



Transformative Innovation for Climate Change Adaptation - A mapping-based framework for territories

Authors: Harding, R., Nauwelaers, C., Haegeman, K.,
Editors: Carat, G., Gnamus, A.

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Abstract

This report looks at the key features of territorial Climate Change Adaptation (CCA) strategies, as they are developing throughout the EU, and examines whether and how the adoption of a Transformative Innovation (TI) approach could add value to these strategies and their implementation. The analysis is based on a literature review covering the two fields. Starting from rationales for linking TI and CCA strategies, seven key TI features are identified which are further explored in this report, in order to form a picture of the possible beneficial contributions TI might make to the design and implementation of CCA strategies. For each feature, potential contributions to climate adaptation are identified. Also, barriers to integrating TI in CCA strategies are formulated, both to strategy formulation and strategy implementation. Infusing TI approaches into the design and implementation of CCA strategies holds a promise to raise their effectiveness, and calls for more experimentation. As a way to start such experimentation, the framework developed in this report has been applied to 16 territories, covered in 14 separate case study reports listed in annex 2, drawing meaningful insights per territory as regards accelerating climate adaptation through transformative innovation. It targets public authorities in EU territories (and beyond) at different governance levels (from national to local), as well as other territorial stakeholders involved in or affected by climate adaptation policies and transformative innovation policies.

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Executive summary

Policy context

Next to mitigation, adaptation to climate change has become an increasingly urgent priority for the EU and its territories. Given this urgency, and the systemic nature of climate resilience, new ways to accelerate adaptation are considered. This report looks in particular at the potential added value of Transformative innovation (TI), and how it can help support and accelerate adaptation to climate change. It draws on the current-state-of-the-art in formulation and deployment of climate change adaptation (CCA) strategies in the EU as well as a literature review on transformative innovation (TI). It proposes an overall framework for how TI can help accelerate climate resilience.

Main findings

Starting from rationales for linking TI and CCA strategies, seven key TI features are identified in order to form a picture of the possible beneficial contributions TI might make to the design and implementation of CCA strategies:

1. Goals and scope definition – articulation of impacts:

Expressing CCA strategy impacts in terms of broader societal dimensions would help to embrace TI approaches and ‘system change’ more fully. TI is also predicated on the recognition and avoidance of lock-ins and generation of new development paths leading to the desired transformation: effective CCA strategies need to phase out unsustainable models and replace them by more resilient ones. Additionally, embedding stronger emphasis on just transformation through TI would help secure high-level political endorsement. Finally, could TI approaches help maintaining the sense of urgency for CCA despite the longer-term and uncertain perspective?

2. Policy portfolios:

Introducing a TI approach in CCA strategies would support a move from small, localised pilot experiments in CCA solutions towards mainstream and large-scale deployment of systemic solutions. Also, systemic portfolios could incorporate instruments of different nature acting in synergy, maximising co-benefits and avoiding perverse effects. Finally, the EU CCA Mission’s portfolio is actually an example of introducing TI features in CCA strategies and develop blueprints of policy portfolios for transformative innovation.

3. Cross-domain synergies:

A TI frame makes the case for cross-domain synergies from the outset, with the focus on breaking silos at strategic level. Within this, harnessing the power of interdisciplinary research and innovation would contribute to cross-domain synergies. More generally, the potential of a ‘climate adaptation economy’ can be further exploited to bring in business-oriented innovation instruments in the portfolio.

4. Stakeholders’ involvement:

The tradition of stakeholder involvement in CCA interventions – although not necessarily system wide – supports increased emphasis on TI. Additionally, new and better data/evidence to provide stronger justifications should help in overcoming resistance towards bolder CCA interventions. There is also scope for co-creation with society by favouring freethinking towards bold solutions, using tools from

the TI community. However, transformative adaptation will require larger funding sources including private funding. Therefore strong business involvement is needed, including the potential for larger involvement of companies adopting Corporate Social Responsibility practices. With TI seeking wider and inclusive societal transformation, 'Socially just' CCA also requires stronger involvement of vulnerable groups.

5. Multilevel governance:

The need for effective multi-level governance structures for successful CCA interventions appears as a key positive element for take-up of TI in CCA strategies. However, there are trade-offs between the institutionalisation of multi-level governance systems and their eventual flexibility/adaptability in the context of 'system change' implicit in TI approaches. Exemplary communications are essential to ensure smooth transitions – even to the extent of enabling co-creation of changes based on input from the different levels.

6. Room for experimentation:

The limited scope for experimentation in CCA strategies appears as a factor restricting expansion of TI approaches. Transformative CCA strategies would need to find ways of incorporating possibilities of taking risk/failure and new types of risk-tolerant funding would be needed.

7. Policy intelligence, learning and strategic capacity:

A TI perspective for CCA would stress the need for robust evidence to understand the baseline situation, and for anticipatory and orchestration capacities to co-create future pathways. Social and behavioural sciences would need to complement knowledge produced by climate scientists. A TI perspective would also require the development of novel monitoring and evaluation frameworks incorporating a systemic dimension beyond sectoral approaches. And 'Transformative' learning capacities will need to be developed beyond absorptive and adaptive capacities.

Key conclusions

The 2021 EU CCA strategy (EC, 2021a) emphasises that '*Climate change is having such a pervasive impact that our response to it must be systemic*'. Incorporating TI into CCA strategies would support their upgrading towards such 'transformative adaptation' goal (IPCC, 2022). This is a goal well beyond shorter-term and sectoral endeavours aimed at maintaining or restoring wealth on a 'back to business as usual' path. In view of the complexity and pervasiveness of future climate change impacts, more radical, more wide-ranging, more integrated transformation will be needed.

While barriers exist both to strategy formulation and strategy implementation, as identified in this report, infusing TI approaches into the design and implementation of CCA strategies holds a promise to raise their effectiveness. TI experimentation is just starting, with initiatives like the ActionBook on innovation for place-based transformation (European Commission, 2024). Similarly, TI approaches can learn from CCA strategies, e.g. regarding a stronger involvement of the local level in implementation.

The best way to test this thesis in the shorter term is to examine efforts deployed so far in frontrunner territories to incorporate TI features in CCA strategies, address the relevant barriers and build up solutions to bridge the gaps between ambitions and reality.

Related JRC work

The ActionBook (European Commission, 2024) on innovation for place-based transformation offers an overview of place-based TI approaches. Annex 2 includes a set of case studies applying the framework developed in this report.

1 Introduction

The term ‘Climate Action’ covers both Climate Change Mitigation – increased efforts to reduce greenhouse gas emissions – and Climate Change Adaptation – strengthening resilience and adaptive capacity to climate-induced impacts already underway or expected. Climate Change Adaptation (hereafter ‘CCA’) has been slower to occupy policy attention than Climate Change Mitigation, but it has gained progressively stronger emphasis at different governance levels in the EU in recent years, thanks to the EU Mission on Climate Adaptation and due to the increasing visibility of climate change impacts in society. This visibility is further increased with the recent European climate risk assessment report of the European Environment Agency (EEA, 2024), identifying 36 major climate risks for Europe, grouped by urgency to act. As a result, CCA strategies have been put in place at an increased pace across EU Member States and regions and the second EU-level CCA strategy was adopted in 2021. Investments in different aspects of CCA are also increasing in the EU, from climate-proofing of infrastructures and enhancement of nature-based solutions to softer measures in health and education systems – including innovative pilot-type initiatives. Yet despite this progress, there is growing consensus that CCA is not being implemented at anything like the scale, depth and speed needed to avoid dangerously increasing climate-related risks for nature and society (IPCC-Intergovernmental Panel on Climate Change, 2022).

In parallel, initiatives are being developed in recent years to better understand how transformative innovation can help in implement solutions to societal challenges in a more systemic way. Transformative Innovation approaches recognise that entire socio-technical systems need to change in order to address the complex interrelated challenges facing society today. Transformative Innovation (TI) is generally seen as challenge-driven and fits well with mission-led policies developing at EU level and in some Member States. The Horizon Europe Missions established for the 2021-2027 funding period come as a novel approach for EU R&I policy. Notably among the five Horizon Missions, there is a Mission focused on CCA.

The complexity of possible Climate Change impacts on society, including through a myriad of interactions with other socio-economic trends such as demographic aging, increasing migration and urbanisation, underlines the enormity of the adaptation challenge. Moreover, given such complexity, well-intentioned intervention in one sector or area can easily have a multitude of unintended consequences in others (EEA, 2019). In view of the scale and diversity of risks involved, the context calls for urgent reflection as to whether CCA strategies could benefit from stronger embodiment of the TI concept.

The aim of this report is therefore to support such reflection by suggesting ways in which TI approaches can make CCA strategies more effective in their conceptualisation and implementation. It proposes a conceptual framework, including a methodology allowing to better explore both the feasibility of and barriers to developing more effective ‘Transformative Climate Change Adaptation Strategies’. The framework has been applied in a series of 16 cases studies on CCA strategies in different territories, grouped into 14 reports referenced in Annex 2. It targets public authorities in EU territories (and beyond) at different governance levels (from national to local), as well as other territorial stakeholders involved in or affected by climate adaptation policies and transformative innovation policies. The analysis is conducted by JRC and external experts in close collaboration with DG CLIMA and DG RTD. It constitutes one out of many ways in which the JRC supports a reinforced evidence base behind accelerating the societal transitions.

The report is built up around 4 sections. In Section 2, the report presents an overview of the current-state-of-the-art in formulation and deployment of CCA strategies in the EU. The overview covers

principal aspects only, concerning their level of ambition, scope of action and methods of implementation. Section 3 of the report goes on to explore the burgeoning literature on TI and summarises the key features of the TI concept, its links to the Mission-oriented policy approach and the challenges for these concepts to be translated into reality. Section 4 is the core of the report. It examines how far the key features of TI align with approaches currently adopted by CCA strategies in the EU and discusses whether the former can support the design and the implementation of more effective CCA strategies. The conclusion argues that the features of TI can all be useful in nurturing more ambitious CCA strategies under the label of 'Transformative Climate Change Adaptation Strategies' and that all TI features are needed to bring this *transformative adaptation* approach to life.

Finally, with the hindsight and experience of carrying out the separate case studies, a number of observations and adjustments have been subsequently formulated in order to improve the methodology described in Annex 1, and are listed in Annex 3 as suggestions for possible future studies on other territories.

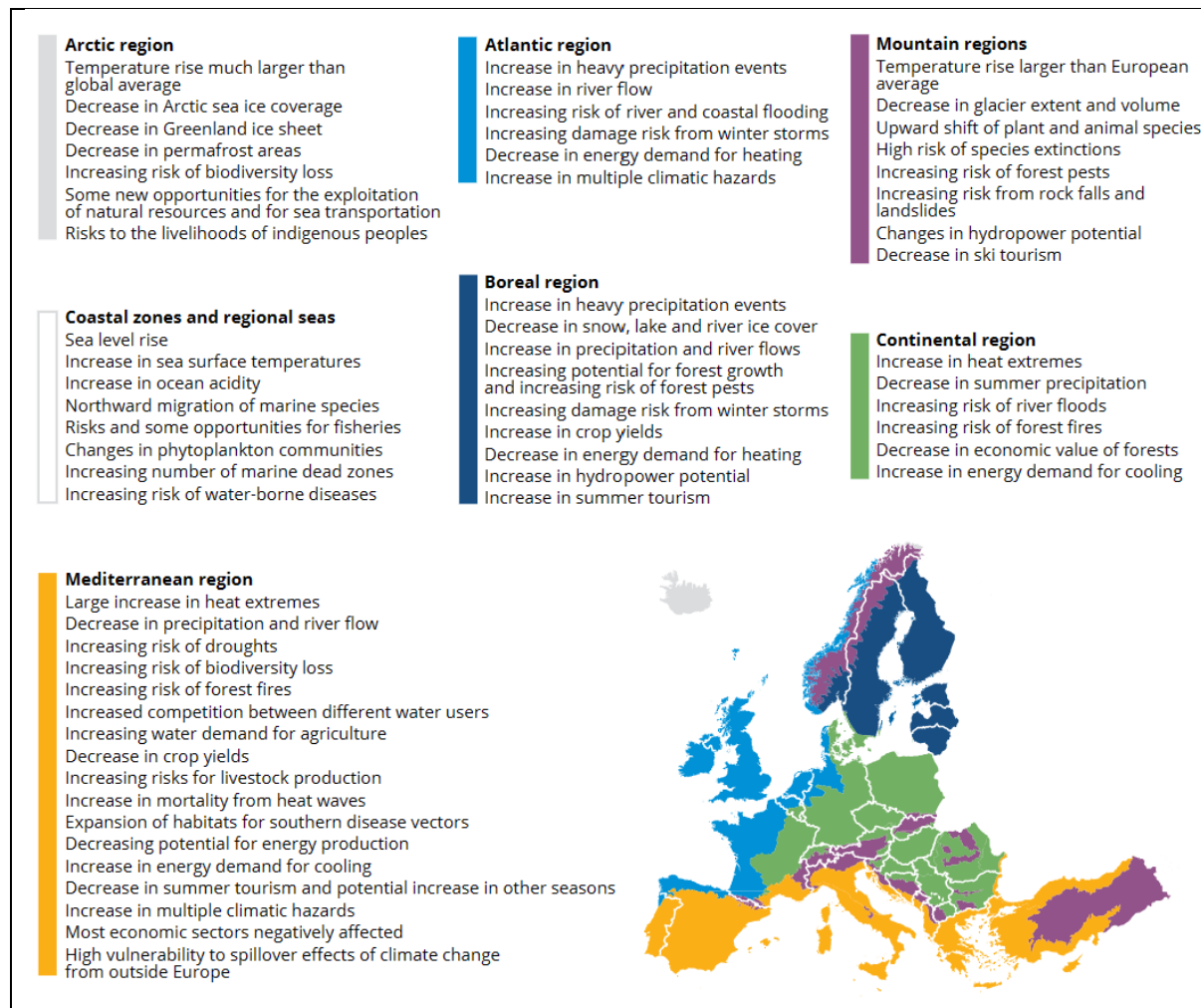
2 State-of-the-art in deployment of Climate Change Adaptation strategies in the EU

This Section provides a brief introduction to Climate Change Adaptation (CCA). It examines the influence of strategies for CCA at the EU level and gives an overview of how CCA strategies are constructed in the Member States and their stage of implementation, culminating in a review of current shortcomings identified.

2.1 Brief introduction to Climate Change Adaptation (CCA)

Climate change is already affecting our world. Land and sea temperatures are rising, precipitation patterns are changing, sea ice, glacier volume and snow cover are decreasing, sea levels are rising and climate-related extreme weather such as heat waves, heavy precipitation and droughts are increasing in frequency and intensity in many regions (EEA, 2017). Key climate change impacts in Europe can be broadly classified for the main biogeographical regions (Figure 1), although there is considerable variation within each of these regions.

Figure 1. Key observed and projected climate change and impacts for the main biogeographical regions in Europe



Source: (EEA, 2017)

Climate change vulnerabilities are particularly severe in: mountainous areas, mainly because of disproportionately high temperature changes; coastal zones, through rising sea levels; cities and urban areas, due to population concentration with particularly high proportions of elderly and vulnerable people, high prevalence of economic activity and specific risks resulting from soil sealing and the urban heat island effect.

The term ‘Climate Action’ covers two distinct action types, Climate Change Mitigation and Climate Change Adaptation (CCA). Essentially, Mitigation seeks to ‘*avoid the unmanageable*’ through increased efforts to reduce greenhouse gas emissions, whilst CCA aims to ‘*manage the unavoidable*’ by strengthening resilience and adaptive capacity to climate-induced impacts already underway or expected (Matos *et al.*, 2022).

Adaptation

Adaptation is the process of adjustment to actual or expected climate and its effects. It is not a one-time emergency response, but a series of proactive measures to deal with the nexus of hazard (e.g. drought, sea

level rise), exposure (e.g. less water in the South), and vulnerability (e.g. poverty or lack of education). Complications (and danger) arise from tipping points (i.e. thresholds in the rate of climate change) like permafrost melting, sea-ice loss, or massive forest dieback.

Source: (IPCC, 2014)

Key driving forces for CCA include the mounting scientific evidence on climate change impacts coupled with recent occurrence of climate change-induced disasters with dramatic consequences on societies: e.g. wildfires have caused huge losses in built environment, natural ecosystems and biodiversity, people's health and economic activities. Recent monetary assessments of future damages from climate extremes on critical infrastructures, for example, show a sevenfold increase by the 2080s compared with the baseline (IPCC, 2022). In the EU, the increasing impact of climate change on certain sectors and regions will affect the very premises or baselines on which many EU macro-economic policies and instruments are based (EC, 2021a). Wider impacts on critical systems at global level can be expected, with disruptions in international trade affecting entire value chains and vital sectors such food or energy supply, generating in turn impacts on health, wellbeing and wealth of populations across borders. More complex impacts and new sources of vulnerability arise when multiple hazards occur simultaneously (e.g. sea level rise with increasing rainfall, combining slow onset with extreme phenomena), causing cascading risks across sectors and regions (IPCC, 2022).

Concerning action taken to better adapt to CCA, an increasing body of literature is being developed in the EU and beyond, such as overviews or comparisons of CCA implementation measures (E.g. Pietrapertosa et al, 2018; Lioubimtseva and da Cunha, 2020). New governance frameworks are also being developed, mostly focusing more widely in sustainability aspects. Whereas Elmqvist et al (2019) propose a general framework for more sustainability in urban policy and implementation processes, Miedzinski et al (2022) focus on the use of Sustainable Development Goals in Smart Specialisation for enhancing territorial sustainability, and Sainz de Murieta et al. (2021) focus on urban governance models. Few authors also have a more specific focus on governance for CCA, like Shi and Moser (2021), on how US climate adaptation policies can become more transformative. This report aims to better understand specifically the European approach to this challenge. In the next sections, we first consider the EU and Member States role in the design and implementation of CCA strategies.

2.2 Influence of EU-level on CCA strategies

European efforts towards CCA strategies and initiatives in Member States are supported by a wide range of EU-level regulations, strategies, initiatives and funding sources. There have been two EU-level CCA strategies, one adopted in 2013 and the most recent in 2021.

The 2021 EU-level CCA strategy presents the vision of the EU as a climate-resilient society, fully adapted to the unavoidable impacts of climate change by 2050 (EC, 2021a). CCA is an integral part of the European Green Deal and the European Climate Law. Article 5 of the Climate Law states that the EU Member States must *'adopt and implement national adaptation strategies and plans (...) based on robust climate change and vulnerability analyses, progress assessments and indicators, and guided by the best available and most recent scientific evidence'* (EP and CEU, 2021). Climate-ADAPT, the EU's comprehensive platform for CCA, shows that national CCA strategies are now in place in

about all Member States, whereas only 15 had adopted national strategies when the first EU-level CCA strategy was introduced in 2013 (EC, 2018).

An important contribution of the EU's previous 2013 CCA strategy was the 'climate-proofing' of EU policies. As part of this drive, the EU Multiannual Financial Framework (MFF) 2014-2020 incorporated a target of at least 20% of the EU budget to be spent on climate-related investments. For the 2021-2027 MFF, the target was raised to 30% of the EU budget. In addition, CCA features in the EU's Covid-19 recovery effort. At least 37% of the budgets of National Recovery and Resilience Plans (NRRPs) have been allocated to climate action, including CCA (EC, 2021a). Under these different frameworks, there is no distinction between climate mitigation and CCA, but some instruments have had dedicated allocations for CCA. EU Cohesion Policy Funds have had distinct Specific Objectives for investments promoting CCA and disaster risk prevention in both 2014-2020 and 2021-2027 programming periods and Common Agricultural and Fisheries Policies have also contained CCA-relevant measures. The cross-border dimension inherent in many climate change impacts (e.g. in the Arctic region, coastal areas, or river basins) are addressed through Cohesion Policy's INTERREG Programmes and Macroregional Strategies.

Under Cohesion Policy an Ex-Ante Conditionality / Enabling Condition has existed for both programming periods requiring Member States to have a '*national or regional risk assessment / disaster risk management plan*' in place (...) '*taking due account of the likely impacts of climate change*' (EP & CEU, 2013 and 2021). For the 2021-2027 phase, the Commission has put in place comprehensive guidance on the climate-proofing of infrastructures, building on experience gained with major project investments during 2014-2020. The Connecting Europe Facility (CEF) also follows related requirements and InvestEU has regulatory provisions on sustainability-proofing of all financing and investment operations above a certain size. In addition, the European Investment Bank (EIB) will ensure that all operations it supports are adapted to future climate change risk (EC, 2021a). The EIB further pledges a share of support for CCA of 15% of its overall finance for climate action by 2025.

The Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives (EP and CEU, 2011 & 2001) provide a vital framework, including CCA provisions, with which EU-funded projects and programmes must comply – even those not otherwise covered by climate and sustainability-proofing guidelines. Also under EU Environment Policy, the LIFE Programme has been financing CCA-relevant projects since its inception and has contained a specific priority for climate action, including CCA, since its 2014-2020 phase.

As regards Research and Innovation (R&I) Policy, Horizon 2020, building on earlier climate-related actions under R&D Framework Programmes FP6 and FP7 with steadily increasing budgets, contained a focus area on fighting and adapting to climate change, covering both mitigation and CCA. For the 2021-2027 phase, Horizon Europe's Pillar 2 contains a cluster on Climate, Energy and Mobility, through which research in CCA will be financed through cooperative projects, in continuity with the previous framework programmes' actions. In addition, Horizon Europe is supporting the new EU Mission 'Adaptation to Climate Change', which constitutes the policy's first singular focus on CCA. The CCA Mission aims, by 2030, to accompany at least 150 European regions and communities towards climate resilience. It has three key objectives:

- Preparing and planning for climate resilience.
- Accelerating transformations to climate resilience.
- Demonstrating systemic transformations to climate resilience.

There are 311 signatories of this Mission Charter from regions/local authorities in 29 different countries - 25 EU Member States and in 4 associated countries (EC, 2023). The Horizon Europe CCA Mission will be a recurring subject of discussion in this report.

The Mission Implementation Plan has established provisional output and outcome for each objective (Table 1). The establishment of 75 demonstrators of systemic CCA transformations under the third objective is where the bulk of EU funding will be directed under this Mission.

Table 1. Provisional indicators for the EU Mission Adaptation to Climate Change

| Transformative steps | Outputs | Outcomes |
|--|--|---|
| Objective 1. Preparing and planning for climate resilience | | |
| Better understanding of climate risk exposure | <ul style="list-style-type: none"> • in depth review of climate risks affecting the key community systems • access to climate risk profiles and enhanced EWS | <ul style="list-style-type: none"> • comprehensive climate risk management plans, ensuring that community infrastructure and services are safe and operable and accessible under critical conditions |
| Objective 2. Accelerating transformations to climate resilience | | |
| Mobilising support and engagement | <ul style="list-style-type: none"> • governance structures steering the transformation to resilience | <ul style="list-style-type: none"> • open and inclusive governance processes for a just transition and resilience |
| Formulating a vision and transformative pathways | <ul style="list-style-type: none"> • vision of a climate resilient future and the transformative pathways | <ul style="list-style-type: none"> • smart specialisation strategy for sustainability • resilience contract |
| Orchestrating innovations and testing transformative solutions | <ul style="list-style-type: none"> • transformative solutions developed, tested and/or brought closer to the market | <ul style="list-style-type: none"> • creating conditions for more competitive and smarter regional economies |
| Objective 3. Demonstrating systemic transformations to climate resilience | | |
| Creating impact at scale | <ul style="list-style-type: none"> • 75 demonstrations of systemic transformations | <ul style="list-style-type: none"> • 150 Resilient regions and communities |

Another EU Mission, the Mission Climate-Neutral and Smart Cities, pursues objectives that are highly relevant for CCA: 1) deliver 100 climate-neutral and smart cities by 2030; and 2) ensure that these cities act as experimentation and innovation hubs to enable all European cities to follow suit by 2050. A joint Horizon Europe call covering the two Missions' objectives is a recognition that both Mitigation and Adaptation are complementary goals to be pursued to achieve sustainable development at regional and local levels.

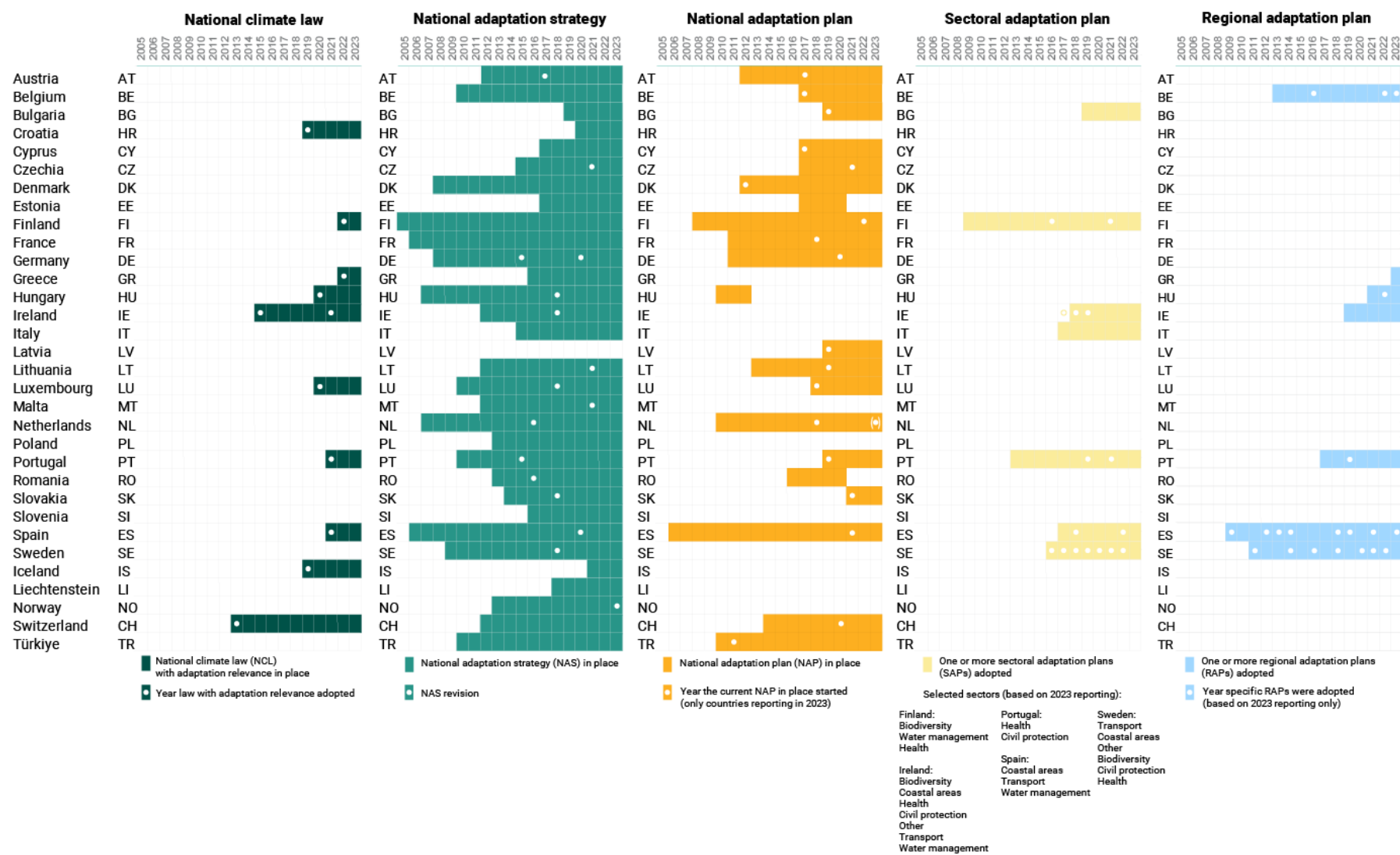
It should be noted that the EU's policy response on CCA is complemented by actions by international organisations, in which EU Member States also participate to differing degrees. OECD's Task Force on Climate Change Adaptation (TFCCA), for example, works to advance countries' policy agendas on resilience to climate change and climate variability. One of its initiatives, a Territorial Approach to Climate Action and Resilience (TACAR), supports cities, regions and countries in their efforts to build systemic resilience across levels of governments. The United Nations Environment Programme (UNEP) is a major player in the Global Adaptation Network (GAN), working to spread CCA knowledge worldwide. Maintaining a broader global perspective is important for the EU since many climate

change threats to Europe originate from outside European territory, just as climate threats to countries in the developing world are often not of their own making.

2.3 Focus and approach of CCA strategies in EU Member States

All EU Member States have a dedicated adaptation policy in place. Figure 2 reflects a large variety in policy approaches, including National Adaptation Strategies (NAS), National Adaptation Plans (NAPs), Sectoral Adaptation Plans (SAPs) or Regional Adaptation Plans (RAPs). In 2023, ten countries reported an adopted national climate law covering adaptation aspects (EEA, 2023).

Table 2. Overview of CCA strategy instruments in EEA countries 2005–2022



Source: (EEA, 2023)

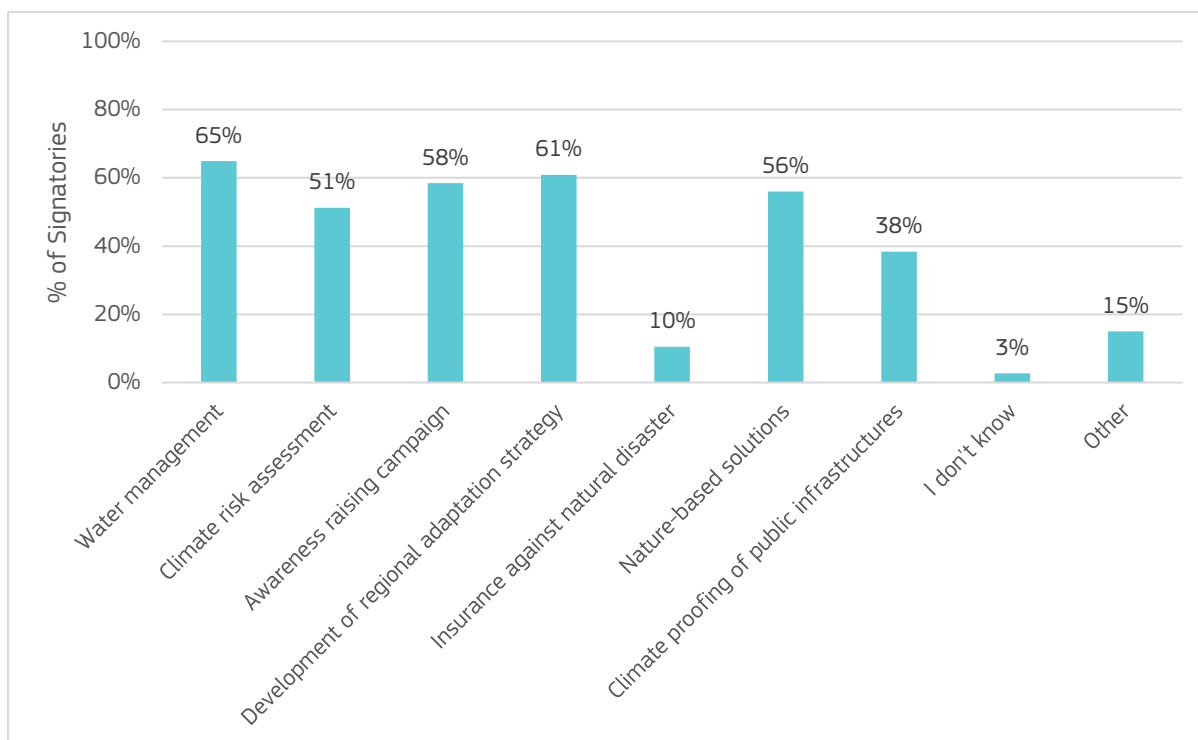
The overall strategic goals of CCA strategies in EU Member States are generally expressed in terms of territorial resilience at their level of application, be it national, regional/local, city-level or trans-national/cross-border.

Intervention fields under CCA strategies in different Member States differ considerably depending on their biogeographical context, their size and the kinds of climate risks they face. These are sometimes mixed with more general disaster resilience goals, depending on the territory. It is challenging to arrive at an overall typology of CCA intervention fields: IPCC, for example, highlights seven broad areas of intervention (IPCC, 2022) while the EU Mission CCA lists 6 key community systems and 4 key enabling conditions (EC, 2021c), largely overlapping but still different. The Climate-ADAPT platform follows a more detailed approach, providing guidance for practitioners on 59 different types of CCA action grouped simply as 'grey', 'green', or 'soft' measures. For the purposes of this report, based on our literature review, the following list of CCA intervention types is proposed to depict the scope of CCA strategies:

- Technology-based experiments/pilots.
- Physical works on 'grey' infrastructures.
- Physical works on 'green' infrastructures – including nature-based solutions.
- Land and food system planning/management.
- Water management.
- Healthcare system capacity planning/expansion.
- Emergency/community facilities/services enhancement.
- Training and awareness raising.
- Business support in 'adaptation economy'.
- Development of specific financial tools for adaptation.
- Building localised data tools to monitor and understand climate threats (observatories, warning systems, crowdsourcing for climate/weather data collection etc.).

Interestingly, in a recent survey carried out under the EU Mission on CCA, Charter Signatories were asked what types of adaptation measures they had implemented in their areas. Of those options which were not connected with risk assessment and strategy building per se, water management was the most reported, followed by awareness raising and implementation of nature-based solutions, with climate proofing of public infrastructures some way behind (Figure 2).

Figure 2. Response to EU Survey question on CCA measures implemented by CCA Mission Charter Signatories (November 2022)



Source: EC DG CLIMA survey of Signatories of Mission Climate Adaptation Charter

2.4 Shortcomings in EU Member States' implementation of CCA strategies

Whilst the EU is generally seen as a world leader in climate policy, various recent assessments from authoritative sources project a broadly negative view on current progress with CCA in the Member States. The IPCC Working Group II report 'Climate Change 2022' states categorically that *'although adaptation is happening across Europe, it is not implemented at the scale, depth and speed needed to avoid the risks'* (IPCC, 2022). This echoes UNEP's diagnosis at global level: *'too little, too slow: climate adaptation failure puts world at risk'* (UNEP, 2022). CCA strategies as they are implemented across Europe show some fundamental limitations:

- Adaptation efforts remain too small in scale: *'novel adaptation options are pilot tested across Europe, but upscaling remains challenging'* (IPCC, 2022).
- Actions undertaken remain too incremental: *'Prioritisation of options and transitions from incremental to transformational adaptation are limited due to vested interests, economic lock-ins, institutional path dependencies and prevalent practices, cultures, norms and belief system'* (IPCC, 2022).

The design and implementation of CCA strategies appears as too fragmented overall. While CCA is increasingly mainstreamed in a number of intervention areas such as agriculture or water management, where the direct impacts of climate change are more readily visible, the incorporation of CCA imperatives is lagging behind in many other policy domains (EEA, 2022).

Part of the problem faced by CCA strategies may have to do with the very concept of resilience. When used in a disaster risk management frame, resilience embodies a connotation of carrying on with business-as-usual in the short term, rather than developing novel pathways within a longer-term perspective: *'Many sectors and systems, such as flood risk management, critical infrastructure and reforestation, are on self-reinforcing development paths that can result in lock-ins and prevent changes needed to reduce risks in the long term and achieve adaptation targets'* (IPCC, 2022).

Resilience: a traditional view

Resilience is the capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function structure, identity and feedbacks.

Source: (OECD, 2014)

Other shortcomings of CCA strategies are visible in:

- Insufficient dedicated funding for CCA, compared to Climate Change Mitigation: *'while the EU spending target on climate action increased from 20% in 2014–2020 to 25% in 2021–2027, most spending is going into mitigation, not adaptation'* (IPCC, 2022); and on a world scale, *'funding for CCA in developing countries is around 5–10 times lower than it needs to be to meet estimated needs, and continues to widen'* (UNEP, 2022). This situation is alarming given the scale of (expected) impacts (see Section 1.1). The costs of non-action are likely to be colossal.
- Limited evidence bases for CCA actions: although political commitments to institutionalise periodic updating of national climate risk assessments are in place in several Member States, *'their systematic, comprehensive and regular renewal is the exception rather than the rule'* (EEA, 2022) and *'most EU Member States currently have no mechanism in place to collect, assess or report economic losses from weather and climate-related extreme events'* (EC, 2021b).

CCA strategies are faced with a common overwhelming conundrum. They must address impacts which are uncertain in nature and scale, within timeframes most likely stretching far into the future, but which are also essentially unknown. Mitigation indeed appears more attractive due to the shorter-term profitability of investments in renewable energy in particular, regulatory incentives as well as generous incentives opening new and large markets in decarbonising large sectors such as energy production and automobile industry, as well as recent high-level concerns on energy security in Europe linked to the war in Ukraine. In addition, some commentators question the relevance of CCA strategies acting as substitutes, or distracting efforts (and competing on funding) from Mitigation strategies, the latter being seen as utmost priority to address the root causes of climate change. In this sense, developing CCA strategies might be interpreted as acknowledging the failure of low-carbon transition strategies.

In view of the inherent complexity and uncertainty of climate risks, problems of a systemic nature in Member States are increasingly highlighted in the literature as hampering the implementation of CCA. Addressing such problems requires systemic thinking from policy-makers and cross-governmental cooperation, both of which are known to be difficult.

- *'Climate risks are notoriously complex as they involve interacting, nonlinear and fundamentally unpredictable environmental, social, economic and geopolitical dynamics that may be irreversibly transformed by the growing concentration of greenhouse gases in the atmosphere'* (EC, 2021a).

- *'Systemic barriers constrain the implementation of adaptation options in vulnerable sectors, regions and societal groups. Key barriers are limited resources, lack of private-sector and citizen engagement, insufficient mobilisation of finance, lack of political leadership and low sense of urgency. Most of the adaptation options to the key risks depend on limited water and land resources, creating competition and trade-offs, also with mitigation options and socioeconomic developments'* (IPCC, 2022).

Finally, CCA to date has been much more public sector led than Mitigation. The involvement of private financing in CCA appears to be lagging considerably. *'The role of the private sector in climate change adaptation has been limited, as traditional financing mechanisms and investment vehicles have not yet been fully utilized'* (OECD, 2018). The evaluation of the 2013 EU-level CCA strategy concluded that the evidence was not strong enough to confirm whether it was adding value in relation to actions to promote insurance and other financial products for resilient investment (EC, 2018).

Nevertheless, CCA can offer potential for private business in the so-called 'adaptation economy', but the opportunities are not fully realised at present. *'Research commissioned by EIT Climate-KIC found the adaptation economy in 2016 was already worth €279 billion globally and was forecast to grow at 11 per cent per year. (...) Innovation can help overcome the climate adaptation gap and create jobs in the new adaptation economy, but only if we seize the moment'* (Mitchell, 2021). Mobilising the private sector around CCA solutions thus appears as a crucial and immediate step to take in moving forward towards building a more climate resilient Europe.

3 The concept and key features of Transformative Innovation

Transformative Innovation (TI) is a relatively new approach currently gaining increasing traction with both policy researchers and policymakers. This section introduces the TI concept and its relationship with mission-oriented innovation policies. It then examines TI's translation, largely through trial and error / experimentation, into recent policymaking. The section culminates in a summary overview of the key features of TI and challenges surrounding the implementing of TI approaches in reality.

3.1 Introduction to TI

3.1.1 The TI concept

TI is a broad concept inspiring a new generation of place-based R&I policies currently emerging in a number of EU Member States and regions. It is seen as representing a third stage of R&I policy evolution, beyond the traditional focus on research-and-technology based knowledge creation of the first generation, and the largely economic *technology-transfer* rationale of the second, which had strong emphasis on developing innovation systems. This emerging third generation incorporates features from the previous generations and adding a new dimension (Table 3). TI-inspired policies are crucially driven by the major challenges facing society today. This constitutes TI's so-called 'directionality' (Diercks et al., 2019; Grillitsch et al., 2019). The new framing postulates that innovation policies aiming to address societal challenges will only be effective if advances in science, technology and innovation are combined with broader changes in the economy and in society. Technological innovation is increasingly seen as only one side of the coin. Business models, organisational, social, infrastructural and public sector innovations, among others, are also needed to bring about wider transformations in socio-economic systems.

Table 3. Key evolutions in the framing of innovation policy

| Overarching framing | Key features | Era | Policy rationale | Policy approaches (examples) |
|--------------------------------|--|-----------------|--|--|
| Innovation for growth | Science and technology for growth, promoting production and consumption. | Since the 1950s | Responding to market failure: public good character of innovation necessitates state action | State financing of basic R&D, incentives for business R&D (e.g. tax breaks, subsidies). |
| National systems of innovation | Importance of knowledge systems in development and uptake of innovations. | Since the 1980s | Responding to system failure: maintaining competitiveness, coordinating system actors. | Promoting science hubs; incentivising coordination; SMEs; education and training. |
| Transformative change | Alignment of social and environmental challenges with innovation objectives. | Since the 2010s | Promoting transformation: pathways, coordination domains, experimentation, learning. | Societal challenges (H2020), goal orientation (SDGs), mission-oriented innovation (FP9). |

Source: (EEA, 2019) based on (Schot and Steinmüller, 2018)

TI policies are territory specific. They rely on the distinct innovation and institutional capacities and natural features of particular places to address the societal challenges faced in those places.

3.1.2 ‘Mission’-oriented innovation policy approaches

The societal challenge directionality of TI is reflected in the growth of interest in the concept of ‘mission’-oriented innovation policies (OECD, 2021). In such policies, the mission is characteristically a grand challenge, also generally societal in nature. The mission-oriented approach implies a shift from solving (technical) problems within a single governmental body, to addressing challenges that require the collaboration of a multitude of actors (Kattel and Mazzucato, 2018). Commentators note that two strands of literature – on transitional innovation approaches and on mission-oriented innovation policies – have recently begun to converge into this third generation of TI policies (Haddad *et al.*, 2022).

Mission-oriented innovation policies

A mission-oriented innovation policy is a co-ordinated package of policy and regulatory measures tailored specifically to mobilise science, technology and innovation in order to address well-defined objectives related to a societal challenge, in a defined timeframe. 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.

Source: OECD (2021a)

For the purposes of this report, given their close proximity, TI and mission-oriented policies are considered together, as possible inspirations respectively for a frame and a policy approach.

3.1.3 Radical changes brought by the TI concept

While both TI and mission concepts can be seen as evolutions from previous approaches to innovation as enabler of growth, they also embody elements that propose more radical changes from the past. These include:

- A focus on system change and on breaking silos between sectors, disciplines, policy domains and levels.
- A need for broader and deeper stakeholder involvement and for experimentation.
- New frames and evidence for higher policy intelligence, monitoring and evaluation.

3.1.3.1 System change and silo breaking

To effectively address societal challenges, TI agendas must cross over a wide spectrum of policy domains, extending well beyond research and technology development. They also need to incorporate demand-side policies, skills development and build synergies with sectoral policies in fields like health, transport, energy, or food, depending on the societal challenge in question. In this sense, TI can be seen to embody a ‘convergence research’ dynamic, in which researchers from different disciplines come together to pursue challenges collectively. The whole enterprise results in a need for far stronger policy coordination across different domains (Nauwelaers and Harding *et al.*, 2022), as well as robust multi-level governance.

Moreover, in view of the inherent complexity and interrelatedness of societal challenges, TI embraces the imperative that entire socio-technical systems need to change in order to achieve transition. *'Socio-technical systems extend beyond individual industries or sectors to embrace whole value chains, including production and consumption, resource extraction and waste management. They include not just techno-economic dimensions but also infrastructure, culture, knowledge and politics, as well as diverse actors and interests'* (EEA, 2019). In this way, TI embodies an approach of system transformation, well beyond that of mere system optimisation.

Convergence research

Convergence research is a means of solving vexing research problems, especially those focusing on societal needs. It has two primary characteristics:

1. It is driven by a specific and compelling problem, whether that problem arises from deep scientific questions or pressing societal needs.
2. It shows deep integration across disciplines. Convergence research intentionally brings together intellectually diverse researchers to develop effective ways of communicating across disciplines. As experts from different disciplines pursue a common research challenge, their knowledge, theories, methods, data and research communities increasingly intermingle.

New frameworks, paradigms or even disciplines can emerge from convergence research, as research communities adopt common frameworks and a new scientific language.

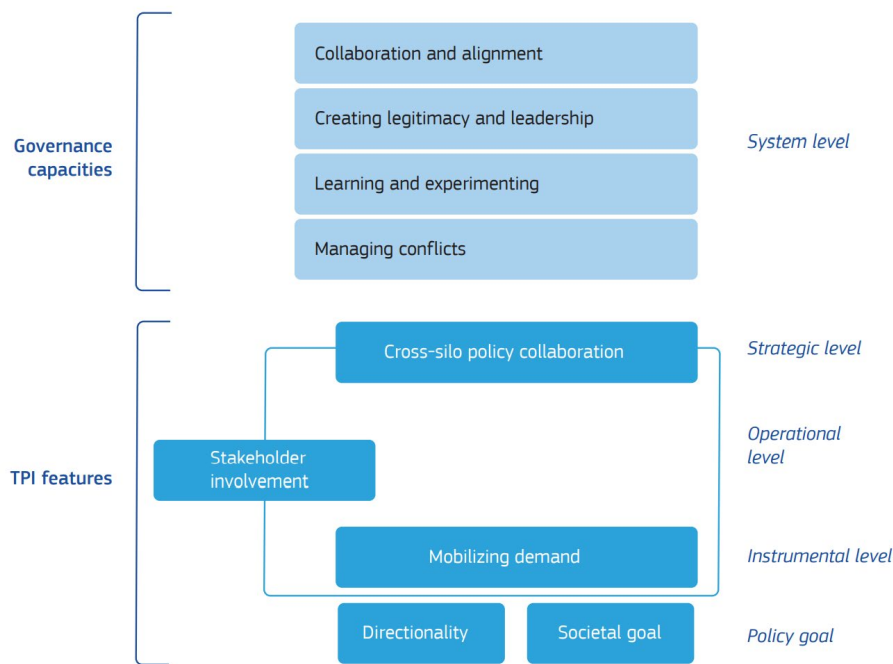
Source: US National Science Foundation <https://beta.nsf.gov/funding/learn/research-types/learn-about-convergence-research>

It should be understood that system transitions necessarily disrupt and challenge established investments, jobs, behaviours, knowledge and values – not to mention the previously existing systems themselves. TI therefore inevitably involves an element of 'creative destruction', where previous system elements are broken down and cleared away to make space for the new (EEA, 2019).

3.1.3.2 Broader and deeper stakeholder involvement and experimentation

TI requires involvement of a broader range of stakeholders, also encompassing those not traditionally considered part of the innovation ecosystem. This can include bodies such as energy or water utilities, local government, actors in the cultural sector etc. Entrepreneurs and peripheral actors, who often pioneer radical niche innovations (Van de Poel, 2000) are particularly important because they are willing to think 'outside the box'.

Figure 3. Governance mechanisms for Transformative Policy



Source: (Pontikakis *et al.* , 2022a)

The involvement of end-users of innovations, usually citizens, also remains vital to testing/validation of innovations and gauging of acceptance. Behavioural changes in society become necessary companions to the introduction of new technology in the context of broader transformation. The emphasis in TI is on co-creation of policies with stakeholders, rather than mere ‘consultation’.

Experiments, pilots and demonstration projects are important for radical innovations in the context of TI, because they can fulfil several specific roles within an exploratory, bottom-up logic (EEA, 2019). Experiments must not be constrained and should be allowed to fail, as this will strengthen learning. Regulatory sandboxes can be a key tool to facilitate the process.

3.1.3.3 New frames and evidence for higher policy intelligence, monitoring and evaluation

TI is problematic for current evaluation practices due to the need to gauge not only innovation outcomes *per se*, but also the impacts of the different policies contributing to mission outcomes and behaviours of actors involved - not to mention the need to take unexpected or indirect impacts into account (Amanatidou *et al.*, 2014). Spillovers and other systemic effects confuse the input-output logic and make it difficult to define a counterfactual (Janssen, 2019). High levels of experimentation and risk also make ex-ante evaluation complicated.

Formative evaluation in the form of repeated and timely monitoring is generally favoured for TI, where feedback is used to make adjustments throughout the policy process (Foray, 2018; Mazzucato, 2018).

3.2 How TI and mission-orientation are percolating into innovation policymaking

The OECD Committee for Scientific and Technological Policy (CSTP) launched a project in 2019 to analyse progress in mission-oriented innovation policies in different countries (OECD, 2021). From a study of 20 cases, OECD concluded that so far, no mission-oriented innovation policy initiative has been started from scratch. They all currently build on previous policies implemented in the countries concerned, through gradual efforts to make existing policies better oriented and coordinated. The design of mission-oriented innovation policies is significantly influenced by the specificities of the national institutional setting in which they are embedded. Their design and implementation move forward through experimentation, negotiation and learning in an evolutionary way, building on existing policy settings and instruments.

In the EU, Smart Specialisation Strategies (S3) play a pivotal role in helping regions make the operational connection between EU R&I and Cohesion Policies. The introduction of S3 for the 2014-2020 programme period coincided with a more than trebling of Cohesion Policy funds potentially available for R&I research and innovation - equivalent to about 13% of all government funded R&D in the EU (Pontikakis *et al.*, 2022a). S3 is a place-based approach, encouraging regions to focus R&I efforts and EU funding in priority areas of greatest strength to maximise opportunities for economic growth. Through its Entrepreneurial Discovery Process (EDP), stakeholder involvement in priority setting – generally triple-helix – is a central feature of S3 governance. In 2018-2019, the EC experimented with a special Pilot Action, 'Regions in Industrial Transition', which sought to encourage more of a TI dimension to their S3 to better address societal challenges linked to the advent of the so-called '3rd Industrial Revolution'. The Pilot Action supported 12 pilot regions in enhancing their S3 for the 2021-2027 period in this direction (Harding and Nauwelaers, 2020).

In 2022 and 2023, the TI theme has notably since been adopted and amplified in the Partnerships for Regional Innovation (PRI) pilot initiative, developed by the Joint Research Centre in collaboration with the committee of the regions. The pilot aspired to test a strategic framework for innovation-driven territorial transformation, to generate co-benefits for the economy, society and environment (Pontikakis *et al.*, 2022a). A PRI Playbook *Concepts and Rationales* document outlined the initiative's underlying philosophy to '*consider the needs of the territory through the lens of transition; adopt a broader framing of innovation; unlearn loaded framings; work backwards from goals with broad coalitions of stakeholders; complement, strengthen and reform governance; diagnose development bottlenecks and deploy a tailored policy mix that goes well beyond project-funding*' (Pontikakis *et al.*, 2022b). The PRI Playbook contains also a toolbox of 68 concise 'fiches' covering different aspects of the PRI approach (Pontikakis *et al.*, 2022a). The pilot initiative was supported by a scientific committee that published a series of articles supporting the foundations of the approach, grouped in *The Square* (Schwaag Serger *et al.*, 2023). In 2024, this was followed by the publication of an *ActionBook*, putting innovation for place-based transformation into concrete action, through the introduction of 6 different dimensions: engaging, envisioning, orchestrating, designing, implementing, learning (European Commission, 2024). It also includes a wide set of practices and tools¹.

¹ The tools which appear most relevant for the TI approach include: T07 Challenge-oriented innovation; T10 Citizens engagement in innovation policy; T11 Co-creation for policy; T17 Contribution of civil society organisations; T62 Small-scale experimentation for transitions; T71 Whole-of-government approach: options to implement it; T72 Whole-of-government approach: power maps.

While Horizon 2020 had one focus area on ‘Climate action, environment, resource efficiency and raw materials’ under its ‘Societal Challenge’ pillar, the TI approach is more explicitly incorporated through the novel Mission approach of Horizon Europe for the 2021-2027 funding period. Under this programme, five Missions, aim at translating the TI concept into policy-making reality, with a strong focus on societal challenges and particularly high levels of ambition (Box 1). The Mission on CCA, introduced in Section 1, is of particular relevance for the discussion in this report and in Section 3 in particular.

Box 1. EU Missions – presentation headlines

The EU missions will:

- be bold, inspirational and widely relevant to society.
- be clearly framed: targeted, measurable and time-bound.
- establish impact-driven but realistic goals.
- mobilise resources on EU, national and local levels.
- link activities across different disciplines and different types of research and innovation.
- make it easier for citizens to understand the value of investments in research and innovation.

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

In its June 2022 Conclusions on the Missions, the Council of the EU underlines that they represent ‘*the development of a systemic and coordinated approach across the whole value chain at EU, national, regional and local level*’ and emphasises the importance to the Mission approach of ‘*the process of co-design, co-implementation and co-monitoring with public actors, the private sector and civil society at national, regional and local level*’ (CEU, 2022). The Horizon Missions give R&I policy a catalytic role, seeking synergies with much larger sums of EU funding available from Cohesion and other policies and resources needed from instruments such as InvestEU, Connecting Europe Facility (CEF), EIB, as well as from the private sector generally. This positive role was reiterated in the interim evaluation carried out in July 2023 (EC, 2023b): “Experience with two years of implementation of five EU Missions has confirmed that the mission-based approach as an instrument of Horizon Europe incentivises the engagement of broad and enthusiastic communities of stakeholders. Through its ability to promote experimentation, coordination and scaling of deployment, the EU Mission instrument can play a pivotal role in necessary societal transitions across multiple domains”.

3.3 Summary overview of key TI features

Bringing together the findings of this Section, from the different strands of literature reviewed, we propose a list of 7 key features of TI for the purposes of our later analysis in Section 3. The summary embraces the following aspects:

- Goals and scope definition – articulation of impacts: directionality.
- Policy portfolios: all-encompassing instrument portfolios.
- Cross domain synergies : whole-of-government approaches.
- Stakeholder involvement: increased breadth and depth.
- Multi-level governance: vertical synergies.
- Room for experimentation: space for creation and risk-tolerant environment.
- Policy intelligence, learning and strategic capacity: learning-oriented context.

A brief explanation is provided for each key TI feature listed, with selected key references from the literature (Table 4).

Table 4. Transformative Innovation: key features

| Key features of TI | Explanation |
|--|--|
| Goals and scope definition – articulation of impacts | <p>Directionality: objectives of TI are increasingly expressed in terms of societal challenges and/or based on ‘mission’-type approaches (Mazzucato, 2018; OECD, 2021a). This directionality will apply to multiple sectors and requires endorsement at the highest political level to secure engagement of all relevant authorities.</p> <p>‘System change’ is considered as the ultimate impact, covering economy and society, beyond traditional RDI or growth/jobs/competitiveness agendas - this will involve phasing out of the previous system(s), or elements thereof. Monitoring and evaluation will primarily look into the processes and pathways followed towards achieving system change (Haddad <i>et al.</i>, 2022).</p> |
| Policy portfolios | <p>All-encompassing instrument portfolios: to achieve its objectives, TI needs to deploy a broad range of instruments addressing the whole innovation cycle – also encompassing aspects beyond support for technological innovation, such as business model innovation and social innovation. There is a strong emphasis on ‘ecosystem’ instruments, such as clusters, (thematic) innovation platforms, collaborative flagship initiatives, living labs and scale-up of pilots.</p> <p>New market creation is a key priority through a mix of supply-push and demand-pull instruments, notably innovative public procurement. Cross-border initiatives and the international dimension generally are of particular importance (EEA, 2019).</p> |
| Cross domain synergies | <p>Whole-of-government approaches: these are required to ensure greater coherence between the various policies affecting economy, society and environment. Multi-domain synergies between thematic policy areas (R&I, agriculture, environment, mobility, health etc.) are actively sought, resulting in coordinated mixes of instruments of different types.</p> <p>Interdisciplinarity and ‘convergence’ research are cornerstone features of TI, inducing multi-technology, multi-actor and multi-sectoral initiatives with high transformative potential. The need to break down silos to achieve ‘system change’ provides the basis for new ways of working (OECD, 2021a).</p> |
| Stakeholder involvement | <p>Increased breadth and depth of stakeholder involvement: broad stakeholder involvement beyond traditional research and innovation actors is crucial for TI. The ‘quadruple helix’ - is a central feature for design and implementation of TI strategic approaches and individual interventions. Specifically, the involvement of citizens / end-users is vital to ensure validation of innovation outcomes and lead to systemic changes in both production and consumption spheres/models.</p> <p>Through significantly enhanced stakeholder involvement, TI aims to ensure social acceptance of new technological and shaping of innovative developments, as well as improving overall public trust in the innovation system and innovation policy. Emphasis is placed on selecting stakeholder reflecting a diversity of opinions and opening up public debates, negotiations and conflicts over alternative pathways (Schot and Steinmueller, 2018).</p> |
| Multi-level governance | <p>Vertical synergies: the systemic approach of TI goes hand-in-hand with the recognition of complementary roles for various levels of governance, in a place-based perspective - local, regional, national and EU. Global actor networks (inter-</p> |

| Key features of TI | Explanation |
|--|--|
| | <p>governmental organisations, transnational cooperation bodies) can also be of high value (Grillitsch <i>et al.</i>, 2019).</p> <p>Tight delineation of responsibilities in multi-level governance systems, without leaving room for exploring synergies, can be a barrier to TI. A meta-approach to governance is needed, which is more '<i>flexible, revisable, dynamic and open ... [and] include[s] experimentation, learning, reflexivity, and reversibility</i>' (Kuhlmann and Rip, 2018).</p> |
| Room for experimentation | <p>Space for creation and risk-tolerant environment: TI is disruptive, so room for experimentation is vital, as is permission to fail. Creating modular protected spaces, or niches, for experimentation can facilitate transition guided by broad societal needs (Fiche 32 in Pontikakis <i>et al.</i> (2022a)).</p> <p>Regulatory sandboxes are proving crucial to the take-up of TI approaches.</p> |
| Policy intelligence, learning and strategic capacity | <p>Learning-oriented context: timely monitoring and evaluation of progress towards TI objectives is crucial, since this is needed for learning and subsequent related adjustment, not only of instruments and their delivery, but also potentially of governance systems.</p> <p>A strong evidence-based policy learning capacity is a necessary companion to the TI experimental approach. However traditional evaluation methods are still embryonic; they are problematic due to the diversity of policy interventions involved, unexpected effects of experimentation and difficulties in capturing system change impacts (Haddad <i>et al.</i>, 2022).</p> |

Source: Authors

3.4 Challenges for implementing TI in reality

It is important to highlight that TI should be understood at present as an 'ideal' type of policy approach. It is not yet a reality. Various shortcomings are currently noted from the literature on TI (Haddad *et al.*, 2022), including:

- Lack of understanding of what developing dynamic capabilities in public sector actors and the related call for '*organizational flexibility and responsiveness to new information*' (Kattel and Maz-zucato, 2018) might actually entail and how they could be achieved.
- Insufficient analysis of the actual role and contribution of different stakeholders in relation to transformative challenges.
- No real enlightenment as yet on how policy experiments should be designed to be able to ensure both stability and flexibility.
- The problematic situation surrounding effective monitoring and evaluation of TI policy implementation and its impacts. There are very few evaluations of mission-oriented innovation policies to date and almost all of them still rely on traditional (non-systemic) evaluation tools and methods (OECD, 2021a).

As regards implementation of the EU Missions, this is also at an early stage. As their noble intentions confront reality, though, the Missions are faced with various existential challenges themselves, relating to:

- The modest size of the Missions' EU R&I Policy budgets and the scale of financial leverage they will need to bring about, not the least from the private sector.

- The multiplicity of platforms and fora for coordination and federation involved in and around each Mission – whether these are really adding value, or simply another layer of complexity.
- Possible dangers of ‘Mission dilution’ and ‘Mission-washing’, as raised with concern in the recent meeting of the TRAMI² cross-Mission Platform meeting (January 2023).
- Dilemmas in the creation of Mission Portfolios between adding new – more radical – instruments/initiatives, or simply re-orienting what is already there.

The Missions have generated strong interest from a wide cross-section of policy practitioners, researchers and citizens around the EU, but the challenges they already face provide an eloquent illustration of the difficult realities of delivering the TI approach.

² TRAnsnational cooperation on the MIssions approach www.trami5missions.eu/

4 Transformative Innovation approach and Climate Change Adaptation strategies: towards ‘Transformative CCA strategies’

This Section examines how far the key features of TI identified in Section 3 align with approaches currently followed under CCA strategies in EU Member States explored previously in Section 2. It discusses if and how a greater incorporation of TI attributes could ultimately improve the design and the implementation of CCA strategies and make them more effective.

4.1 Rationale for linking TI and CCA strategies

While CCA strategies have been adopted and are being deployed currently, fully-fledged TI strategies are still in their infancy. Our starting point is that the two policy areas, which so far have largely been designed and implemented separately, are becoming increasingly intertwined for several reasons:

1. **CCA is one goal for TI-inspired policies:** The TI concept – in contrast to the frame used for traditional innovation strategies – aims not only at increasing the rate and diffusion of innovation, but also at maximising its impact on societal challenges, one of which increasingly being CCA.
2. **R&I is one leverage/instrument for CCA strategies:** CCA strategies, which have their roots in environmental policies, increasingly recognise the value and necessity of R&I to develop solutions for CCA. The ambitions of the Mission CCA under Horizon Europe provide a good illustration of the increasing R&I content of CCA strategies.
3. **Both the TI concept and frontrunner CCA strategies seek a combination of economic, social and environmental impacts.** Impacts of innovation strategies have been traditionally viewed in terms of technology advances leading to economic benefits (competitiveness, jobs and growth), whilst those of environment policies have generally been considered in terms of environmental improvement. The new wave of TI and CCA strategies, on the other hand, articulate their goals in terms of economic, social and environmental impacts: notably the proposal for a Mission CCA at EU level includes three interrelated dimensions that guide and determine the success of the Mission: Resilience of environmental systems; Resilience of social and economic systems; Resilience of political systems (EC, 2020).
4. **The TI concept, as well as frontrunner CCA strategies, ultimately aim at system changes:** in both cases, there is a recognition that deep and wide socio-economic transformations of production and consumption systems are at stake and require changes in technologies, infrastructure, legislation, markets and behaviours. Environmental policy has evolved from a linear frame towards a ‘systemic’ understanding (Table 5).

Table 5. Changing understanding of environmental challenges, policies and assessment approaches and tools

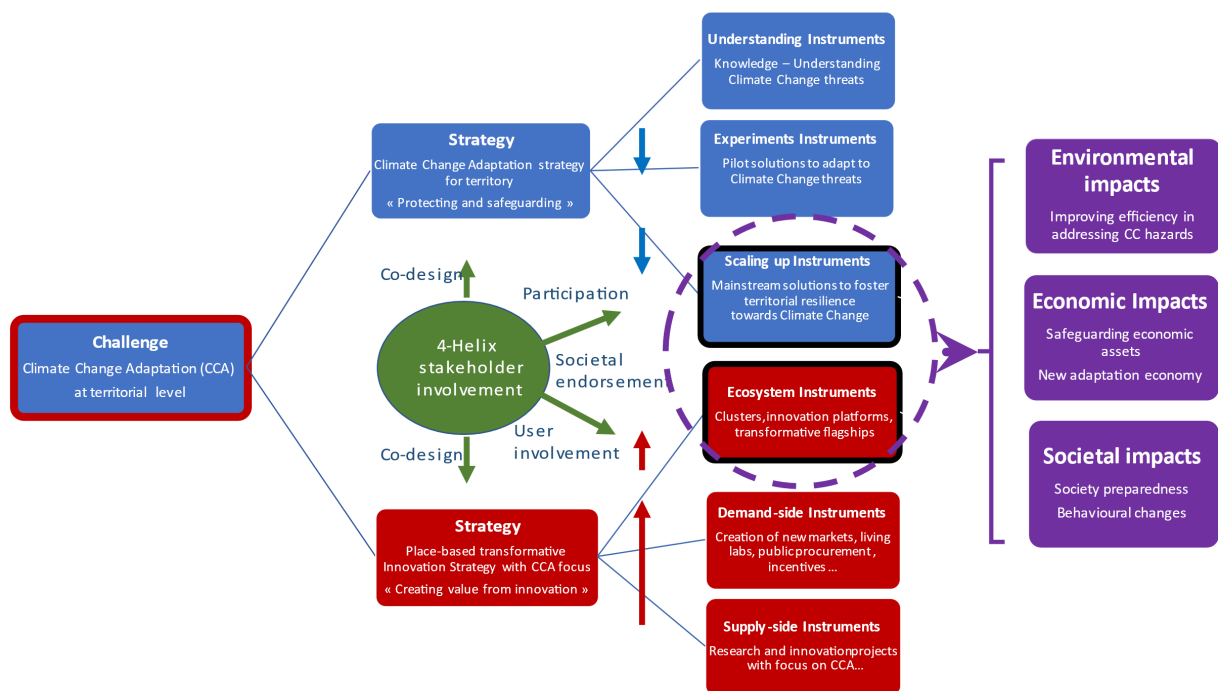
| Characterisation of key challenges | Key features | In policy since | Policy approaches (examples) | Assessment approaches and tools (examples) |
|------------------------------------|--|-----------------|--|--|
| Specific | Linear cause-effect, point source, local | 1970s | Targeted policies and single-use instruments | Data sets, indicators |
| Diffuse | Cumulative causes | 1990s | Policy integration, market-based instruments, raising public awareness | Data sets, indicators, environmental accounts, outlooks |
| Systemic | Systemic causes | 2010s | Policy coherence, systemic focus (e.g. mobility), multidimensional goals (e.g. SDGs) | Indicators, accounts, practice-based knowledge, systems assessment, stakeholder participation, foresight |

Source: (EEA, 2019)

On the innovation policy side, a case in point is the use of demand-side instruments: pricing mechanisms, regulations, standards, new public procurement rules etc. Such instruments are often underplayed compared to supply-side instruments, but they can provide strong incentives for expanding the emerging ‘adaptation economy’.

The proximity in both goals and conceptual frames underpinning CCA strategies and the TI concept, as well as the importance placed on stakeholder involvement thus provides the rationale for analysing areas of synergies between these two strands (Figure 4).

Figure 4 - Co-benefits from linking Climate Change Adaptation Strategies with place-based transformative Innovation Strategies



Source: Authors

4.2 Mapping of CCA strategy features against the TI approach

To form a picture of possible beneficial contributions TI might make to the design and implementation of CCA strategies, our basic method of exploration is to map TI features onto key CCA strategy approaches. The mapping is carried out in tabular form with respect to the seven key TI features identified in Section 2.3 (Table 4), each being subject of one sub-section below:

- Goals and scope definition – articulation of impacts.
- Policy portfolios.
- Cross-domain synergies.
- Stakeholders’ involvement.
- Multilevel governance.
- Room for experimentation.
- Policy intelligence, learning and strategic capacity.

The examination of each feature culminates in a box showing its specific conclusions, which are then carried forward into the overall conclusions of the report.

4.2.1 Goals and scope definition – articulation of impacts

Table 6. Mapping CCA strategies with TI approaches on Goals and scope definition – Articulation of impacts

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|--|---|
| <i>Goals and scope definition - Articulation of impacts</i> | |
| <ul style="list-style-type: none"> ▪ Directionality added to innovation strategies - increasingly expressed in terms of societal challenges and/or based on ‘mission’-type approaches. ▪ Requires high-level political endorsement. ▪ ‘System change’ as ultimate impact, covering economy and society, beyond traditional RDI or growth/jobs/competitiveness impacts. ▪ High attention to processes and pathways towards impacts. | <ul style="list-style-type: none"> ▪ Overriding challenge is the uncertain nature and size of CC risks and timing of their occurrence – if ever. Resistance due to the limits of adaptation strategies or perceived competition with mitigation strategies. ▪ General impact articulated as ‘territorial resilience’, or similar. Can be narrowed down to disaster resilience. ▪ Increased emphasis on social justice dimension in goal definition in response to uneven distribution of climate risks. ▪ Long-term perspective (horizon 2030, 2050). Can be narrowed down to a short-term ‘repair’ objective. ▪ Otherwise, scope and impacts expressed in relation to individual interventions. |

Source: Authors

The essential aim of CCA strategies is to build resilience, understood as the capacity of territories to prepare and react to such events and trends in the future. However, in contrast to Mitigation strategies, whose goals can be expressed in terms of net-zero targets, CCA strategies pursue goals that are not easily translated into clear and measurable targets: they rather tend to refer to *processes* for ensuring preparedness (developing knowledge bases and risk assessments analyses, visions and adaptation plans, etc.) rather than to measurable *outcomes*.

This difficulty of articulating CCA strategies' outcomes is compounded by that of articulating pathways towards such outcomes:

- As mentioned in Section 1, 'resilience' can be understood as a static concept rather than one of transforming systems for a different future: 'building back as it was before' rather than 'building forward to a new path'.
- Adaptation can be narrowed down to disaster risk management.
- Long-term perspectives are needed for CCA strategies that aim higher than merely short-term repair and restoring an existing situation.
- With uncertainty in climate change impacts, CCA outcomes are moving targets and so are the pathways towards them.
- Realising wider societal transformations not only requires building new solutions, but also phasing out past systems, practices, behaviours, etc. addressing lock-in in past trajectories.

Lock-in

Dynamic interactions between social-ecological drivers and tipping points that are likely to lead to traps, maladaptation or to hindering transformational change towards sustainability.

Source: (IPCC, 2022)

Low sense of urgency, lack of both political leadership and wider societal endorsement in the face of huge uncertainty concerning climate change-induced risks, complicate the goal definition process. There needs to be an acknowledgement that effective CCA requires deep transformations of the socio-economic system and the various sectors most affected by these impacts: food production, built habitat, health, etc. and that action is required now.

The TI concept helps raise awareness on the depth and breadth needed in CCA strategies; it points to the necessity to develop capacity to imagine entirely new pathways including the elimination of obsolete institutions or practices. Adopting the TI concept would imply a shift of goals for CCA strategies from 'climate resilience' to broader 'socio-economic systems adaptation'.

Table 7. Conclusion summary of mapping exercise for Goals and scope definition – Articulation of impacts

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| <i>Goals and scope definition - Articulation of impacts</i> |
| <ul style="list-style-type: none"> ▪ <i>Expressing CCA strategy impacts in terms of broader societal dimensions would help to embrace TI approaches and 'system change' more fully.</i> ▪ <i>TI is predicated on the recognition and avoidance of lock-ins and generation of new development paths leading to the desired transformation: effective CCA strategies need to phase out unsustainable models and replace them by more resilient ones.</i> ▪ <i>Embedding stronger emphasis on just transformation through TI would help secure high-level political endorsement.</i> ▪ <i>Could TI approaches help maintaining the sense of urgency for CCA despite the longer-term and uncertain perspective?</i> |

Source: Authors

4.2.2 Policy portfolios

Table 8. Mapping CCA strategies with TI approaches on Policy portfolios

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|--|--|
| Policy portfolios | |
| <ul style="list-style-type: none"> ▪ Support beyond technological innovation: incorporating business model innovation and social innovation. ▪ ‘Ecosystem’ instruments: clusters, (thematic) innovation platforms, collaborative flagship initiatives. ▪ Pilots, living labs, experiments. ▪ New market creation, notably through use of innovative public procurement. ▪ Cross-border initiatives. | <ul style="list-style-type: none"> ▪ Overall gap between design and implementation of CCA Strategies – no integrated policy portfolio. ▪ Many instruments are sector-specific planning and investments. ▪ Substantial efforts on building localised data and observatories, warning systems, tools to monitor and understand climate threats. ▪ Insufficient private sector presence in strategies that are perceived as essentially publicly led. |

Source: Authors

There is a general gap between design of strategies on paper and their effective implementation. As a result, CCA strategies do not yet translate into fully-fledged efficient policy portfolios: *‘Current measures mostly focus on awareness raising, institutional organisation or policy development, but actually rolling out physical solutions ... is lagging behind’* (EC, 2021a). CCA policy portfolios remain embryonic and fragmented today: instruments focus mostly on building adaptive capacity through the creation locally relevant databases and monitoring systems, awareness raising and capacity building actions, education and training (EEA, 2022). For example, the increasing attention to ‘just resilience’ at strategic level is not matched with corresponding actions in the field; *‘issues of equity and social justice are still rarely considered in local-level adaptation planning and actions’* (Breil et al., 2021); *‘many climate adaptation measures focus on technological interventions, without accounting for the social characteristics of cities, and thus fail to address the unequal burdens of climate impacts’* (EEA, 2020).

This situation stands in contrast with mounting evidence that synergetic portfolios of complementary actions are needed to adequately address the challenges posed by climate hazards in a forward-looking perspective. For example, in the health sector it is found that, *‘combining multiple types of adaptation options into a consistent policy portfolio may have an amplifying effect in reducing risks, particularly at higher global warming levels’* (IPCC, 2022). Synergetic portfolios maximise co-benefits and avoid negative effects leading to maladaptation (Box 2). CCA strategies embodying a ‘just resilience’ goal would need to check the effectiveness of the CCA policy portfolio against that goal: *‘The risk of gentrification that can follow from making a neighbourhood more attractive through nature-based solutions and hence more expensive can be mitigated by focusing adaptation measures inside public housing estates and intervening on the housing market’* (Breil et al., 2021).

The EU Mission on CCA incorporates, in its third and last step, the ambition to nurture policy portfolios through *‘larger scale deployment of tested solutions for climate resilience and the transformation of key community systems and enabling conditions’* (EC, 2021c). Moreover, the Council of the EU, in its 2022 Conclusions on the Missions, emphasised that the portfolio approach for Missions, should reflect entire value chains, including aspects related to Social Sciences and Humanities and include projects with high innovation potential (CEU, 2022). Hence the Mission CCA should provide opportunities to develop and test policy portfolios for transformative innovation in the field of CCA.

Box 2 - Positive and negative interactions in policy portfolios addressing health impacts of climate change

Positive interactions (synergies):

'Health adaptation actions have demonstrable synergies and trade-offs. For example, increasing green-blue spaces in Europe's densely populated areas can be effective in improving microclimates, reducing the impact of heatwaves, improving air quality and improving mental health by increasing access to fresh air and green (restorative) environments (Gascon et al., 2015; Kondo et al., 2018; Kumar et al., 2019).'

Negative interactions (adverse effects): 'Health adaptations can also have negative trade-offs, be inconsistent with mitigation ambitions and could lead to maladaptation. Green-blue spaces, for example, may create new nesting grounds for carriers of vector-borne diseases, increase pollen and allergies (Kabisch et al., 2016), enlarge freshwater use for irrigation (Reyes-Paecke et al., 2019) and could raise climate equity and justice issues such as green gentrification (Yazar et al., 2019). Similarly, air conditioning and cooling devices are considered highly effective but have low economic and social feasibility as well as negative trade-offs due to increasing energy consumption, raising energy costs which is particularly challenging for the poor (Section 13.8.1.1), enhancing the Urban Heat Island effect and increasing noise pollution (Fernandez Milan and Creutzig, 2015; Hunt et al., 2017; Macintyre et al., 2018).'

Source: (IPCC, 2022)

Transnational cooperation on CCA is already well underway due to the transboundary character of many Climate Change issues (EEA, 2022). This calls for policy portfolios that incorporate a transnational dimension and for a reinforcement of alignment and joint initiatives crossing administrative borders.

Introducing a TI approach at the implementation stage of CCA strategies would facilitate a move towards broader policy portfolios conducive to the types of wider impacts expected under systemic transformation frames. Such portfolios could support a move from small, localised pilot experiments with CCA solutions in specific sectors towards large scale deployment of systemic solutions involving deeper changes in production and consumption systems, including not only new technology development but also behavioural changes, new business models, adapted regulations, etc. An important component of CCA portfolios would consist of incentives and instruments to promote business participation in the 'climate adaptation economy', which is yet underdeveloped today, as mentioned in Section 2. Business-oriented innovation instruments should be part of the portfolio to ensure that wider transformation can take place.

Table 9. Conclusion summary of mapping exercise for Policy portfolios

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| Policy portfolios |
| <ul style="list-style-type: none"> ▪ <i>Introducing a TI approach in CCA strategies would support a move from small, localised pilot experiments in CCA solutions towards mainstream and large-scale deployment of systemic solutions.</i> ▪ <i>Systemic portfolios incorporate instruments of different nature acting in synergy, maximising co-benefits and avoiding perverse effects.</i> ▪ <i>The EU CCA Mission's portfolio in the making is an attempt to introduce TI features in CCA strategies and develop blueprints of policy portfolios for transformative innovation.</i> |

Source: Authors

4.2.3 Cross-domain synergies

Table 10. Mapping CCA strategies with TI approaches on Cross domain synergies

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|---|--|
| <i>Cross-domain synergies</i> | |
| <ul style="list-style-type: none"> ▪ Whole-of-government approaches required to ensure greater coherence between various policies affecting economy, society and environment. ▪ Interdisciplinarity or even ‘convergence’ research as a key cornerstone feature. ▪ Breaking down of silos leading to ‘system change’ provides basis for new ways of working. | <ul style="list-style-type: none"> ▪ CCA increasingly incorporated in various sectors most directly affected by CC, but these remain separate intervention areas. ▪ True cross-domain synergies with other policy fields frequently under-exploited. ▪ Joint budgets across policy areas an exception. ▪ Effective cross-ministerial and cross-department structures difficult to put in place and maintain. |

Source: Authors

Within CCA strategies, true cross-domain synergies are often under-exploited. Policy instruments for sectoral integration of adaptation mostly exist in sectoral policy fields with EU mainstreaming requirements (e.g. EU Directives transposed into Member State legislation), especially the water sector (EEA, 2022). While the need for CCA is increasingly taken into account in sectoral policies, programmes and regulatory frameworks in water management, disaster risk management, forestry, agriculture, biodiversity, this is less frequently the case in other domains such as transport, construction, education and skills, R&I, general economic policy and sectoral policies like tourism (Box 3), as well as social policies e.g. housing (EEA, 2022). This lack of cross-domain synergies is visible in the state-of-play with Climate Risk Assessments (CRAs): ‘*new multi-sectoral assessments were conducted less frequently than sector-based or thematically focused assessments*’ (...) ‘*Integrated assessments were reported occasionally*’ (EEA, 2022).

Box 2. Shortcomings in incorporating Climate Change Adaptation in the tourism sector

| |
|---|
| <p>CCA is not yet mainstreamed in policies for the tourism sector, or shows maladaptation:</p> <ul style="list-style-type: none"> • Lack of cross-domain synergies: ‘<i>Consideration of tourism in national adaptation strategies is limited, and national tourism strategies rarely mention adaptation</i>’ with a few exceptions ‘<i>in some countries there is legally binding consideration of climate change when constructing new tourism units (e.g., the 2016 French Mountain Act)</i>’. • Incremental and reactive adaptation at best: ‘<i>Many tourism operators focus on near-term coping strategies and do not consider longer term adaptation.</i>’ ‘<i>Water saving measures, primarily for cost reduction, have been implemented, e.g. in hotels</i>’. • Maladaptation: ‘<i>snow making is widely applied in the Alps and Pyrenees ski resorts; e.g. from 18% of ski slopes in Germany to 67% in Austria.</i>’ |
|---|

Source: (IPCC, 2022)

This field reality stands in contrast with the EU Climate Law, which foresees cross-domain synergies through integration of CCA into all policies: ‘*Member States shall also ensure that policies on adaptation in the Union and in Member States are coherent, mutually supportive, provide co-benefits*

for sectoral policies, and work towards better integration of adaptation to climate change in a consistent manner in all policy areas, including relevant socioeconomic and environmental policies and actions, where appropriate, as well as in the Union's external action' (Art 5(2) of EU Climate Law).

Here again, the new CCA Mission is trying to address this issue of lack of cross-domain synergies, as it is set to 'employ an integrated and systemic approach to risk management and resilience building, moving away from piecemeal sectorial and linear cause-effect-solution focus.' (EC, 2020). In reinforcing cross-domain synergies for CCA, two possible pathways, among others, could be:

- The establishment of joint funding schemes or budgets, where different sectoral ministries contribute to implementing actions of relevance for their respective domain. This is not yet the case in current CCA strategies (EEA, 2022).
- The establishment of cross-governmental or cross-department structures to facilitate joint planning and joint implementation. Apart from a few frontrunners, most cities experience difficulties in departmental coordination for climate change adaptation (IPCC, 2022). 'Despite the cross-cutting nature of climate impacts, responsibility for adaptation tends to be concentrated in a single department, typically concerned with planning or the environment. Therefore, collaboration with other departments or stakeholders is necessary to secure adequate coverage of health and social issues in adaptation' (EEA, 2020).

Although successful practical experience of implementing either is scarce in the EU at present. Bringing private actors into the new business opportunities offered by the 'adaptation economy' would require synergies with the economic, industrial and innovation policy fields (see section 3.2.4).

Cross-domain synergies in governance should be matched with cross-disciplinary work in the R&I domain. In an analysis of the future of innovation studies and climate change, (Matos *et al.*, 2022) see 'the nexus of climate change and innovation as interdisciplinary and coevolutionary, as opposed to a traditional disciplinary focused approach'. Cross-fertilisation between scientific disciplines relevant to address the Climate Adaptation challenges is however difficult to achieve in reality, due to a tradition of disciplinary organisation in public research organisations and universities.

Multi-disciplinarity is increasingly sought through the establishment of research groups gathering scientists from different fields united under a common umbrella, e.g. climate change research: however it is often the case that several research strands still evolve in parallel in such settings. The next step is that of transdisciplinary research – sometimes referred to as 'convergence research' as mentioned in Section 2 – where new knowledge is created through deep integration of research approaches, methods and paradigms from different disciplines.

Framing CCA strategies in a TI approach would make the case for cross-domain synergies, governance and funding, as well as highlight the benefits of transdisciplinary research for understanding and developing solutions for complex climate change issues.

Table 11. Conclusion summary of mapping exercise for Cross-domain synergies

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| <i>Cross-domain synergies</i> |
| <ul style="list-style-type: none"> ▪ <i>TI frame makes the case for cross-domain synergies from the outset, with focus on breaking silos at strategic level.</i> ▪ <i>Harnessing the power of interdisciplinary research and innovation would contribute to cross-domain synergies.</i> |

▪ Potential of 'climate adaptation economy' to be further exploited to bring in business-oriented innovation instruments in the portfolio.

Source: Authors

3.2.4. Stakeholder involvement

Table 12. Mapping CCA strategies with TI approaches on Stakeholder involvement

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|---|---|
| Stakeholder involvement | |
| <ul style="list-style-type: none"> ▪ Broad stakeholder involvement beyond traditional research and innovation actors – the ‘quadruple helix’ – is a central feature for design and implementation of strategies and individual interventions. ▪ Specifically – involvement of citizens / end-users is crucial to ensure validation of innovation outcomes and lead to systemic changes in both production and consumption spheres/models. ▪ Co-creation becomes the norm, with innovative methods for stakeholders involvement (challenge labs, etc.). ▪ Motivations include: ensuring social acceptance (and shaping) of new technological/innovative developments and mixing a diversity of types of knowledge. | <ul style="list-style-type: none"> ▪ Stakeholder involvement – including citizens / local residents – at planning stage is common, particularly for physical interventions affecting the layout of public spaces. Outcomes are not always positive, if proposed interventions lead to unwillingness to give up on current modes of living and NIMBY syndromes. ▪ Motivations include: mobilising local environmental knowledge, understanding and managing subjective informal and perceptions as well as socio-cultural and affective-emotive factors. ▪ Citizen involvement at overall strategic level is less common, with the exception of frontrunners. ▪ Stakeholder involvement is rarely in place for monitoring and evaluation. ▪ Business involvement is limited due to lack of awareness and incentives, especially for SMEs, and weak understanding of the ‘adaptation economy’. |

Source: Authors

CCA action has its roots in public works and land planning fields, as well as environmental policy. This has two consequences for CCA strategies:

1. In line with land planning regulations, which generally impose citizens’ consultations procedures, CCA often incorporates a dimension of citizen participation at the level of deployment of specific actions. However, except for frontrunners, wider citizen involvement in co-creation of CCA strategies is less common. This engagement is needed not only for legitimation and endorsement purposes but also to incorporate a variety of types of knowledge in the build-up of the strategies: *‘local environmental knowledge, lay perceptions and socio-cultural and affective-emotive factors can add fundamental information to the design of adaptation policies and public engagement strategies.’* (Matos *et al.*, 2022). However, current processes of engaging citizens are generally one-way rather than co-creational: *‘The participatory involvement and engagement of stakeholders is an implicit part of developing national adaptation policy; however, vulnerable populations are not yet regularly included in or addressed by the process’* (EEA, 2022).
2. There is little role for private funding nor for business innovation in those domains, which are heavily public-sector driven – with the exception of cases where there is private ownership of land and real estate.

Adopting a TI approach requires wider and deeper societal engagement processes to ensure that the various aspects of systemic transformation are well understood and the views of a wide variety of stakeholders are taken fully into account. Also, the uneven impacts of climate change call for a good representation of all types of actors, in particular those that are more vulnerable to those impacts and tend to be under-represented in consultation processes. The expectation is that TI-inspired CCA strategies would be in a better position to tap into the potential from a wider range of actors in society, beyond usual actors, also in the R&I field and to unleash ‘out-of-the box’ visions and solutions. TI opens up scope for co-creation with society by favouring free thinking towards bold solutions, using tools from TI communities such as challenge-labs. The starting point for engaging society in building and endorsing CCA strategies is the availability of convincing evidence that CCA impacts are a reality, need urgent action and that the costs of non-action or patchy action are too high. The social justice dimension that is increasingly incorporated in CCA strategies’ goals needs to be fully reflected in participatory processes.

Truly transformative CCA strategies would require strong involvement of businesses of all sizes to ensure endorsement and funding of measures to be implemented. However, large national and multinational companies, and companies regulated by mitigation policy are usually the first movers in corporate adaptation, while small and medium-sized enterprises often lack the knowledge and resources to address risks and adaptation options (IPCC, 2022).

As mentioned in Section 1, under Mitigation strategies, funding schemes have been made available by governments for the development of clean technologies and green energy, phasing-out fossil fuel activities, progressively changing the relative prices between ‘grey’ and ‘green’ products and opening new profitable markets. Regulations and taxes stimulate efforts towards energy-efficient processes and technologies in industry and the adoption of ‘green’ business models in the private sector. Consumer preferences are also evolving towards increased demand for decarbonised products and services, which provides incentives for green innovation in many sectors such as mobility, food, tourism, etc. There is nothing at play in the field of CCA comparable to these business incentives to engage in and devote private funds to Mitigation strategies.

Promoting innovation in CCA solutions, as is done – on a limited scale – with Horizon Europe funding for the Mission CCA, provides a message that this is a (new) relevant domain in which to invest R&I efforts. The influence of the EU Mission’s objectives on Member States R&I policies should help to provide a stronger message supporting involvement of companies.

Table 13. Conclusion summary of mapping exercise for Stakeholder involvement

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| <i>Stakeholder involvement</i> |
| <ul style="list-style-type: none"> ▪ <i>The tradition of stakeholder involvement in CCA interventions – although not necessarily system wide - supports increased emphasis on TI.</i> ▪ <i>New and better data/evidence to provide stronger justifications should help overcome resistance towards bolder CCA interventions.</i> ▪ <i>There is scope for co-creation with society by favouring free thinking towards bold solutions, using tools from TI community.</i> ▪ <i>Transformative adaptation will require larger funding sources including private funding; strong business involvement is needed. Potential for larger involvement of companies adopting Corporate Social Responsibility practices.</i> ▪ <i>TI seeks wider and inclusive societal transformation. ‘Socially just’ CCA require stronger involvement of vulnerable groups.</i> |

4.2.4 Multi-level governance

Table 14. Mapping CCA strategies with TI approaches on Multi-level governance

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|---|--|
| Multi-level governance | |
| <ul style="list-style-type: none"> ▪ The systemic approach to TI goes hand in hand with the recognition of roles for various levels of governance, in a place-based perspective. ▪ Tight delineation of responsibilities in multi-level governance systems, without leaving room for exploring synergies – or change/adjustment of systems - can nevertheless be a barrier to TI. | <ul style="list-style-type: none"> ▪ The local level is often the main focus of interventions, but this must be clearly situated within national/regional strategic and legal frameworks. ▪ Limited range of responsibilities and corresponding powers of local authorities is often a barrier for ambitious place-based CCA strategies. ▪ Balance of power and policy coverage between national/regional and local levels varies from Member State to Member State. ▪ The EU level is of crucial importance for strategic input (as well as legal framework through transposition of Directives) and aspects such as CC reporting requirements and Enabling Conditions for use of EU Funds. |

Source: Authors

The implementation of CCA solutions rests for a large part on the shoulders of local authorities (EEA, 2020). Land planning is under the remit of these authorities and their proximity to population and territories confronted with climate hazards puts them at the forefront of concrete CCA actions. They are well-placed to understand the characteristics of the population, of built and natural habitats and local manifestations of climate change and will often engage citizens and local actors through formal or informal mechanisms. The large number of local networks around CCA involving local authorities reflects this prominent role.

However, the ‘local authorities’ grouping hides strong variations in capacity and means for action between individual authorities: *‘there are pronounced differences between smaller and larger local authorities in terms of their remit, budget available for adaptation (smaller local authorities have less funding) and level of stakeholder engagement. This indicates the challenges faced by small local authorities’* (EEA, 2020). Indeed, while some large metropolitan areas might be considered as frontrunners in CCA strategies, small rural municipalities are often still far behind in undertaking the first steps towards such strategies or actions.

When it comes to CCA strategy formulation, a higher level of authorities also comes into play for the development of more ambitious responses to Climate Change risks. Depending on the institutional situation in a specific Member State, regions and/or the national level have the remit and budgetary means in domains that are relevant for effective policy portfolios for CCA, such as education, R&I, economic policy etc. They are also responsible for the relevant legal frameworks.

The EU level plays an important role in pushing new narratives on the importance of CCA – with the Green Deal, the EU Adaptation Strategy (EC, 2021a) and other related strategies. The EU sets rules

in Regulations and Directives, as well as funding and incentives under R&I, Cohesion, Agriculture, Fisheries and Environment Policies in particular.

The bottom-up and open process followed by the EU Mission on CCA requires signatories of the Mission Charter to be a legal entity that has responsibility for adaptation measures in a defined administrative area. As a result, the Charter signatories include a broad range of administrative structures, from individual municipalities and town councils to inter-municipality and geographical groupings at sub-regional and regional levels, spread between entities with less than 50.000 inhabitants to those with more than 1 million inhabitants. Some signatories are authorities in the same territories at different level (e.g. a small municipality part of a larger urban conurbation, the urban metropolitan area, and the region to which these entities belong). This emphasises the need for good articulation between authorities acting in the same territory, with different remits and means for action.

Effective and ambitious CCA strategies need good articulation between regulations, strategies and actions taken at local, regional, national and EU levels: *‘political commitment, persistence and consistent action across scales of government is critical to move beyond planning for adaptation and to ensure adequacy of implementation’* (IPCC, 2022). Cross-domain synergies also rely on effective vertical synergies, in cases of policy domains under responsibility of authorities at different institutional levels. Difficulties can arise when binding vertical governance frameworks for engaging regional and local authorities in adaptation planning are missing, as is often the case except where development of urban adaptation plans is mandatory, as in the UK, France and Denmark (EEA, 2022).

The need for effective multi-level governance for successful CCA interventions is strongly in line with the premises at the heart of TI. Yet arguably outside of Cohesion Policy, there is a persistent shortage of examples of successful multi-level governance in the EU. Wider systemic transformation will require better communication between the various levels of authorities, synergies between their action and a sound combination of initiatives and instruments from these various levels. However, there can be trade-offs between the strength of multi-level governance systems and their eventual flexibility/adaptability in the context of ‘system change’ implicit in TI approaches.

Table 15. Conclusion summary of mapping exercise for Multi-level governance

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| <i>Multi-level governance</i> |
| <ul style="list-style-type: none"> ▪ <i>The need for effective multi-level governance structures for successful CCA interventions appears as a key positive for take-up of TI in CCA strategies.</i> ▪ <i>However, there are trade-offs between the institutionalisation of multi-level governance systems and their eventual flexibility/adaptability in the context of ‘system change’ implicit in TI approaches.</i> ▪ <i>Exemplary communications are essential to ensure smooth transitions – even to the extent of enabling co-creation of changes based on input from the different levels.</i> |

Source: Authors

4.2.5 Room for experimentation

Table 16. Mapping CCA strategies with TI approaches on Room for experimentation

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|--|--|
| <i>Room for experimentation</i> | |
| <ul style="list-style-type: none"> ▪ TI is disruptive, so room for experimentation – together with the ability to apply related learning – is existential to the approach. ▪ Tolerance for failure is an integral part of TI. ▪ Regulatory sandboxes are proving crucial to the take-up of TI approaches. | <ul style="list-style-type: none"> ▪ CCA strategies are not only concerned with fixing problems in the short term, but about planning future-proof solutions embodying a degree of risk and uncertainty. ▪ Whilst there is some room for experimentation within individual shorter-term incremental CCA interventions, longer-term radical CCA strategies overall do not lend themselves to experimentation. The price of eventual failure is generally considered too high. |

Source: Authors

Transformative Innovation requires ‘unlearning from the past’ and imagining radically new pathways in a changed environment: this emphasizes the need for experimentation and protected temporary niches. Experimentation also means that exploratory projects based on a challenge, rather than on a pre-determined solution, should be allowed to flourish to offer a variety of possible solutions. But this can be a costly process if CCA is seen in a narrow perspective of responding to a short-term risk, rather than as an investment for the future. The level of genuine experimentation in CCA strategies as currently deployed is insufficient to enable full exploration of more radical, rather than merely incremental, solutions.

Beyond experimentation, upscaling is challenging. The Mission CCA’s third and last step is about upscaling solutions that will have been piloted in the previous step (EC, 2021c). It aims at large-scale applications and deployment of innovative solutions with wider transformative impact. At this step too, beyond small-scale experimentation, risk is present because of the uncertainty linked to climate change and the novelty and radicality of envisaged systemic changes. Thus, at both stages, the lack of risk-tolerant funding acts as an important barrier.

The goal of aligning finance flows with climate Mitigation and CCA, as foreseen in Article 2.1c of the Paris Agreement (UNFCCC, 2015), is yet to be operationalised. *‘Alignment looks at whether finance flows are materially supporting the policy goal of helping societies to adapt to the impacts of climate change. It takes a longer-term, social perspective while risk management tends to focus on the organisational, shorter-term perspective. Indeed, financial risk management without adaptation alignment could draw capital away from the most at risk communities and lead to maladaptation.’* (OECD, 2018). Adaptation-aligned finance would need to be risk-tolerant to a relatively high degree if it is to support the experimentation needed for ambitious CCA strategies seeking to develop new socio-economic systems resilient to climate change.

Table 17. Conclusion summary of mapping exercise for Room for experimentation

| |
|--|
| <p>Potential contribution of TI approaches to shape Transformative CCA strategies</p> <p><i>Room for experimentation</i></p> |
|--|

- *The limited scope for experimentation in CCA strategies appears as a factor restricting expansion of TI approaches. Transformative CCA strategies would need to find ways of incorporating possibilities of taking risk/failure and new types of risk-tolerant funding would be needed.*

Source: Authors

4.2.6 Policy intelligence, learning and strategic capacity

Table 18. Mapping CCA strategies with TI approaches on Policy intelligence, learning and strategic capacity

| Transformative Innovation approach | Climate Change Adaptation Strategies |
|---|--|
| Policy intelligence, learning and strategic capacity | |
| <ul style="list-style-type: none"> ▪ A strong evidence-based policy learning capacity is a vital component of the TI approach. ▪ Evaluating TI-inspired policies requires strong and diverse capacities spanning a wide policy spectrum and system change effects, as well as in-built uncertainties linked to experimentation. ▪ Systemic evaluation in a TI context is novel – still embryonic and not yet entirely successful. Operational type monitoring approaches, giving relatively quick feedback to enable timely adjustment, are currently preferred. | <ul style="list-style-type: none"> ▪ Increased emphasis on initiatives aimed at filling adaptation knowledge gap: translating global data on climate hazards and impacts into locally-relevant knowledge in support to policies. ▪ Fragmentation between intervention areas and policy levels acts as a barrier for policy intelligence and policy learning at the level of strategies. In particular, there is a lack of knowledge on social factors affecting vulnerability. ▪ Monitoring and evaluating <i>effectiveness</i> of climate adaptation actions are not yet widespread. ▪ Smaller local authorities generally lack capacity to plan and implement ambitious strategies and actions. ▪ Capacities for long-term planning under uncertainty is a key enabler, often underdeveloped. |

Source: Authors

Despite the efforts currently deployed across Europe to improve the generation of data on possible climate change and related impact indicators, a key barrier to design effective territorial CCA strategies remains the lack of appropriate evidence on the nature, extent and likelihood of climate hazards and their likely impacts for specific geographical areas. *‘Most urban adaptation plans include ecosystem-based measures, but often with limited baseline information and convincing implementation actions. Adaptation to risks from climate extremes (mostly flooding) is often addressed through municipal emergency plans’* (IPCC, 2022).

A further difficulty is that of understanding the link between climate change-induced effects and the state of different sectors of the society, disentangling these from the other factors at play - e.g. for understanding the impact of heatwaves on physical and mental health: *‘while there is advanced research on climate hazards and how they affect people and assets, there is less detailed evidence and knowledge about the social factors (e.g., network, age, and resources) that drive individual or communities’ vulnerability to climate change’* (Breil *et al.*, 2021).

The presence of indirect impacts, cross-sectoral and cross-border interactions and cascading risks complicate the creation of policy-friendly intelligence bases to inform strategic planning. Increasing the diversity of knowledge sources beyond data produced by researchers is another challenge: *‘improving access to knowledge can be achieved through collaborating with researchers and making greater use of existing data and information sources, including citizen science, insurance claims data, and sharing knowledge with other cities’* (EEA, 2020).

Other types of barriers for the development of evidence based CCA strategies and actions concern monitoring and evaluation systems. While reviews report a steady recent increase and understanding of the use of monitoring and evaluation systems, *'monitoring and evaluation of the adaptation actions implemented requires substantial improvement, as very few local authorities systematically assess their adaptation efforts' ... 'Using monitoring, reporting and evaluation (MRE) to measure how impacts, vulnerabilities and risks are reduced seems to be emphasised less than the other uses: only five Member States appear to use MRE in this particular fashion'* (EEA, 2022).

Monitoring and evaluation systems need to be fine-grained if they are to capture the different goals pursued by CCA strategies, e.g. *'despite the increasing interest in social justice in adaptation, information on how vulnerable stakeholder groups are involved in or addressed by adaptation policy at national and sub-national levels in Europe is still limited'* (EEA, 2022). They also have to feed back in policy but there is no evidence yet that this is the case (EEA, 2022). Finally, stakeholder involvement in MRE appears as a new topic of interest, but is still underdeveloped (EEA, 2022). Bringing a TI perspective, embodying an experimental approach, in CCA strategies would help to stress the need for robust evidence to understand the baseline situation, the various options for future pathways, with the help of 'hard' as well as 'behavioural' sciences to capture the complexity of systemic transformations based on climate change and human actions and perceptions.

Incorporating TI features into CCA strategies could raise the bar further in terms of capacities required from authorities and stakeholders in charge of planning and deploying CCA strategies. Not only would they have to deploy absorptive capacities to make use of information and implementation practices under current systems. They would also have to develop adaptive capacities to adjust to new data or insights generated from new ways of addressing goals and/or from changes in systems.

Going further would call for 'transformative capacities' to be developed, requiring complex skills and anticipatory capacity to enable long-term planning under uncertainty. 'Transformative capacity' of this kind is needed when 'disturbances are not manageable anymore, when the system needs to engineer bigger changes, which in extreme cases will lead to a transformation – i.e. *'bounce forward instead of bouncing back'* (Manca *et al.*, 2017).

Table 19. Conclusion summary of mapping exercise for Policy intelligence, learning and strategic capacity

| Potential contribution of TI approaches to shape Transformative CCA strategies |
|---|
| <i>Policy intelligence, learning and strategic capacity</i> |
| <ul style="list-style-type: none"> ▪ <i>A TI perspective for CCA would stress the need for robust evidence to understand the baseline situation, and for anticipatory and orchestration capacities to co-create future pathways.</i> ▪ <i>Social and behavioural sciences would need to complement knowledge produced by climate scientists.</i> ▪ <i>A TI perspective would also require the development of novel monitoring and evaluation frameworks incorporating a systemic dimension beyond sectoral approaches.</i> ▪ <i>'Transformative' learning capacities will need to be developed beyond absorptive and adaptive capacities.</i> |

Source: Authors

4.2.7 Mapping overview

Table 20. Overall mapping of Transformative Innovation (TI) approach against key features of Climate Change Adaptation (CCA) Strategies

| Transformative Innovation approach | Climate Change Adaptation Strategies | <i>Potential contribution of TI approaches to shape Transformative CCA strategies</i> |
|--|---|---|
| Goals and scope definition - Articulation of impacts | | |
| <ul style="list-style-type: none"> ▪ Directionality added to innovation strategies - increasingly expressed in terms of societal challenges and/or based on 'mission'-type approaches. ▪ Requires high-level political endorsement. ▪ 'System change' as ultimate impact, covering economy and society, beyond traditional RDI or growth/jobs/competitiveness impacts. ▪ High attention to processes and pathways towards impacts. | <ul style="list-style-type: none"> ▪ Overriding challenge is the uncertain nature and size of CC risks and timing of their occurrence – if ever. Resistance due to the limits of adaptation strategies or perceived competition with mitigation strategies. ▪ General impact articulated as 'territorial resilience', or similar. Can be narrowed down to disaster resilience. ▪ Increased emphasis on social justice dimension in goal definition in response to uneven distribution of climate risks. ▪ Long-term perspective (horizon 2030, 2050). Can be narrowed down to a short-term 'repair' objective. ▪ Otherwise, scope and impacts expressed in relation to individual interventions. | <ul style="list-style-type: none"> ▪ <i>Expressing CCA strategy impacts in terms of broader societal dimensions would help to embrace TI approaches and 'system change' more fully.</i> ▪ <i>TI is predicated on the recognition and avoidance of lock-ins and generation of new development paths leading to the desired transformation: effective CCA strategies need to phase out unsustainable models and replace them by more resilient ones.</i> ▪ <i>Embedding stronger emphasis on just transformation through TI would help secure high-level political endorsement.</i> ▪ <i>Could TI approaches help maintaining the sense of urgency for CCA despite the longer-term and uncertain perspective?</i> |
| Policy portfolios | | |
| <ul style="list-style-type: none"> ▪ Support beyond technological innovation: incorporating business model innovation and social innovation. ▪ 'Ecosystem' instruments: clusters, (thematic) innovation platforms, collaborative flagship initiatives. ▪ Pilots, living labs, experiments. ▪ New market creation, notably through use of innovative public procurement. | <ul style="list-style-type: none"> ▪ Overall gap between design and implementation of CCA Strategies – no integrated policy portfolio. ▪ Many instruments are sector-specific planning and investments. ▪ Substantial efforts on building localised data and observatories, warning systems, tools to monitor and understand climate threats. | <ul style="list-style-type: none"> ▪ <i>Introducing a TI approach in CCA strategies would support a move from small, localised pilot experiments in CCA solutions towards mainstream and large-scale deployment of systemic solutions.</i> ▪ <i>Systemic portfolios incorporate instruments of different nature acting in synergy, maximising co-benefits and avoiding perverse effects.</i> |

| Transformative Innovation approach | Climate Change Adaptation Strategies | <i>Potential contribution of TI approaches to shape Transformative CCA strategies</i> |
|---|---|---|
| <ul style="list-style-type: none"> ▪ Cross-border initiatives. | <ul style="list-style-type: none"> ▪ Insufficient private sector presence in strategies that are perceived as essentially publicly-led. | <ul style="list-style-type: none"> ▪ <i>The EU CCA Mission's portfolio in the making is an attempt to introduce TI features in CCA strategies and develop blueprints of policy portfolios for transformative innovation.</i> |
| Cross-domain synergies | | |
| <ul style="list-style-type: none"> ▪ Whole-of-government approaches required to ensure greater coherence between various policies affecting economy, society and environment. ▪ Interdisciplinarity or even 'convergence' research is a key cornerstone feature. ▪ Breaking down of silos leading to 'system change', provides basis for new ways of working. | <ul style="list-style-type: none"> ▪ CCA is increasingly incorporated in various sectors most directly affected by CC, but these remain separate intervention areas. ▪ True cross-domain synergies with other policy fields are frequently under-exploited. ▪ Joint budgets across policy areas are an exception. ▪ Effective cross-ministerial and cross-department structures difficult to put in place and maintain. | <ul style="list-style-type: none"> ▪ <i>A TI frame makes the case for cross-domain synergies from the outset, with the focus on breaking silos at strategic level.</i> ▪ <i>Harnessing the power of interdisciplinary research and innovation would contribute to cross-domain synergies.</i> ▪ <i>Potential of 'climate adaptation economy' to be further exploited to bring in business-oriented innovation instruments in the portfolio.</i> |
| Stakeholders' involvement | | |
| <ul style="list-style-type: none"> ▪ Broad stakeholder involvement beyond traditional research and innovation actors – the 'quadruple helix' – is a central feature for design and implementation of strategies and individual interventions. ▪ Specifically – involvement of citizens / end-users is crucial to ensure validation of innovation outcomes and lead to systemic changes in both production and consumption spheres/models. ▪ Co-creation becomes the norm, with innovative methods for stakeholders involvement (challenge labs, etc.). ▪ Motivations include: ensuring social acceptance (and shaping) of new technological/innovative developments and mixing a diversity of types of knowledge. | <ul style="list-style-type: none"> ▪ Stakeholder involvement – including citizens / local residents – at planning stage is common, particularly for physical interventions affecting the layout of public spaces. Outcomes are not always positive, if proposed interventions lead to unwillingness to give up on current modes of living and NIMBY syndromes. ▪ Motivations include: mobilising local environmental knowledge, understanding and managing subjective informal and perceptions as well as socio-cultural and affective-emotive factors. ▪ Citizen involvement at overall strategic level is less common, with the exception of frontrunners. | <ul style="list-style-type: none"> ▪ <i>The tradition of stakeholder involvement in CCA interventions – although not necessarily system wide - supports increased emphasis on TI.</i> ▪ <i>New and better data/evidence to provide stronger justifications should help overcome resistance towards bolder CCA interventions.</i> ▪ <i>There is scope for co-creation with society by favouring free thinking towards bold solutions, using tools from TI community.</i> ▪ <i>Transformative adaptation will require larger funding sources including private funding: strong business involvement is needed. Potential for larger involvement</i> |

| Transformative Innovation approach | Climate Change Adaptation Strategies | <i>Potential contribution of TI approaches to shape Transformative CCA strategies</i> |
|---|--|---|
| | <ul style="list-style-type: none"> ▪ Stakeholder involvement is rarely in place for monitoring and evaluation. ▪ Business involvement is limited due to lack of awareness and incentives, especially for SMEs, and weak understanding of the 'adaptation economy'. | <p><i>of companies adopting Corporate Social Responsibility practices.</i></p> <ul style="list-style-type: none"> ▪ <i>TI seeks wider and inclusive societal transformation. 'Socially just' CCA require stronger involvement of vulnerable groups.</i> |
| Multi-level governance | | |
| <ul style="list-style-type: none"> ▪ The systemic approach to TI goes hand in hand with the recognition of roles for various levels of governance, in a place-based perspective. ▪ Tight delineation of responsibilities in multi-level governance systems, without leaving room for exploring synergies – or change/adjustment of systems - can nevertheless be a barrier to TI. | <ul style="list-style-type: none"> ▪ The local level is often the main focus of interventions, but this must be clearly situated within national/regional strategic and legal frameworks. ▪ Limited range of responsibilities and corresponding powers of local authorities is often a barrier for ambitious place-based CCA strategies. ▪ Balance of power and policy coverage between national/regional and local levels varies from Member State to Member State. ▪ The EU level is of crucial importance for strategic input (as well as legal framework through transposition of Directives) and aspects such as CC reporting requirements and Enabling Conditions for use of EU Funds. | <ul style="list-style-type: none"> ▪ <i>The need for effective multi-level governance structures for successful CCA interventions appears as a key positive for take-up of TI in CCA strategies.</i> ▪ <i>However, there are trade-offs between the institutionalisation of multi-level governance systems and their eventual flexibility/adaptability in the context of 'system change' implicit in TI approaches.</i> ▪ <i>Exemplary communications are essential to ensure smooth transitions – even to the extent of enabling co-creation of changes based on input from the different levels.</i> |
| Room for experimentation | | |
| <ul style="list-style-type: none"> ▪ TI is disruptive, so room for experimentation – together with the ability to apply related learning – is existential to the approach. ▪ Tolerance for failure is an integral part of TI. ▪ Regulatory sandboxes are proving crucial to the take-up of TI approaches. | <ul style="list-style-type: none"> ▪ CCA strategies are not only concerned with fixing problems in the short term, but about planning future-proof solutions embodying a degree of risk and uncertainty. ▪ Whilst there is some room for experimentation within individual shorter-term incremental CCA interventions, longer-term radical CCA strategies overall do not lend themselves to experimentation. The price of eventual failure is generally considered too high. | <ul style="list-style-type: none"> ▪ <i>The limited scope for experimentation in CCA strategies appears as a factor restricting expansion of TI approaches. Transformative CCA strategies would need to find ways of incorporating possibilities of taking risk/failure and new types of risk-tolerant funding would be needed.</i> |

| Transformative Innovation approach | Climate Change Adaptation Strategies | <i>Potential contribution of TI approaches to shape Transformative CCA strategies</i> |
|---|--|---|
| <i>Policy intelligence, learning and strategic capacity</i> | | |
| <ul style="list-style-type: none"> ▪ A strong evidence-based policy learning capacity is a vital component of the TI approach. ▪ Evaluating TI-inspired policies requires strong and diverse capacities spanning a wide policy spectrum and system change effects, as well as in-built uncertainties linked to experimentation. ▪ Systemic evaluation in a TI context is novel – still embryonic and not yet entirely successful. Operational type monitoring approaches, giving relatively quick feedback to enable timely adjustment, are currently preferred. | <ul style="list-style-type: none"> ▪ Increased emphasis on initiatives aimed at filling adaptation knowledge gap: translating global data on climate hazards and impacts into locally-relevant knowledge in support to policies. ▪ Fragmentation between intervention areas and policy levels acts as a barrier for policy intelligence and policy learning at the level of strategies. In particular, there is a lack of knowledge on social factors affecting vulnerability. ▪ Monitoring and evaluating <i>effectiveness</i> of climate adaptation actions are not yet widespread. ▪ Smaller local authorities generally lack capacity to plan and implement ambitious strategies and actions. ▪ Capacities for long-term planning under uncertainty is a key enabler, often underdeveloped. | <ul style="list-style-type: none"> ▪ <i>A TI perspective for CCA would stress the need for robust evidence to understand the baseline situation, and for anticipatory and orchestration capacities to co-create future pathways.</i> ▪ <i>Social and behavioural sciences would need to complement knowledge produced by climate scientists.</i> ▪ <i>A TI perspective would also require the development of novel monitoring and evaluation frameworks incorporating a systemic dimension beyond sectoral approaches.</i> ▪ <i>'Transformative' learning capacities will need to be developed beyond absorptive and adaptive capacities.</i> |

Source: Authors

5 Conclusions

Building up strategies to prepare for and adapt to the unavoidable impacts of climate change may long have been seen as a ‘second order’ goal compared to that of Climate Change Mitigation. The former may even have been perceived as competing with the latter by distracting attention, efforts and funds towards the symptoms rather than on the causes of the climate crisis. Such a view is no longer valid: both CCA and Mitigation are now seen as strategically equal, as well as complementary to each other.

‘Transformative adaptation’ – ambition versus current reality

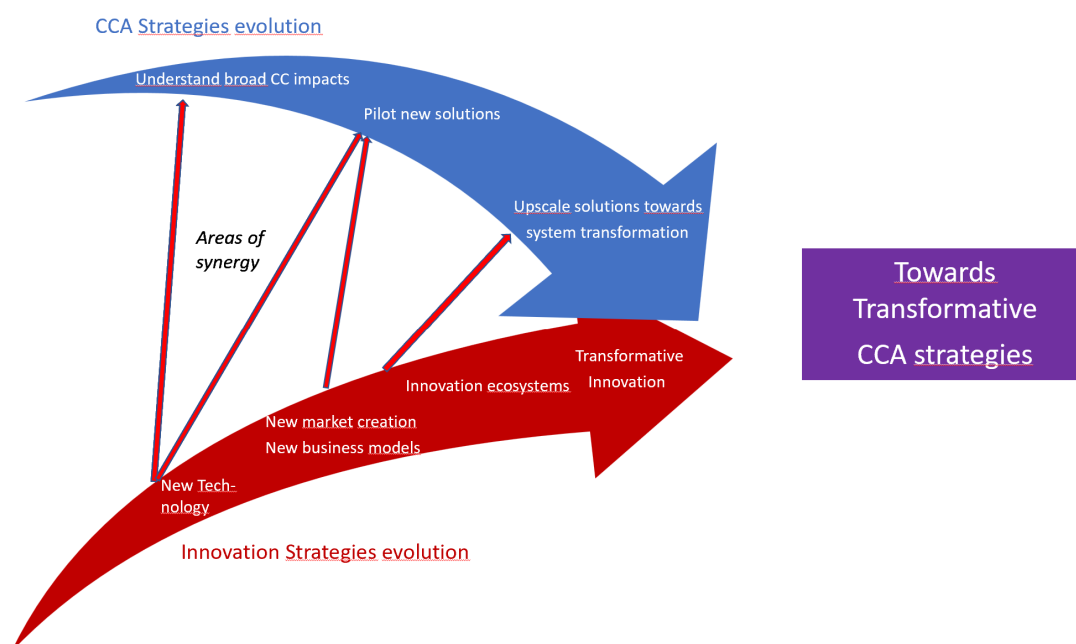
The 2021 EU CCA strategy is a high-level affirmation of the importance of CCA for the well-being of European citizens (EC, 2021a). The strategy emphasizes that *‘Climate change is having such a pervasive impact that our response to it must be systemic’*. Moving towards ‘more systemic adaptation’ – the title of its second pillar – requires deep changes in vision, governance approaches and implementation mechanisms. *‘The gravity of the adaptation challenge makes it a whole-government and whole-society endeavour. It is vital for the private and public sectors to work together more closely, in particular on financing adaptation’* (EC, 2021a).

Transformative adaptation: Adaptation that changes the fundamental attributes of a social-ecological system in anticipation of climate change and its impacts.

IPCC (2022)

Yet these ambitions stand in stark contrast to our assessment of deployment of CCA strategies in EU Member States so far. They are still seen as too incremental in nature, too limited in scale and scope and too fragmented. The thesis of this report is that incorporating TI into CCA strategies would support their upgrading towards a ‘transformative adaptation’ goal (IPCC, 2022). This is a goal well beyond shorter-term and sectoral endeavours aimed at maintaining or restoring wealth on a ‘back to business as usual’ path. In view of the complexity and pervasiveness of future climate change impacts, more radical, more wide-ranging, more integrated transformation will be needed.

Figure 5 - Towards Transformative Climate Change Adaptation Strategies



Source: Authors

The ongoing experiment with EU Missions represents a step forward in turning such ambitions into reality. The ultimate expectation from the EU Mission on CCA (EC, 2021c), in its full deployment phase, is to support transformative adaptation through *'large-scale demonstrations of systemic transformation to climate resilience'* with a strong stakeholder participation component. Achieving this will necessarily involve multiple levels of authorities, alignment of actions across several policy domains, experimentation and upscaling, as well as substantially enhanced intelligence and strategic capacity. In short, the ambitions of the EU's CCA Mission cover all the features highlighted in this report as forming the essence of the TI concept.

Barriers to transformative CCA

The report nevertheless highlights various significant barriers to be addressed in the journey towards such a new generation of 'transformative' CCA strategies. These barriers are present at strategy formulation and strategy implementation stages. They relate to shortcomings in knowledge, governance and established institutions (regulations, norms, values, behaviour and models). Some are intrinsic to the CCA field of action - e.g. the challenges in creating a sound evidence base. Others relate more to the ambitions of the TI approach - e.g. the challenges with wider societal involvement or the emphasis on lock-ins. Most of the barriers are valid for both.

Strategy formulation barriers

The high degree of uncertainty and long-term nature of CCA impacts create huge difficulties in ensuring awareness of the 'need to act now' in building CCA strategies, especially regarding the more indirect effects (e.g. on health). This presents barriers to creating the following necessary conditions:

- High-level political endorsement: CCA goals conflict with more immediate societal needs and short-term horizon of legislatures. Risk aversion in the public sector impedes the development of strategies with an experimental dimension.
- Bottom-up endorsement by society: weak awareness or unwillingness to acknowledge the urgency of CCA despite mounting societal pressures, fuelled by severe and dramatic climate change impacts such as flooding and wildfires.
- Private sector engagement in the embryonic 'adaptation economy'.

There is insufficient tailor-made information and data (baseline and forecasted) for understanding CCA impacts as bases for designing strategies and for planning measures and actions. This limits the ability to formulate clear objectives, which are inherently moving targets. Particular difficulties include:

- Lack of data on climate hazards, and especially on complex and cascading effects, as well as problems with data interpretation.
- Unreliable data on economic and societal costs of climate change and on the cost of non-action.
- Limited incorporation of social distribution of risks.

The systemic character of transformative CCA has impacts in different sectors of society. This calls for whole-of-government approaches to strategy formulation, but conflicts with current governance models and leads to coordination challenges. These are mainly due to a lack of tradition in the public sector for aligning strategies between different sectoral Ministries or departments such as RTD, environment, regional development, social action etc.

Finally, the broader stakeholder involvement needed to ensure co-creation processes for transformative CCA strategies will require novel engagement methods and facilitation that are not yet well tested or available. Identifying and engaging non-usual suspects in defining long-term strategies spanning several policy domains is far from an obvious task. Engagement processes themselves are notoriously tricky to manage, due to the likely presence of conflicting views and interests. They can all too easily end up delivering strategic goals which are too vague or too broad, often generating additional unwanted effects due to the power of incumbents and of vested interests, as well as increasing coordination costs and the risk of 'engagement fatigue'.

Strategy implementation barriers

Strategy implementation in the form of integrated and effective policy portfolios is held back by the same problem of lack of appropriate, locally relevant and action-oriented data on climate risks and their impacts. Also similar to strategy formulation, the design and implementation of genuinely transformative CCA actions conflict with established practices in institutions, business models, values and behaviour, creating resistance to change and path-dependencies. Furthermore:

- The availability of public funds is limited for transformative, forward-looking preventive CCA actions. Available funds tend to cover emergency responses or shorter-term preparatory actions.

The practice of joined-up funding channels crossing different policy domains is a rarity. Integrated policy portfolios combining various types of instruments - R&I, regulations, skills, infrastructure, public procurement etc. - are currently underdeveloped.

- The private sector is only marginally involved in implementing CCA strategies that are perceived as mostly publicly led. As a consequence, private funding for CCA actions is especially limited.
- Concerning R&I in particular, the move towards transdisciplinary or convergence research approaches is slow, due to disciplinary traditions anchored in organisations and human behaviour.
- Capacity issues compound the implementation stage of CCA strategies. Capacities for decision-making in uncertainty are limited in risk adverse institutions, such as the local authorities, which are at the forefront of much CCA action. Changes in methods and mindsets are needed to implement impact-oriented policy portfolios.

All of the barriers discussed are summarised in tabular form below (Table 21).

Table 21. Barriers to transformative Climate Change Adaptation strategies

| | Knowledge | Governance and capacity | Established institutions |
|--------------------------------|---|--|--|
| Strategy formulation | <ul style="list-style-type: none"> ↻ Uncertainty and long-term nature of CCA impacts. ↻ Overall objective as moving target. ↻ Lack of data on climate hazards and cascading effects. ↻ Weak understanding on societal factors affecting CC impacts and on the cost of non-action. ↻ Limited understanding of social justice aspects. | <ul style="list-style-type: none"> ↻ Lack of high-level political endorsement. ↻ Difficulty to plan in long-term horizon. ↻ Lock-in in disaster risk management and short-term frames. ↻ Difficulty to establish genuine cross-silo cooperation and strategic steering, both horizontally and vertically. ↻ Imperfect methods and dangers and costs of wider societal involvement in a co-creation perspective. | <ul style="list-style-type: none"> ↻ Low societal awareness and sense of urgency. ↻ Limited attractiveness of the 'adaptation economy' for businesses. ↻ Economic lock-ins and vested interests. ↻ Risk aversion in public sector. |
| Strategy implementation | <ul style="list-style-type: none"> ↻ Lack of operationalizable data for action planning. ↻ Unsuitable monitoring, reporting and evaluation systems. ↻ Underdeveloped methods and inadequate mindsets for impact-driven implementation. | <ul style="list-style-type: none"> ↻ Lack of dedicated CCA budgets associated to strategy. ↻ No joined-up budgets and fragmented instruments portfolios. ↻ Limited governance and funding capacity at lower administrative levels. ↻ Limited private sector involvement and funding. | <ul style="list-style-type: none"> ↻ Stickiness of models, values and behaviour. ↻ Institutional path dependencies hindering e.g. convergence research. ↻ Underdeveloped regulatory incentives. |

Source: Authors

Case studies, further research and way ahead

The thesis of this report – that infusing TI approaches into the design and implementation of CCA strategies would raise their effectiveness – generates bright perspectives, but it is a purely speculative thesis. TI is a concept that has climbed to the forefront of academic and policy debates only in recent times. It is not yet applied in reality: TI experimentation is just starting, with initiatives like the ActionBook on innovation for place-based transformation (European Commission, 2024). A research agenda on the different aspects explored here should be drawn up as a matter of priority, with emphasis placed on the development of monitoring indicators to measuring overall climate resilience at territorial level.

The best way to test the thesis in the shorter term is to examine efforts deployed so far in frontrunner territories to incorporate TI features in CCA strategies, address the relevant barriers and build up solutions to bridge the gaps between ambitions and reality. The mapping exercise carried out here and the above list of barriers have been applied to a set of 16 case studies, covered in 14 reports, that deliver meaningful insights into this complex multi-faceted subject area, in EU territories willing to engage fully in 'transformative CCA' strategies. The results of the case studies to which this framework has been applied are presented in a separate series of reports, as listed in Annex 2.

Finally, with the hindsight and experience of carrying out these case studies, a number of observations and adjustments have been subsequently formulated in order to improve the methodology described in Annex 1, and are listed in Annex 3 as suggestions for possible future studies on other territories.

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List of abbreviations and definitions

| | |
|------|---|
| CCA | Climate Change Adaptation |
| CEF | Connecting Europe Facility |
| EEA | European Environment Agency |
| EIA | Environmental Impact Assessment |
| GHC | Green House Gas |
| JRC | Joint Research Center |
| IPCC | Intergovernmental Panel on Climate Change |
| MOIP | Mission-oriented innovation policies |
| NAP | National Adaptation Plan |
| PPS | Purchasing power standard |
| PRI | Partnerships for regional innovation |
| R&D | Research and development |
| R&I | Research and innovation |
| RAPs | Regional Adaptation Plans |
| SAP | Sectoral Adaptation Plans |
| SEA | Strategic Environmental Assessment |
| TCR | Transboundary climate risks |
| TI | Transformative innovation |
| TTO | Technology Transfer Office |
| US | United States |

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Annexes

Annex 1. Methodology for undertaking territorial case studies

Case studies (listed in Annex 2) have been conducted as part of this research to analyse to what extent and how enabling factors towards 'Transformative Climate Change Adaptation' strategies, as identified in this conceptual report, are at play in reality, and what can be done to overcome barriers in various territorial contexts. The methodological framework presented in this annex essentially acts as a practical guide for undertaking cases studies on CCA strategies in different territories, in a uniform way.

The framework takes the form of an analytical grid, structured into seven sections, each of them representing a key feature of the 'transformative innovation' approach – features understood as essential conditions for the design and implementation of CCA strategies with this high level of ambition. Each section sets out the main question(s) to be addressed in relation to its respective transformative innovation feature.

A brief explanatory text is provided for the interpretation of each question and to help guide discussion during interviews. Reference to relevant PRI Playbook Fiches³ is also made.

Annex 1 starts with an analytical grid for undertaking cases studies and is followed by summary fiches with questions only.

³ https://publications.jrc.ec.europa.eu/repository/bitstream/JRC129327/pri_playbook_online_simples.pdf

Annex 1-A. Analytical grid for undertaking cases studies on territorial Transformative Climate Change Adaptation strategies

1. Defining goals and expected impacts

1.1. How is the ultimate goal of the strategy articulated? How broad or narrow is it? To what extent does the vision incorporate broader societal transformation with an adequate time perspective?

‘System change’ is expected to be a central component, covering economy and society and fully incorporating the environmental dimension⁴. For broader transformation to take place, the overall vision has to recognise two imperatives: first, the need to avoid lock-ins to past unsustainable trajectories; second the need to articulate new development paths leading to the desired transformation. In other words, effective CCA strategies must phase out unsustainable models and replace them with more resilient ones.

There is a need to create a consensus on the actual meaning of the general impact expected from the strategy, namely ‘territorial climate resilience’, which:

- is broader than disaster resilience;
- has a long-term perspective (e.g. to 2030, 2050) and adopts a prospective approach, beyond short-term ‘repair’;
- places emphasis on social justice in response to uneven distribution of climate risks;
- articulates complementarity (avoiding any substitution) with mitigation strategies;
- defines scope and impacts beyond individual interventions in specific sectors.

1.2. Is there adequate political endorsement for the strategy? How is this demonstrated? Are the overall governance mechanisms for the strategy clearly established and fit for purpose?

A key enabling condition for the success of the strategy is achieving **endorsement at the highest political** level to secure active and deep engagement of all relevant authorities.

Strong political endorsement goes hand-in-hand with the establishment of a clear **framework and allocation of responsibilities for steering, monitoring and evaluating the strategy**. The governance mechanisms should go far beyond simply ensuring a correct implementation of the strategy as planned and focus on processes and pathways towards achieving system change. This will require strong monitoring systems and steering capacities (see also Section 7 below).

⁴ See also PRI Playbook Fiche 7 - Challenge-oriented innovation

2. Articulating policy portfolios

2.1. What are the instruments making up the policy portfolio to implement the strategy? Is this portfolio explicitly articulated or only implicitly? Are synergies and complementarities between instruments systematically sought and if so, how?

Transformative CCA strategies need to be implemented through systemic policy portfolios.

This denotes sets of policy instruments of diverse nature (funding lines, incentives, soft support, regulations, etc.), which have the following characteristics:

- they incorporate instruments of different natures acting in synergy, maximising co-benefits and avoiding perverse maladaptation-type effects;
- they support a move from small, localised pilot experiments in CCA solutions towards mainstreaming CCA in many programmes and instruments and supporting large-scale deployment of systemic solutions;
- they give large space to ‘ecosystem’ instruments, such as clusters, (thematic) innovation platforms, collaborative flagship initiatives, living labs, etc.;
- they include instruments for creating evidence base for action: localised data and observatories, warning systems, tools to monitor and understand climate threats and impacts.

2.2. How well does the policy portfolio address the demand and business side of CCA?

CCA as a policy field is less subject than climate change mitigation to regulation, such as that creating new markets around green and circular technologies and solutions. There is a need to raise the potential of ‘climate adaptation economy’, with a view to incorporating business-oriented innovation instruments in the portfolio. **Demand-side instruments with a focus on new market creation** should feature strongly in the portfolio to increase private sector presence in strategies that are perceived as essentially public-led.

To foster the demand side, ensuring wide coverage of innovation is crucial. To be effective, the policy portfolio needs to cover the whole innovation cycle and consider technological innovation, non-technological innovation, business model innovation and social innovation.

2.3. How well does the policy portfolio incorporate the cross-border and international dimensions?

Not only do climate change impacts manifest themselves often across administrative borders, solutions also often need to be deployed across borders. The **policy portfolio would therefore need to facilitate and foster the cross-border and international dimensions**. This might be through dedicated instruments, or through opening up territorial instruments for participation by actors located beyond the borders, as well as through a good articulation of existing joint instruments with the territorial strategy (e.g. Horizon Europe collaborative projects including mission on CCA, Interreg programmes, EU partnerships, bilateral agreements, lead agency models, etc.).

3. Ensuring cross domain synergies

3.1. How effective are the efforts and structures set up to facilitate synergies across the various policy domains relevant for CCA?

Because the impacts of climate change are felt across many domains of intervention for policy, there is a need to develop whole-of-government approaches to CCA⁵. Such approaches should help break down silos that are traditionally present at strategic level because of divisions between Ministries' portfolios. Formal and informal solutions need to be put in place to ensure greater coherence between the various policies deployed (R&I, agriculture, environment, mobility, health etc.) in relevant thematic areas.

Establishing functional cross-ministerial and cross-department structures and cooperation mechanisms are typical solutions to address the 'siloisation' of policies and to facilitate exchange of information, as a first step; and the search for synergies by aligning respective actions, as a second step, in enhancing the feasibility of joint actions or even joint budgets across policy areas.

3.2. How well does the research system accommodate and foster interdisciplinary research?

Innovative climate change adaptation solutions generally require the contribution of different disciplines, harnessing the power of interdisciplinary research. Multi-technology, multi-actor and multi-sectoral initiatives with high transformative potential are complex and will rely on combinations of natural science, engineering, behavioural sciences etc. Disciplinary organisation of universities or research institutions creates barriers to conduct truly interdisciplinary research. Institutional path dependencies hindering this type of research need to be addressed.

⁵ See also PRI Playbook Fiche 25 – Steps towards a Whole-of-Government approach

4. Broadening and deepening stakeholder involvement

4.1. Which stakeholders are engaged at the stage of design of the strategy and what is their actual contribution? How do the contributions of the various actors evolve as the strategy moves forward towards concrete implementation? What broader stakeholder engagement strategies have been used and how effective have they proved to be?

Increasing breadth and depth of stakeholder involvement is crucial for strategies seeking broader CCA impacts in terms of societal transformation⁶. At strategic level, a ‘multiple helix’ of actors needs to be mobilised, beyond traditional research and innovation actors. This might include citizens and actors affected by climate-induced risks, such as farmers, fishermen or health professionals, as well as organisations in charge of managing key systems and implementing solutions such as water agencies or nature conservation bodies. **Focusing specifically on the involvement of citizens and end-users** is needed to ensure social acceptance of new solutions and fight inertia. It is also essential for shaping innovative developments possibly leading to systemic changes in both production and consumption spheres/models. **Ensuring stronger involvement of vulnerable groups** (people, territories) is an additional specific challenge to ensure ‘socially just’ CCA strategies⁷.

Mobilisation of the ‘multiple helix’ around design of transformative pathways towards climate resilience requires new methodologies. The design of truly transformative strategies relies on an appropriate selection of stakeholders reflecting a diversity of situations and opinions. There is a need for effective ‘places’ and new methods for public debate, creating the conditions for genuine co-creation with society by favouring free thinking towards bold solutions. The owner(s) of the strategy should have adequate capacities to steer negotiations, manage conflicting views about alternative pathways to resilience, mobilise local environmental knowledge, understand and manage subjective perceptions as well as socio-cultural and affective-emotive factors.

Securing deep and steady business involvement is necessary, since transformative adaptation will require larger funding sources, including private investment, in climate-resilient solutions. The costs of non-action on climate adaptation are large and increasing, not only for public authorities responsible for land planning and infrastructure, but also for economic actors and entire sectors (potentially deeply) affected by climate change.

⁶ See also PRI Playbook Fiche 36 - Co-creation for policy

⁷ See also PRI Playbook Fiche 37 - Engaging citizens in innovation and innovation policy
and Fiche 38 – Contribution of civil society organisations

5. Setting up effective multi-level governance models

5.1. How are the respective roles of public authorities at various levels articulated? What are the mechanisms for effective synergies between territorial governance levels?

Effective CCA strategies require sound **articulation between the mandates and respective leverage of authorities at various levels of governance**, in a place-based perspective – local, regional, national and EU:

- the local level is often the main focus of CCA interventions, but this must be clearly situated within national/regional strategic and legal frameworks and policy portfolios;
- the EU level is of crucial importance for strategic reference (as well as legal framework through transposition of Directives) and aspects such as climate strategy reporting requirements and enabling conditions for use of EU Funds.

Creating effective multi-level governance structures⁸ is necessary to ensure successful CCA interventions, starting with exemplary communications to ensure smooth transitions – even to the extent of enabling co-creation of changes based on input from the different levels.

6. Providing room for experimentation

6.1. How well does the overall territorial environment foster experimentation towards multiple novel solutions for CCA? Are specific efforts being made to overcome barriers to experimentation in the field of CCA?

Creating space for creativity and a risk-tolerant environment are key enabling factors for the design and implementation of CCA strategies, where ‘out-of-the box’ solutions are often needed to address the uncertain future of territories affected by climate-induced hazards. Slow-onset trends as well as dramatic events are expected but their magnitude, frequency and their exact consequences are largely unknown. Transformative CCA strategies are about planning future-proof solutions embodying a degree of risk and uncertainty. New ways of incorporating possibilities of taking risks and accepting failure in policy instruments as well as new types of risk-tolerant finance are needed⁹.

Regulatory sandboxes or innovative public procurement models are among the available mechanisms. Modular protected spaces, or niches for experimentation to trial new and sometimes competing solutions are crucial to the take-up of transformative approaches to CCA. This contrasts sharply with the approach of short-term incremental CCA interventions, which rely on known solutions.

⁸ See also PRI Playbook Fiche 26 – Multi-level coordination mechanisms

⁹ See also PRI Playbook Fiche 34 – Small-scale experimentation for transitions

7. Securing high levels of policy intelligence, learning and strategic capacity

7.1. What is the knowledge base available? Is it adequate to support decision-making for CCA strategy?

Supporting the creation of a robust, policy-oriented and territory-specific evidence base is vital to understand the territory's baseline situation in terms of climate change vulnerability and to bridge the adaptation knowledge gap. Global data on climate hazards and impacts need to translate into locally relevant knowledge in support to policies. Convincing evidence (quantitative, qualitative) is required to underpin anticipatory and orchestration capacities to co-create future adaptation pathways. Such evidence will need to blend behavioural sciences with knowledge produced by climate scientists and other specialists (e.g. in biodiversity or agriculture), to better understand social factors affecting vulnerability.

Developing novel monitoring and evaluation frameworks incorporating a systemic dimension beyond sectoral approaches is an important challenge for transformative strategies. Monitoring is currently carried out in relation to specific fields of intervention, but the overall climate resilience of a territory is can only be derived from understanding complex interactions between multiple and cascading risks and multiple responses. Frameworks for this type of monitoring will need to capture the functioning of impact pathways to enable assessment of whether transformation is really happening.

7.2 How is the knowledge base effectively used to support decision-making for CCA strategy? Are strategic capacities sufficiently well developed to ensure an adequate and continuous learning process? What efforts are being made to upgrading such capacities?

Engaging in ambitious CCA strategies requires 'transformative' learning capacities, including capacities for long-term planning under uncertainty. Smaller local authorities generally lack capacities to plan and implement ambitious strategies and actions. Although multiple sources of information, good practice cases, guidance manuals, peer learning networks and support bodies are available for learning (e.g. within the new Mission CCA Implementation Platform, or the Climate-ADAPT knowledge base), local authority capacities to exploit them for the purpose of a specific territory are often lacking.

Annex 1-B. Summary fiches with questions only

| Analytical grid for undertaking cases studies Summary version | |
|---|--|
| 1. Defining goals and expected impacts | |
| 1.1. | How is the ultimate goal of the strategy articulated? How broad or narrow is it? To what extent does the vision incorporate broader societal transformation with an adequate time perspective? |
| 1.2. | Is there adequate political endorsement for the strategy? How is this demonstrated? Are the overall governance mechanisms for the strategy clearly established and fit for purpose? |
| 2. Articulating policy portfolios | |
| 2.1. | What are the instruments making up the policy portfolio to implement the strategy? Is this portfolio explicitly articulated or only implicitly? Are synergies and complementarities between instruments systematically sought and if so, how? |
| 2.2. | How well does the policy portfolio address the demand and business side of CCA? |
| 3. Ensuring cross domain synergies | |
| 3.1. | How effective are the efforts and structures set up to facilitate synergies across the various policy domains relevant for CCA? |
| 4. Broadening and deepening stakeholder involvement | |

Analytical grid for undertaking cases studies

Summary version

4.1. Which stakeholders are engaged at the stage of design of the strategy and what is their actual contribution? How do the contributions of the various actors evolve as the strategy moves forward towards concrete implementation? What broader stakeholder engagement strategies have been used and how effective have they proved to be?

5. Setting up effective multi-level governance models

5.1. How are the respective roles of public authorities at various levels articulated? What are the mechanisms for effective synergies between territorial governance levels?

6. Providing room for experimentation

6.1. How well does the overall territorial environment foster experimentation towards multiple novel solutions for CCA? Are specific efforts being made to overcome barriers to experimentation in the field of CCA?

7. Securing high levels of policy intelligence, learning and strategic capacity

7.1. What is the knowledge base available? Is it adequate to support decision-making for CCA strategy?

7.2. How is the knowledge base effectively used to support decision-making for CCA strategy? Are strategic capacities sufficiently well developed to ensure an adequate and continuous learning process? What efforts are being made to upgrading such capacities?

Annex 2: List of case studies based on the methodology

The methodology described in Annex 1 laid the ground for a series of case studies listed below, which have been undertaken in the second semester of 2023 and early 2024.

The case study research comprises overall 14 case study reports covering 16 different territories from across the EU and beyond, casing various institutional contexts, a variety of biogeographical regions within different climate risks, different ranges of population sizes, and representing a diversity of approaches to CCA and transformative innovation.

“Transformative innovation for better climate change adaptation” – Case studies

| Country | Territory | URL (*) | DOI | JRC number |
|-------------|---------------------------------|---|----------------|------------|
| Belgium | Leuven | https://publications.jrc.ec.europa.eu/repository/handle/JRC137313 | 10.2760/58125 | JRC137313 |
| Finland | Espoo | https://publications.jrc.ec.europa.eu/repository/handle/JRC137316 | 10.2760/177322 | JRC137316 |
| Finland | Turku - Southwest Finland | https://publications.jrc.ec.europa.eu/repository/handle/JRC137315 | 10.2760/211155 | JRC137315 |
| France | Provence-Alpes-Côte d'Azur | https://publications.jrc.ec.europa.eu/repository/handle/JRC137314 | 10.2760/46893 | JRC137314 |
| Greece | Attica and North Aegean regions | https://publications.jrc.ec.europa.eu/repository/handle/JRC137322 | 10.2760/493562 | JRC137322 |
| Iceland | | https://publications.jrc.ec.europa.eu/repository/handle/JRC137291 | 10.2760/305796 | JRC137291 |
| Italia | Emilia-Romagna | https://publications.jrc.ec.europa.eu/repository/handle/JRC137319 | 10.2760/790200 | JRC137319 |
| Netherlands | Northern Netherlands | https://publications.jrc.ec.europa.eu/repository/handle/JRC137312 | 10.2760/10862 | JRC137312 |
| Poland | Mazovia - Stare Babice | https://publications.jrc.ec.europa.eu/repository/handle/JRC137323 | 10.2760/58125 | JRC137323 |
| Portugal | Norte | https://publications.jrc.ec.europa.eu/repository/handle/JRC137321 | 10.2760/399394 | JRC137321 |
| Romania | Nord Vest - Cluj | https://publications.jrc.ec.europa.eu/repository/handle/JRC137317 | 10.2760/923916 | JRC137317 |
| Slovenia | Gorenjska | https://publications.jrc.ec.europa.eu/repository/handle/JRC137320 | 10.2760/502482 | JRC137320 |
| Spain | Andalucia - Granada | https://publications.jrc.ec.europa.eu/repository/handle/JRC137324 | 10.2760/104672 | JRC137324 |
| Sweden | Blekinge and Värmland | https://publications.jrc.ec.europa.eu/repository/handle/JRC137318 | 10.2760/249067 | JRC137318 |

(*) Links may give error message for those studies still under publication

Annex 3: Revised analytical framework for future case studies

With the hindsight and experience of carrying out 5 of the 14 case studies¹⁰, a number of adjustments to the analytical framework have been subsequently formulated in order to improve the methodology described in Annex 1, and are listed here as suggestions for possible future case studies on other territories.

The main lesson learned from applying the framework to real life situations in the case study territories is that **the seven features are necessary but not sufficient** for effective transformative CCA strategies to thrive. Specifically:

- All seven features appear as key enablers for the emergence and the deployment of CCA strategies that have the potential to address the need for wider transformation of the many domains impacted by climate change on a territory. Weaknesses in relation to any of these features were found to hamper the deployment of effective and transformative CCA strategies.
- Nonetheless, when applying the framework to the real situations encountered in the case study territories, it was found that an additional feature was needed - namely **'Achieving high levels of awareness and understanding on CCA'**. Previously, the analytical framework had taken for granted that this awareness and understanding was present and widespread. The empirical work on five cases demonstrated that the understanding of the true meaning of CCA - notably how different the concept is from climate change mitigation - was often insufficient. Broad awareness and correct understanding of CCA are therefore necessary overall pre-conditions. If they are under-developed, this will have negative impacts on all the other features in the framework. In the Case Study Reports, this dimension was covered under Feature 7, in relation to 'policy intelligence', because it is linked to the availability of evidence on climate risks. However, this positioning does not fully address the central importance of proper awareness and understanding of CCA. A new separate feature relating to this pre-condition is therefore recommended to be added as the first feature in the framework.

The empirical testing of the methodology also revealed the need to **fine-tune the definition of six of the existing seven features**, as follows:

- 'Directionality: defining goals and expected impacts for society': the dimension of **'leadership'**, although broadly understood under the 'political endorsement' item, needs to be highlighted more explicitly. The case study research demonstrated that unclear or invisible leadership represented an important barrier to successful transformative CCA strategies.
- 'Ensuring cross domain synergies' was confirmed as an essential feature to ensure that the pervasive nature of CCA is embraced. However, the research revealed the need to take this a crucial step further by emphasising the importance of **'mainstreaming'** CCA concretely in the strategies, actions and rules of all other relevant policy domains - and hence also in the analytical framework.
- 'Articulating instrument portfolios and defining synergies between funding sources' is the feature providing the essential link between aspirations in strategies and action in the field of CCA. In

¹⁰ Iceland, Northern Netherlands, Gorejnska (SI), Turku (FI), Provence-Alpes-Côte d'Azur (FR). The authors of the other case studies were consulted and endorsed the updated methodology.

the context of this study, it was decided at the outset to place special emphasis on the **role of EU Cohesion Policy Funds and Smart Specialisation Strategy (S3)**, which should therefore be added explicitly to the framework.

- In ‘Setting up effective multi-level governance models’, in particular the capacities of the local government to integrate and implement CCA policies came up as a central issue, pointing to the fact that most municipalities do not have enough **human and financial resources**, and in many cases, the required knowledge to effectively coordinate and implement CCA strategies, making the **local level** reliant on the existence of support from other levels of government and the EU.
- ‘Making room for experimentation’ is a feature needed for developing more forward-looking solutions to the challenges of CCA, that go beyond traditional responses and/or possibly imply fundamental rethinking of existing solutions. Here, the findings from the case studies underlined the importance of **‘capitalising on experiments’**, which should be further highlighted. In many cases, useful experiments were indeed found to be underway in the territories examined, but often in a fragmented manner and without properly developed mechanisms to ensure their sustainability, scale-up and eventual replication.
- Within the feature ‘Securing high levels of policy intelligence, learning and strategic capacity’, a key lesson was learnt from the field research on the importance of distinguishing between knowledge of climate risk, impacts and vulnerabilities on the one hand, and **costs/benefits of CCA solutions** on the other. Again, the analytical framework would benefit from added emphasis in this regard.

Finally, practical deployment of the analytical grid showed a **need for re-ordering certain features**, in order to ensure a better story line in reporting:

- As explained above, the first feature to appear in the grid should be the newly introduced precondition: ‘Achieving high levels of awareness and understanding of CCA’, since it impacts on all other features.
- ‘Increasing breadth and depth of stakeholder involvement’ is closely linked to both the above new feature, as well as to ‘Directionality: defining goals and expected impacts for society’, hence it would be better positioned directly after those two features.
- As regards the feature ‘Articulating instrument portfolios and defining synergies between funding sources’, given its strong dependence on which policy domains are mainstreaming CCA and which governance levels are most active as a result, the optimum positioning would be after the respective features ‘Ensuring cross domain synergies’ and ‘Setting up effective multi-level governance models’.

After incorporating the three types of changes discussed above, a revised analytical framework is proposed in Table 22.

Table 22. Revised and re-ordered analytical framework mapping eight key features Transformative Innovation onto CCA strategic approaches (with new elements underlined and in red font)

| Key feature | Explanation |
|--|--|
| <p>1. <u>Achieving high levels of awareness and understanding of CCA</u></p> | <p><u>Making sure that CCA is adequately seen and communicated as a process of proactive adjustment to actual or expected climate change effects, within a long-term perspective, not confused with mitigation or short-term emergency response.</u></p> <p><u>1.1. How is CCA understood by decision-makers? Is there a widespread awareness in the general public about the need and urgency of CCA? What is being done to raise this awareness?</u></p> <p><u>1.2. What is the main message (if any) communicated about CCA? Are positive and/or negative narratives prevailing concerning CCA?</u></p> |
| <p>2. <u>Directionality and leadership: defining goals and expected impacts for society</u></p> | <p>Defining goals and scope of strategic action, as well as articulating impacts, in a way which reflects societal challenges with wide appeal, formalised through endorsement at highest political level to secure engagement of all relevant authorities and stakeholders.</p> <p>2.1. <u>Is there a dedicated CCA strategy, or is CCA part of broader strategy/ies?</u> How is the ultimate goal <u>for CCA</u> articulated? How broad or narrow is it? To what extent does the vision incorporate broader societal transformation with an adequate time perspective?</p> <p>2.2. Is there adequate political endorsement for the strategy? How is this demonstrated? Are the overall governance mechanisms for the strategy clearly established and fit for purpose? <u>Is there clear and legitimate leadership on CCA?</u></p> |
| <p>3. <u>Increasing breadth and depth of stakeholder involvement</u></p> | <p>Working towards social acceptance of new solutions and shaping of innovative developments, as well as improving public trust, opening up public debates, managing diverse and sometimes conflicting views over alternative pathways.</p> <p>3.1. Which stakeholders are engaged at the stage of design of the strategy and what is their actual contribution? How do the contributions of the various actors evolve as the strategy moves forward towards concrete implementation? What broader stakeholder engagement strategies have been used and how effective have they proved to be?</p> |
| <p>4. <u>Ensuring cross domain synergies and mainstreaming of CCA</u></p> | <p>Favouring whole-of-government approaches to ensure <u>mainstreaming of CCA</u> in various thematic policy areas (R&I, agriculture, environment, mobility, health etc.), resulting in coordinated mixes of instruments of different types.</p> <p>4.1. How effective are the efforts and structures set up to facilitate synergies across the various policy domains relevant for CCA?</p> <p>4.2. <u>In which policy domains is CCA taken into mainstream consideration and how?</u></p> <p>4.3. How well does the research system accommodate and foster interdisciplinary research?</p> |
| <p>5. <u>Setting up effective multi-level governance models</u></p> | <p>Maximising potential of vertical synergies, recognising complementary roles for various governance levels – local, regional, national and EU.</p> <p>5.1. How are the respective roles of public authorities <u>with respect to CCA</u> at various levels articulated? What are the mechanisms for effective synergies</p> |

| Key feature | Explanation |
|---|---|
| | between territorial governance levels? How is availability of human and financial resources guaranteed, in particular at local level? ¹¹ |
| 6. Articulating instrument portfolios and defining synergies between funding sources | <p>Establishing all-encompassing instrument portfolios addressing the whole innovation cycle and the various aspects of CCA, paired with adequate funding resources.</p> <p>6.1. What are the instruments making up the policy portfolio to implement the strategy? Is this portfolio explicitly articulated or only implicitly? Are synergies and complementarities between instruments systematically sought and if so, how?</p> <p>6.2. What is the role played by Cohesion Policy and S3 in supporting transformative CCA strategies?</p> <p>6.3. How well does the policy portfolio address the demand and business side of CCA?</p> |
| 7. Making room for and capitalising on experimentation | <p>Providing adequate spaces for risk-taking and creativity – ensuring a risk-tolerant environment to facilitate development of new and/or radical solutions - and establishing mechanisms for learning from experiments.</p> <p>7.1. How well does the overall territorial environment foster experimentation towards multiple novel solutions for CCA? Are specific efforts being made to overcome barriers to experimentation in the field of CCA?</p> <p>7.2. Are there platforms or other mechanisms established with the purpose of drawing lessons from experiments and fostering their diffusion and scaling-up?</p> |
| 8. Securing high levels of policy intelligence, learning and strategic capacity | <p>Building strong evidence-based policy learning capacities, based on a solid knowledge base and special skills to manage transitions, as necessary companions to the transformative innovation approach.</p> <p>8.1. What is the knowledge base available? Is it adequate to support decision-making for CCA strategy? Does it cover both knowledge on climate risks and vulnerabilities and costs/benefits of CCA action and non-action?</p> <p>8.2. How is the knowledge base effectively used to support decision-making for CCA strategy? Are strategic capacities sufficiently well developed to ensure an adequate and continuous learning process? What efforts are being made to upgrading such capacities?</p> |

Source: Authors' elaboration

This revised framework bears strong similarities to the structure of the 'ACTIONbook on Innovation for place-based transformations' (European Commission, 2024). The ACTIONbook aims to, *"identify activities to help us reflect on how we can do things differently and make innovation policies be part of the collective purpose-driven change necessary to achieve place-based transformations"*. It highlights six broad themes, each covering different groups of activities, together with practical tools proposed to implement the activities.

¹¹ Revision proposed by Diana Morales, the author of the Norte (PT) and Blekinge (SE) and Warmland (SE) case studies

Rounding off this Report, Table 24 shows the relationship between the eight features of the revised and reordered analytical framework proposed above and the themes and activities of the ACTIONbook. This presentation is intended to be thought-provoking – opening up linkages to the practical tools proposed in the ACTIONbook, which could potentially support the design and deployment of transformative CCA strategies.

Table 23. The revised analytical framework for transformative CCA strategies, in relation to the themes and actions of the EC-JRC ACTIONbook on Innovation for place-based transformations

| Key features of revised analytical framework for transformative CCA strategies | ACTIONbook Innovation for place-based transformations: themes and actions |
|---|--|
| 1. Achieving high levels of awareness, understanding and communication on CCA | |
| 2. Directionality and leadership: defining goals and expected impacts for society | Envisioning <ul style="list-style-type: none"> • Diagnosing and developing a vision • Conducting participatory foresight • Developing transition pathways and roadmaps • Setting milestones and targets Orchestrating <ul style="list-style-type: none"> • Agenda setting and sharing Designing <ul style="list-style-type: none"> • Developing a strategy |
| 3. Increasing breadth and depth of stakeholder involvement | Engaging <ul style="list-style-type: none"> • Identifying stakeholders for given societal goals • Continuously engaging with stakeholders • Setting up a network governance • Building legitimacy |
| 4. Ensuring cross domain synergies - Mainstreaming CCA | Orchestrating <ul style="list-style-type: none"> • Collaborating across departments Implementing <ul style="list-style-type: none"> • Scaling and mainstreaming |
| 5. Setting up effective multi-level governance models | Orchestrating <ul style="list-style-type: none"> • Enabling multilevel cooperation • Collaborating across territories |
| 6. Articulating instrument portfolios and defining synergies between funding sources | Designing <ul style="list-style-type: none"> • Developing the policy and action mix • Mobilising resources • Designing ecosystem support • Designing local missions Implementing <ul style="list-style-type: none"> • Deploying a strategy • Coordinating the policy and action mix • Prioritising funds |
| 7. Making room for and capitalising on experimentation | Implementing <ul style="list-style-type: none"> • Experimenting and demonstrating |
| 8. Securing high levels of policy intelligence, learning and strategic capacity | Learning <ul style="list-style-type: none"> • Managing and transforming knowledge • Continuous monitoring • Evaluating impact • Learning from experimentation • Mobilising competences |

Sources: Authors' elaboration based on European Commission (2024).

The figure below graphically summarizes the revised analytical framework.

Figure 5. Methodological lessons from five territorial case studies



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