transitions;
- Governance and EDP rarely include civil society and citizens or reach out to vulnerable groups impacted, or likely to be impacted, by transitions;
- Policy mix of S3 is limited mainly to supply-side instruments supporting R&D and innovation;
- S3 has a limited focus on supporting and scaling bottom-up place-based transformative innovation addressing sustainability challenges.

To overcome these limitations the successful design and implementation of transformative missions in the framework of S3 requires a patient investment in new capacities and policy learning. The report proposes the following lessons for policy makers willing to integrate transformative mission-oriented approaches into S3 and wider research and innovation policy.

Smart specialisation can foster policy experimentation and learning

- Smart specialisation offers 'experimental policy spaces' and collaboration capacities developed over years of entrepreneurial discovery process (EDP) and policy experimentation. S3 offers a suitable space to pilot and scale challenge-oriented policy approaches and foster the shift towards transformative innovation policy on the national and regional level.
- Transformative approaches need place-based and challenge-oriented experimentation and broader collaboration than the R&D and innovation policy approaches pursuing narrow technical specialisation and specific competence. Transformative approaches need targeted policy support since their development and scale-up are often limited or actively hindered by existing institutions and prevailing expectations.

Policy framing needs to embrace the need for system change

- There is a need to reflect how R&I policy can contribute to fostering system-level transformation towards the goals of the EGD and the SDGs by focusing on systemic processes of change (e.g. focus on the space between high-level vision and innovation processes supported by public policy). Research and innovation policy needs to be open to various types of innovation and alternative transition pathways considering global and localised R&I challenges and opportunities.
- Mission-oriented approaches offer an opportunity to embed systemic directionality and transformative ambition in smart specialisation. Challenge-led transformative missions offer a new approach to S3 and place-based innovation policies which is better suited to sustainability goals than technology-driven accelerator missions.
- Challenge led missions need new approaches in their design and implementation, particularly with regard to system framing, innovation pathways, future visioning and understanding

their impact on sustainability. The narrative of transition underpinning transformative missions can provide a shared learning process which enable innovators and policy makers in the present to position themselves in relation to the current system and to the desired future. The mission can empower a range of innovators to navigate pathways to mission accomplishment.

- The support for emergence and scaling of place-based initiatives fostering transformative change (e.g. changing regional industrial specialisation patterns and labour needs) should be integrated with the reflection and concrete action to ensure that the transition is leaving no one and no place behind. Transformative missions should be linked to just transitions.

Gradually build a comprehensive policy mix for missions

- To effectively address societal challenges policy makers need to strengthen policy integration by new mechanisms and channels of collaboration across ministries and public bodies. The focus on transformative missions can improve consistency and coherence of policy mix. With their cross-cutting challenge-oriented approach, missions can help streamline R&I funds and other forms of support supported by different programmes and budget lines. Missions can be powerful consolidation mechanisms helping to improve efficiency and effectiveness of policies.

- One way to improve the directionality and coherence of R&I policy is a gradual shift from a programme-based approach towards challenge-oriented portfolios. Mission-oriented approaches supported with systemic instruments, such as policy roadmaps, can become a policy spaces to test and develop portfolio-based policy approaches.

- The policy mix needs to balance the support for challenge-oriented R&I projects with the systemic support to making innovation systems fit for developing and scaling innovation for sustainability. To strengthen transformative impact of R&I policy makers need to mobilise policy instruments from beyond the traditional R&I policy mix. Policy mixes mobilised for missions can gradually extend beyond an emphasis on R&D and innovation funding instruments to including demand side (e.g. innovation procurement) and regulatory instruments.

Mobilise multi-level governance mechanisms to scale up transformative change

- There is a need to establish multi-level governance mechanisms to orchestrate and mediate alignment and tensions between bottom up and top-down mechanisms of prioritisation of R&I policy (e.g. bodies bringing together national and regional actors; instruments supporting local missions requesting inter-regional collaboration).

- Policy makers need to actively encourage and nurture place-based bottom-up innovation collaborations aligned with national and EU level strategic goals. Improving vertical coherence of R&I policies will enhance their impact. The deployment of mission goals at sub-national level requires further support with the option of piloting and demonstrating interventions in several regions that can then be scaled to a national (or EU) level.

Invest in policy learning and transformative capacities

- The shift towards transformative innovation policies, including challenge-led missions, requires a different approach to monitoring and evaluation (M&E). The M&E framework should be based on the shared understanding of theory of change underpinning the policy vision. Theory of change can be translated in expected impact pathways that include a range of short-medium-long term effects of R&I policy intervention and related indicators. These indicators can be inspired by the systemic approaches elaborating linkages and dependencies between SDGs.

- M&E frameworks should provide a dedicated space for policy reflection and learning engaging policy makers and relevant stakeholders. They should place less emphasis on standard 'programme' indicators and foster formative approaches to evaluation. The urgency and com-

plexity of societal challenge call for testing new ways of monitoring and evaluating policy outcomes and impacts relevant for missions and sustainability challenges such as tracing effects of interventions in 'real-time' and better understanding learning and behavioural effects of policy interventions.

- There is a need to patiently and systematically invest in individual, organisational, and system-level transformative capacities across governance levels. There are a number of existing practices and new tools to promote transformative innovation capabilities, which have been developed experimentally over recent decades, such as system innovation portfolios, transdisciplinary sandpits or transformative innovation labs featured in this report. Transformative capacities are necessary to ensure that promising innovations are developed and scaled up to drive change in a sustainable and just way.

Introduction

In 2018, the Joint Research Centre (JRC) started developing a challenge-oriented approach to place-based innovation strategies and policies, notably smart specialisation strategies (S3), to align them with the ambitions of the European Green Deal (EGD) and the UN 2030 Agenda. The report applies a transformative mission-oriented approach to smart specialisation to address societal challenges and better contribute to the SDGs. Missions are considered systemic policy instruments that can give a stronger strategic direction to smart specialisation and help orchestrate and implement policy instruments and portfolios of projects mobilised by S3.

The report has been developed in a close collaboration with policy makers from the Czech Ministry of Industry and Trade responsible for the Czech S3. The Czech Government requested to cooperate with the JRC on smart specialisation for the SDGs methodology in June 2021 in the context of their newly revamped National RIS3 Strategy 2021+. The Czech S3 strategy emphasised the importance of sustainability challenges in line with the EGD and the UN 2030 agenda and pioneered a mission-oriented approach to strengthen the directionality of the strategy. JRC has since engaged in a close collaboration with the National RIS3 Team to support it with evidence and expertise to design and implement S3 missions.

The Czech S3 mission-oriented approach focuses on selected societal challenges deemed of key importance for the Czech economy and society. The report focuses on the areas relevant for the implementation of missions including: **(1)** missions framing, **(2)** policy mix for missions, **(3)** concrete measures and practices to support mission implementation, **(4)** adjusting monitoring and evaluation system to assess and learn from policy implementation and (5) a proposal for a mission-oriented roadmapping framework as a tool helping to ensure coherence and directionality of policy strategies, instruments and processes supporting missions.

The policy roadmapping framework proposed in this report builds on the 'mission card' used to frame the S3 missions in Czechia. Together with the Czech policy makers, the expert team and JRC researchers proposed to extend the card to turn it into a 'mission roadmapping framework' which can become an orchestrating tool for the implementation of mission-oriented approaches to S3 or other place-based innovation strategies.

The publication is addressed to policy makers responsible for designing and implementation of challenge-oriented innovation policies focused on sustainability goals, such as the SDGs. The report will be useful for S3 practitioners translating strategic visions and goals into concrete policy instruments and activities. The report is a part of the series of JRC reports focused on developing policy guidance and tools to support design and implementation of new challenge-led approaches to place-based innovation strategies and policies addressing the Sustainable Development Goals (SDGs).

Methodology

The report is based on a literature review, stakeholder workshops with the Czech RIS3 stakeholders and an ongoing action research activity with the RIS3 Team at the Czech Ministry of Industry and Trade. The literature review drew on previous JRC reports, academic sources and technical reports as well as policy and programme documents from selected European countries and regions relevant for the S3 missions.

The cooperation between the Czech RIS3 Team and the JRC expert team has been a process of continuous exchange and feedback. There were two rounds of stakeholder workshops held during this project. The first series of three online workshops was run by the Dutch Research Institute for Transitions (DRIFT). The workshops introduced sustainability transitions and transition management as an approach to S3 and opened a discussion on its possible application to Czech S3 missions. The workshops brought together Czech policy makers and stakeholders involved in S3.

The second round was organised by independent experts (Alasdair Reid and Fred Steward) and JRC researchers and focused on the areas of work particularly relevant for the Czech S3 missions. The workshops provided a space for discussion and taking into consideration the perspective of policy practitioners. The two workshops took place on 13-14 October 2022 in Prague, Czechia, at the Ministry of Industry and Trade. The first workshop session focused on framing and governing S3 missions. The second workshop session was on policy mix and evaluation and monitoring of S3 missions. The outcome of the workshops helped to focus the report on the areas particularly relevant for the implementation of missions.

The final report was designed to reflect on the Czech case while offering useful insights and reflections for policy makers in other countries and regions. The report benefitted from inputs and feedback from the Czech S3 team.

1. Towards challenge-oriented smart specialisation for the SDGs

1.1. Rethinking Smart Specialisation for societal challenges and the SDGs

There is a widely shared expectation that smart specialisation strategies (S3) can foster transformative innovations responding to societal challenges and the Sustainable Development Goals (SDGs). The overall orientation towards addressing sustainability goals is now accepted by policy practitioners involved in S3 across diverse territories (Miedzinski et al., 2022). This is partly because of the overall strategic direction given by EU policies (e.g. the EGD in the EU) but also because of a growing understanding of the necessity and urgency to act to address sustainability challenges at national, regional and local levels.

The JRC launched a reflection on the opportunities and challenges of aligning smart specialisation with societal challenges and the SDGs in 2018. The concept of smart specialisation for sustainable development goals (S3 for SDGs) builds on S3 as a place-based approach to designing a research and innovation (R&I) agenda for regional economic transformation. Moreover, it explicitly addresses the ambitions of the EGD and the objectives of the UN 2030 Agenda. The work conducted with experts and policy practitioners has resulted in a series of publications and well-attended policy workshops on S3 for SDGs.

The first phase of the work was a reflection on the fitness of the S3 framework to address sustainability challenges. S3 was compared to selected approaches focused on transformative innovation, notably sociotechnical transitions, social-ecological resilience and challenge-driven innovation policy. The comparison helped identify the strengths and limitations of the current S3 framework and makes suggestions on how to strengthen and revisit the S3 approach based on the insights from these approaches. The study proposes the guidelines, accompanied with a self-assessment tool for regions, in support of their effort in designing and implementing S3 for SDGs.

The main message from the first phase of studies was that the S3 framework and methodology needed to be revisited and extended if S3 is to facilitate innovation and systemic change in line with the SDGs (Nakicenovic et al., 2021; Miedzinski et al., 2021). To align with the SDGs, S3 should explicitly embrace and embed sustainability goals in its conceptual and methodological framework. A revised S3 framework needs to be open to a great variety of pathways towards sustainability. The variety of place-based pathways and emphasis on bottom-up experimentation, however, needs to go hand in hand with a strong directionality towards sustainability guiding S3 across different territories and governance levels.

A renewed S3 framework needs to extend its focus from supporting predominantly technological innovation towards a variety of innovations driving wider economic, environmental and social transitions required to achieve the SDGs. S3 can act as a testbed for system innovation and governance experiments to develop, demonstrate and scale SDG-aligned mission-oriented approaches at regional and trans-regional level. Moreover, system innovation and sustainability transitions are not concepts for advanced regions only. The renewed S3 framework should support all types of regions. As in the past, the new framework will need to be supported by policy platforms and interregional 'communities of practice' where novel approaches can be discussed, practical experiences shared and new collaborations forged.

The S3 framework and methodology should benefit from expanding its theoretical and conceptual foundations to address complex, interconnected and uncertain societal challenges. Sustainability goals create new expectations and needs in terms of innovation, stakeholder engagement and governance arrangements as well as data and evidence used in monitoring and evaluation.

The most recent product of this collaborative work is a reflection tool with guidance for policy makers for enhancing sustainability of S3 at regional and national levels (Miedzinski et al., 2022). The tool has been included in the Playbook of the Partnerships for Regional Innovation (PRI).[1] It was designed to guide a process of critical reflection on how to mobilise R&I to address the SDGs and sustainability challenges in diverse territorial contexts, including in places facing significant institutional and structural challenges. The reflection framework was an invitation to all the regions and countries to reflect on their current S3 practices and consider how to step up their efforts to foster sustainability in their strategies.

Implementing lessons learned through the reflection requires changes in the wider policy implementation process. There is a need to develop a policy environment that enables and incentivises regions and countries to experiment with innovative designs of policy portfolios and programmes and to invest in transformative projects. In the context of S3, one such approach could be encouraging place-based missions selected and co-designed during the EDP. Place-based missions could be a constructive way to foster bottom-up experimentation in EU R&I policy.

The next step is to draw conclusions from this reflection and change existing approaches to policy design and implementation across governance levels. This may include applying mission-oriented approaches to design of policy instruments and portfolios as well as the development of new collaborative governance models.

1.2. Mission-oriented approach to align Smart Specialisation with the SDGs

Over the last decade, scholars have observed a change in the rationale of R&I policy from a focus on economic growth and competitiveness towards addressing societal challenges and fostering transformational change towards a sustainable and fair economy and society (Weber and Rohracher, 2012; Chataway et al., 2017; Mazzucato, 2018ab; Fagerberg, 2018; Schot & Steinmueller, 2016, 2018; Grillitsch et al., 2019). This shift has profound implications for the practical design and implementation of innovation policies. Robert et al. (2022) argue the policy rationales change from 'an intervention motivated by failures of different types and complexity to an intervention based on problem solving (grand societal challenges) (...) giving certain directionality to the system according to the diverse objectives and priorities constructed by the stakeholders and policy makers within a specific institutional context.'.

The shift to challenge-led innovation policy resulted in a renewed interest and growing popularity of mission-oriented approaches. There are many approaches to defining mission and mission-orient-

1 *https://s3platform.jrc.ec.europa.eu/pri-playbook#fragment-89005-agna*

ed policy (Wittmann et al., 2021; Larrue, 2021). In this report, we adopt a broad definition proposed by the OECD based on wide consultations and a review of existing approaches.

The OECD defined mission-oriented innovation policy (MOIP) as '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. These measures possibly span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors and disciplines.' (Larrue, 2021). Three prominent dimensions of MOIPs are, therefore, strategic orientation (directionality), policy co-ordination (policy mix) and policy implementation.

Missions are implemented in different shapes and forms. There are several ways to classify and characterise missions considering the challenges they address and the solutions they pursue. The report draws on the typology proposed by Wittmann et al. (2020; 2021) building on the prior differentiation between 'accelerator' and 'transformer missions' (Fisher et al., 2018; Polt et al., 2019).

Smart specialisation and MOIPs share some common features such as strategic prioritisation, active stakeholder engagement and policy coordination. Foray (2018) argues, for example, that S3 and MOIP belong to the same policy family and that with its high degree of intentionality, centralisation, prioritisation and specialisation in specific areas of innovation S3 is well suited to embrace a mission-oriented approach. While broad similarities undoubtedly exist, there are, however, clear differences between the current S3 and transformative mission-oriented approaches. Given the variety of mission-oriented approaches, there is a need for a more granular and nuanced view on the relationship between S3 and missions.

The relationship between mission-oriented approaches and S3 can be addressed by two closely interrelated questions. First, to what extent is the S3 framework open to embracing different types of challenge-led approaches to innovation policy, including transformative missions? Second, could the mission-oriented approach be adopted as a practical tool adding a stronger directionality to S3?

Regarding the first question, the simple answer is that the conventional S3 framework is does not explicitly comprise a mission-like problem-based action plan with a defined timeline and milestones related to the addressed challenges or problems. Smart specialisation is an explorative bottom-up approach that focuses on increasing competitiveness and economic growth rather than on resolving societal problems. The current framework has a limited potential especially in relation to fostering challenge-oriented transformative innovation.

To be able to enable transformative changes and contribute to the SDGs, the S3 approach needs a stronger directionality towards sustainability goals, an emphasis on systemic transformation and a focus on policy reflexivity, experimentation and learning (Miedzinski et al., 2021; 2022). The revised framework for smart specialisation for the SDGs comes closer to the mission-oriented approaches and strongly resonates with the ambition of transformer missions.

Regarding the second question, given the realisation of the need to align smart specialisation and place-based innovation strategies in general with the ambitions of the EGD, mission-oriented approaches, especially the ones focused on transformative change, appear as one possible way to inject a stronger strategic orientation and transformative ambition into S3. A comprehensive review of a wide range of mission-oriented instruments suggests MOIP is suitable to engage broad range of stakeholders, align various strategies and actors towards common goals, coordinate and manage interaction between a wide range of instruments and increase and secure commitments of public and private resources towards missions (Larrue, 2021).

Adopting a mission-oriented approach with strong directionality provides a vehicle to reframe smart specialisation and orientate it towards transform-

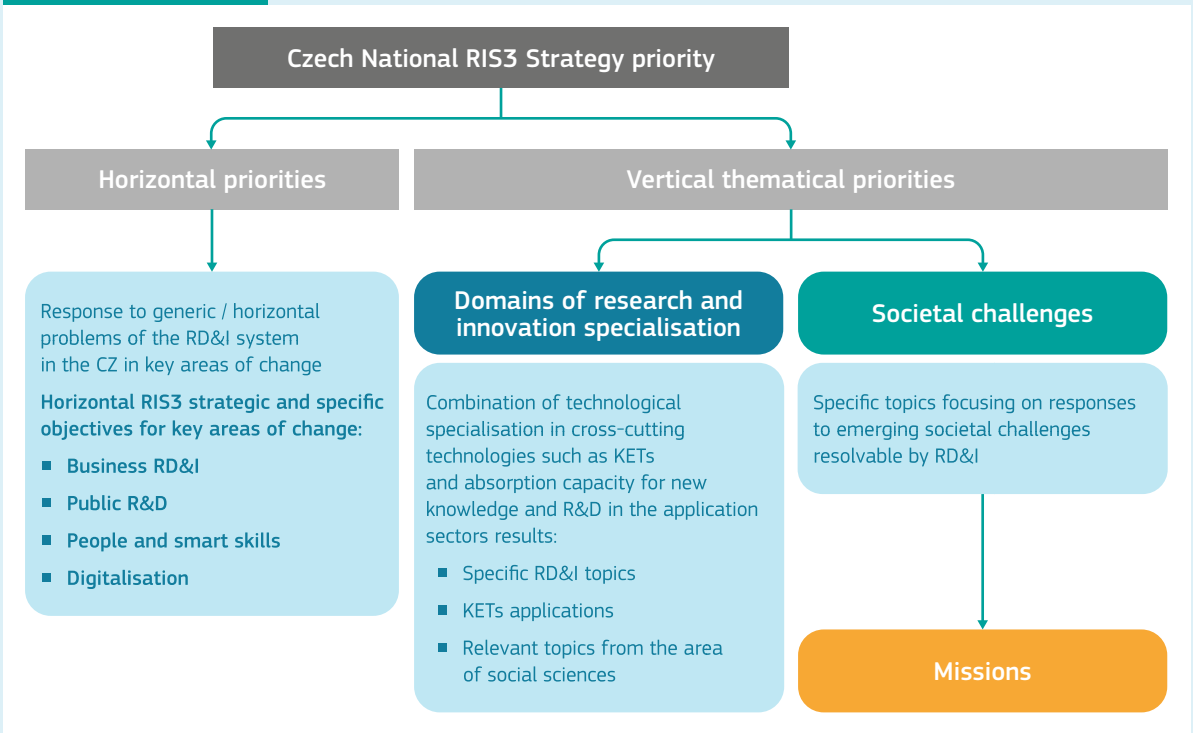
ative outcomes. Hence, this report assembles a number of practical policy design and implementation practices which can be used to foster challenge-led innovation policy approaches.

BOX 1

Mission-oriented approach to strengthen directionality of the Czech National RIS3 Strategy

The Czech government is piloting the mission-oriented approach in its National Research and Innovation Strategy for Smart Specialisation (NRIS3) to give it a stronger directionality towards addressing societal challenges and the Sustainable Development Goals (SDGs). The focus on societal challenges reinforces the ambition of the Czech National Research, Development and Innovation Policy 2021+. The strategy aims at harnessing research and innovation, including experimental developments and activities, to respond to threats with a pan-societal impact to increase the resilience of Czech society. In this sense, the approach in the Czech Republic is clearly part of the emerging trend to link S3, sustainable development and mission-oriented policies (McCann & Soete, 2020; Foray, 2018).

FIGURE 1 *Priorities of the Czech National Research and Innovation Strategy for Smart Specialisation (NRIS3)*



Source: National RIS for Smart Specialisation (NRIS3); Czech Ministry of Industry and Trade

The Czech approach to smart specialisation integrates elements of MOIP and the Science, Technology and Innovation (STI) for SDGs roadmap methodology into the S3 process and governance. The exercise is a policy experiment but the ambitions and expectations towards the new approach are high.

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The mission-oriented approach in NRIS3 is expected to:

- Focus research, development and innovation (RDI) in Czechia on solving selected societal challenges and SDGs considering the geopolitical situation and sustainability challenges
- Link topics across domains of specialisation, stimulate cooperation across National Innovation Platforms, and promote inter-sectoral and interdisciplinary approach
- Provide support to collaborative innovation projects based on cross-sectoral collaborations and inter-disciplinary knowledge with the potential to foster systemic solutions to sustainability challenges in Czechia
- Involve other relevant actors in the S3 strategy, activate existing participants in the EDP process, including national support providers and regional authorities
- Tap in opportunities presented by the European Green Deal through the EU funds (e.g. European Structural and Investment Funds, EU missions in Horizon Europe) and Czech R&I instruments
- Set a result-driven roadmap with specific, measurable goals achievable through RDI.

Two missions were adopted to test the mission-oriented approach in close collaboration with R&I stakeholders and experts. Mission 'Streamlining the material, energy and emission intensity of the economy' is to address the challenges of climate change and resource efficiency. Mission 'Strengthening the resilience of society against security threats' addresses the societal challenge of increased security risks and variability of security threats. The missions have the same status as the domains of specialisation introduced in the NRIS3 strategy.

Missions were initially elaborated at the beginning of 2022 by the Czech National S3 team at the Ministry of Industry and Trade (MIT) in collaboration working with the National Innovation Platforms and expert groups. The broad scope and direction of the missions were approved by the RIS3 Steering Committee in April 2022. The missions were further elaborated during the EDP with the participation of broader group of stakeholders.

The discussions and exchanges informed detailed 'Mission objective cards' submitted to the NRIS3 Steering Committee for formal approval and subsequent publication in updated Annex 1 to the NRIS3. The 'Mission objective cards' were published in December 2022 and shared with the relevant Managing Authorities of the EU Operational Programmes and the Managers of the key R&I support programmes in Czechia.

Source: JRC workshops with the Czech National RIS3 team; Annex 1 to the NRIS (Czech Ministry of Industry and Trade, 2022)
Further reading: S3 for SDGs reports; STI for SDGs roadmaps

TABLE 1 *Smart Specialisation and characteristics of missions*

MOIP DIMENSION	MOIP FEATURE		SMART SPECIALISATION	SMART SPECIALISATION FOR THE SDGS (AS A TOOL FOR PRI)
STRATEGIC ORIENTATION	*Legitimacy*	A consensus is found among a wide group of stakeholders (including citizens) regarding the need and relevance of the mission	Mostly yes, but rarely including citizens	Yes, invites the extension of governance and discovery process to a wide group of stakeholders, including citizens
	Directionality	The policy is guided by clear and well-informed orientations and strategic guidance formalised in a mission	No, priority areas based on regional assets are defined but not formulated as missions	Yes, priority areas formulated to mobilise regional assets to respond to sustainability challenges
	Intentionality	Specific and well-articulated need-based goals, with clear timeline and milestones, are derived from the mission	No	Yes
	Flexibility	The targets and means of intervention to meet them can be revised at different stages of the process when needed	No	Yes
POLICY COORDINATION	*Horizontality*	The plans and activities of policy bodies covering different policy fields are coordinated to achieve the mission	The need to mobilise policy mix is mentioned but not in the context of achieving missions	The need to mobilise policy mix essential to address sustainability challenges
	Verticality	The plans and activities of policy bodies at different levels of government are coordinated to achieve the mission	Yes, but not in relation to mission-like objectives	Yes
	Intensity	The decisions regarding the intervention (objectives, modalities, resources) are taken collectively by the involved policy bodies and are binding	No	Yes
	Novelty	The plans and activities of different policy bodies and stakeholders are co-ordinated (e.g. via a portfolio approach) so as to cover and experiment various alternative solutions to achieve the mission	No	Yes

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MOIP *DIMENSION*	*MOIP* *FEATURE*		*Smart Specialisation*	*Smart Specialisation for the SDGs (as a tool for PRI)*
Policy implementation	*Consistency*	The policy encompasses a diverse and consistent set of policy interventions (technical, financial, regulatory, etc.) to support different disciplines, sectors, areas and markets, across the innovation cycle, as needed to achieve the mission	No, the policy mix is limited mainly to supply-side innovation and industrial policy measures	Yes, the ambition is to mobilise a wider STI policy mix
	Fundability	Public and private stakeholders involved in the different facets of the initiatives (phases of the innovation process, sectors, markets, etc.) are mobilised to commit resources for the achievement of the mission	Yes, although to a limited extent: the private stakeholders are rarely involved in funding the S3 projects	Yes
	Evaluability	The policy is endowed with input and output indicators and evaluation procedures adapted to its systemic nature, in order to assess its results and learn from its implementation in view of continuous improvement	Yes, but limited focus on transformative change and sustainability impacts	Yes, the indicators extend to measure sustainability impacts and have an ambition to capture transformative outcomes
	Reflexivity	Evaluation and monitoring results are used to inform decision-making and reform the initiative (revision of objectives, adaptation of governance and operating procedures, etc.), as needed to achieve the mission	Yes	Yes

Source: Dimensions and features of MOIP is based on Larrue (2021). The columns on S3 are added by authors based on Miedzinski et al. (2021) and Miedzinski et al. (2022)

2. Framing challenge-led S3 missions

Recent knowledge developments in the fields of sustainability transitions, sociotechnical systems and transformative innovation policy imply fundamental changes in the way we frame innovation and how we seek to influence it. The reframing of innovation for transformative challenge-led missions entails:

- Reorientation to a systems approach which expresses the sociotechnical character of innovation and brings societal end-use (or societal function) to the foreground, and
- Embedding purposeful directionality in design and implementation which prioritises sustainability while embracing variety and experimentation.

This chapter offers some practical guidance for policy makers to meet these demands. It addresses four interconnected activities to support the design of a transformative challenge-led mission:

- System framing – how to designate a system which combines transformative potential with realistic opportunities for changes in the short term as well as the long term
- Problem targeting and innovation pathways – how to combine directionality and diversity in the setting of challenges and the quest for solution pathways
- Future visioning – how to identify goals and alternative transformative pathways with societal breadth and relevance to a variety of actors
- Sustainability mapping – how to navigate between environmental and social SDGs in a meaningful way.

2.1. System framing

Conventional innovation policies tend to focus on either an industrial sector or a technology domain. An industrial or business sector is defined by a set of firms with similar capabilities. A technology domain is structured as a group of interrelated fields of specialised knowledge. Established business sectors are commonly disrupted in the process of transformative innovation. For example, the internet has drastically reconfigured the business landscape. Policies which are focused on existing business sectors therefore risk being shaped more by the past than in shaping the future. Conversely technology domains offer future promise yet in practice are often victims of a hype-disappointment cycle. Policies which focus exclusively on such expectations risk being disconnected from near-term meaningful innovation.

The new approach of transition studies argues that, if one is interested in transformative change a more suitable system for attention is that of the 'sociotechnical system' which is defined as the col-

lection of actors and institutions which deliver an end user societal function Geels (2002, 2004). For example transport innovation policy would be re-oriented to the sociotechnical system of mobility in contrast with its traditional focus on a technology domain like fuel cell propulsion or an industrial sector such as the car industry.

The sociotechnical transitions approach pioneered by Geels (2002, 2004) rests on the idea that 'societal functions are fulfilled by sociotechnical configurations'. This fundamentally shifts the perspective on innovation to one which is framed through consumption or end use and which embraces a heterogeneous mix of social and technological change. 'A change from one sociotechnical configuration to another' is the basic notion of a transition. It relocates innovation away from one focal actor, such as a business enterprise, to the interactions of a network of diverse actors.

The systemic approach to innovation reframes the challenge of innovation and sustainability. The policy target is now seen as a multi-actor network, involving the interlinkage of a mix of social and technical elements, which is defined in terms of its performance of a societal end use function such as mobility, shelter, hygiene, or communication. This is an alternative to limiting the scope of innovation to sectors or technologies. Instead, the innovation terrain becomes defined as a patchwork of use and consumption oriented sociotechnical configurations. The existing configuration of such regimes underpins the continuity and lock-in of unsustainable systems of mobility or intensive food production. It is also the arena in which sustainable transformation needs to be pursued. This extends the policy focus from the bounds of existing sectors to functional systems within the overall economy. It implies a quite new policy repertoire of experiments, networks, learning and expectations, involving consumers as well as producers, and oriented to changing the nature of prevailing regimes which are unsustainable in terms of their impacts on society and the environment.

The new focus is on innovation as the expression of novelty in systems of practice and provision rather than as singular 'point' innovations in products and processes. This turn toward 'system innovation' is a substantive change in the framing of innovation. System innovation is defined in an OECD (2015) report as 'radical innovation in sociotechnical systems which fulfil societal functions which entails changes in components and architecture' It therefore draws attention to changes in a configuration of elements which are defined through a particular end use. Hence, innovation involves a mixture of social and technological change; 'socio-technical innovation' not just new technologies (Steward 2012).

This new framework proposes that the bounding of a system rests on the definition of an end-use societal function. An illustration of this approach is shown in recent reports by EEA and OECD (see ***Boxes 2*** and ***3***).

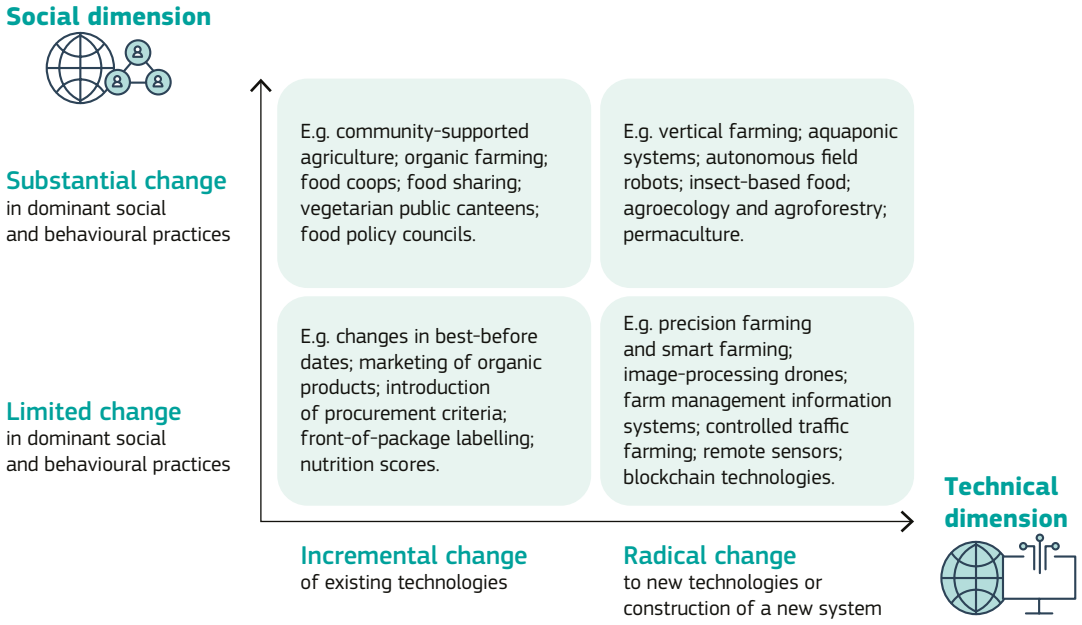
BOX 2 *Transforming Europe's Food System (EEA)*

The food system comprises actors and processes of the production and consumption of food.

Actors in the food chain

The systemic approach allows to define a variety of socio-technical innovation pathways.

Classification of innovations in terms of incremental and radical social and technological change

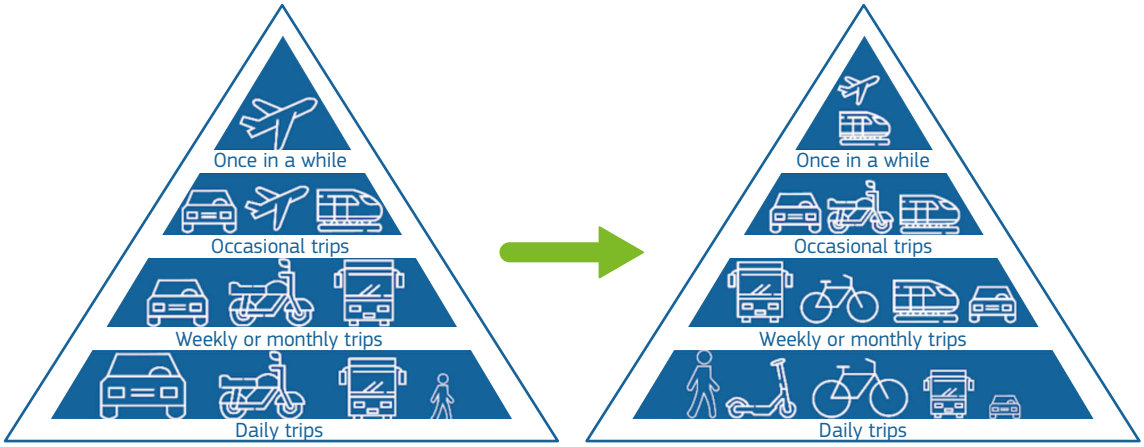


Source: EEA (2023)

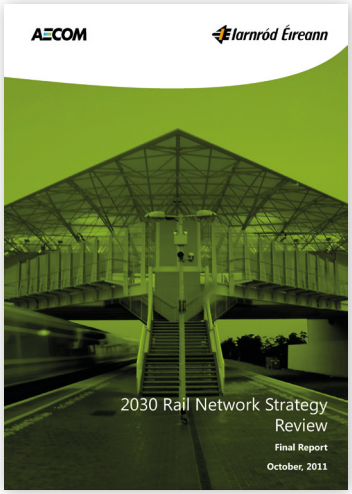
BOX 3 *Systemic reframing of mobility challenges (OECD)*

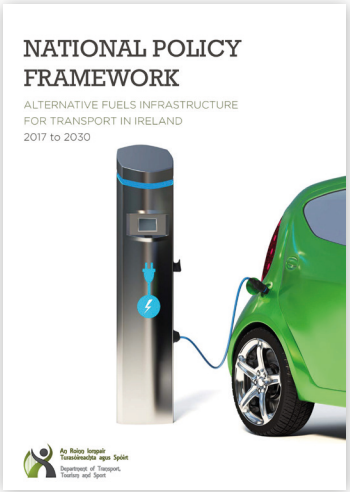
In the framework of the OECD 'Systems Innovation for Net Zero' process, the OECD conducted an assessment of Irish policy initiatives aiming to reduce emissions in the transport sector. The report takes on a systems approach to reframe the problem of reducing transport emissions from improving 'mobility' to 'accessibility'. The transport system is defined as the societal use of different mobility modes. The mission is to reduce emissions by transforming the modal mix. The systemic approach allows to define a variety of socio-technical innovation pathways.

The patterns of behaviour in 'healthy' transport systems



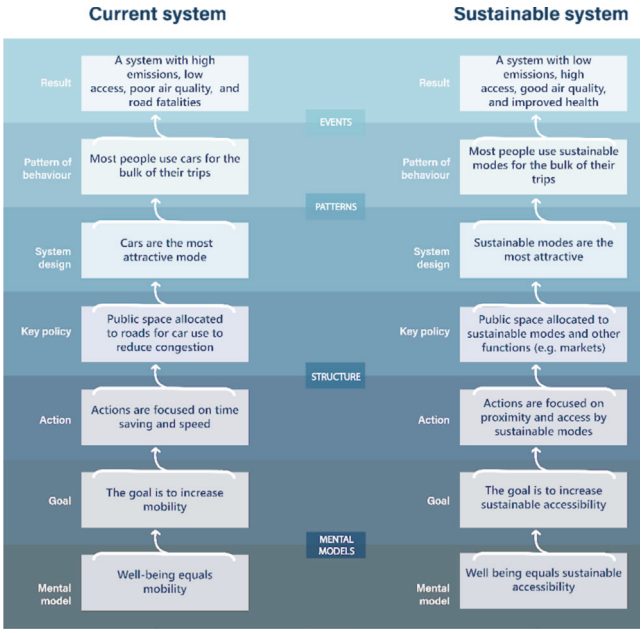
Earlier approaches only addressed sectors (buses, trains) or technology (EVs):





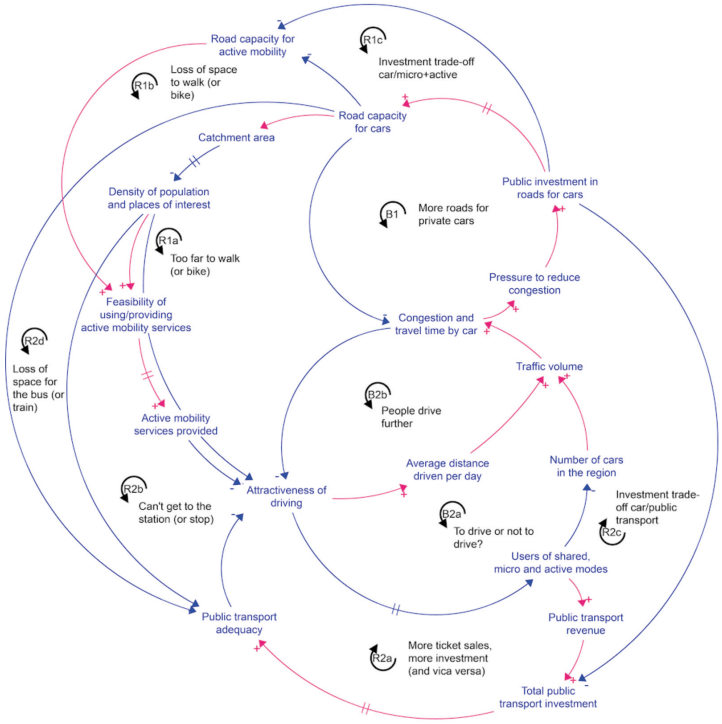
The system is redefined with the focus on access to services and amenities.

The transformative potential of redefining policies and system goals



System dynamics are used to reveal relationships within the system to illustrate existing bottlenecks.

Detailed causal loop of the Irish transport system



Source: OECD (2022)

Framing system boundaries in this way provides a powerful and comprehensive innovation policy framework which avoids the constraints of favouring sectors shaped by past success or picking technologies with highly uncertain future success. It provides a far more plausible framework for the engagement of consumers and citizens in the innovation process, essential to the politics of transformative change (Steward 2016).

System innovation needs new types of innovation actors and new types of knowledge. The actors who will play the lead in system innovation will be the institutions and organisations who deal with key systems such as transport, housing, waste and energy systems. They enable the participation of the diversity of actors involved in system innovation – universities, business enterprises, community groups, public institutions, and research/ technology organisations. Often local in scope, they frequently play a key focal bridging role between universities, competitive clusters of businesses, and a diversity of public bodies.

The EGD expresses this approach with its focus on the transformation of five key sociotechnical systems – energy, industry, buildings, mobility and food – responsible for the primary challenges for ecological sustainability. It marks a significant turning point in framing innovation policy.

2.2. Problem targeting and innovation pathways

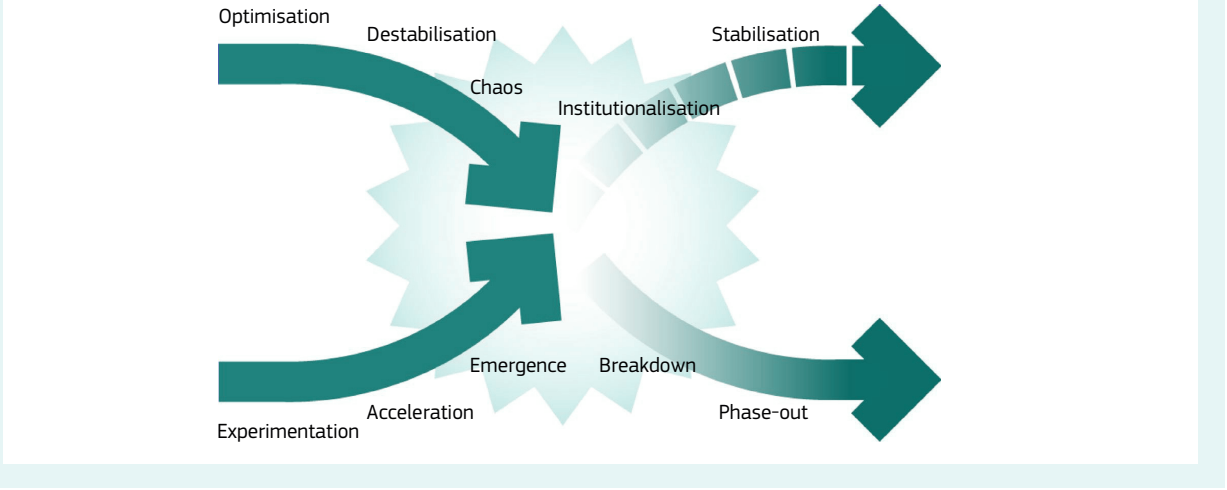
A key consequence of a policy focus on a socio-technical system is that directionality is no longer confined to improving the performance of a particular technology or the competitiveness of a specific business sector. The new system framing enables global sustainability challenges to be addressed explicitly and directly. These challenges have a variety of potential (but uncertain) solutions which may have disruptive impacts on established sectors and incumbents.

Directionality of a challenge-led mission is expressed by a sustainability goal and targets which are chosen as the desired outcome of transforming the system concerned. Policy targets may be qualitative (e.g. a more biodiverse food system) or quantitative (e.g. reducing carbon emissions from the transport by 50%). This is challenge-led directionality since it does not prejudge the nature of the solutions that may eventually prevail.

Key societal challenges call for a transformation in the performance of a societal system. The type of innovation needed to achieve these is likely to involve a transformation in customary ways of thinking and doing. It will involve changes both in knowledge norms and in business models. Such challenge-led directionality requires innovation policy to promote a much higher degree of diversity than is traditionally the case. Conventional framings tend instead to emphasise priorities which arise from similarity, not diversity, in expertise or interests. Yet it is often uncertain whether currently favoured solutions will turn out to be those that count in the long run.

The X-curve framework (Loorbach, 2014; Loorbach et al. 2017; Hebinck et al., 2022) distinguishes between different phases of transition processes showing the dynamic relationships between the emergence of a new system and the breakdown of the old regime. As far as innovation policy is concerned it shows that the early phases of experimentation and acceleration needs to 'open up'and test diverse alternative pathways protecting new niches from being captured by the old regime (see ***Figure 2***). In later phases the balance shifts to the phases of institutionalisation and stabilisation which involve more selective consolidation of promising options while still maintaining some 'requisite' variety.

FIGURE 2 *The X-curve framework*



Source: Loorbach et al. (2017)

This transition framework demonstrates the need for a much stronger emphasis in innovation policy on the facilitation of a diversity of pathways to explore a variety of solutions. It needs to ensure that innovation opportunities are not confined to the preferences of currently dominant technical advocates or incumbent businesses.

There is a persisting tendency in innovation policy to over-selectively focus on emerging new technologies which offer transformative promise. The risk is to fall into the trap of putting too much hope into an early speculative bet on a 'solution in search of a problem'. For example the Singapore Blockchain Innovation Programme, a $12m initiative of the National Research Foundation was launched in 2020. Yet Amazon's senior engineers are reported by former Amazon Web Services VP Tim Bray to think 'blockchain is a solution looking for a problem' which could explain the cancellation of the Australian Stock Exchange's flagship $165m blockchain trading project in November 2022. (Bray, 2022)

An alternative focus on challenges, rather than technologies, avoids this trap. However, if the challenge is very broad in scope it can face the opposite pitfall: the risk of an over general 'problem in search of a solution'. The participation of a wide variety of actors and the exploration and experimentation with a rich assortment of different innovation pathways is not an end in itself and may lead to a dissipative and directionless diversity. Some sort of balance is needed.

Directionality and diversity present a classic innovation dilemma (Steward 2009) of which many are well known in the business world of innovation management. Techniques to navigate the contradictory requirements of successful innovation are also needed in policy. The need is to combine clear directionality of a problem to be addressed with an adequate diversity of solutions being pursued. The mapping of such a hybrid pathway is an active and reflexive process.

A useful way of thinking about it is as a route through a problem-solution space which seeks a changing mix of convergence and divergence during the process. A diversity of problem–solution constellations needs to be supported which will be positioned at different points of the convergence-divergence spectrum. One of the goals of policy is to facilitate a diversity of problem–solution constellations to become sufficiently stable to serve as common frame and direction for relevant groups of innovation actors (Wanzenbock 2022). The need for diversity poses a key challenge for innovation policy: to devise governance mechanisms and processes which facilitate learning and

systemic 'concertation' of this diversity expressed through a challenge-led mission.

Box 4 introduces the approach of the Swedish Innovation Agency Vinnova – a pioneer of challenge led system innovation policy – to scoping problem-solution spaces for innovation policy. ***Box 5*** introduces the Czech approach to defining S3 missions in the context of their national S3 strategy.

BOX 4

Vinnova's hybrid of challenge-driven problems with mission-oriented solutions

The Challenge Driven Innovation programme launched by the Swedish innovation agency Vinnova from 2011 was a deliberate strategy to elicit innovation proposals from new coalitions of actors instead of the established technical or sectoral groupings. It posed general challenges which were open to new unorthodox solutions. Proposals were invited for any relevant solutions so long as they were pursued by a boundary spanning collaborative network. Initially the four challenges included: competitive industries, future healthcare, information society and sustainable attractive cities (Fuenfschilling, 2021). In 2017 these were replaced with the broader set of SDGs (Vinnova, 2017b).

This open ended approach required a long time scale with significant downstream support to enable such bottom up initiatives. The result was a highly diverse portfolio of solutions (Vinnova, 2017a). Fostering diversity through this highly open ended approach proved a complex process and the programme has evolved to embrace more defined missions and coordination in its development over more than a decade.

The policy perspective of Vinnova was summarised in 2018 (Ulmanen et al., 2022) as:

- Depart from societal challenges and visions instead of established sectors or academic disciplines;
- Stimulate the formation of new actor constellations able to see beyond incremental solutions and develop novel business and organizational models;
- Introduce a wider view on which policy areas are necessary and should be included to realize system change. In other words, include all policy and political areas relevant to innovation and system change;
- Work with issues related to policy and regulations as natural parts of innovation processes.

Between 2019 and 2022 Vinnova looked to a mission-oriented approach to introduce more strategic focus to this challenge led perspective (Hill, 2022). Nine candidate missions were identified through combining SDGs with national priorities.

They are systemic problem-solution spaces which suggest "a portfolio of various different innovation activities. This portfolio can begin to indicate how a systemic approach requires a rich set of experiments firing in parallel, and balanced across both the 'push' of traditional technology-led innovation processes with the 'pull' of societal, behavioural, cultural, political, and social movement-led dynamics" (Hill 2022:41). They are quite different to the technical specialisations that might contribute as enablers. Two pilot missions were selected Healthy Sustainable Food and Healthy Sustainable Mobility.

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Touchpoints	01 Health at-hand	02 Healthy sustainable food	03 Carbon positive consumption
Conditions	04 Affordable sustainable neighborhoods	05 21stC learning systems	06 Active mobility at-hand
Keystones	07 Zero carbon health system	08 Healthy zero carbon buildings	09 Safe and clean logistics

Sources: Vinnova (2017ab), Hill (2022)

BOX 5 ***Defining and developing S3 missions in the Czech national S3 strategy***

The process of defining and implementing missions within the Czech NRIS3 follows three activities:

1. Identification and definition of key societal challenges relevant for Czechia and NRIS3: The activity identifies societal challenges most relevant to Czechia which can be addressed through research, development and innovation (RDI). The process is based on studies and inputs from the EDP process. Societal challenges with most relevance for Czechia are selected by dedicated expert groups.

2. Definition of missions responding to the selected societal challenges: The activity defines thematic missions and RDI areas with the potential to address selected societal challenges. The thematic scope and activities of missions are proposed by expert working groups and various R&I stakeholders engaged in the continuous and bottom-up EDP. The proposals for missions and their RDI topics are discussed within the relevant National Innovation Platforms. The proposals are approved by the NRIS3 Management Committee. The RIS3 Team leads the preparation of detailed descriptions of the mission, its work plan and possible sources of funding. The descriptions of missions – 'mission objective cards'- are shared with national R&I providers.

3. Concentration of funding on the prioritised R&I areas: The activity aims to mobilise EU and national R&I funds in support to missions. The RDI areas and topics within the missions should be reflected in support programmes, notably ESIF and national R&I support programmes.

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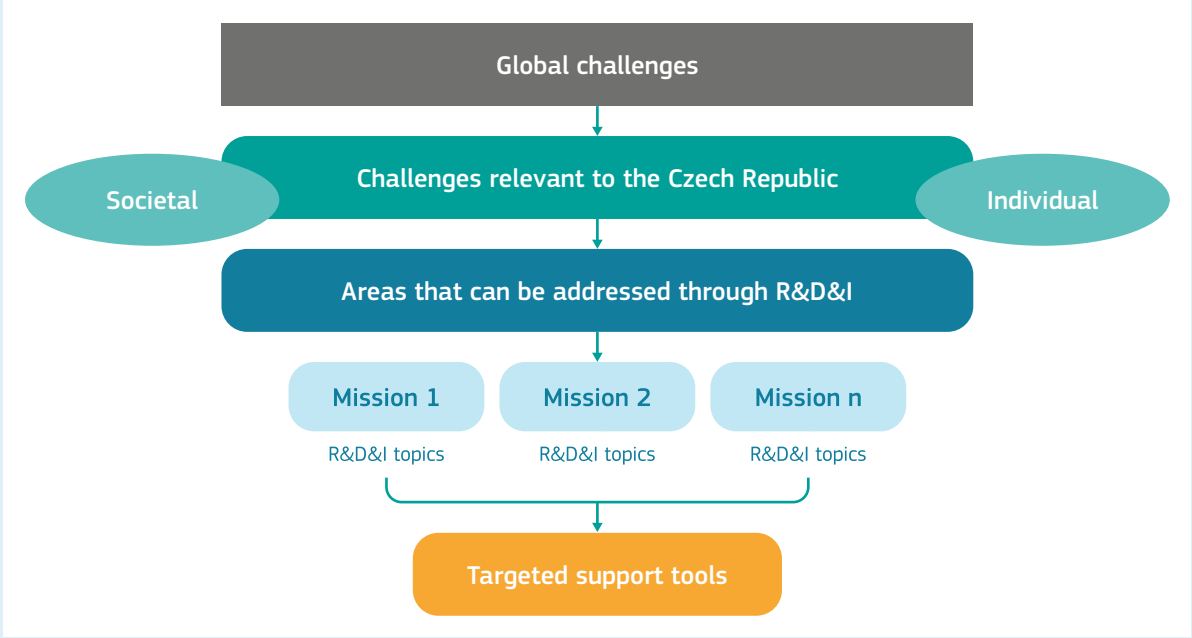
FIGURE 3 *The logic of the NRIS pillar focused on societal challenges and megatrends*



Source: the Czech National RIS3 strategy

The process of mission design and implementation is open to a continuous learning and adaptation. It is set up to engage all relevant Czech ministries and agencies as well as relevant R&I stakeholders via National Innovation Platforms and consultations with regional R&I actors. As the descriptions of S3 missions are published in an annex to the NRIS, they can be adjusted relatively easily. Amendments to annexes require only approval of the RIS3 Steering Committee.

Both the substance and the modes of implementation of S3 missions can be adjusted over time:

- The scope and targeted R&I areas of missions can be refined based on the continuous EDP and new relevant evidence from experts and researchers. The S3 missions will also benefit from monitoring data and evaluation studies conducted during and after implementation of policy instruments.
- The mode and channels of implementation of missions are intentionally flexible. The NRIS3 documents put forward several possible options for mission implementation ranging from adjusting elements of existing programmes (e.g. adaptation of selection and award criteria) to setting up dedicated instruments and portfolios targeting mission objectives. Depending on the success of the two first missions and available support, this open mechanism may gradually lead to building up more comprehensive portfolios of instruments supporting missions at scale.

The flexibility of the approach fits the experimental nature of the S3 missions and reflects a cautious approach adopted by Czech policy makers. The mission-oriented approach extends the usual S3 policy debates. Policy makers were conscious of the need to adopt an open and patient approach allowing R&I stakeholders to familiarise themselves with new concepts and ideas. The process is innovative and ambitious but, at the same time, benefits from the well-known S3 governance mechanisms.

Source: JRC workshops with the Czech S3 team; Annex 1 to the NRIS (Czech Ministry of Industry and Trade, 2022)

2.3. Future visioning

Central to transformative innovation policy which aims at systemic transition is the articulation of future pathways of system change agreed by a wide range of societal actors. The pursuit of broad transformative missions requires a supportive political context based on the alignment of a variety of stakeholders. They include citizens and consumers. This proactive and participative approach to the future builds on the policy practices of technology foresight developed from the 1980s onwards (Miles 2010).

The foresight approach marked a break with the earlier technology forecasting tradition with its narrow focus on expert prediction of technical trends. Foresight had a broader remit of exploring, anticipating and shaping the future to build and use collective intelligence in a structured and systemic way to anticipate future developments. Foresight can help prepare a territory or an organisation to anticipate and tackle shocks and foster the transition towards a desired future. It is not about predicting the future but rather about reflecting and exploring possible futures and their implications. The main applications of foresight have followed the traditional innovation policy priorities of business sectors (Pietrobelli & Puppato 2016) or emerging technologies. While they have developed more strategic and action-oriented approaches they have remained dominated by business and technical stakeholders with economic competitiveness or technical leadership as the principal goals.

The reorientation of innovation to societal challenges and sustainability goals requires a different type of foresight. While still needing expertise it is much more inclusive and identifies end goals and transition pathways that are seen as socially desirable as well as technically feasible. It looks beyond the horizons and boundaries of narrow groups of actors to broader shared agendas of change. It uses extensive participatory methods (Neels 2020). It builds on the 'backcasting' approach of sustainability studies which turn the conventional forecasting logic on its head by defining desirable end goals and working back to the present. (Bibri 2018).

Participatory foresight methods have been developed to facilitate this process. Rosa et al. (2021) summarise some recent approaches:

- **Citizen visioning** is understood as a method through which citizens develop a shared vision of their preferred future as a community. Its primary methodological function is to broaden the scope of perspectives informing a particular set of decisions by encouraging stakeholders to develop multiple, often contentious, desirable futures.
- **Futures dialogues** present opportunities for multi-lateral learning and awareness raising on issues like local concerns, policy goals, and sociotechnical trends.
- **Narrative generation** is linked to human cognitive processes with regard to learning and sense-making, along with simulation of future possibilities to create actionable convictions under radical uncertainty. Depending on the scale and ambitions of the project, public participation can range from tens of participants to thousands and despite a historical record that reaches back decades, it remains an under-utilized methodological format.

Deliberating alternative scenarios towards mission objectives is crucial. First, having a collective reflection about future scenarios helps develop a more methodical approach to thinking about future development and identifying new opportunities and challenges for research and innovation. Foresight methods and tools foster participatory approaches that help to solicit diverse views and expertise on future opportunities and challenges. Ensuring an open approach to future is crucial for the process, just as is avoiding falling prey to predetermined assumptions and future visions.

Second, just as before one sets off for any long journey, it is prudent to consider alternative ways of getting to the destination. Consideration of pros and cons of different types of innovation to achieve SDGs helps to take more resilient policy

and better-informed investment decisions. It does not mean that considering various pathways reduces all the risks but it allows making choices based on the available evidence and collective intelligence about these risks.

Third, thinking about alternative scenarios of change can mobilise diverse stakeholder groups to join the roadmapping process. Using participatory methods to collectively imagine and deliberate scenarios can help to mobilise new types of stakeholders, including NGOs and civil society. They help create space for new ways of thinking about innovation, which may encourage new voices and help to manage powerful incumbent players.

It is important to ensure that foresight brings to the light a variety of visions of future and development pathways, including voices rarely reflected in the dominant narratives promoted by the most powerful actors. Participatory foresight gives an opportunity to engage groups, organisations and individuals who can bring new ideas to the policy space, including groups typically not included in the deliberations of research and innovation policy. This variety of new ideas is one of the key values foresight process can bring to policy. It is, therefore, important to avoid capture of the process by any single actor or narrative. The risk of capture can be managed by, for example, ensuring a broad and balanced participation in the process and by using independent facilitators.

A recent relevant example is a participative foresight exercise run by the Fraunhofer Institute for the German Federal Ministry of Education and Research (BMBF) on alternative pathways for a transition from fossil-based to bio-based resources up to 2040 (see ***Box 6***).

BOX 6

The Biokompass future dialogue: participatory foresight for bioeconomic transition mission

The German Federal Ministry of Education and Research (BMBF) ran a foresight on alternative pathways for a transition from fossil-based to bio-based resources up to 2040. The exercise was implemented by a partnership between the Fraunhofer Institute for Systems and Innovation research (ISI) and the Senckenberg Naturmuseum Frankfurt.

The participative foresight process used the following methods:

- Stakeholder mapping of actors playing different roles in the present and future innovation system
- Future dialogue on the 'everyday life' implications of the bioeconomy with 60 citizens and experts focused on end user needs (mobility, housing, consumption etc.)
- Four alternative scenarios were co-developed by experts and citizens
- Contrasts between the pathways associated with these visions were explored through a narrative co-creation storytelling process in a dialogue with over 50 citizens
- A natural history museum created an interactive exhibition based on the outcome of these dialogues and provided a place based forum for public learning activities.

The conclusions from the Biokompass project:

- Mission-oriented policy has much to gain from citizen involvement
- Participatory foresight processes are capable of engendering the type of 'bottom-up' engagement that can contribute to creating ambitious and powerful societal 'missions' across diverse regions and places.
- Citizens' input is transdisciplinary, holistic, and systemic as well as embedded into local cultural and social context.

Source: Fuchs et al. (2020), Rosa et al. (2021)

2.4. Sustainability mapping

The adoption of the UN 2030 Agenda and the SDGs marked a global turning point for challenge-led innovation policy through agreement on a set of broad societal goals for the first time. This means that governments now have a shared directionality. The 2030 Agenda covers a wide range of different issues. Effective R&I policy needs to reframe its priorities and find a targeted focus on important societal challenges while respecting fundamental indivisibility of the SDGs. This is not an easy policy task.

The colourful 'pick and mix smorgasbord' visualisation of SDGs does not offer much guidance on this policy challenge and various proposals have been made to facilitate the process. One of the best known of these is the 'wedding cake' arrangement of the SDGs (Rockstrom & Sudhev 2016). It groups the SDGs into environmental, social and economic categories. The approach highlights general relationships between SDGs but it does this in an implicitly hierarchical manner. It emphasises the ecological foundations of society and economy but other than that offers little practical policy help. A useful approach for operationalising

SDGs draws on Kate Raworth's (2017) 'doughnut' metaphor that emphasises the relational nature of SDGs and points to the essential need to combine social foundation with ecological ceiling goals in the transformation of sociotechnical systems (see ***Figure 4***).

From a transformative policy point of view, SDGs can be grouped into four clusters (see Schot et al., 2018):

- SDGs which cover sociotechnical systems or application areas, including SDG 3 on health, SDG 4 on education, SDG 6 on clean water and sanitation, SDG 7 on affordable and clean energy;
- SDGs which emphasise normative directionality for social provision (transversal direction), including SDGs 1 No poverty; SDG 2 Zero hunger; SDG 5 Gender Equality; SDG 8 Decent work and economic growth; SDG 10 Reduced inequalities;
- SDGs concerning ecological ceiling and planetary ecosystems, including SDG 14 life below water, SDG 15 life on land, SDG 13 Climate Action;
- SDGs which focus on governance and institutional framework necessary for transformation, including changing governance arrangements among the state, the market, civil society and science, for example SDG 16 Peace, justice and strong institutions and SDG 17 Partnerships for the goals.

The reorientation towards a transformative policy approach to the SDGs can be facilitated by Raworth's 'doughnut model'. The doughnut approach, which has been taken up by a number of major European cities such as Brussels and Amsterdam[2], can be used as a tool to ensure that different types of SDG are combined in the implementation of a mission. The policy utility of this model is to serve as a 'compass' to find and guide a meaningful course of action considering links between different social and ecological goals. This navigational metaphor helps to embed a stronger directionality into often complicated policy frameworks. This approach can make the SDGs more meaningful at the innovation programme, project and portfolio levels. Linking missions to the SDGs can enhance the relevance of an overall mission and assist the achievement of co-benefits between various policy instruments and projects.

The combination of transformative approach and the doughnut model places the efforts to transforming socio-technical systems in the context of the social-ecological system. Alignment with the SDGs needs to respect their 'indivisibility' in a practical and realistic manner. This is achieved by grouping into four main clusters: sociotechnical system, social foundation, ecological ceiling and wider institutional framework.

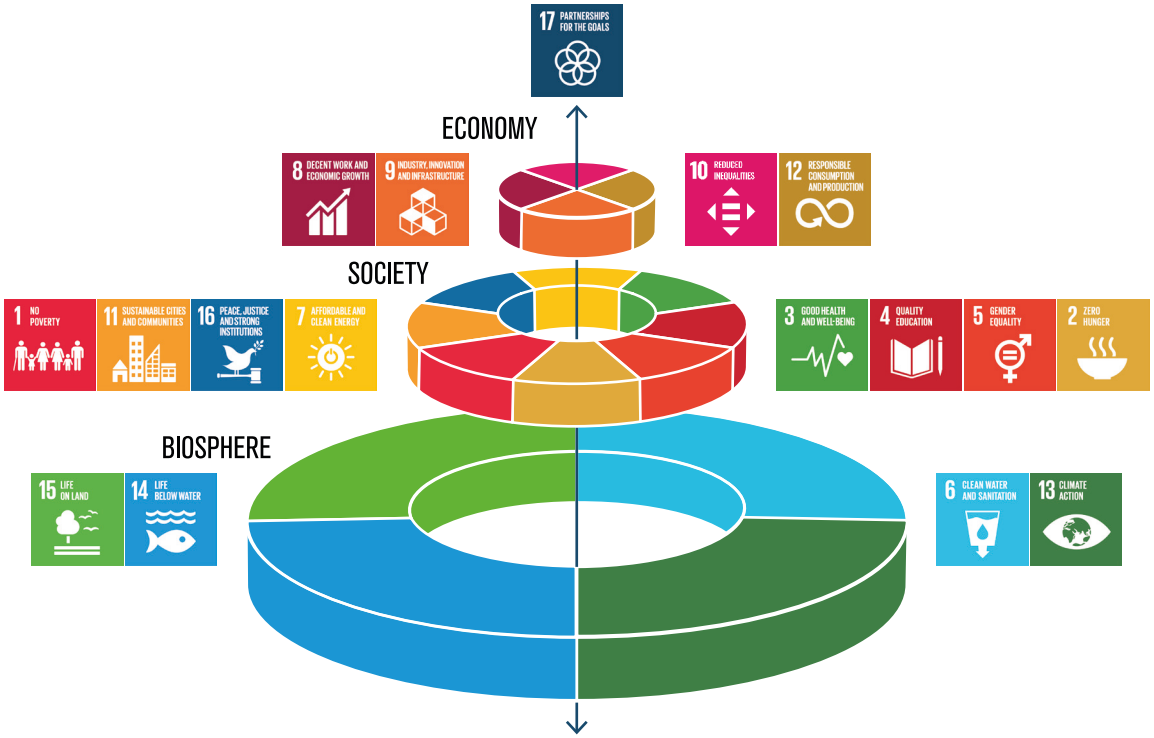
The doughnut model can provide a heuristic devise to support mission framing which has a clear focus on a sociotechnical system with a blend of goals which address social foundation and ecological ceiling challenges. The initial system framing is essential to create a broad understanding on the needed systemic change to address the societal challenges underpinning the missions. This theory of change thinking can guide reflection on the role of research and innovation in fostering systemic change considering specific challenges and context of a territory.

2 *See for instance:* ***https://donut.brussels/en/homepage*** *or* ***https://doughnuteconomics.org/stories/1***

FIGURE 4 *'Big picture' perspectives on the SDGs*

A. Smorgasbord

B. Wedding cake



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C. Doughnut

Ecological ceiling:
ecological and ecosystem services SDGs

Operating space:
economic and infrastructure SDGs

Social foundation:
economic and social SDGs

Sources: A: UN (2015), B: Azote for Stockholm Resilience Centre, Stockholm University CC BY-ND 3.0 (2016), C: Authors, based on Raworth (2017) and Schot et al. (2018)

Policy mix for S3 missions

3.

3.1. Developing a policy framework for mission-oriented innovation policies

The policy mix concept has been used, customarily, to refer to the set of instruments used to implement a policy addressing a specific 'domain' (whether it be research and innovation (R&I), energy, transport, etc.). In contrast, in considering policy mixes adapted for sustainability transitions, Rogge and Reichardt (2016) stressed that 'a policy mix goes beyond the combination of interacting instruments – the instrument mix – but also includes a policy strategy, policy processes and characteristics'.

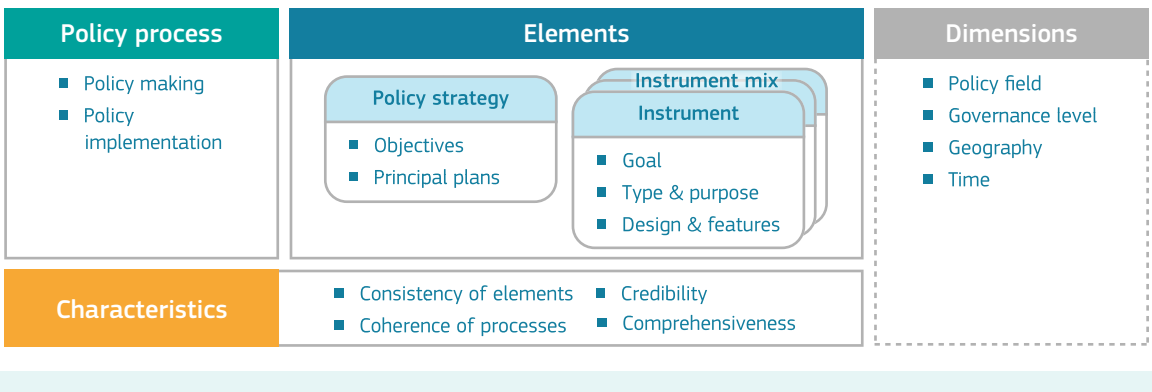
Rogge and Reichardt proposed an 'extended policy mix' concept that includes three 'building blocks':

- policy strategy and instrument types and design
- the policy process
- characteristics of the policy mix (consistency of instrument mix, coherence of the policy process, and credibility and comprehensiveness of the mix).

A policy mix four dimensions:

- policy field
- governance level
- geography, and
- time.

FIGURE 5 *Policy mix building blocks for transitions*

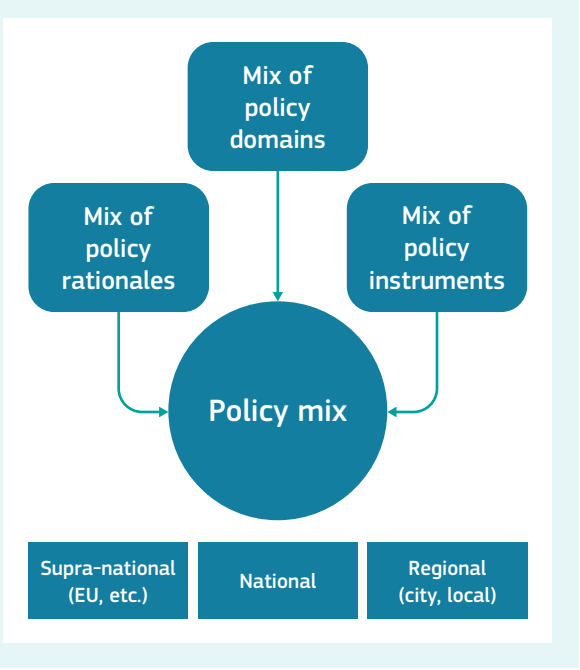


Source: Rogge & Reichardt (2016)

Similarly, Nykamp (2020) argues that a policy mix is the combination of policy domains, rationales and instruments:

- Policy domains are established coalitions of actors who propose ideas, define problems and solutions to problems about issues. Domains contain different goals, different understandings of the appropriate way to reach those goals, and different rationales for each policy;
- Policy rationales are based on policy actors' understanding of problem definitions and on which tools are best suited to deal with the problems – e.g. market failure and systems failure that provide different motives for policy intervention. Conflicting rationales or disagreements on the nature of challenges may lead to conflicting ways to frame, define and solve problems, and consequently underpin different styles of policy design and implementation.
- A mix of policy instruments that may include: instruments that belong to the same policy domain (e.g. environmental regulation and environmental taxes), and/or those that belong to different policy domains (e.g. environmental taxes and R&D subsidies).

FIGURE 6 *Policy mix dimensions for addressing S3 missions*



Source: Authors, adapted from Nykamp (2020)

Nykamp frames this extended policy mix against the geographic/governance level dimensions to take account of a multi-level governance approach to implementing mission policies. Hence, the choice of what to include in and how to operationalise a policy mix depends on the 'policy space' (number of domains addressed, etc.), governance levels involved in the policy design and implementation and the time horizon adopted.

Five principles should guide the process of developing a policy mix for transformative change.

First, a mission-oriented policy should **build upon existing policies, governance and institutional structures.** In other words, it does need to be designed from scratch. This also implies that the strengths and weaknesses of the innovation system and pre-existing policy landscape should be considered (Larrue 2021). While new policy instruments may have to be designed, many successful examples from other countries consist primarily of actions to better coordinate, integrate and orient existing programmes towards a shared goal. For example, Norway's Pilot-E is a cross-agency initiative that support projects in the area of reducing climate emissions and promoting energy saving solutions from conception to market (Larrue, 2021).

A second principle is that the challenge-oriented transformative missions require a **systemic and cross-sectoral** approach to overcome the fragmentation of policies that is a common feature of the policy landscape in many countries, including Czechia. This fragmentation can take various forms. First, it may take a sectoral dimension. Missions are, almost by definition cross-disciplinary and cross-sectoral by nature. This means that agencies may need to connect sectors that would not be (well) connected in the absence of the mission. In similar fashion, they involve several ministries, support agencies and other public and private bodies that typically operate 'in silos' (OECD, 2020).

A third principle, common to mission-oriented policy as well as smart specialisation is that they entail **engagement with a broad range**

of stakeholders. Policy processes should reach beyond higher education institutions, research and technology organisations or businesses to engage more fully with civil society. Moreover, a multi-level governance perspective is required as policy experimentation will often require the involvement of local or city authorities, etc. to test and trial solutions that can be scaled up nationally at a later stage. All these actors must mediate and coordinate their efforts towards a common goal, notwithstanding differences in their organisational culture and approach (with private businesses, research organisations and public actors often reputed to 'speak different languages'). The Dutch Top Sectors experience may offer a useful reference in this respect to Czech policy makers (see ***Box 7***).

BOX 7 *The Dutch Top Sectors experience*

Description of the approach

The Top sector approach was launched in 2012 with the Ministry of Economic Affairs and the Ministry of Education, Science and Culture the driving forces. Nine sectors, typically with high R&D capacity and/or export potential, were identified as part of the approach. For each of these sectors, a team representing research organisations, for-profit businesses and public actors was established with the aim to create and implement the 'Knowledge and Innovation Agendas (KIAs).' The KIAs present the strategic direction in which the respective sector should be developed and detail the course of action appropriate to achieve this goal. The KIAs are developed in close consultation with various stakeholders through various networking activities, among others. In 2019, the programme was revamped with a focus on four central mission themes and 25 missions overall, rather than on the nine sectors.

Obstacles encountered

A 2020 evaluation of the programme revealed that it is hard to engage with firms that are less innovative. This entails that the focus lies primarily on R&I that is relatively close to the knowledge frontier, rather than on its diffusion across the broader economy. A downside to the organisational structure of the mission and its extensive stakeholder involvement is the relatively high governance burden and costs, and the risk of top-heavy slow and difficult decision making. Finally, there is a strong focus on financial R&I support schemes.

Relevance for Czechia

In a nutshell, the Dutch approach is centred on overcoming silos between different actors in the triple helix. While the sectoral approach may not be well suited to the missions in Czechia, the governance mechanism with actors from various backgrounds in the driver's seat, as well as the efforts to set up the strategy after extensive consultation may be a potential model to emulate. An evaluation suggests that the programme has been largely successful in that respect.

It is worth noting that most of the instruments being employed were already in place (with fiscal schemes like the patent box and the WBSO taking centre stage), but have become better directed. At the same time, there are a few exceptions to this general rule, either for all sectors or for specific sectors of specific Ministries. Of particular note is the MOOI (mission-oriented research, development and innovation) subsidy whereby consortia comprising three organisations can submit plans proposing integrated solutions rather than individual technologies. Czechia could follow this model,

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relying foremost on existing policy levers, but with the flexibility (and budget) to fill in possible gaps in the portfolio of instruments on a needs basis.

In addition, there are four mission themes as part of the overall project, two of which are quite similar to the Czech missions (i.e. security and energy transition and sustainability). As the Dutch approach has been relatively longstanding and perceived as overall successful, policy makers in Czechia can draw inspiration from the Netherlands, for instance on the development of key performance indicators, or on the selection and implementation of programmes.

Sources and additional reading:

- *Janssen M. (2020), Post-commencement analysis of the Dutch 'Mission-oriented Topsector and Innovation Policy' strategy.*
- *https://stip.oecd.org/covid/moip/case-studies/3*
- *https://www.rvo.nl/subsidies-financiering/mooi*

There are several reasons why policy makers need to be especially aware of this issue. First, the innovation support landscape is multi-faceted and requires coordination that is beyond the remit of a single ministry or agency. Second, the S3 missions require coordinated action at the national level, but also the mobilisation of policy makers at the sub-national level. In Czechia, for example, the regions play a significant role in the policy system through innovation centres, co-working spaces, regional development agencies, incubators, regional innovation platforms and technology centres. In addition, a sizeable proportion of the funding and a good number of programmes relevant for the missions originate at the EU level. As the Czech mission approach is embedded within S3, this calls for careful tailoring of policy implementation to align with local and regional innovation priorities and opportunities.

A **fourth design principle** is that mission-oriented policy should be based on adaptability and will typically **evolve over time.** There is usually a lot of experimentation, learning by doing and trial and error involved. Conscious of this, this report aims to set out options for how to design and implement S3 mission type policies, while avoiding to be overly prescriptive in how the approach should be implemented in practice, especially over the long run. As a corollary of this principle, it is of crucial important to monitor a relevant set of indicators that measure progress towards the mission objectives rather than output, result and outcome indicators used in standard programming. Setting and tracking progress towards intermediate milestones helps to identify emerging issues in a timely manner (Mazzucato, 2018). The importance given to policy experimentation means there is a need for a more formative process to the monitoring and evaluation of mission-oriented policies.

A **fifth design principle** is to select **a suitable policy instrument mix** from a range of options including financial instruments such as grants, subsidies, equity and tax credits as well as regulatory or demand side instruments (e.g. innovative public procurement). While grant based funding for R&I projects is likely to remain a core element of S3 mission implementation, other types of instruments should also be mobilised. This implies the need for building **a 'coalition' – or 'whole**

of government approach'[3] – with other governmental bodies (ministries, agencies etc.) that not agree on a common mission design but work collaboratively on implementation.

3.2. Designing a policy instrument mix

A set of guiding questions can be used when considering the development of a policy instrument mix:

- What is the required mix between R&I instruments and, instruments from other policy fields?
- What types of supporting actions should be envisaged to complement funding instruments?
- How well do the instruments/actions span a technological or societal readiness level (TRL or SRL) scale?
- To what extent are projects and activities interdisciplinary and cross-sectoral?
- What are the planned (or possible) evolutions of the policy mix and what are the rationales and driving forces behind this evolution?

The adoption of a mission approach (in an S3 framework) implies a shift from:

- a mix of standard often 'stand-alone' industrial/innovation policy instruments (programmes) implemented by a single ministry or agency; to
- a portfolio of instruments requiring a cross-ministerial/agency and multi-level (local/regional, national, supra-national) implementation model.

A first step is to select from a 'menu of instruments' and assess the pros and cons of using different types of instruments. A wide set of instruments can be deployed to achieve the desired impact, including:

- Financial support instruments such as (R&D) grants, subsidies, tax incentives;
- Business support services (e.g. mentoring, coaching, advisory services, networking) for innovative high-potential firms in emerging niches;
- Regulatory measures, e.g. regulatory sandboxes and other regulatory pilot projects (Gangale et al., 2023).
- Pricing mechanisms (emissions trading, etc.)
- Challenge-oriented initiatives to mobilise innovators to experiment with alternative solutions to a public policy or societal problem; see, for instance, the Civtech challenges that are used to develop solution to challenges faced by the public sector in Scotland[4]
- Public procurement for innovation (OECD, 2017a) which has already been tested in Czech Republic through the BETA programme of the TACR[5]
- Networking and platform instruments (that help mobilise a broad range of stakeholders, users/citizens) (see Walloon strategic innovation initiatives in ***Box 8***).

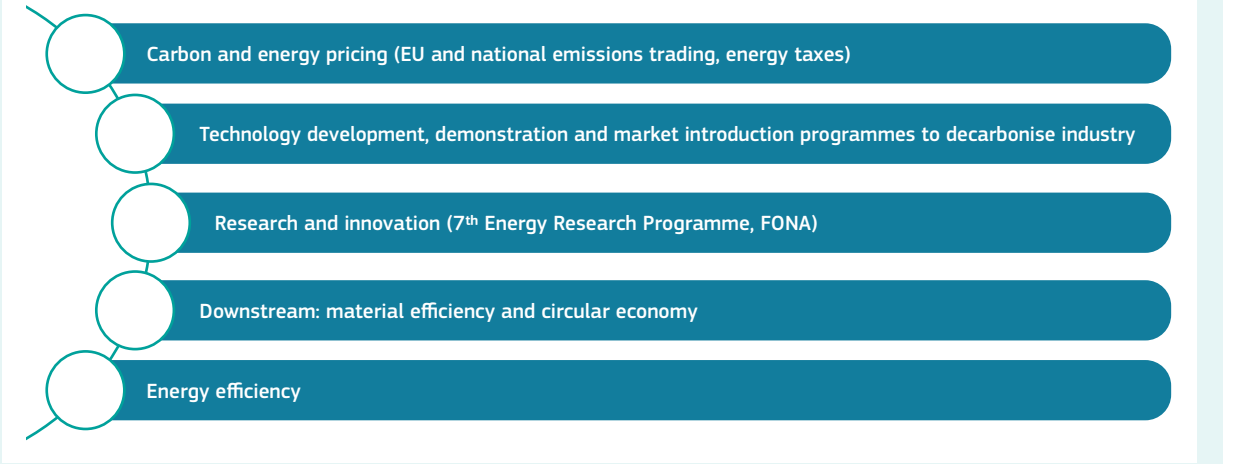
The instruments can originate from diverse government agencies, involve the private sector and span different levels of government (national, regional, local). An example of a policy mix aimed at decarbonising basic material industries in Germany underlines that while R&D type projects including demonstration and market introduction are key elements, other mechanisms are critical to achieve the aims, both in terms of pricing (regulatory, taxes) and downstream measures to enhance material efficiency and energy efficiency by users.

3 *See for instance the working being done in the framework of the Horizon Europe Policy Support Facility Mutual Learning Exercise on this topic.* ***https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-whole-government-approach-research-and-innovation***

4 *See* ***https://www.civtech.scot*** *and* ***https://www.civtechalliance.org***

5 *See* ***https://www.tacr.cz/en/beta-progammme***

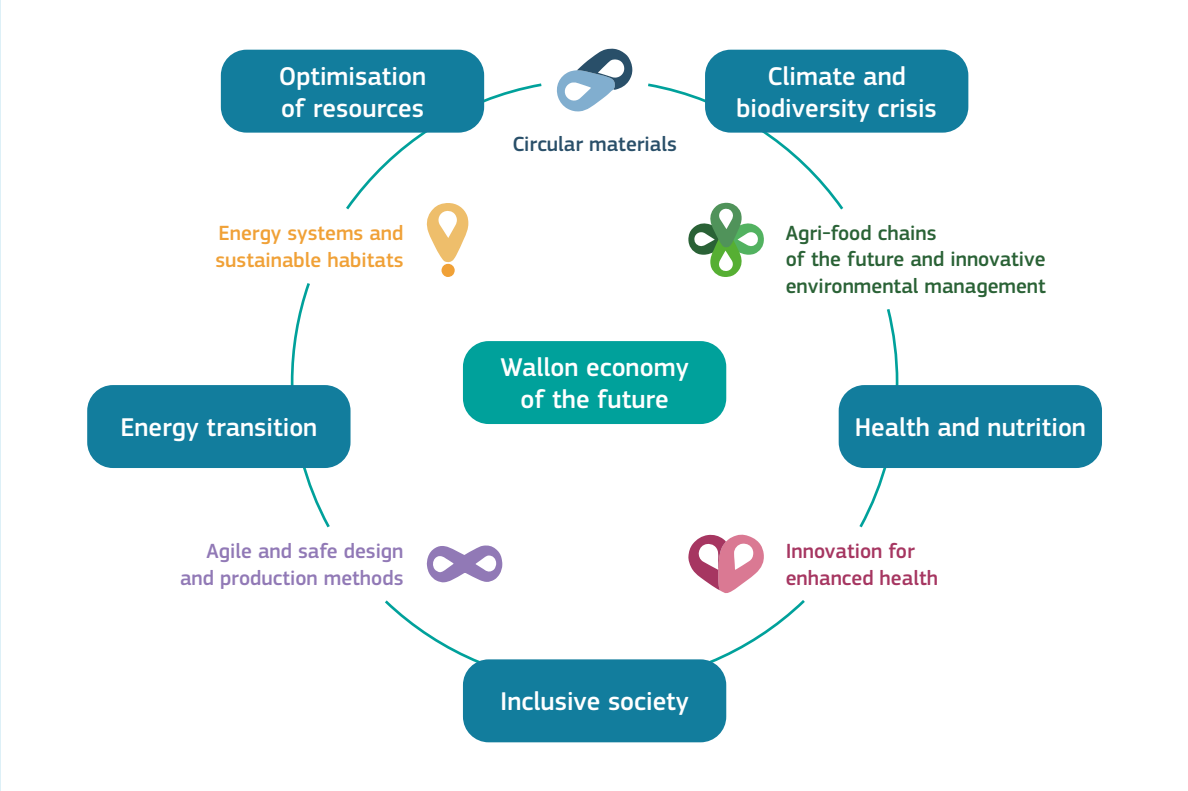
FIGURE 7 *Policy mix to decarbonise basic material industries in Germany*



Source: Fleiter et al. (2021)

BOX 8 ***Building a portfolio of mission driven projects through bottom-up initiatives in Wallonia***

In Wallonia (Belgium), the S3 for 2021-2027 is designed around five strategic innovation areas (SIA) derived from an identification of the potential to respond through mobilising R&I to six key societal challenges facing the region, while creating new business opportunities.



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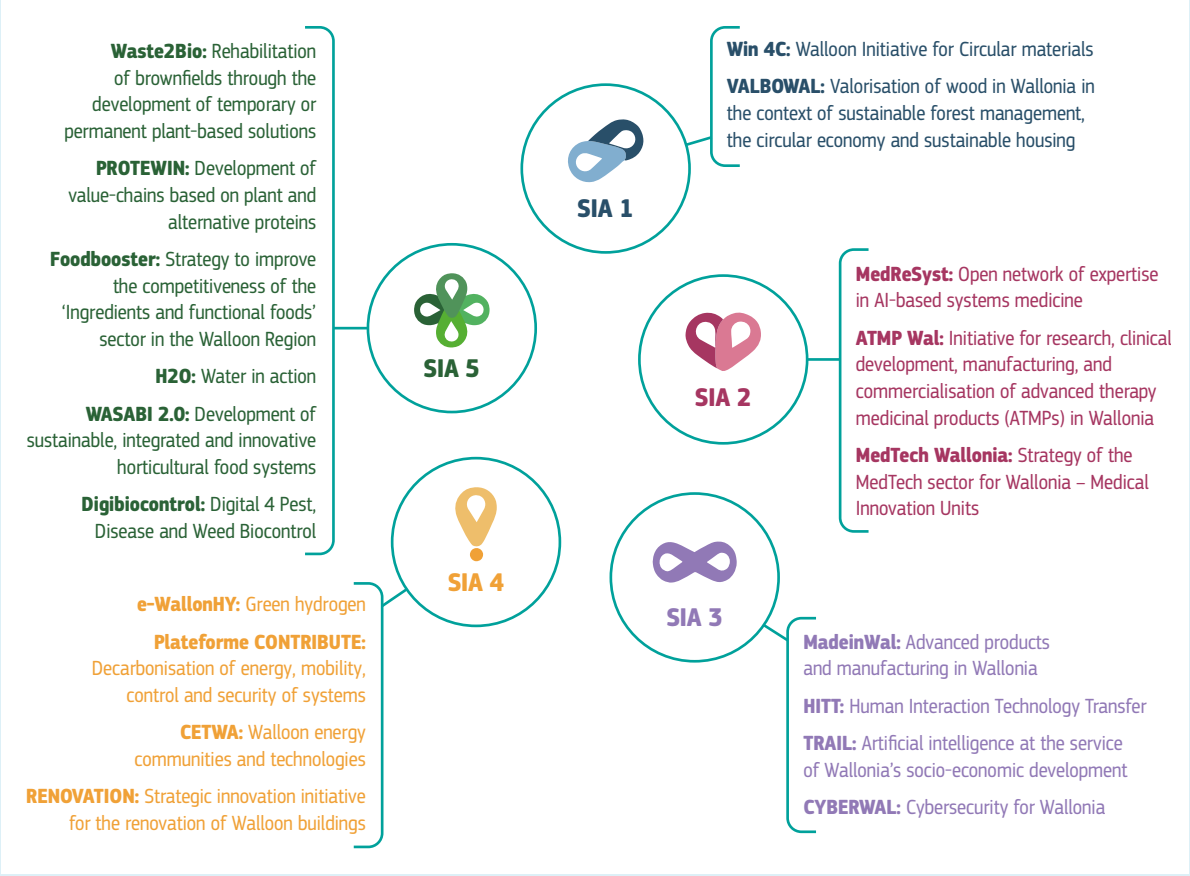
Following the definition of roadmaps for each SIA, a call for proposals strategic innovation initiatives (SII) was launched. SII are defined as a 'coherent set of activities and projects with a sufficient critical mass bringing together the available forces and relevant actors in response to one or more goals of one or more SIA. 19 SII were selected following the call for proposals addressing various opportunities in the five SIA that can help the region both become more sustainable and resilient while developing or reinforcing regional value chains and their links to international partners and clients.



A key innovation in the process was that the call for proposals was not directly linked to any public funding. Rather the SII proposals were expected to explain how they would use the existing policy-mix in Wallonia (or from Belgian or European level initiatives) to mobilise the necessary funding, regulatory, information or governance resources required to implement a plan of action. The work of the SII may lead to adjustments to the policy mix over time inspired by the bottom-up learning initiated through the collaboration,

The composition of the 19 SII partnerships (the 19 partnerships bring together over a 1 000 organisations) shows a balanced mobilisation of the quadruple helix actors: companies, the academic world (universities and research centres), civil society and public actors (municipalities, local development agencies, etc.) which will enable the development of innovative and result-oriented collaborations.

Source: Authors, based on documents available at ***https://s3.wallonie.be***

Nykamp (2020) assessing the policy mix supporting the transition to green housing in Norway identified 15 different instruments across four categories (regulatory, regulative/information, financial, network/information) managed by a mix of national ministries and agencies (Regional Development, Environment, Energy, Norwegian State Housing Bank, Innovation Norway, Research Council of Norway, Enova, Agency for planning and building, etc.) as well as municipal authorities and EU funding programmes for R&I. The research found the instrument mix was relatively consistent and that there was a powerful self-reinforcing dynamic among financial, regulatory, and information-based instruments.

In the case of Czechia, as presented in ***Box 9*** and ***Table 2***, the instrument mix for implementing the S3 missions remains mainly composed of standard R&I instruments with room for further broadening towards additional instruments notably from a demand (societal, government, etc.) or use driven perspective but also by combining regulatory instruments such as sandboxes, etc. with the funding support.

Gangale et al. (2023) examined the role of regulatory experimentation as an innovation tool to enable and facilitate the energy transition. In the case of Czechia, the Energy Regulatory Office of Czechia (ERU) confirmed that there are no regulatory experimentation initiatives currently in place. The possible introduction of a regulatory sandbox scheme is, however, under consideration. The current Czech legislative framework does not allow for the set-up of regulatory experiments, which would need the adoption of an ad-hoc legal basis. This is an example of the need for policy action to be taken to broaden, over time, the policy space in which S3 missions are designed and implemented by going beyond standard R&I funding instruments.

BOX 9

Shaping instrument mix for the Czech S3 missions: from selection criteria adjustments to portfolios

The Czech government has an ambition to implement missions through a comprehensive instrument mix. The main instruments targeted by the S3 missions are Operational Programmes financed from EU Structural Funds, Czech R&I instruments supporting R&I policy and R&I-related programmes in other policy areas managed by the line ministries. The ambition is also to foster Czech participation in the submissions to the relevant EU calls under the Horizon Europe programme.

The National S3 team has been making a considerable progress in embedding missions in support programmes and raising awareness of S3 missions across the government and R&I stakeholders. Relevant funders are involved in the process in the Expert Group of Support Providers (i.e. ministries and agencies managing programmes). The National RIS3 team shares the 'mission cards' (Annex 1 of the NRIS3) with providers and meets them on a monthly basis to exchange information and discuss topics relevant for S3 missions.

The RIS3 puts envisages four broad ways of embedding missions in support programmes:

- **Selection criteria adjustment:** First option is to make mission-focused project proposals eligible for S3 funding on the same level as proposals targeting S3 objectives, specialisation domains or enabling technologies

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- **Award criteria adjustment:** Second option is to adjust proposal evaluation in standard S3 calls to award bonuses for mission-relevant proposals (e.g. calls focused on RIS3 objectives or specialisation domain or focused on key enabling technologies). The intention was to test various ways of funding missions to give space for bottom-up projects and solutions.
- **Dedicated mission calls:** Third option is to implement specific targeted calls fully dedicated to RDI topics relevant for the mission's objectives.
- **Portfolio management approach:** Fourth option, feasible in a longer term, is a portfolio management approach aiming to implement various instruments in a coordinated way.

The National S3 team has been working with a number of programme managers across ministries and agencies to create a more favourable policy environment for mission-oriented project proposals (see ***Table 2*** for an overview). The instrument mix mobilised for the S3 missions so far focuses mainly on adjusting selection and award criteria of the calls. R&I projects proposals focused on missions are eligible for R&I support on the same level as project proposals targeting S3 objectives, specialisation domains or enabling technologies and, in some instances, they get additional bonus points for addressing S3 missions.

For example, project proposals submitted to the TREND programme – funded by the Recovery and Resilience Facility (RRF) – will need to address one of the specialisation domains of NRIS3 and will significantly boost their evaluation score if they also target missions.

The S3 team is also piloting implementation of mission-dedicated calls. For example, SIGMA – programme supporting young researchers and equal opportunities - introduced a call with a dedicated allocation of CZK30m (€1.3m) for project proposals addressing one of the three strategic objectives of the environmental mission (decarbonisation, decentralisation, circularity). Importantly, the focus on missions can allow projects, which would otherwise fall below the selection threshold, to move up in ranking thanks to bonus points received for addressing the mission.

The instrument mix mobilised so far for S3 missions on supply-side R&I instruments. It has not yet extended to demand-side instruments (e.g. public procurement or fiscal instruments) or regulatory measures (e.g. via regulatory sandboxes) which require further extending the reach of NRIS3.

The current support for missions has not yet included instruments providing a long-term support for mission-oriented innovation collaborations and regional innovation eco-systems supporting bottom-up experiments and place-based approaches. Creating a 'soft support system' is important to foster challenge-led innovation projects and collaborations between diverse actors. Nurturing mission-oriented collaborations is key for creating synergies contributing to transformative impacts of public investments.

The National RIS Team has been actively engaged in establishing working contacts with programme managers across Czech government. Although it is premature to talk about the portfolio approach to S3 missions in Czechia, the current policy experiment may gradually evolve from information sharing to closer coordination and collaborative implementation of mission-oriented investments.

Source: RIS3 documents and communication with the National RIS3 Team

TABLE 2 *List of Czech support programmes mobilised to support S3 missions*

Name of programme	Call for proposal or Public tender	R&I support provider	RIS3 mission addressed	Mission support mechanism
Technologies and Application for Competitiveness	Establishment or development of centres for industrial research, development and innovation	MIT	Improving the material, energy and emissions efficiency of the economy	Support for mission objective among selection criteria
Johannes Amos Comenius	Development and support of excellent research teams to provide top results with cutting-edge equipment	MEYS	Improving the material, energy and emissions efficiency of the economy Strengthening society's resilience to security threats	Support for mission objective among selection criteria
SIGMA	Support to young researchers conducting applied research	TA CR	Improving the material, energy and emissions efficiency of the economy	Support for mission objective among selection criteria; Funding for missions ring-fenced
TREND	Support to in-house R&D and application in own operations (intramural innovation)	MIT	Improving the material, energy and emissions efficiency of the economy Strengthening society's resilience to security threats	Support for mission objective among selection and award criteria (bonus offered to mission-oriented project proposals)
TRANSPORT 2030	Research with the potential for innovative applications in the transport sector	MoT	Improving the material, energy and emissions efficiency of the economy	*Design phase ongoing*
Environment for Life	Innovative solutions in the field of environment, ensuring a healthy and quality environment and minimising the negative impacts of human activity on the environment	MoE	Improving the material, energy and emissions efficiency of the economy	*Design phase ongoing*
SECTECH	Development, testing and evaluation of new security technologies	MoI	Strengthening society's resilience to security threats	*Design phase ongoing*

Legend: MIT – Ministry of Industry and Trade; MEYS – Ministry of Education, Youth and Sports; TA CR – Technology Agency of Czechia; MoT – Ministry of Transport; MoE – Ministry of Environment; MoI – Ministry of Interior; Source: Communication with the Czech S3 team; NRIS+ and Annex 1 to the NRIS+ (Czech Ministry of Industry and Trade, 2022)

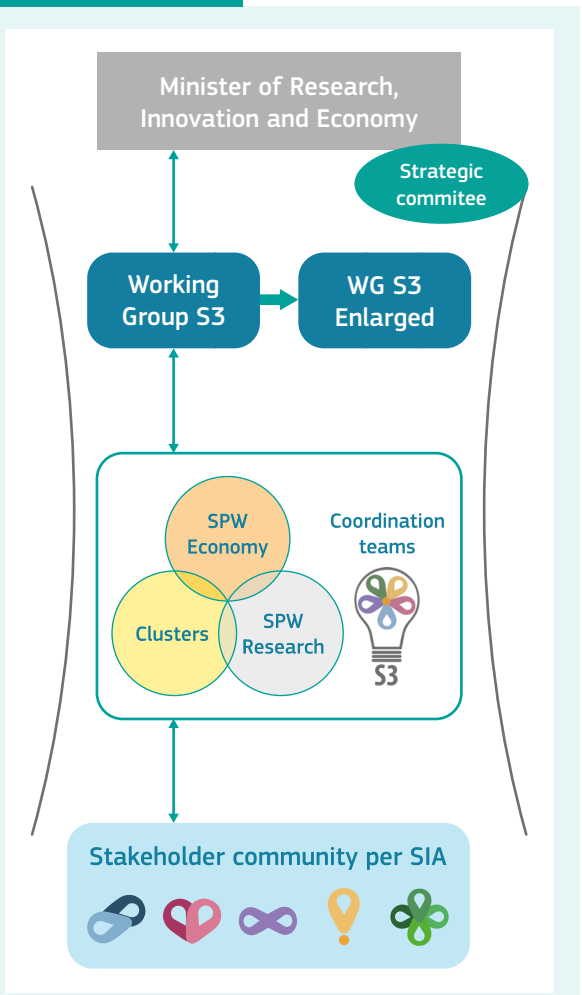
3.3. Governance of S3 missions

Governance structures of S3 missions

The governing and steering of a mission requires a dedicated governance structure that is sufficiently resourced over time to be able to assure both a coordination function and a monitoring and evaluation function as well as engage and communicate to a broad set of stakeholders on progress to ensure sufficient mobilisation and ownership. Models differ across countries but a mission secretariat with sufficient staff resources and a mandate to operate at a cross-ministerial level (in a 'whole of government' perspective) is necessary to ensure efficient and effective implementation. The mission secretariat should be distinguished from the role of programme managers in ministries or agencies responsible for implementing specific instruments. The Czech S3 missions are embedded in the existing S3 governance structures (see ***Box 10*** and ***Figure 9***).

The Walloon and Catalan cases illustrate alternative governance models to agenda setting and implementation of S3 type missions. The Walloon S3 2021-2027 is based on a co-coordination model involving regional government departments (SPW Economy and SPW Research), public sector agencies including the digital agency (AdN) and the business support agency (Wallonie Entreprendre), cluster managers and the selected SIIs. A cross-departmental working group oversees the S3 implementation with the working group enlarged to cover other agencies (such as the employment and training agency) and other departments (e.g. the department managing structural funds). The day-to-day support and coordination to the 20 SII is provided by coordination teams for each SIA composed of the clusters in partnership with the regional administration. The self-organised stakeholder community for each SIA and the SII partnerships work with the coordination teams to draw up roadmaps, monitor progress, report on results and success stories.

FIGURE 8 *Governance structure of S3 in Wallonia*



Source: Authors, based on documents available at ***https://s3.wallonie.be***

In Catalonia, the RIS3CAT 2030[6] governance system is coordinated by the office of economic affairs and European funds of the Ministry of Economic Affairs and Finance. The system is based on a cross-departmental management committee from 12 policy domains, including one representative of the advisory council for sustainable development. The work is structured in a set of shared agendas for sustainability and social change which – like the Czech S3 missions – are complementary to the more traditional priorities derived from technology areas. Shared agendas are initiatives

6 *RIS3CAT is available in English at* ***https://fonseuropeus.gencat.cat/web/.content/ris3cat/documents/angles/ris3cat-2030-en.pdf***

launched by various stakeholders in a territory to address systemic challenges aligned with the SDGs. They are adopted through a participatory governance model.[7]

The main pillar of the RIS3CAT's governance system is the Opportunities Discovery Mechanism coordinated by the Ministry of Economic Affairs and Finance and managed by a cross-departmental team. The approach is articulated around seven challenge-oriented and ecosystem-based shared agendas or missions. The Opportunities Discovery Mechanism serves to:

- Define the scope of the shared agendas prioritising systemic transformations aligned with the SDGs;
- Support the transformative initiatives promoted by actors of the research and innovation system aligned with the RIS3CAT's shared agendas;
- Contribute to the development of capacities for smart S3, industrial transition and entrepreneurship
- Propose formulas and instruments to finance transformative actions in the framework of the shared agendas;
- Promote initiatives and projects that can obtain European funding by identifying opportunities for synergies and complementarities between European funds and programmes and supporting participation in European networks and projects;
- Monitor the activities of the shared agendas through participatory evaluation systems that focus on strategic learning and transformative processes in the medium and long term, and which enable more effective actions to be developed;
- Create synergies and complementarities with other strategies promoted by the Government;
- Strengthen international collaboration by finding opportunities for synergies and complementarities between European funds and programmes and supporting participation in European networks and projects.

BOX 10 *Governance of the Czech S3 missions*

The Czech S3 missions are designed and implemented using the institutional set-up and governance mechanisms established for the Czech National RISS3 Strategy. The government has an ambition to ensure that the process leads to the generation of specific solutions to societal challenges in a bottom-up process engaging business, research and wider public through the EDP. In addition to the EDP, the Czech RIS3 proposes the 'public discovery process' to explore ideas for public sector-driven innovations responding to the societal challenges faced by the Czech society.

The main actors in the Czech NRIS institutional set-up include:

- **RIS3 Management Committee** is the high-level national body setting-up, managing, coordinating and monitoring the interventions planned in RIS3. It is composed of representatives of ministries and relevant R&I institutions, notably the MIT, Ministry of Education, Youth and Sports (MEYS), Ministry of Regional Development (MRD), Technology Agency of Czech Republic (TA CR) and the Research, Development and Innovation Council (RDIC).

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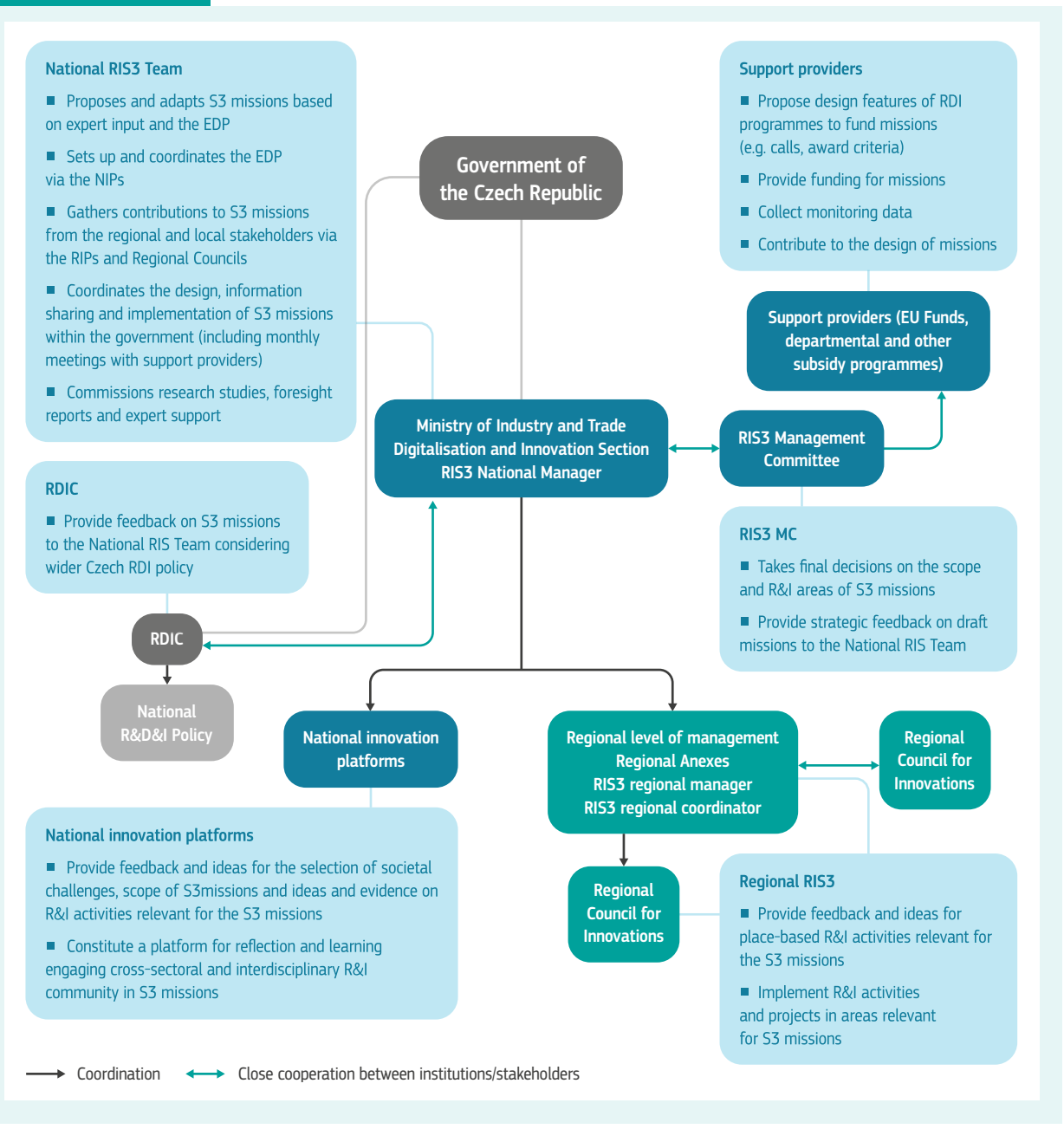
7 *For more information on the RISCAT's shared agendas see https://fonseuropeus.gencat.cat/ca/ris3cat/2030/agendes-compartides*

- **National RIS3 Team** is the executive unit managing and coordinating the National RIS3 Strategy:
  - **RIS National Manager** is a senior representative of the unit for managing and coordinating the National RIS3 Strategy. The role is assumed by the Director of the MIT Department of Digital Economy and S3, Digitalisation and Innovation Section.
  - **The S3 Strategy Unit,** located at Digitalisation and Innovation Section of the MIT, analyses evidence relevant for the implementation of RIS3, and monitors the implementation of the strategy. It processes and evaluates input from the EDP process and prepares proposals for updating the National RIS3 Strategy and related documents.
  - **The wider National RIS3 Team** includes regional S3 managers and coordinators, representatives of CzechInvest, TA CR and Prague Technology Centre.
- **National Innovation Platforms (NIPs)** are advisory and consultative groups with the task to identify needs, specify and refine strategic priorities, identify business opportunities and discuss the scope and objectives of proposed S3 measures. They are a key vehicle of the EDP in Czechia. Set up by the RIS3 Management Committee, NIPs include representatives of diverse stakeholders, including business and business support (e.g. clusters), research (e.g. representatives of the Czech Academy of Sciences, higher education institutions, research organisations), public administration and representatives of the regional level.
- **Expert Group of Support Providers** includes providers of support for RDI including relevant Operational Programme Managers and Support Programme Managers responsible for implementing relevant programmes and calls in the 2021–2027 period.
- **Regional RIS3 Teams,** led by Regional Councils, include representatives of regional and local authorities, innovative businesses, research and clusters. Councils coordinate and approve supporting documents from the RIS3 executive unit regarding the implementation of regional RIS3 interventions and projects, updates to the RIS3 and regional specialisation domains.
- **Regional Innovation Platforms (RIPs)** are advisory and consultative bodies on the regional level generating proposals for new interventions based on local needs and provide feedback on the S3 process. RIPs include representatives of regional and local authorities, innovative businesses and research organisations. They are focal points for the EDP on the regional level.
- **Ad-hoc expert groups** are established to work on specific topics, most notably crosscutting topics most relevant for specialisation domains or missions.

The S3 missions were consulted with R&I stakeholders and further elaborated in a series of the EDP meetings on the national and regional level. ***Figure 9*** highlights the roles of RIS actors in designing and implementing missions.

Source: JRC workshops with the Czech S3 team; NRIS+ and Annex 1 to the NRIS+ (Czech Ministry of Industry and Trade 2022)

FIGURE 9 *Roles of the main NRIS3 bodies in designing and implementing Czech S3 missions*



Source: the Czech National RIS3 strategy; call-outs added by authors

The EU Missions governance structures have involved a mission board, mission secretariats (drawn from the staff of one or more directorates-general), mission owner groups (bringing together all the Commissions DGs with a stake in the mission to coordinate support for the mission), mission implementation platforms (via a procurement contract) and mission charters or manifestos signed by cities and regions which commit to the mission goals. The challenge is to ensure that the necessary management and steering to coordinate funding and support to the mission goals are balanced by mechanisms which enable stakeholders on the ground at national, regional or local levels to express ideas, experiment and co-design calls, joint initiatives, etc. The possibility for combining a mix of top-down (national) coordination with bottom-up (local and regional) dynamics has been explored in the Czech case through a series of meetings between national and regional authorities, regional RIS teams and regional innovation platforms.

Multilevel governance perspectives on S3 missions

This section outlines a framework for assessing opportunities for and managing strategic alignment and operational synergies between:

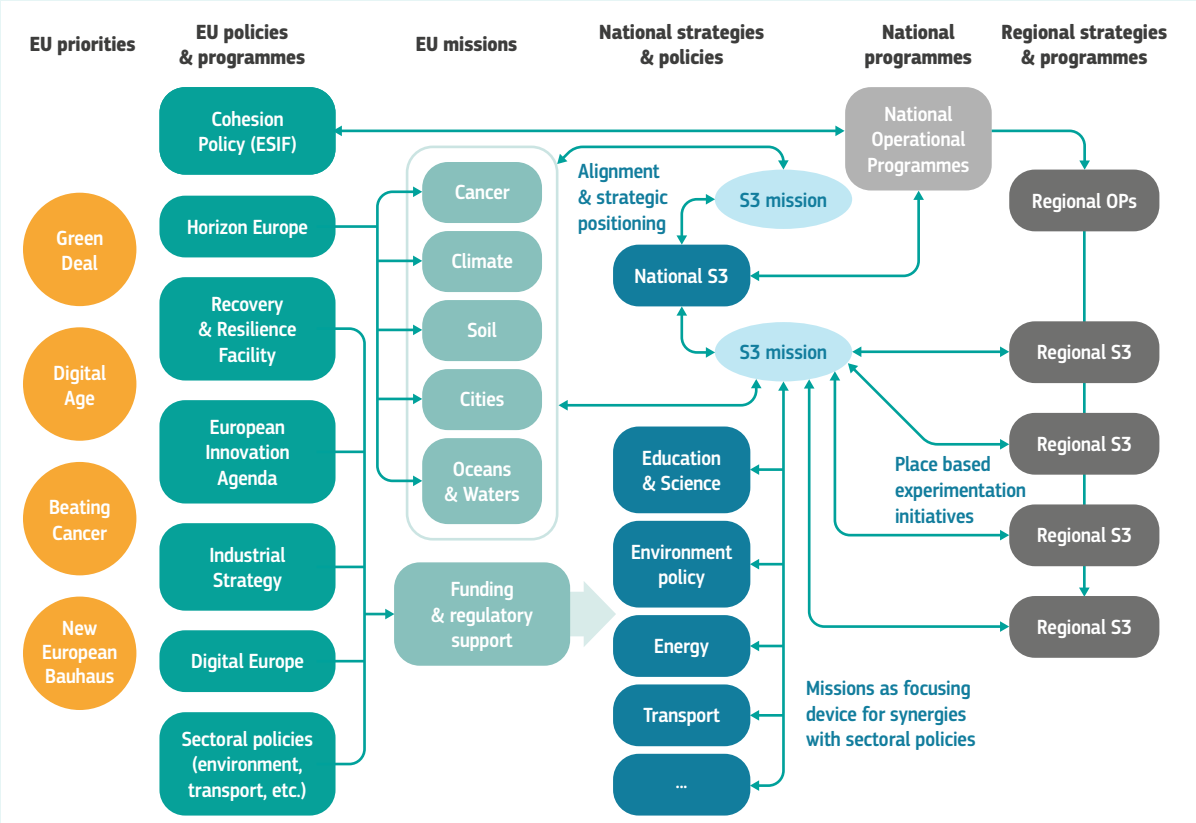
- National S3 missions and European missions (and related policies)
- National S3 missions and related missions in other countries (regions)
- National S3 missions and regional (place-based) initiatives.

The guidance published by the European Commission on synergies between Horizon Europe and the ERDF (EC, 2022) underlines that S3 is crucial for synergies with smart growth-related instruments at EU level especially with Horizon Europe priorities and actions, and notably the missions and partnerships. These priorities and actions are a reference point for developing complementarities.

According to the Commission's guidance, synergies can be optimised by 'designing strategic plans that complement each other and using different funding streams (in line with the specific objectives of each programme/fund)'. In particular, bottom-up S3 priority setting should 'make it easier to find partners in other Member States with a view to cooperating on related topics and value chains'.

Concerning the EU missions, a dedicated Commission governance model has been set up to ensure coordination and identify synergies between the EU Missions' implementation plans in support of the mission's objectives. The Commission (EC, 2021) foresees that 'Close engagement of Member States will be crucial in achieving the missions' objectives and aligning with national strategies. Complementarities with regional strategies and smart specialisation strategies will be identified, to help bridge the innovation divide between Member States and regions'.

FIGURE 10 *Multi-level governance and policy context of S3 missions*



Source: Authors, own idea and design

The diagram above summarises the position of S3 missions within the three main policy dimensions: EU priorities/programmes, national and regional. It provides a simplified view of a policy framework that, in reality, is even more complex. Horizon Europe, for example, includes a range of instruments and funding programmes including the EU partnerships, EIT KICs, ESFRI (research infrastructures). Under the EU industrial policy funding is available via the European Innovation Council, the Single Market programme, Interregional Innovation Investments instruments etc.

In this context, an S3 mission may have three broad functions:

- Ensuring alignment between national S3 priorities and S3 missions and the EU missions (and/or relevant partnerships) and coordinating a strategic positioning of national players in participating in EU missions
- S3 missions as a 'focusing device' (increasing synergies) between national R&I (S3) priorities and policies and other national (sectoral) policies (environment, energy, industrial policy, etc.)
- S3 missions as a means of guiding and scaling regional level policy experiments and initiatives that contribute to the national (and potential EU) mission priorities.

For the first function, the choice of implementation mechanism will enable a greater or lesser strategic steering at national level of the initiatives of individual organisations at European level. A national mission board or partnership may be able to identify (as part of a strategic road-mapping process) priority calls or European initiatives which are best aligned with national priorities and capacities. Alternatively, the mission coordinators can map the involvement of national organisations in Horizon Europe and other programmes or partnerships of relevance building up a visualisation of 'portfolios' of participation at European level that can be used to inform or reinforce national S3 missions.

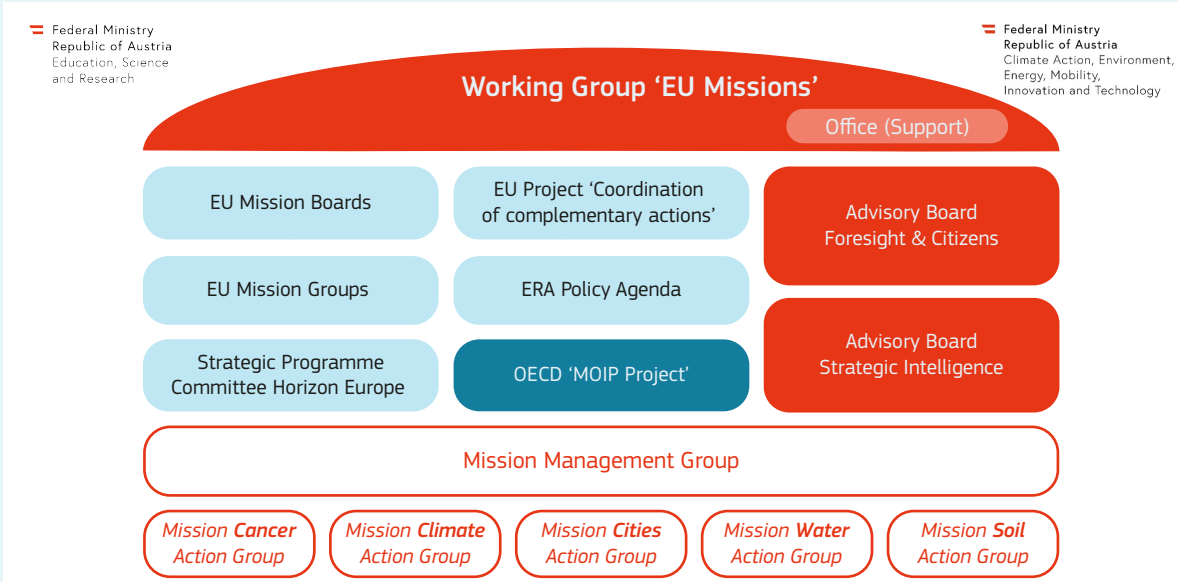
At the EU level, there is a clear and stated intention to mobilise, pool and leverage both EU level instruments (Horizon Europe, European Innovation Council, LIFE, Invest EU, EIB, etc.) and national and regional initiatives in support of the five EU Missions[8]. The implementation plans for the missions underline that a portfolio approach to innovation policy is key to addressing an identified challenge, enabling experimentation with a range of different innovations and solutions. For instance, the Mission Climate Change Adaptation's implementation plan foresees the development over time of coordinated actions between the EU, national and regional levels in three phases (building up, full-deployment and consolidation).

An EU level mission implementation platform is tasked with supporting regions in managing their own portfolios of innovations aimed at developing and testing transformative solutions and creating more climate resilient regional economies. In the framework of most of the missions (Cancer, Ocean & Waters, Soil, Cities), national mirror groups or hubs are being established to structure on a cross-departmental (ministry and agencies) level the national response to the EU Mission. Given that the process of alignment, activation and implementation of the EU Missions is uneven across the Member States (Reid et al., 2023), a national S3 mission, in areas directly related to, or complementary to, the EU Missions, may facilitate multi-level governance arrangements that provide an effective means of EU-national level coordination.

In Austria, for example, a dedicated governance structure has been established to coordinate the national missions that seek to align Austrian efforts to implement the EU missions at national level A working group on EU Missions has been set up under the umbrella of an inter-ministerial task force, in order to coordinate and manage the implementation of the EU missions at national level.

8 *See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en*

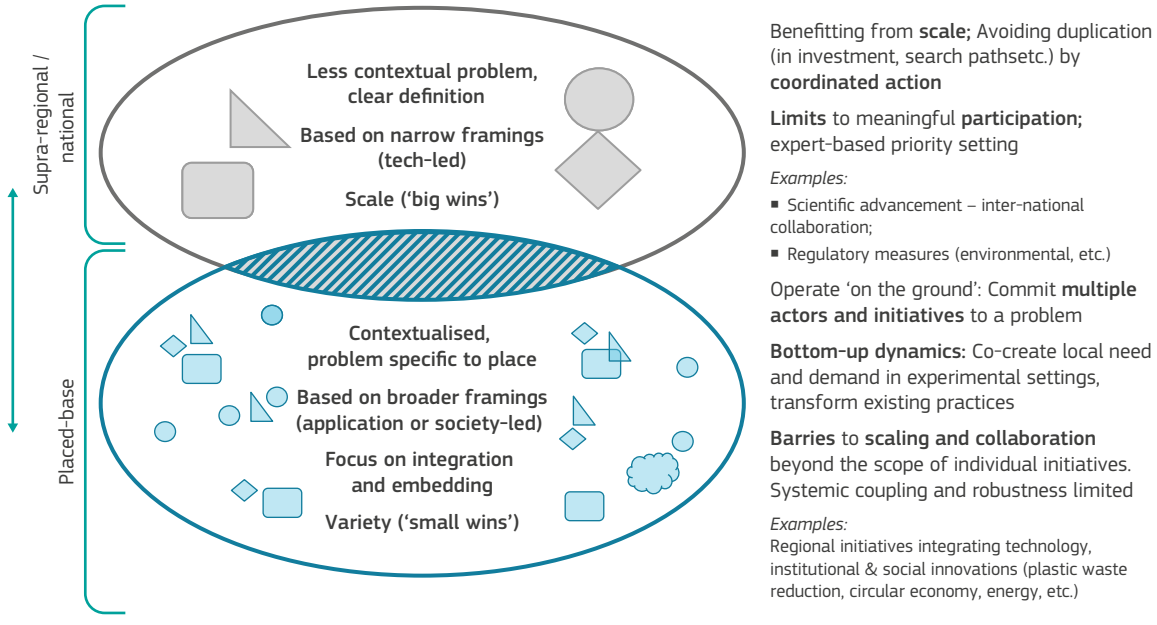
FIGURE 11 *Governance structure of the 'EU Mission' working group in Austria*



Source: ***https://era.gv.at***

The multi-ministerial nature of the S3 missions create the potential for a governance framework that overcomes different policy rationales across policy domains and foster an aligned use of diverse instruments to achieve the mission goal. In the Czech case, the involvement and steering of several ministries is foreseen for both missions with the ministries of industry, environment, transport, interior, agriculture, etc. expected to mobilise their programmes and initiatives in support of the delivery of the S3 missions. This may help to overcome, what one observer noted, are often competing policy rationales (e.g. between the ministries of environment and agriculture).

FIGURE 12 *Governing societal challenges from a multi-level perspective*



Source: Wanzenböck (2022)

Overcoming the key barriers and capturing opportunities for combing interventions at different levels is a main challenge for successful implementation of mission policies, as Wanzenböck (2022) has illustrated (see ***Figure 12***). The interaction between national S3 missions and regional and local stakeholders and initiatives can provide opportunities for testing solutions in a place-based process, particularly if the 'prototypes' are tested in multiple places (e.g. smart city solutions for material recovery or repair and reuse in several towns or cities). This may provide evidence convincing enough for a national agency or ministry to then scale the initiative (something which a single town or city partnership will struggle to do).

Hill (2022) calls this the 'snowball approach' that starts with a small portfolio of experiments which combine to form prototypes of new practices and technologies (see ***Box 11***). These start to produce new evidence of impact and as momentum builds, resistance to change – a 'friction' in the system – is easier to overcome, and a mission begins to develop its own 'gravity', reinforced by public debates and discourse.

BOX 11 ***Vinnova's snowball approach to foster the Swedish missions***

The snowball approach has been illustrated by the example of the Swedish 'missions' Vinnova has been pursuing in two systemic challenge areas, mobility and food, with both framed in terms of sustainability and health. Two practical and down-to-earth cases were pursued to test the approach: ensure that every street in Sweden is healthy, sustainable and full of life by 2030; and ensure that every student in Sweden eats sustainable and tasty school food by 2025. On one level, these missions may seem odd choices, but if you think about them as attempts to transform the entire school food system (the single largest food system in Sweden which is currently focused on cost and hygiene goals but could be oriented towards other goals too); or to retrofit every street in Sweden (40 000 kilometres, with 50m^2 of parking per person but only 44m^2 of living space per person on average per street) in a nationwide urban development initiative, then their potential scale and impact becomes clearer.

They are also inherently place-based focusing on a specific place (school canteen or streets) where a range of both problems and solutions come together. The logic is to start with a series of prototype (life-size wooden models enabling to test new 'car-free' street layouts co-designed by residents; or school food that Is more nutritious and school meals are co-designed by pupils and school staff, integrated in local food systems with farmers encouraged to produce seasonal and sustainable foodstuffs, etc.).

In the case of the school food mission, four municipalities were selected, after a call, to test, with the support of the National Food Administration, Vinnova and several other national actors, innovative solutions to make meals sustainable from the farmer to the classroom and back again. Whether it be new street furniture and layouts or innovative way to produce school meals, the prototypes are expected to lead to the development of larger scale demonstrators that 'begin to rewire system of systems', procurement, co-operation with local farmers and food producers, logistics and warehousing of school food, for instance. So the learning from the prototypes, then is scaled across multiple schools or streets, then municipalities, leading to potential system wide changes (e.g. changes to national legal frameworks, new co-managed platforms, etc.).

Source: Authors, based on Hill (2022)

In many respects a similar approach is adopted by some of the EU Missions with the climate change adaptation, climate neutral cities, soil, ocean and waters, etc. missions fostering different approaches to testing alternative solutions across the EU, through soil living labs (addressing different stakeholders with a stake in improving the health of agricultural, urban or forestry soils) or patient-centred cancer living labs enabling to test new care and recovery methods. Once tested, the most promising solutions are expected to be scaled across Europe (e.g. national, ERDF or common agricultural policy funding may be used to replicate solutions tested in specific living labs).

4. Practices supporting implementation of S3 missions

Experience with challenge-led and mission-oriented policy initiatives shows that there are often inadequate bottom-up capabilities of innovation actors to meet top-down aspirations. Bottom-up 'soft' system support measures are needed which include the ability to blend different knowledge disciplines, combine social and technological innovation, and develop competences through situated learning.

Policy measures are needed with near-term impact to build these capabilities through direct involvement of innovation actors (as well as longer term educational changes). They can also give greater local visibility and meaning to a national mission. Policy measures such as top-down formal governance mechanisms and resource concentration through topic selectivity are insufficient for a societal challenge, complex problem and systemic policy focus. They need to be supplemented with targeted tools providing support to co-creation processes and collaboration between projects and various stakeholder groups. Essential to fulfil transformer aspirations are measures to foster bottom up, informal governance, path variety and system interaction.

A suite of 'soft' system support measures needs to promote:

- Portfolio management of a system of standalone projects
- Cross-disciplinary conversations between different knowledge communities
- Boundary spanning between social and technological innovation actors
- Place-based situated learning.

Many tools and instruments are available, often developed in experimental international projects. They need to be orchestrated as a support framework for challenge led missions.

4.1. Designing and managing project portfolios for system innovation

The field of transition studies shows that a useful framing of a transformative mission is given by defining a particular sociotechnical system which is a priority focus of innovation policy. Building on Geels' (2002, 2004) definition, a sociotechnical system comprises the actors, institutions, technologies and practices involved in the provision of key societal functions. Such functions include, for example, urban mobility, household energy, food consumption, personal security etc. The prevailing technologies and industries in these systems are often locked-in to unsustainability (e.g. business models relying on consumption of fast moving

goods). At the same time there are many alternative niches and entrepreneurial activities that are being developed and promoted. The existing system often needs fundamental change, yet it is unclear how it will change.

The framing of a mission around the challenge to transform sociotechnical system enables a broad approach to different types of innovation and a wide inclusion of a variety of innovators. If RDI projects are situated in a specific sociotechnical system of everyday provision with a clear 'end-use' it creates a new space for user-led social innovation in addition to producer driven technological innovation. Portfolio guidance offers a method of ensuring both diversity and directionality of innovation in a sociotechnical system toward a defined sustainability goal. Climate-KIC provides as illustration of the type of system innovation that is involved in a sociotechnical transition in mobility. It shows the new significance of digital platforms and lifestyle changes.

Innovation portfolio management is well established within the business sector. It is usually framed as a firm based strategy for managing a portfolio of innovations of varying novelty to the organisation. (Nagji & Tuff 2012). It can however be applied as a system-oriented strategy for managing different types of innovation oriented toward a societal mission. This can be used explicitly as a policy tool to enable effective concertation of different actors around a societal challenge.

System innovation portfolio guidance can be pursued in two different ways. It can be used as an **ex-ante approach to shape the design and implementation of projects and programmes** by funders at the regional or national level. This can take the form of calls which are either directly targeted, or indirectly addressed, at system framed missions. The funded projects are then treated as a portfolio with some form of coordination mechanisms. The starting point for many mission oriented innovation policies is the R&I funding system. This seeks to fund future projects in accordance with the goals of the mission. Such a funding approach is likely to be an addition to established instruments rather than a fundamental replacement. It is useful to treat this as an experimental niche for possible wider changes subsequently.

Alternatively, portfolios can be constructed as an **ex-post approach to map and orient a variety of existing ongoing projects,** irrespective of origin or funding source, toward a system framed mission in a more explicit fashion. These are then treated as a portfolio through coordinative or interactive measures. This approach lends itself to local and regional strategies which engage with place-based system innovation. An ex-post approach is to 'missionise' an existing array of ongoing innovation projects. The EIT Climate-KIC implemented an innovative approach to construct project portfolios out of existing projects on the city level in the Transition Cities initiative (see ***Box 12***).

BOX 12 *Climate-KIC Transition Cities*

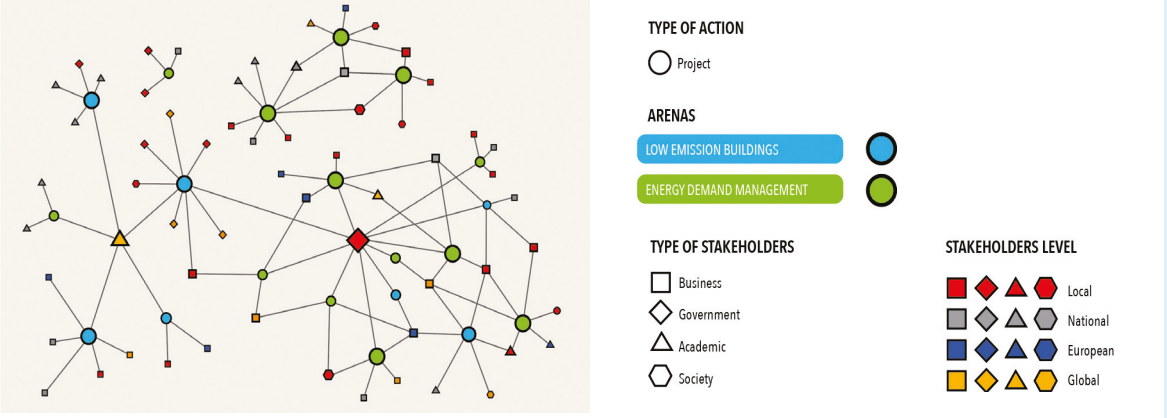
In 2015 EIT Climate-KIC selected six European cities to map their system innovation potential building on van den Bosch's method that reframes ongoing RDI projects as 'transition experiments' (van den Bosch, 2010). The selected cities – Birmingham, Frankfurt, Valencia, Bologna-Modena, Wroclaw and Budapest – had an extensive portfolio of low carbon innovation projects. The projects ranged across technology, service, organisation and business models. The degree of novelty varied considerably as did their scale, and whether they were upstream or downstream.

Cities identified well over 100 climate innovation projects with total resources of more than €200 billion. Each project was managed in a standalone fashion with an average lifetime of about three years. The links between the different projects were weak and there was no long term strategy regarding their outcomes.

The projects were grouped into three socio-technical systems of transport, buildings and energy networks.

Broad system	*Number of projects*	*Missions*
Transport	50	Low emission vehicles Integrated mobility
Buildings	47	Low emission buildings Energy demand management
Energy networks	36	Cogeneration of heat and power Waste into energy

Using a socio-technical system mapping the projects and their stakeholders were visualised as a network:



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This method revealed a portfolio of ongoing innovation projects which share a mission of transforming a sociotechnical system. Participatory methods were developed to encourage a new shared portfolio management approach. This gave shape and coherence to this diverse range of low carbon activity and provided the linkages between individual projects and the overall strategic ambition set at the city level. The approach allows to promote bottom-up collaboration and top-down co-ordination in a much more transparent and grounded fashion (Matti et al. 2020).

The key steps in the process include:

- Make an inventory of ongoing innovation actions taking place which contribute to a common mission
- Identify all of the stakeholders involved in these projects
- Create 'system innovation maps' of these actions and actors as sociotechnical networks
- Facilitate stakeholder dialogue on strengths and weaknesses of the portfolio revealed
- Relate the portfolio to innovation strategies for specified mission
- Enable an ongoing process of transition pathways to achieve the mission.

Source: Matti et al. (2020)

4.2. Interacting across disciplinary boundaries

Success of top down interdisciplinary research initiatives is variable and very dependent on the organisational flexibility of funding bodies. Collaboration between natural science/engineering and social science/humanities needs particular care to ensure a positive interaction between different scales and styles. An alternative successful approach are bottom up methods to promote inter-disciplinary interaction. The most well-known is the sandbox model pioneered by UK Research and Innovation (UKRI) and there is growing international experience in this approach of organising interactive workshops of 20-30 stakeholders and mentors

There have been many initiatives to promote funding calls for interdisciplinary research. Their success is variable and very dependent on the organisational flexibility of funding bodies. Collaboration between natural science/engineering and social science/humanities needs particular care to ensure a positive interaction between different scales and styles.

O'Donovan et al. (2022) recognise that a policy desire to promote transdisciplinary research on societal challenges often confronts a lack of capability. The urgency of such challenges has promoted a search for 'pump-priming instruments such as sandpits'. The sandpit methodology has been reviewed by Lodge (2022) who presents a definition: as 'residential workshops that bring together researchers from different institutions and disciplines to discuss a specific topic or problem.'A pioneer in the development of sandpits has been the UK Research & Innovation through the individual research councils (see ***Box 13***).

The sandpit process covers:

- Defining the scope of the issue;
- Agreeing a common language and terminology amongst diverse backgrounds and disciplines;

- Sharing understanding of the problem participants' expertise;
- Using creative and innovative thinking techniques in break-out sessions to focus on a problem;
- Turning sandpit outputs into a research project.

Participants come from a range of disciplines and backgrounds including the arts, humanities and social sciences, and have the right mix of personal attributes, such as willingness to take risks, creativity, and communication skills. People are sought at different stages in their career as sandpits are not just for senior academic posts. Sandpits bring together people who would not normally interact to inspire creativity thinking to solve existing problems. You do not need prior knowledge of the problem area to participate, but must demonstrate an enthusiasm for working at the interface between disciplines.

The ethos of the sandpit is that participants shape the process and the outputs. It is their responsibility to contribute fully and constructively and this includes making hard decisions about prioritisation of ideas and research groupings. People with real experience of the issue provide invaluable insights and unique perspectives. Stakeholders often include industry representatives, government officials, charities, lobby groups or citizens' groups. Their input and knowledge helps participants explore the issue and shape potential ideas. This can include challenging presentations on the current state of play and can lead to future involvement with research groups.

The director is fundamental to a successful sandpit. A director, from the academic or the business community, is appointed to each sandpit and it is their vision and leadership that shapes the process. Work starts about six months before a workshop is held, appointing mentors and ensuring the call for participants reaches those with the desired skills. During the sandpit, the director, with support from mentors and facilitators, needs to maintain the group's focus on the key aim and ensure the intensive environment remains constructive. After the sandpit, the director plays a key role in validating, providing advice and monitoring projects.

A team of mentors work alongside the director in selecting the participants and providing objective advice, feedback and input at the sandpit. Selected for their knowledge and experience, their overall aim is to ensure the sandpit leads to high-quality innovative research. Like the director, mentors need the intellectual standing and impartiality to lead the group through this challenging experience.

While the director and mentors are responsible for the content of the sandpit, the facilitators are responsible for the process. They design the activities and schedule sessions to create an environment where innovative ideas can be formed, developed and implemented. In the intensive sandpit environment, facilitators need to constantly adapt schedules and activities to maintain the group's focus.

BOX 13 *UKRI's sandpit on food systems, UK*

In 2018 the transdisciplinary Global Food Security programme held a sandpit for 30 early career researchers on 'Transforming the food system for health, sustainability and resilience across production and demand'. It involved an initial session of 2.5 days followed by a second two-day workshop two weeks later. The aim was to develop research proposals for funding.

Participants were presented with three key questions:

- How can we transform our food system so it is based on healthy and sustainable diets and how would this impact on sustainable and resilient food production and supply?
- What should we be eating, and producing sustainably, and where in the world would those crops be grown, those livestock reared, or those fish be caught to ensure UK food system resilience? What impact would this have on livelihoods?
- What level of demand change would be required to have a major impact on resilience and sustainability, and what would be the potential benefits/dis-benefits to nutrition and/or the environment of different scenarios?

It aimed to capture the outputs of the discussions in the form of highly innovative research projects and reach a funding decision on those projects at the sandpit using 'real time' peer review (the decisions on funding will be communicated after the event). The sandpit was framed with a system map of the food system and a challenge framed as 'what we should be eating' compared with 'what we are producing'.

Three collaborative projects were funded following the sandpit: Rurban Revolution on ruralising urban areas, Diverseafood on aquaculture diversification and T-GRAINS on transforming regional food systems.

Source: UKRI Global Food Security Third Call (2018) Resilience of the UK food system in a global context third call Archives – Global Food Security

4.3. Blending social and technological innovation

System transformation needs a blend of social and technological innovation. Social innovation needs a different ecosystem to technological innovation and requires a new policy focus. 'Social innovation' ecosystems are characterised by stakeholder variety expressing a quadruple helix and an emphasis on non-technological change. Stocktaking of social innovation ecosystem initiatives shows that they have been pursued mainly in a place based and often regional fashion. The most detailed methodological guidance is from the OECD and focuses on building local ecosystems for social innovation (Bulakovsky, 2021). It emphasises the importance of creating new spaces for stakeholder interaction and social experimentation.

The place based 'innovation lab', known under various labels such as the 'living' lab or 'real world' lab, is a space which brings different types of innovator together. These labs are 'research-change intervention hybrids' addressing systemic co-creation innovation processes. The early use of the 'living lab' as an institutional innovation was still confined to a narrow technology based model of innovation with competitiveness as its primary

goal. In the past decade has been closely associated with the turn towards a broad sociotechnical model of innovation and the new priority for societal challenges.

Innovation labs offer a vital support measure for a challenge-led missions. Challenge led missions rest on a broad model of innovation which includes both social and technological innovation and promotes a socio-technical approach. Given the persistent dominance of the innovation policy space by a primary focus on technology there is a recognition that changes to the prevailing innovation ecosystem are essential to enable sociotechnical breadth.

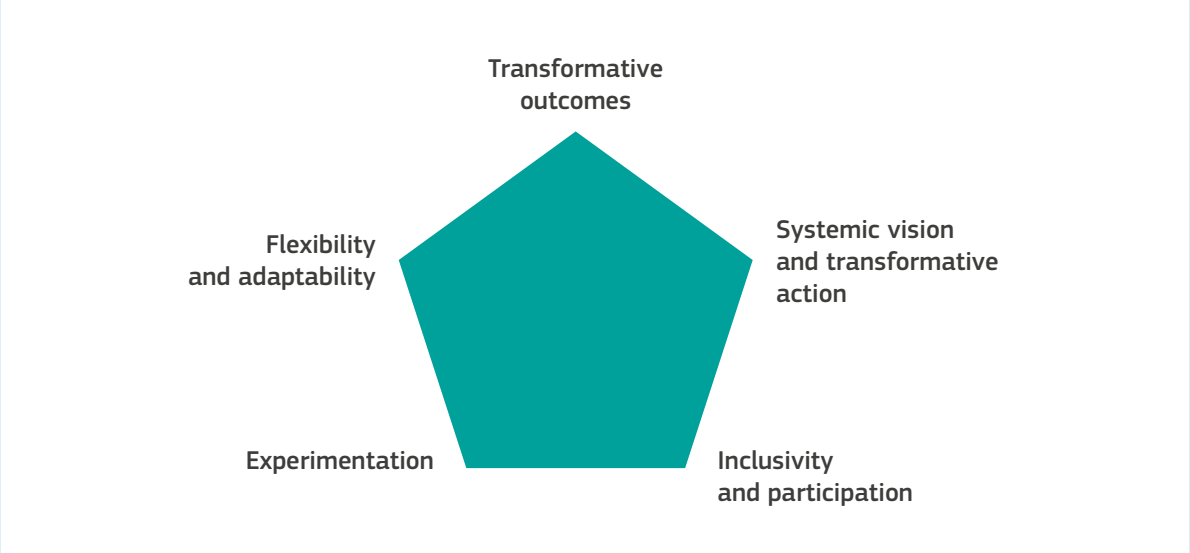
In order to support transformative innovation, innovation labs should build on the features of the different types of lab that have been explored in place based innovation settings (McRory et al., 2020):

- Space for co-creation and testing technological and/or social innovation (a service, a product, societal infrastructure) with the goal of solving real-world problems);
- Real-life test and experimentation environment (e.g. house, school, city, region or virtual network);
- Collaboration of diverse stakeholders with a common interest in the respective domain, including actors from business, government and academia as well as citizens;
- Active, open and conscious co-involvement of 'users' of the respective service or product in the innovation process, equally among other stakeholders as opposed to more passive approaches where they are seen as subjects whose behaviour is to be studied over a period of months or years;
- Contribute to transformation by experimenting with potential solutions and support transitions by providing evidence for the robustness of solutions;
- Transdisciplinarity as the core research mode in order to '(...) integrate scientific and societal knowledge, related to a real-world problem';
- Culture of sustainability around the laboratory, stabilize the cooperation between the actors and empower the involved practitioners;
- Strong normative and ethical component to contribute to the common good;
- Experiments as a core research method which they provide concrete settings for, and which stakeholders are actively involved in (co-design and co-production);
- Creating solution options with 'a long-term horizon, potentially going beyond the existence of the lab';
- Strong educational aspect and support three levels of reflexive learning: individual competency, social learning and learning with regard to transdisciplinary collaboration.

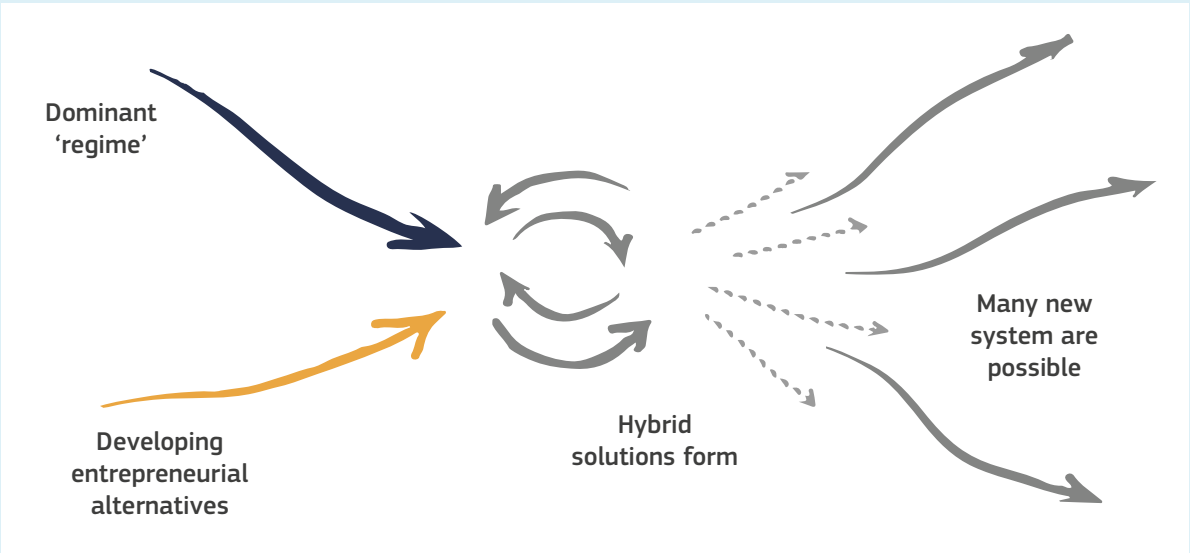
A new interactive space is needed to facilitate the sociotechnical innovation needed for transformative change. The transformative approaches to innovation labs offer a useful model (see ***Box 14***).

BOX 14 *Transformative innovation labs in Catalonia's S3, Spain*

The government of Catalonia has built on the experience of a variety of social innovation labs to identify the characteristics that a transformer lab would require. It is seen as an ongoing physical space and/or virtual platform to bring stakeholders from technology and society together to facilitate experimentation around a shared agenda or mission.



The labs seek to explore a diversity of systemic solutions for a shared direction pf transformation.



Five innovation labs in Catalonia participated in the development of this framework for transformer labs.

Source: Fernandez & Herrera (2022)

4.4. Place-based situated learning

The new mechanisms and instruments to support transformer missions must be accompanied by individuals with new competences: people who are multi-skilled and able to combine technical specialisation with social understanding and entrepreneurial capacity. This requires practitioners nurtured through new types of training programmes which recognise the breadth of the SDG agenda and the cross-disciplinary capacities necessary to tackle it. Situated learning offers a fast track to these new competences.

Climate-KIC introduced a new 'Pioneers into Practice' programme to bring together those engaged in initiatives focused on the low carbon agenda within six European regions: Central Hungary, Emilia Romagna, Hessen, Lower Silesia, Valencia and West Midlands (see ***Box 15***). From these projects a range of one month placements are offered to pioneers within their own region during which the pioneer is given both a specific task and learns more broadly about their new environment.

This placement is complemented by a mentoring programme which involves an introductory workshop on sustainable transition with training materials and a two-day concluding crucible where participants share their placement experiences and wider thinking on systemic innovation. This process is broadly repeated for the one month international placement in the autumn, when the pioneer works in one of the other regions (Bloomfield and Steward, 2017).

The programme recognises that practitioners are the backbone of climate change innovation and implementation: they are the key link in the innovation cycle. The programme brings together professionals from industry, SMEs, universities, research institutes, local councils as well as non-profit and public organisations; takes them out of their comfort zone and places them in new settings. Such placement programmes crossing between different parts of the innovation system are a good route to develop the new capacities. Any transformative policy also needs individuals with political competences to manage a process of significant change with sensitivity to differential consequences for stakeholders. Collaborative mechanisms have been shown to assist in this competence development (Torfing and Ansell, 2017).

BOX 15 *Climate-KIC's pioneers into practice programme*

The Climate-KIC's 'Pioneers into practice' is a knowledge development programme to promote world-class learning about the dynamics and management of system innovation for the transition to a low carbon economy in Europe. The programme has been delivered across six diverse regions in Europe: Hessen (Germany), Valencia (Spain), Emilia Romagna (Italy), Lower Silesia (Poland), Central Hungary and West Midlands (UK).

The programme was designed to promote the individual capabilities needed for:

- innovation in systems of practice and provision rather than single innovation in products and process;
- mixture of social and technological change; 'socio-technical innovation' not just new technologies;
- transformative not incremental innovation;
- significant role for entrepreneurial and public actors in addition to universities and businesses;
- combining global significance with local based relevance;
- blending long-term strategy with near-term implementation.

This is done through a learning-by-doing approach accompanied by the development of social science knowledge about innovation. Each region developed transition platforms around two key themes – low carbon living and low carbon mobility – where the reduction of greenhouse gas emissions can make a significant contribution to the achievement of Europe's 2020 targets. These platforms connect people from a range of organisations in each region (companies, research institutions and public authorities) who are actively delivering low carbon projects and provide a cluster of existing knowledge and expertise.

A placement programme allows participants to be placed in a range of these projects. They enable participants to develop their knowledge and understanding of the day-to-day management of climate change innovation. Projects cover a range of socio-technical activity related to the themes of low carbon living and low carbon mobility, including energy-efficient buildings, decentralised energy systems, low emissions energy production, integrated water management, electric vehicle demonstrators and intelligent and sustainable mobility systems. Participants undertake three one-month placements over a twelvemonth period. The first and final placements are in the participant's 'home' region, the middle placement is in one of the other European regions. Participants will be required to complete a project assessment during each placement, based on their reflections of what they have seen and learnt. The programme involved about 200 participants annually for 5 years.

Source: Bloomfield & Steward (2017)

5. Monitoring and evaluation of S3 missions

5.1. Developing a monitoring and evaluation framework for S3 missions

The growing interest in transformative and challenge-driven or mission-oriented innovation policies addressing societal challenges (e.g. targeting specific SDGs) has raised interest on how to monitor and evaluate the progress, results and impacts of such policy. Given the importance and urgency of societal challenges addressed, missions should be defined with respect to clear and measurable goals.

Setting intermediary milestones on the way to the achievement of the goals is important for three reasons. First, systematic transformation is inherently uncertain. Second, there is a need to monitor progress and adjust plans (means or goals) through learning from experimentation (Mazzucato, 2019). Third, enhancing learning capacity through monitoring and on-going evaluation contributes toward reconciling the social complexity of missions with the requirement for effective public policy intervention. Thus, monitoring and evaluation (M&E) of mission policies needs to be an integral part of the policy implementation itself.

Monitoring is a management tool which offers a 'comprehensive transformational agenda for the way territorial innovation policies are conceived and implemented' (Gianelle et al., 2016). An evaluation looks at the assessment of outputs, outcomes and impacts produced by implemented actions, under certain contextual conditions and taking place intentionally or un-intentionally. It plays a role in policy development as it allows policymakers to react to new information and emerging results. M&E systems need to measure results of instruments and projects, the S3 process and the impact of the strategy (Esparza-Masana, 2021).

To date, evaluation tools and techniques for MOIPs tend to be inspired by those developed for the evaluation of specific programmes despite the trend towards more complex systemic policies (Larrue, 2021). Few MOIPs have developed an evaluation plan and methods early in the policy process, whereas this is widely accepted as good evaluation practice. MOIP evaluations should not only consider their success and failure in absolute terms but also their additionality (i.e. what is their additional value?) with regards to traditional (individual) policy interventions (see ***Box 16*** for guiding questions for designing M&E for missions).

In relation to the characteristics of the MOIPs, there are three main challenges emerging in the M&E process. First, the lack of adequate and timely data allowing to develop sound indicators, connected to the objectives and allowing to go beyond a mere accountability-based approach (Hegyi & Prota, 2020). Second, MOIP looks to solve societal challenges embedded in complex social systems and therefore posing higher levels of uncertainty

BOX 16

Guiding questions for designing monitoring and evaluation framework for S3 missions

- Are the S3 mission objectives sufficiently clear and measurable?
- Does the intervention logic leave room for exploration, uncertainty and risk in searching for new and diverse solutions for the mission challenge?
- Is the portfolio of instruments and the scale of financial and human resources mobilised coherent with the level of investment required to attain the expected outcomes?
- Do the M&E system include methods, indicators and processes designed to capture transformative outcomes of the interventions?
- Does the M&E system ensure continuous participation and feedback from and between key stakeholder groups and civil society? What are the links between M&E and the EDP?

in the nature and timing of impacts arising from interventions. Third, the need to involve and meet the needs of different stakeholders (public, private, citizens, etc.) on which policies can have impacts. This requires mechanisms capable of mapping these stakeholders, collecting their views and engaging directly with them in the monitoring and evaluation process[9].

Given the complex and uncertain scenarios which MOIPs aim to contribute and considering the broader group of stakeholders involved (with particular emphasis of the increasing roles of private sector and citizens), it is important to foresee learning processes. The so-called Collingridge dilemma implies the need to continuously acquire new knowledge about relevant social, economic and scientific-technological developments, as well as about the impacts of these developments on mission goals, and, as a consequence, about the impacts of policy instruments (EC, 2018). The learning process should contribute to a continuous adjustment of the longer-term mission goals, implementation plans, governance structures and the portfolio of instruments.

There are five guiding principles of a monitoring and evaluation process:

- Integrate evaluation (or an evaluation strategy) as a core part of policy design;
- Adopt formative, developmental and realist evaluation practices, including a flexible theory of change, real-time observations, and participatory techniques;
- Ensure iterative and reflexive monitoring is used to support learning and ongoing change processes (on project, programme and policy levels);
- Combine a mix of methods and analytical approaches to gather intelligence and track change over different periods of time;
- Use a nested approach to assess multiple levels of transformative initiatives.

Literature on evaluation supports the idea that evaluating systemic innovation and transition programmes requires assessment of **(i)** programmes against a broader set of relevant impacts and system-level transformative outcomes, **(ii)** account for synergies and trades-off between instruments, and **(iii)** stakeholders' engagement and governance models. This requires reflecting on evaluation

9 *For instance, the 2023 assessment of the five EU Missions carried out a survey gathering responses from over 340 stakeholders across the EU and organised 5 policy workshops involving stakeholders from different types of organisations and levels of governance (Reid et al., 2023).*

approaches already at the mission policy design stage. Janssen et al. (2022) propose a framework for the evaluation of MOIP: 'from formative evaluations, which can help us to understand why and how policies work (or not), to summative evaluations, which serve to attribute observed outcomes to policy effects.'

This framework applies to **overarching mission-oriented frameworks,** that are more challenging to evaluate due to their scale, scope (e.g. portfolio of instruments) and nested structure (system, sub-system, projects). Larrue (2021) argued that the **evaluation of more focused challenge-based programmes** should be easier but that similar attention should be given to the way the programme integrates interventions of different agencies and the mix between the supply-push and the demand-pull instruments.

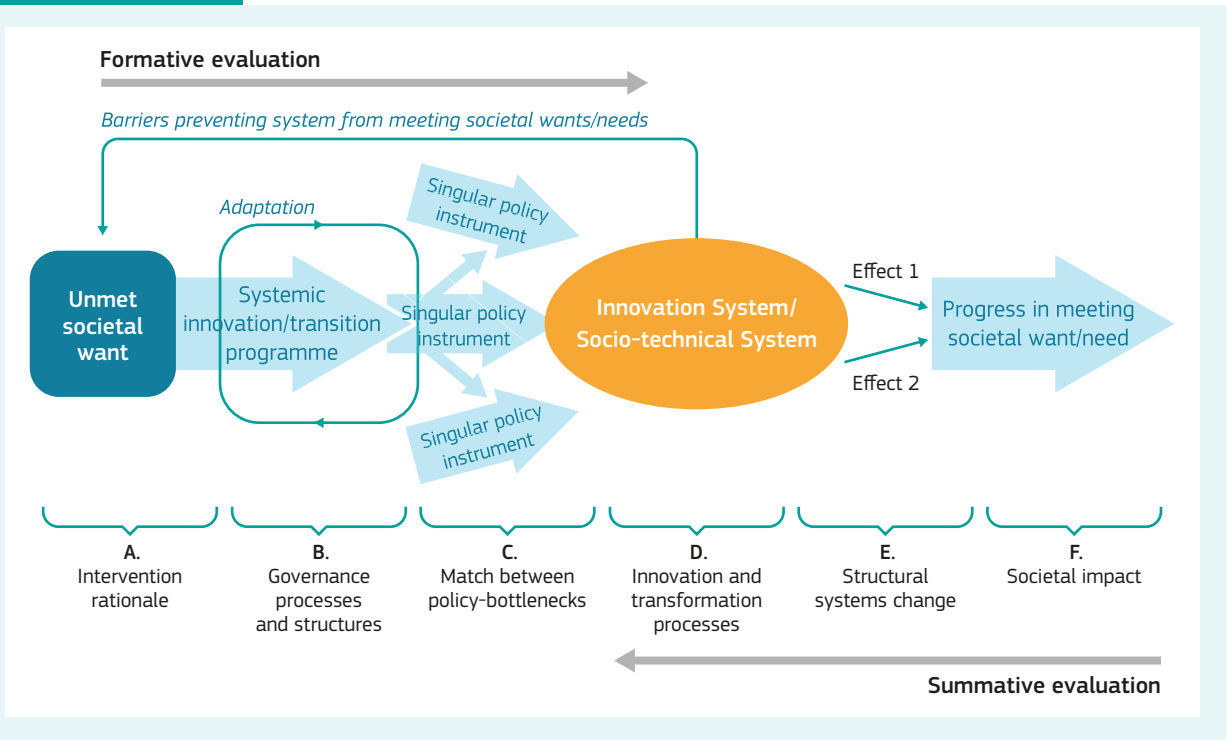
Evaluation practice has emphasised the importance of ex-ante assessments: policy frameworks with potentially long gestation periods and substantial impacts on societies and economies need to undergo a careful ex-ante analysis of their potential impacts (including unintended and undesired ones). This requires an assessment of the broader R&I ecosystem, as the programme is part of a package or portfolio of policy instruments with a concrete directionality towards defined mission-goals.

Due to the difficulty of the task, which requires more than a one-off exercise commissioned to an external service provider, some initiatives have set up dedicated governance body with an evaluation mandate. Wise and Arnold (2022) state the "steering transitions requires a particular kind of sense making: the ability to 'zoom in and out' between levels of analysis and to 'zip back and forth in time'. This can be done by linking the different perspectives and the multiplicities of scale and temporalities they offer."

Overall, the M&E exercise should align with a set of characteristics, as detailed below:

- Multi-dimensionality of impacts: as missions aim typically to impact more than technological change, there is a need to capture impact across a variety dimensions (social, environmental, economic, organisational and governance, etc.

FIGURE 13 *Evaluation framework for MOIP*



Source: Janssen et al. (2022)

- Multiple levels of analysis: striving for systemic change, missions require the analysis of dynamics at different levels, including both programme and system level.
- Map complex interactions and impact pathways: bringing together different stakeholders from different areas and bundling diverse types of instruments.
- Long-time horizon: goals formulated by MOIP are often expected to be achieved only in a relatively long-time frame (often longer than the traditional 4-5 years policy or programme cycle).
- New roles for evaluation: shift towards a stronger focus on ex-ante and formative components and an emphasis on capacity building and learning.

The Dutch Top Sector case provides an example of the evolution of monitoring and evaluation frameworks over time to align with mission type goals (see ***Box 17***).

BOX 17 ***Evaluating MOIP in the Netherlands***

Since 2019, the Top Sectors' cooperation between business, science and government has been reformulated as a challenge-oriented approach under the Mission-Driven Top Sectors and Innovation Policy (MTIP). Through this approach, the Netherlands built on ten years of public-private cooperation in the Top Sectors to implement 25 missions addressing four societal themes: **(1)** Energy Transition and Sustainability; **(2)** Health and Care; **(3)** Agriculture, Water, Food and **(4)** Safety. Missions for each Top Sector are collaboratively devised by the relevant ministries and, once defined, are translated into themes and then programmes implemented by Top Consortia for Knowledge and Innovation (TKIs).

M&E Practices. Monitoring is handled at various levels within the Dutch mission-oriented ecosystem, from the line ministries to the TKIs and the Netherlands Enterprise Agency (***RVO.nl***). Apart from units charged with policy implementation, RVO.nl has a unit specifically concerned with monitoring and evaluation. This unit gathers project data in a dashboard and generates periodic reports providing aggregate accounts of which actors are working on which topics and with whom. This data is then shared with the TKIs. However, RVO.nl does not monitor all of the policy initiatives deployed by the line ministries responsible for a mission. For instance, for the mission on Built Environment the Interior Ministry (BZK) has designed initiatives involving both the TKI Urban Energy and RVO.nl, just the TKI and just RVO.nl, or none of them at all.

At the TKI-level, the consortia engage in monitoring and learning activities as well to inform and update their programmes. Besides collecting and analysing data from RVO.nl, the TKIs develop or commission their own reports. This involves portfolio analyses to study the composition and outputs of granted projects. Those studies aim to give insights into how the projects relate to the programmes, and what actual progress is being made.

In terms of evaluation, the uniformity element in evaluation approaches is rather modest as there are a lot of different TKI secretariats for each mission which all have different evaluation approaches. The Ministry of Economic Affairs and Climate Policy tries to engage other ministries in enacting their individual responsibilities while it focuses on assessing expected results of an innovation project (e.g. patents, TRLs, with societal readiness levels currently under discussion). To track what

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is being achieved on the multi-annual innovation programmes (MMIPs), the TKIs plan to publish annual portfolio analyses (reporting on new projects) as well as a 'permanent' monitor providing cumulative account of all projects granted so far (including new, ongoing and completed projects).

As the TKIs are deeply embedded in the networks from which projects emerge, they are in the position to directly collect input / data from firms and institutes working on promising developments fitting the MMIPs. Because legally RVO.nl cannot simply share project data with the TKIs, parties submitting a proposal are given the possibility to grant RVO.nl permission to share information with the TKIs. This feature helps to ensure that the TKIs have detailed information when advising on programming activities.

Until the adoption of the mission-driven approach in 2019, the Top Sector policy followed a relatively traditional M&E KPI system e.g. one reflecting input and output indicators linked to the European Innovation Scoreboard (EIS). This has been changing to a stronger emphasis on outcomes as the new Top Sector policies defined missions to be achieved by 2030. A good example is the carbon reduction mission which was enabled by the 2017 alignment of economic affairs with the climate agenda in within a single ministry. Once the climate agreement was in place, it framed ownership and a clear policy basis on which the carbon reduction mission could be formulated. It enabled 'SMARTification' by narrowing down targets which brought stakeholders from industry and academia per sector (agriculture, mobility, etc.) to a common table.

Learnings and Recommendations

- Lack of an overarching, clear monitoring approach calls for a need for its implementation in the mission design phase, with dedicated people for monitoring each of the missions.
- Establishing sharper directionality would lead to approximation of counterfactual and further enable evaluation.
- Move from producing overviews to actual learning: turn monitoring practices more into 'learning systems' providing, for example, early warnings or information prepared for decision-making processes.
- Have a clear policy base on which the missions are formulated in a SMART way. The Dutch Climate Agreement ('Climat Accord') embedded in the Climate and Innovation Agenda makes the achievement of established goals legally binding and is the basis the definition of targets (e.g. reduction of CO_2 in cities by fixed % by 2030).
- Leverage initial touchpoints e.g. asking for data sharing permission from parties submitting a project proposal (RVO.nl shares the information with a support office like the TKI).
- The TKI secretariats should and have a more central role in monitoring and being the link between the mission teams and the Ministry of Economic Affairs.
- Improve the consistency and compatibility of monitoring activities by RVO.nl and the TKIs, on the one hand; and monitoring of line ministries' 'own' innovation diffusion policies (and goal progress), on the other hand, to better map outcomes to mission goals.

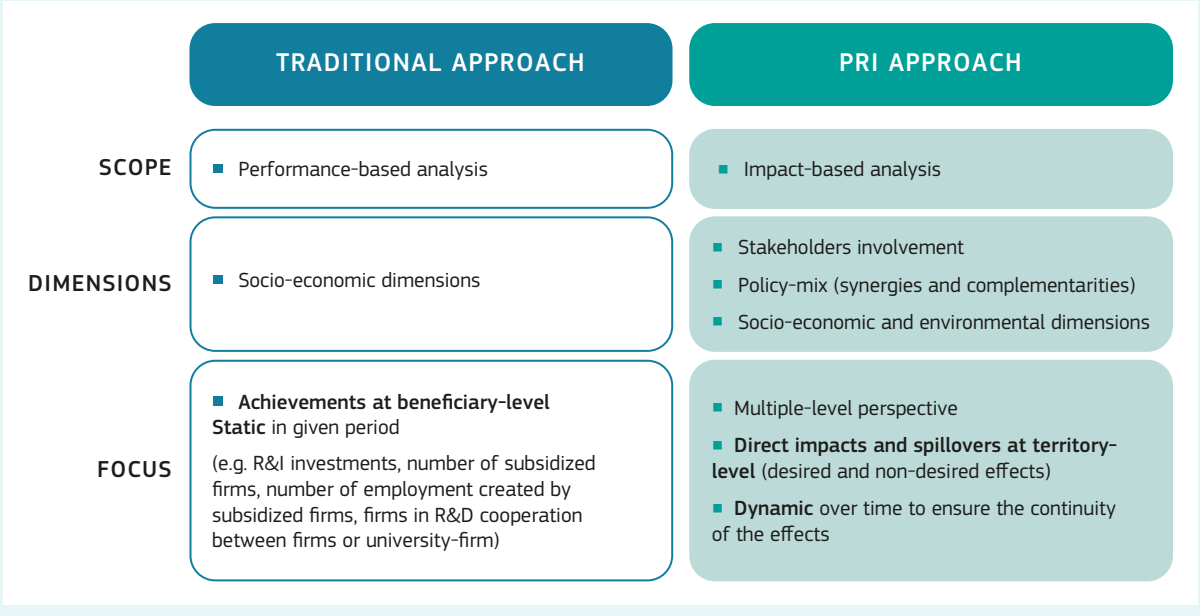
Sources: Authors, based on Janssen (2020) and Netherlands Enterprise Agency reports

Similarly, in the context of the European Commission's (JRC) Partnerships for Regional Innovation (PRI) initiatives, which seek to test different pilot approaches to a strategic framework for innovation-driven territorial transformation, the need to shift from a traditional 'performance based' M&E system to a multi-dimensional impact-based analysis that tracks change towards meeting goals over time has been underlined.

A number of examples of approaches to monitoring S3 interventions in a more dynamic way capturing the changes in co-operation, combining (open) data from a range of regional, national and European policy instruments and measuring contribution to specific S3 objectives and SDGs.

For instance, the RIS3-MCAT Platform[10] maps and characterises the activity of Catalan entities in projects of the RIS3CAT instruments and European programmes (Horizon 2020 and Horizon Europe). It dynamically maps the relationships between entities of the R&I system in Catalonia (and with international partners) and detects the configuration and evolution of innovative networks and communities in the various areas of specialisation. Projects are grouped by topic and the tools show the intended contribution to the SDGs. The platform is being continuously developed with the aim to extend analysis from a focus on the R&I ecosystem, based on data sources from this field such as financing, projects, publications, patents, etc. often linked to economic variables (added value, employment, exports, new companies, etc.). As Bigas et al. (2021) point out, 'when it comes to addressing challenges through shared missions or agendas, in addition to data and indicators on input, process, and result, transformative outcome indicators are also essential to analyse the extent to which actions contribute to the SDGs or the objectives of the Green Deal, for example'.

FIGURE 14 *Differences between a traditional and an impact based approach to monitoring and evaluation*



Source: Pontikakis et al. (2022)

10 See: **https://fonseuropeus.gencat.cat/ca/ris3cat/plataforma-ris3mcat**

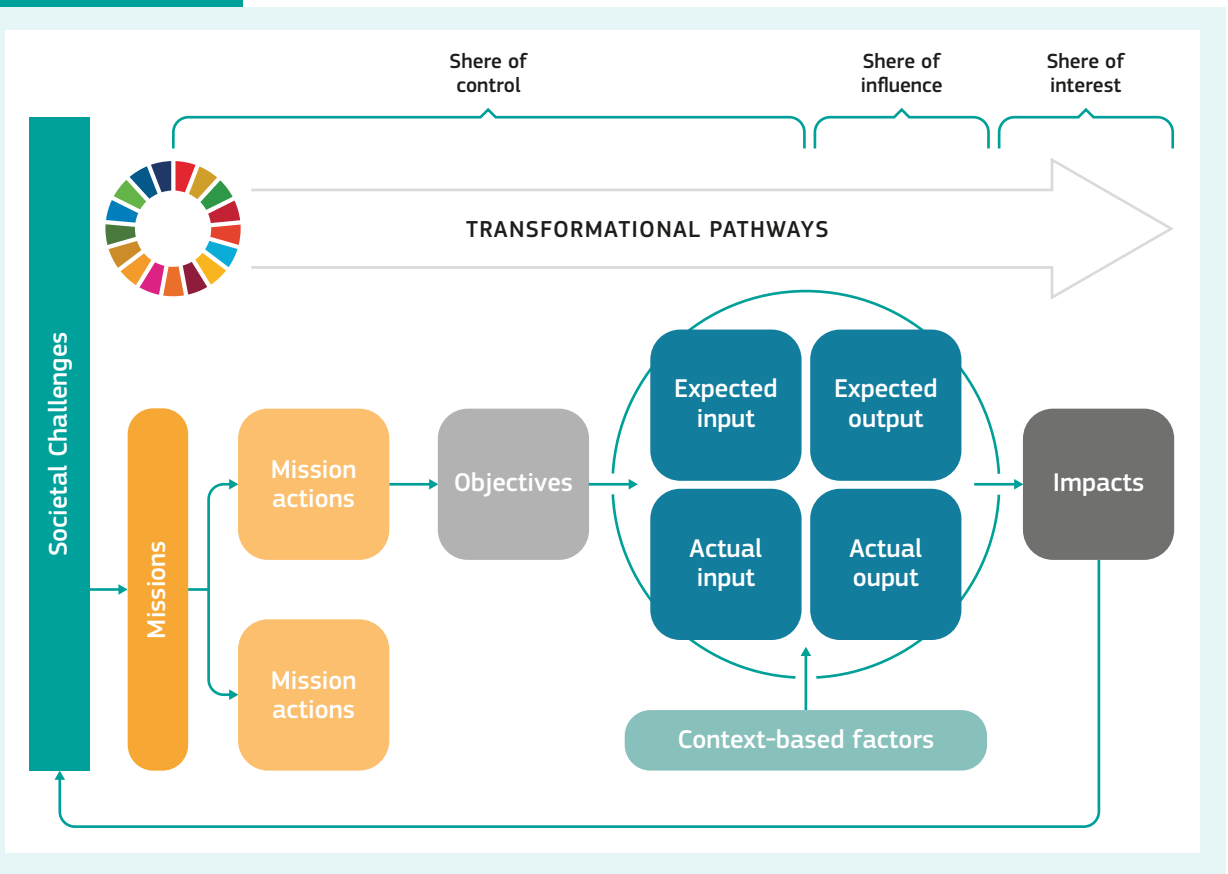
5.2. Applying a theory of change to track the impact of S3 missions

To be useful, the indicators of a M&E system should be linked to the longer-term mission goals within the context of the S3 priorities, which requires an explicit intervention logic or theory of change. The following figure illustrates how an intervention logic can be adapted to a transformational mission-oriented approach targeting sustainability (contribution to SDGs).

A theory of change approach helps to identify underlying assumptions (e.g. about complementary action such as legislative/regulatory changes) required or involvement of other agencies or stakeholders) and the pre-identification of possible external factors (risks) that may influence outcomes, to take them into account during implementation. This will favour a more structured approach to M&E and help to propose and experiment, over time with appropriate success criteria and indicators for missions.

Haddad and Berger (2022) propose 'an integrated framework for evaluating transformative innovation policy that builds on a theory of change as part of a seven step process in assessing the contribution policy interventions to socio-technical transitions. However, the application of the framework remains focused more at a programme level rather than assessing the multi-dimensional impact a broader mission portfolio of instruments. Wittmann et al. (2021) used a theory of change approach to evaluate the German High-Tech strategy (an oft-cited example of MOIP). The evaluation was built on a comprehensive, modular, flexible, process-oriented and theory-based approach that combines process-support with impact assessment of MOIP (see ***Box 18***).

FIGURE 15 *Intervention logic for mission-oriented approaches*



Source: Authors

BOX 18 *Evaluating the German High-Tech Strategy*

The mission on combating cancer is one of the twelve dedicated missions that were formulated in the German High-Tech Strategy 2025. The core initiative of the mission is the National Decade against Cancer (NDK), led by the BMBF and bringing together stakeholders from different spheres, including public administration, (medical) professional organizations, representatives from industry, patient organisations and foundations.

The strategy socio-technical system includes four main topics with numerous sub-aspects that can be considered as relevant: prevention, diagnosis/early detection, treatment, and aftercare. The socio-technical system displays a strong STI orientation, particularly with regard to diagnosis and treatment. Furthermore, there is a diversity of long-standing and large instruments mobilising considerable resources: National cancer plan (NKP) is a flagship policy led by the BMG and complemented by EraNET TransCan, the European Partnership for Actions Against Cancer (EPAAC).

The analytical model uses theory of change approach and defines concrete pathways that reflect the logic achievement of certain outputs, outcomes and impacts of the mission. In total, the authors identified six specific pathways:

- **P1:** Through the provision of dedicated research funding this pathway has the objective to stimulate research activities and thereby facilitate the development of new therapies that can contribute to improving treatment success. Moreover, such insights might also benefit attempts in the field of prevention, e.g. through the development of vaccines.
- **P2:** This pathway aims for the development of new therapies by the means of strengthening translational research activities allowing to better link clinical practice and research.
- **P3:** By improving the overarching framework conditions for research and service pro- vision for patients under treatment, both research activities and treatment success are assumed to be influenced positively.
- **P4:** This pathway seeks to strengthen the research process through patient involvement, improving the quality and speed of the process and thereby contributing to treatment success (P1).
- **P5:** Referring to the second overarching goal, this pathway aims to strengthen prevention measures in order to reduce avoidable cases of cancer, which might be achieved through a modified lifestyle or earlier detection of cancer.
- **P6:** The final pathway is closely linked with P5, aiming to reduce the societal taboo of cancer through information provision and awareness raising, and thereby supporting the readiness of the wider society to participate in prevention measures.

The logical framework visualising the pathways using the theory of change logic showing causal assumptions between inputs, outputs, outcomes and impact of pathways and their interconnections.

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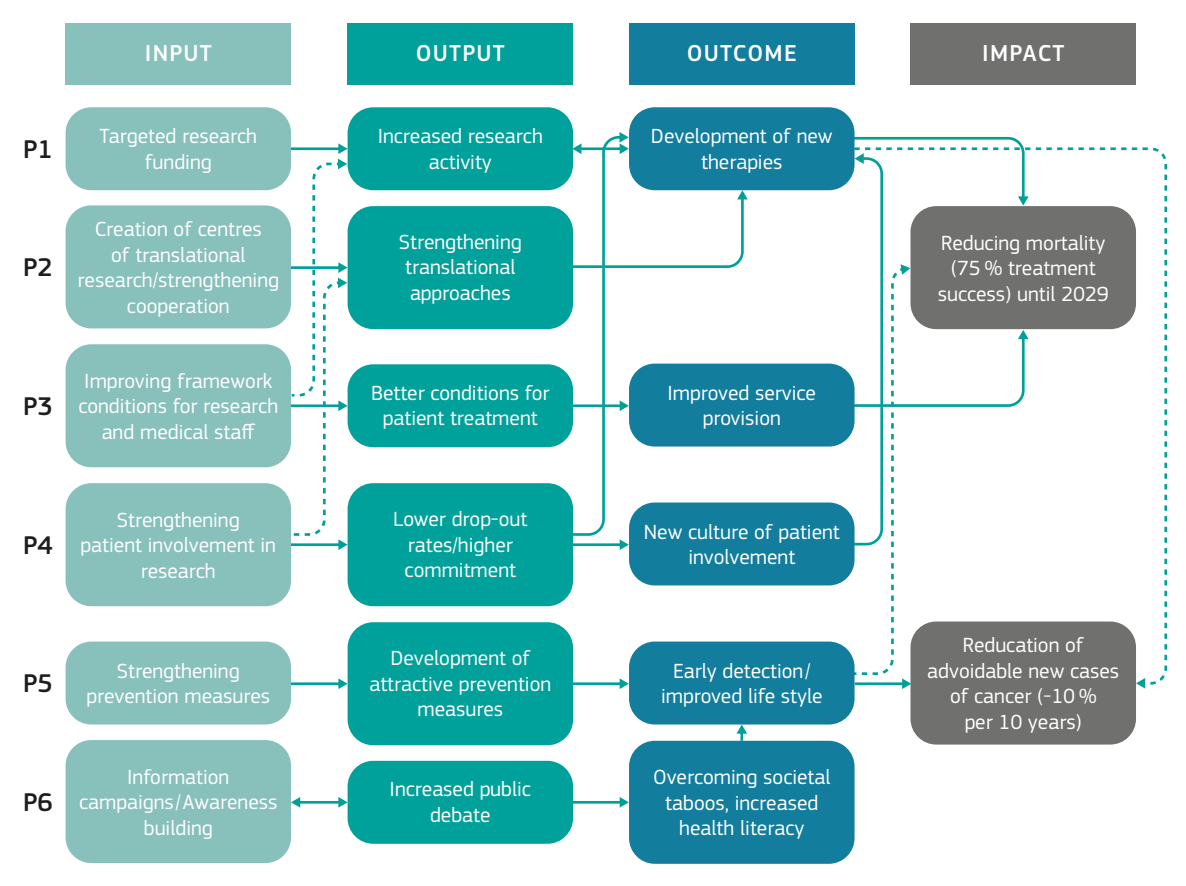
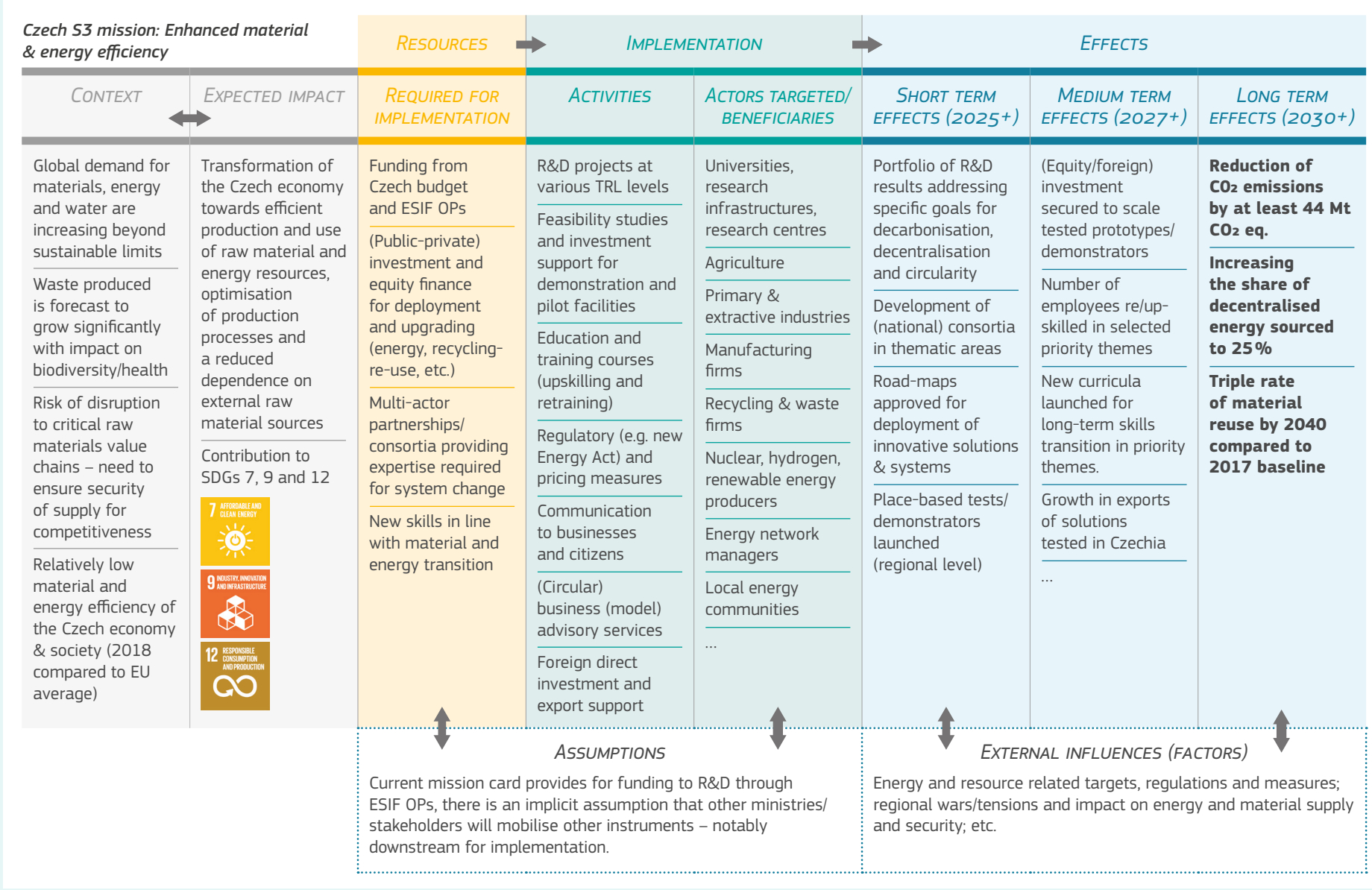


Source: Wittmann et al. (2021)

Beyond the indicators identified in the mission cards, the Czech S3 missions would benefit from a (macro) theory of change that underpins the development of a set of expected short-, medium- and long-term outcomes (effects) for which specific quantitative and qualitative indicators can be used to track progress towards the overall mission goal.

As part of the work with the Czech authorities such a theory of change was developed for the mission on enhanced material and energy efficiency. The theory of change identifies additional instruments (in the activities column) that should be mobilised as well as a series of short-term and medium-term effects which are necessary steps towards achieving the mission goals (see ***Figure 16***).

FIGURE 16 *Theory of change for the Czech S3 mission on enhanced material and energy efficiency*



Source: Authors, based on MPO (2022)

This framework can then be used to further develop and identify alternative innovation and impact pathways that can be followed and experimented with to reach the desired long-term objectives. The pathways help identify casual assumptions and, if needed, reflect on the initial mission framing, the selection of priority R&I areas and implementation mechanisms. The pathway thinking encourages stakeholders to think about various internal and external factors that may influence achieving the desired outcomes of R&I policies.

The short-medium-long term effects provide a framework for tracking the contribution of the mission portfolio of actions to the overall goals. The theory of change provides a framework to elaborate:

- The range and type of actors the mission targets and for which 'behavioural change' (e.g. greater involvement of citizens and users in innovation projects, new forms of co-operation, etc.) can be tracked and measured. The RIS3CAT monitoring platform example shows how using programme and open data can help visualise and capture changes in patterns of co-operation and behaviour.
- Building up a mapping of projects and initiatives contributing to the S3 mission goals that span more than the R&I projects traditionally captured by S3 monitoring systems is essential. An S3 Mission seeks to drive transformational change in a socio-technical system (e.g. in the Czech case above material and energy systems) so the monitoring system needs to cover a portfolio of actions that span ministries, agencies and governance levels.
- Indicators of transformative change of system capacity (rather than only relying on the traditional 'result' indicators at project or cluster of projects level) that can measure 'transformative milestones' and provide a periodic check on the direction of travel toward specific targets. For instance in the Czech material and energy efficiency case, this could involve measuring the trends in investment in and deployment of decentralised energy sources. To illustrate the link between the portfolio of R&I projects and related deployment measures (investment, regulatory change, etc.), impact case studies can be used as a qualitative means of showing the contribution of the mission.

Towards a roadmapping framework for S3 missions

6.

6.1. Mission-oriented roadmapping as a process and tool for directionality and coherence

Transformative missions engage many diverse actors and actions resulting in a complex mix of dynamically evolving and interlinked processes. It is challenging for any single person or an organisation to have a full overview of this mix. This chapter puts forward an integrated framework for orchestration, implementing and monitoring and evaluation of the S3 missions.

The framework is a flexible roadmapping approach helping policy makers and stakeholders to co-develop 'a big picture' of missions which can become a navigating tool helping them to coordinate relevant actions and gradually improve coherence and directionality of the policy mix.

The case in point reviewed by the authors is the Czech S3 mission policy mix for their two S3 missions. The framework builds on a 'mission card' framework introduced by the Czech S3 team to describe the missions (see ***Box 19***). The tool can be seen as a systemic theory of change which can provide a reference framework for designing more granular plans linked to specific programmes or projects.

The design of the transformative mission roadmap includes three layers:

- **Mission objective and transition pathways** describing the rationale of mission and the narrative of system change from the current state towards the desired future
- **Innovation pathways** focusing on the role of research and innovation in fostering the emergence and scaling of innovations with transformative impact and phasing out unsustainable practices
- **Policy and governance roadmap** highlighting policy instruments, governance arrangements and policy learning mechanisms for a continuous improvement of policy intervention.

The proposed framework presents the three layers on a timeline that allows the planned activities and expected results to be placed in the context of existing strategic and programming periods. The framework can be adjusted to be more or less precise in terms of anticipated time lags between interventions and expected results (e.g. it can be more precise for short-term plans and outcomes and more flexible considering longer-term impacts).

6.2. Roadmap design

6.2.1. Mission objective and transition pathways

This layer provides the description of the problem addressed by mission featuring the narrative of desired system change from the current state towards the desired future. The layer includes three dimensions:

- Problem statement and the narrative of change underpinning the mission
- Mission objectives and targets over time (attributable to mission)
- Wider sustainability benefits (contributions to the SDGs).

The problem statement describes the systemic challenge addressed by the mission. The narrative of system change should describe transition pathway - or pathways - towards the desired vision. Tackling complex societal challenges typically requires action along multiple, alternative or mutually reinforcing, paths to achieve transformative impact. For example, transforming food system cannot be captured by one simple narrative of change but needs to capture the multidimensional nature of the process (e.g. transforming diets, land use, production processes, business models, food pricing mechanisms, trade etc.). While the mission may focus on one or several of these dimensions, it is important to explain how it aims to transform the system. The statement should be based on the participatory deliberation and the historical evidence and anticipated future developments putting the statement into a wider context. Chapter 3 includes our suggestions and examples on how to frame policy problems for transformative missions.

Specifying mission objectives and targets is key for translating the mission into effective and transformative policy initiative. The targets are important operational and political tools that, on the one hand, create expectations and mobilise action and, on the other hand, allow to track progress in accomplishing mission. Objectives and targets may have different status ranging from formally binding goals to largely symbolic constructs. They may be introduced by a top-down policy decision or could result from bottom-up commitments put forward by stakeholders or localities. Choosing the right process of setting targets and finding the level of ambition is key for mobilising action and engagement. In any case, mission objectives and targets should be always attributable to actions included in the mission.

Including wider sustainability goals, such as the SDGs, to R&I missions is an important element ensuring the overall directionality of missions and allowing to identify and, if possible, quantify contributions of R&I to fostering sustainability transitions.

6.2.2. Innovation pathways

This second layer focuses on the role of R&I for meeting the mission goals. The proposed dimensions of the innovation pathways layer include:

- Priority R&I areas (including narratives on how research and innovation is expected to contribute to achieving the mission objectives in the short and longer term)
- Flagship R&I projects and experiments
- Key actors and partnerships (local, national and international actors; reflection on who stands to benefit and who may be exposed to new risks because of the mission)
- Innovation capacities needed to foster the missions (individual, organisational and network capacities needed for transformative change)
- Geography of mission (roles of regions and cities in accomplishing the mission).

This layer zooms in on specific innovation areas and projects with a demonstrated potential to foster the emergence and scale up of innovations with transformative impact. As the overall rationale is to foster transitions, the layer can also include innovative practices helping to phase out unsustainable production and consumption

patterns. The selection of the priority areas can draw on the EDP processes and the diagnosis underpinning S3 but the focus is on the areas with the current or emergent potential to contribute to the mission objectives.

The scope is on innovation areas and systems enabling their development and scale up. Transformative missions should be open to diverse types of innovation pathways ranging from wider deployment of existing technological and non-technological innovations to experimenting with emerging disruptive innovations and business models requiring investments in new R&I capacities (Miedzinski et al., 2019).

The missions need to strengthen R&I systems enabling transformative innovations. The focus can be on strengthening individual, organisational and system-level capacities needed to enable the emergence and scaling of innovations leading to systemic change. Building up challenge-oriented innovation systems can include a range of activities including supporting human and social capital, adjusting technical and technological infrastructures as well as improving the policy and regulatory framework. This layer should identify key innovation areas and value chains as well as consider the geography of missions (e.g. regional R&I hot spots, places which stand to benefit from the mission etc.).

6.2.3. Policy and governance roadmap

This third layer is a policy action plan of the roadmap for a coordinated implementation and continuous improvement of the mission. It includes policy instruments, governance arrangements and policy learning mechanisms supporting the priority innovations and challenge-oriented innovation systems. Depending on the policy context, the layer could be designed as an instrument portfolio with formalised implementation and coordination mechanisms or a softer coordination mechanism.

Regardless of the formal status, the layer should include three dimensions:

- Governance and coordination mechanisms
- Mission instruments
- Policy learning and capacity building.

Governance and coordination is a fundamental dimension of mission-oriented policies. The roadmap should explain how the mission is coordinated with relevant policy strategies at relevant governance levels (e.g. EU, national, regional and local). The roadmap should explain how the mission is connected and coordinated with the wider policy mix at the time of its design and how it may be taken up by various strategies and instruments over time.

The dimension should include envisaged mechanisms of horizontal coordination within the government (e.g. cross-ministerial collaboration) and vertical collaboration across governance layers (e.g. EU-national-local). Crucially, the governance dimension in the roadmap should explain the mechanisms of co-creation and consultation of missions with relevant stakeholders and citizens. As the Czech case described in this report demonstrates, the EDP process and S3 governance structures can be used and adjusted to support missions.

The dimension featuring mission instruments should describe the instruments mobilised to support the mission. The instrument mix can include instruments providing direct support (e.g. R&I investments and calls), soft support (e.g. networks, clusters) and stimulation of the demand side (e.g. procurement, tax system). Importantly, the roadmap should explain how the instruments are expected to contribute to achieving the mission goals by supporting R&I (impact pathways). With its layered design, the roadmap can be used to visualise the envisaged interactions and dependencies between the different types of support measures, notably to explain how they are expected to create complementarities and synergies fostering the prioritised innovation pathways.

Policy learning is crucial to ensure that policy interventions are monitored and continuously improved. Monitoring and evaluation is an integral part of policy learning ensuring timely collection of data and reflection on the effects of policy. The focus on policy learning emphasises the need to connect monitoring and evaluation to an ongoing participatory reflection on the outcomes of the mission. In the context of smart specialisation this may mean using ongoing EDP to reflect on the evidence gathered form the implementation of the mission and to ensuring that these reflections are considered in adjustments and the redesign of S3 mission instruments.

FIGURE 17 *Tentative design of a roadmapping framework for S3 missions*

Dimensions	Current state and challenges	Short-term	Medium-term	Long-term (2030 & beyond)	Overall vision
Mission objectives and transition pathways					
Problem statement and the narrative of change underpinning the mission (single or multiple transition pathways)					
Mission objectives and targets over time (attributable to mission)					
Wider sustainability benefits (contributions to the SDGs)					
Innovation pathways					
Priority R&I areas and explanation how they contribute to the mission					
Flagship R&I projects and experiments					
Key actors and partnerships (local, national and international)					
Innovation capacities for the missions (individual, organisational, network)					
Geography of mission (roles of regions and cities in accomplishing the mission)					
Policy and governance roadmap					
Governance and coordination mechanisms, including mission management, stakeholder engagement and policy coordination					
Mission instruments and resourcing: • Direct support instruments (e.g. confirmed and foreseen R&I investments in mission projects) • Demand side instruments (e.g. procurement, tax system) • Soft support system (e.g. networks, clusters)					
Policy learning and capacity building					

Source: Authors, based on the mission-oriented policy roadmap proposed by Miedzinski et al. (2019)

BOX 19

'Mission objective cards': practical tool to operationalise Czech S3 missions

The overall logic and detailed content of S3 missions are introduced as an annex to NRIS3 strategy. The annex is communicated to all the relevant Managing Authorities of the Operational Programmes and to the managers of the Support Programmes in Czechia.

The National RIS3 Team introduced 'mission objective cards' as a practical tool to frame and communicate the missions in a way accessible to policy makers. The cards elaborate the following elements of missions:

- Mission objective
- Description of scope
- Areas and topics for research, development and innovation activities
- Policy instruments and tools to be used to implement the activities
- Monitoring and evaluation.

The cards are not mere descriptions. They are a tool the NRIS team uses to:

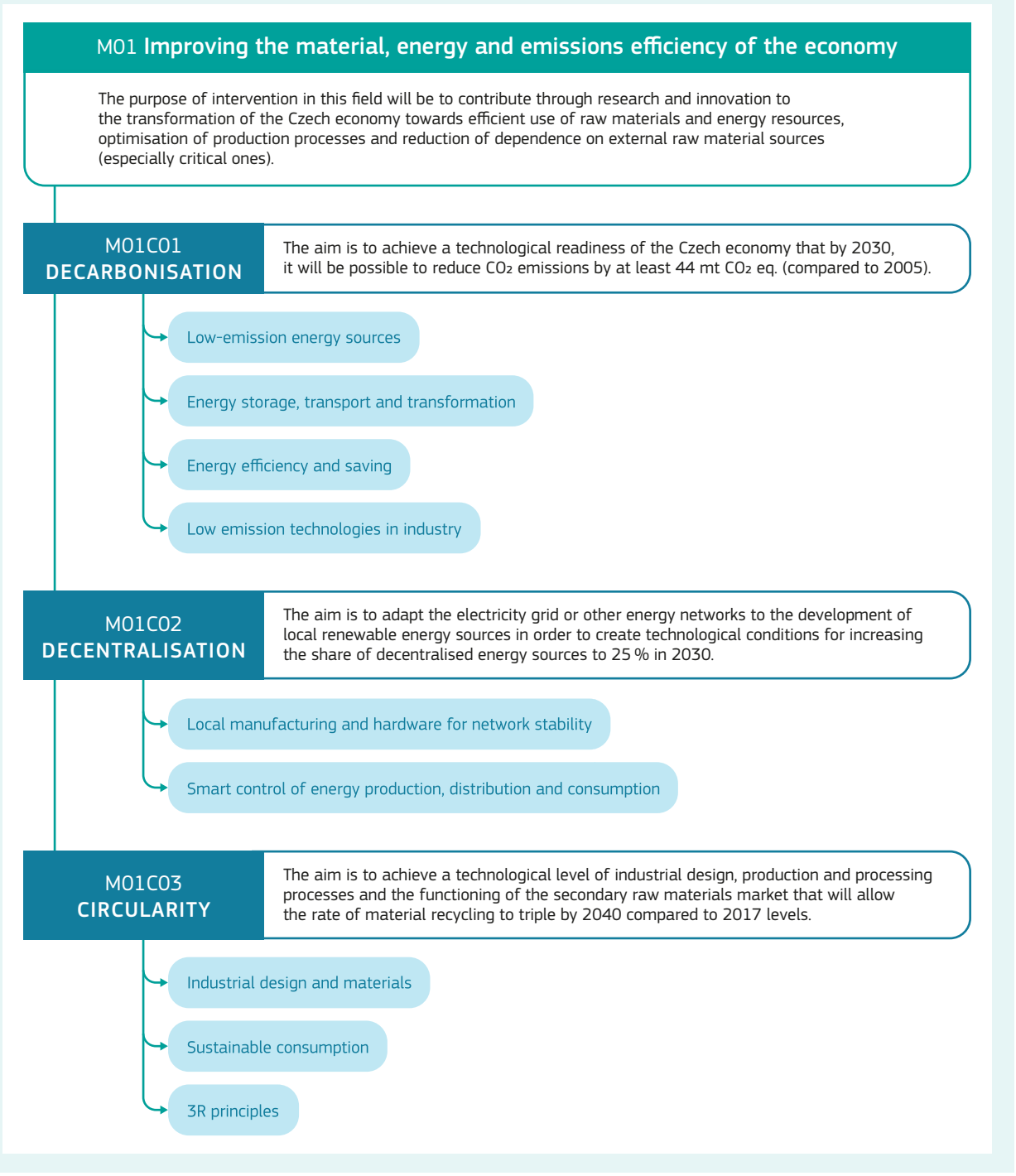
- Support programme managers in designing calls and instruments by providing concrete ideas for fundable R&I actions contributing to the NRIS3, in particular S3 missions
- Document in a structured way contributions received from stakeholders from the national and regional level throughout the S3 process, notably via the EDP
- Raise awareness and build shared understanding of the scope and ambitions of S3 missions among key Czech R&I stakeholders and other actors concerned with the mission objectives.

For example, the Czech S3 mission 'Improving the material, energy and emission efficiency of the economy' is structured into three strategic objectives of decarbonisation, decentralisation and circularity (see ***Figure 18***).

This report proposes a mission roadmapping framework that extends the mission card into a long-term action framework explaining how policy interventions are envisaged to contribute to a system-level transformation.

Sources: Authors, based on Janssen (2020) and Netherlands Enterprise Agency reports

FIGURE 18 *Scope of Czech S3 mission 'Improving the material, energy and emission efficiency of the economy'*



Source: JRC workshops with the Czech S3 team; Annex 1 to the NRIS+ (Czech Ministry of Industry and Trade, 2022x)

7. Conclusions and recommendations

Countries and regions in Europe increasingly engage in new approaches to research and innovation policies to address societal challenges. This is partly in response to the increasing gravity and urgency of these challenges and partly driven by visions put forward in EU and international policy strategies, notably the European Green Deal (EGD) and UN 2030 Agenda.

In 2018, the Joint Research Centre (JRC) started developing a challenge-oriented approach to smart specialisation strategies (S3) to align them with the ambitions of the EGD and the Sustainable Development Goals (SDGs). Based on the literature review and co-creation with S3 practitioners, JRC proposed a framework for reflection for policymakers on how to embed sustainability goals in the S3 process. The framework is among key tools supporting the Partnerships for Regional Innovation (PRI) – a new voluntary policy initiative supporting transformative innovation policy co-led by the JRC and the Committee of the Regions.

The S3 for SDGs framework builds on policy experiences and lessons learned across European countries and regions. In recent years, smart specialisation has emerged as an important testing ground for new challenge-oriented policy approaches in practice. National and regional governments – including Czechia featured in this report – use smart specialisation as a policy space to experiment with new policy approaches, such as missions, to support transformative innovation and leverage system change towards sustainability. Governance arrangements and implementation frameworks developed for S3 are employed to test and implement a generation of innovation policies.

However, the original conceptual framework and policy arrangements of smart specialisation are not fully aligned with the ambitions of sustainability transitions and the SDGs. There is a number of limitations carried in the design and conceptualisation of smart specialisation:

- Directionality and system-level change towards sustainability are not embedded in the S3 approach;
- S3 governance has limited capacity to orchestrate and mediate alignment and tensions between bottom-up experimental approaches and top-down priorities such as the ambitions and targets set up in the EGD;
- Entrepreneurial discovery process (EDP) is not equipped to foster 'alternative pathway thinking' on variety of ways innovation can contribute to sustainability transitions;
- Governance and EDP rarely include civil society and citizens or reach out to vulnerable groups impacted, or likely to be impacted, by transitions;
- Policy mix of S3 is limited mainly to supply-side instruments supporting R&D and innovation;

- S3 has a limited focus on supporting and scaling bottom-up place-based transformative innovation addressing sustainability challenges.

Despite these challenges, smart specialisation has a potential to become a breeding ground for gradually developing new approaches to challenge-oriented innovation policy. Nevertheless, the successful design and implementation of transformative missions in the framework of S3 require a patient investment in new capacities and policy learning. Based on the literature review and the action research with policy practitioners involved in the Czech National RIS3, we propose the following lessons for policy makers willing to integrate transformative mission-oriented approaches into smart specialisation strategies and wider research and innovation policy.

Smart specialisation can foster policy experimentation and learning

Smart specialisation offers 'experimental policy space' and collaboration capacities which can be mobilised to test challenge-oriented policy approaches and foster the shift towards transformative innovation policy on the national and regional level. However, transformative innovation needs a deliberate policy support since its emergence and scale-up is often limited by prevailing institutions and expectations. Transformative missions need to be supported by challenge-oriented experimentation and wider partnerships than in the usual S3 approaches pursuing R&D projects and specific technical specialisation and competence.

Policy framing needs to embrace the need for system change

Transformative missions offer an opportunity for embedding systemic directionality and system change in smart specialisation. Missions require a reflection on how innovation policy is expected to contribute to system-level transformation towards the goals of the EGD and the SDGs. One approach is to think of impact pathways between innovation supported by public policy and the high-level vision. Transformative missions need to be open to various types of innovations to discuss and support alternative transition pathways considering global and localised challenges and opportunities.

The narrative of transition underpinning transformative missions can provide a shared visioning and learning process which enable innovators and policy makers in the present to position themselves in relation to the current system and to the desired future. The mission can empower innovators and policy makers alike to navigate pathways towards mission accomplishment.

The support for emergence and scaling of place-based initiatives fostering transformation (e.g. changing regional industrial specialisation patterns and labour needs) should be integrated with the reflection and concrete action to ensure that the transition is leaving no one and no place behind. Transformative missions should be linked to just transitions.

Gradually build a comprehensive policy mix for missions

To effectively address societal challenges policy makers need to strengthen policy integration by new mechanisms and channels of collaboration across ministries and public bodies. The focus on transformative missions can improve consistency and coherence of policy mix. With their cross-cutting challenge-oriented approach, missions can help streamline R&I funds and other forms of support supported by different programmes and budget lines. Missions can be powerful consolidation mechanisms helping to improve efficiency and effectiveness of policies.

One way to improve the directionality and coherence of R&I policy is a gradual shift from a programme-based approach towards challenge-oriented portfolios. Mission-oriented approaches supported with systemic instruments, such as policy roadmaps, can become a policy spaces to test and develop portfolio-based policy approaches.

The policy mix needs to balance the support for challenge-oriented R&I projects with the systemic support to making innovation systems fit for de-

veloping and scaling innovation for sustainability. To strengthen transformative impact of R&I policy makers need to mobilise policy instruments from beyond the traditional R&I policy mix. Policy mixes mobilised for missions can gradually extend beyond an emphasis on R&D and innovation funding instruments to including demand side (e.g. innovation procurement) and regulatory instruments.

Mobilise multi-level governance mechanisms to scale up transformative change

There is a need to establish multi-level governance mechanisms to orchestrate and mediate alignment and tensions between bottom up and top-down mechanisms of prioritisation of R&I policy (e.g. bodies bringing together national and regional actors; instruments supporting local missions requesting inter-regional collaboration).

Policy makers need to actively encourage and nurture place-based bottom-up innovation collaborations aligned with national and EU level strategic goals. Improving vertical coherence of R&I policies will enhance their impact. The deployment of mission goals at sub-national level requires further support with the option of piloting and demonstrating interventions in several regions that can then be scaled to a national (or EU) level.

Invest in policy learning and transformative capacities

The shift towards transformative innovation policies, including challenge-led missions, requires a different approach to monitoring and evaluation (M&E). The M&E framework should be based on the shared understanding of theory of change underpinning the policy vision. Theory of change can be translated in expected impact pathways that include a range of short-medium-long term effects of R&I policy intervention and related indicators. These indicators can be inspired by the systemic approaches elaborating linkages and dependencies between SDGs.

M&E frameworks should provide a dedicated space for policy reflection and learning engaging policy makers and relevant stakeholders. They should place less emphasis on standard 'programme' indicators and foster formative approaches to evaluation. The urgency and complexity of societal challenge call for the testing of new ways to monitor and evaluate policy outcomes and impacts relevant for missions and sustainability challenges such as tracing effects of interventions in 'real-time' and better understanding learning and behavioural effects of policy interventions.

There is a need to patiently and systematically invest in individual, organisational, and system-level transformative capacities across governance levels. There are a number of existing practices and new tools to promote transformative innovation capabilities which have been developed experimentally over recent decades, such as system innovation portfolios, transdisciplinary sandpits or transformative innovation labs featured in this report. Transformative capacities are necessary to ensure that promising innovations are developed and scaled up to drive change in a sustainable and just way.

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LIST OF ABBREVIATIONS AND DEFINITIONS

DRIFT – The Dutch Research Institute for Transitions

EC – European Commission

EEA – European Environmental Agency

EU – European Union

EDP – Entrepreneurial Discovery Process

EGD – European Green Deal

ESFRI – European Strategy Forum on Research Infrastructures

ESIF – European Structural and Investment Funds

EU – European Union

IATT – Inter-Agency Task Team

JRC – Directorate-General Joint Research Centre of the European Commission

KIC – Knowledge and Innovation Community

M&E – monitoring and evaluation

MIT – Czech Ministry of Industry and Trade

MLP - multi-level perspective

MOIP - mission-oriented innovation policy

NIP – national innovation platforms

OECD – Organisation for Economic Co-operation and Development

PRI – Partnerships of Regional Innovation

R&D – Research and Development

RDI – research, development and innovation

RFF – Recovery and Resilience Facility

R&I- research and innovation

RIP – regional innovation platform

RIS3 – regional innovation strategy for smart specialisation

RRI – responsible research and innovation

S3 – smart specialisation strategies

SDGs – Sustainable Development Goals

SES – social-ecological system

SIA – strategic innovation area

SII – strategic innovation initiatives

S&T – science and technology

STI – science, technology and innovation

STR – societal readiness level

SNM – strategic niche management

SPW – Service Public de Wallonie (Public Service of Wallonia)

TACR – Technology Agency of Czech Republic

TIP – Transformative innovation policy

TKI – Topconsortium voor Kennis en Innovatie (Top Consortium for Knowledge and Innovation)

TM – Transition Management

TRL – technology readiness level

UN – United Nations

VP – vice president

LIST OF BOXES

LIST OF FIGURES

LIST OF TABLES

GETTING IN TOUCH WITH THE EU

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