

# **Transformation** **Pathways**

**Bridging Research, Practice and Governance**

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**Transformation pathways**  
Bridging research, practice and governance

## Executive summary

This report summarizes the key findings of the internal project "Transformation Pathways in Research and Practice," funded by the Center for Climate Change and Transformation (CCT) at Eurac Research.

The project aims to investigate existing socio-political, theoretical, and methodological approaches to transformation in response to global environmental change. This knowledge base informs an examination of Eurac Research projects, focusing on their employed methods and theoretical frameworks. It also analyzes how select South Tyrolean organizations conceive and implement social-ecological transformation. Furthermore, the project explores how policy frameworks can either enable or hinder effective responses to global environmental change, with a specific focus on South Tyrol's Climate Plan. Rather than defining specific pathways for social-ecological transformation or outlining steps to shift from unsustainable practices to desired outcomes, the project reflects on existing theoretical and practical approaches for navigating the complexities of change, particularly within applied research, practice, and governance.

Below are the key findings derived from the project:

- The project synthesized approaches to transformation and developed a conceptual/analytical framework applicable to analyzing Eurac Research projects and existing practices, with potential for replication.
- Application of the framework to existing Eurac projects reveals that while many projects aim to contribute to socio-ecological transformation, most do so implicitly, lacking a specific theoretical framework and an explicit understanding of transformation.
- The project highlights the increasing shift towards inter- and transdisciplinary research as essential for addressing complex societal challenges, while acknowledging the epistemological and methodological challenges that remain.
- Application of the framework to local organizations actively engaged in contributing to change underscored the critical role of accessible information in facilitating socio-ecological transformation. Also, it revealed a problem in implementing inclusive decision-making processes and the existing power imbalances.
- Analysis of South Tyrol's Climate Plan identifies gaps in transformative governance, including the need for enhanced citizen engagement, greater adaptability, improved intersectoral coordination, increased resources, and a stronger emphasis on equity and social justice.

This project establishes a foundation that enables researchers, even those unfamiliar with the concept of transformation, to better understand its complex nature and applicability in research. It provides a conceptual framework for its analysis, particularly within the research domain. By examining a selection of Eurac research projects the project highlights existing gaps in research and competences, as well as the challenges faced by researchers, while offering insights for future development. Ultimately, it has fostered connections among researchers, encouraging reflection on their work and promoting opportunities for interdisciplinary dialogue across Eurac Research. The insights from organizations working on social-ecological transformation offer practical knowledge about implementing transformative change, highlighting the information gap and the research-policy-society gap that still needs to be reduced. Finally, the project's analysis of policy documents, such as South Tyrol's Climate Plan, offers valuable insights for shaping effective policies.

Overall, the project contributes a valuable knowledge base, helping researchers understand approaches for contributing to transformations needed for more socially and ecologically just societies, aligning with Eurac Research's mission.

# 1 Introduction

Written by: Elisa Ravazzoli

This report presents the results of the internal project "Transformation Pathways in research and practice" funded by the Center for Climate Change and Transformation (CCT) at Eurac Research. It emerges from a collaborative "journey" marked by numerous discussions among researchers at Eurac Research, who are exploring and using theoretical approaches and concepts of transformation and aiming to contribute to a social-ecological transformation.

The overall aim of the project is to better understand and reflect on existing theoretical concepts and approaches used to navigate the complexities of change, both in our applied research practice as well as in the practice and governance field, with a focus on South Tyrol. It does not delineate concrete pathways for contributing to social-ecological transformation in a specific field or economic sector, nor it outlines the steps needed to move from current unsustainable practices to desired sustainability outcomes; rather, it creates the necessary knowledge base that lays the groundwork for strategic research actions.

The project is based on the understanding that a fundamental and potentially rapid systemic change towards sustainability is necessary to preserve and further advance civilizational achievements, while protecting the natural foundations of human (and non-human) life and ensuring equal opportunities for a good life for people across time and space (IPCC, 2023). The concept of transformation is increasingly recognized as a critical framework within both academic and political discourse, particularly in response to pressing global challenges such as climate change and social inequality. There is a scientific and political consensus that social-ecological transformation requires structural changes across all dimensions of society, including the economy, politics, culture, technology, and values. However, its interpretation remains highly contested, reflecting a diversity of perspectives across various disciplines.

The key concepts of transformation and transition are often used interchangeably by different scholars and research communities, leading to conceptual ambiguity. Some attempts have been made to provide a heuristic distinction between the two. Transitions are characterized as more intentionally, top-down steered processes of change within existing political-institutional orders. In contrast, transformations are conceived of as all-encompassing socio-economic, political, and sociocultural shifts that challenge and contest predominant power relations and resist full control (Brand, 2014; Stirling, 2014). However, transition scholars might particularly object to this distinction (Hölscher et al., 2018). Addressing these conceptual tensions will be crucial for advancing the analytical clarity and practical relevance of research on sustainability transformations, fostering a more unified understanding that can guide both academic inquiry and real-world action.

As the concept of transformation remains highly contested in academic and political debates, the role of science in addressing these challenges is also evolving. The discourse surrounding transformation has gained momentum within inter-transdisciplinary research, particularly in the social sciences. There is a growing recognition that effective solutions require collaboration across fields, integrating insights from sociology, economics, environmental science, and political theory. Transformation is increasingly employed as a strategic driver for research aimed at addressing complex societal issues with science playing the role of informing and guiding the process. Scientists are increasingly tasked with not only providing empirical data but also engaging with policymakers to ensure that research aligns with real-world challenges. This engagement is crucial for developing actionable strategies that can lead to meaningful societal change. This evolution emphasizes a shift towards inter- and transdisciplinary approaches, with transformation research emerging as a crucial means for science to effectively contribute to societal change.

Giving this background, this project has four specific objectives:



Enhance conceptual clarity. It investigates how various socio-political, theoretical, and methodological approaches conceptualize transformative in response to global environmental change. This provides a more solid foundation for future empirical analyses.



Explore the role of science in transformation processes toward sustainability. It examines how selected Eurac Research projects are engaged in transformation research. This clarifies the competences, methods and theoretical frameworks used to explicitly or implicitly address transformation.



Analyzes how some South Tyrolian organizations working on social-ecological transformation conceive and aims to contribute so transformative change. It focuses on the experience of Climate Action South Tyrol.



Investigate the role of governance in shaping these transformative processes. It examines how the Climate Plan of South Tyrol enables or hinders transformative governance in times of climate crisis.

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The research approach we use to achieve the project objectives is structured around a selective review of the literature on theoretical approaches and concepts on transformation, which informs the investigation into how research, practice, and governance conceptualize and aim to contribute to transformative change. The literature informs the creation of a conceptual framework tailored for analytical purposes. The framework will be used to examine how research projects conducted at Eurac Research conceived transformation (e.g., theory used, methods applied) as well as to know more of how organizations in South Tyrol (e.g., Climate Action South Tyrol) aims to contribute to societal transformation. Empirical data on research will be collected through surveys and workshops. This will provide insights into diverse approaches to transformation, the challenges researchers face, the limitations encountered, thereby deepening our understanding of key mechanisms for an actionable contribution to societal transformation. Empirical data on practice will be collected via a workshop with local organizations aiming to contribute to transformation. Also, a policy analysis will be conducted to investigate how existing relevant policy documents, such as the Clima Plan South Tyrol, foster the streamlining of transformative governance.

The report is structured into eight chapters, addressing transformation in the research, practice and governance spheres. Chapter 2 introduces key theoretical concepts. Chapter 3 reflects on the role of research and researchers in facilitating social and ecological transformations toward sustainability as well as transdisciplinary approaches to transformation, primarily within the social sciences. Chapter 4

presents a conceptual framework useful to operationalize various concepts and approaches to transformation, preparing the ground for analytical examination. Chapter 5 investigates the transformative nature of projects conducted at Eurac Research, emphasizing how researchers' reflections were stimulated and presenting the resulting insights. Chapter 6, building on the findings from Chapter 5. Chapter 6, discuss the challenges inherent in transformation-focused research and outlines future research directions within the context of Eurac Research. Chapter 7 provides an overview of how organizations aim to contribute to societal transformation, using the climate action network in South Tyrol as a case study. Chapter 8 examines the role of governance in shaping societal changes. The report concludes by synthesizing the findings and reflecting on their implications for future research and practice.

## 2 Social-ecological transformation: unravelling a contested concept

Written by: Windegger Felix, Kircher Christoph, and Ilaria De March

Social-ecological transformation has become a central term in academic and policy debates, serving as an umbrella term to describe social, economic, and cultural shifts resulting from attempts to tackle the current social-ecological crisis (Brand & Wissen, 2017). Under this conceptual and epistemic framework, terms like deliberate transformation, progressive transformation, socioecological transition, sociotechnical transition, and green economy have gained increased prominence in recent years, aiming to provide a comprehensive understanding of ongoing global environmental change and offer impetus for social and political solution strategies (Feola, 2015).

Despite the increasing importance of these concepts and related debates, there is relatively little consensus around the conceptual basis of transformation. Different approaches rely on divergent, and sometimes even contrasting, theoretical perspectives and understandings of transformative change (Brand et al., 2013). Thus, to prevent social-ecological transformation from becoming a mere buzzword and enhance its analytical usefulness, a conceptual clarification is much needed.

This chapter aims to contribute to this effort by systematically analyzing and comparing the diverse ways in which the current social-ecological crisis has been addressed in both sociopolitical and academic debates.<sup>1</sup> Section 2.1 explores major sociopolitical approaches to transformation, framed within a newly developed systematization that provides clarity amidst the multitude of concepts. Subsequently, Section 2.2 focuses on academic approaches to transformation. After introducing four key classification criteria to illuminate core assumptions underpinning theories of transformation, five important theoretical clusters engaging with social-ecological transformation are identified and discussed in relation to these criteria.

### 2.1 Sociopolitical approaches to transformation

There is a longstanding tradition of social and political engagement with environmental crises, focusing on their connections to dominant development models and exploring potential solution strategies. In recent years, these debates have gained increased prominence, driven by the interconnected and multidimensional crises societies are grappling with today, including environmental degradation, social inequality, economic instability, and political tensions. Against this backdrop, this section examines the dominant sociopolitical approaches in the discourse on social-ecological transformation. These approaches reflect the ways in which political and societal debates, concepts, and initiatives have attempted to tackle the ongoing social-ecological crises. They are typically framed normatively and strategically, aiming to diagnose societal problems and propose effective and socially desirable solutions.

A shared premise among these sociopolitical approaches is the recognition that addressing the current crises requires some degree of social change. However, they diverge significantly in their visions of the desired type, scope, and depth of transformation, as well as in their normative orientations and underlying assumptions. This diversity results in a wide array of differing—and at times contrasting—analyses and solution proposals (Brand, 2012). In the following, a systematization of different types of

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<sup>1</sup> While the distinction between sociopolitical and academic approaches is analytically helpful, it is important to stress that it is by no means clear-cut. In fact, social and political debates are often inspired by and rooted in academic findings and discourses, while scientific practices and outcomes are always embedded in and influenced by their social and political context.

sociopolitical approaches to transformation is introduced and helps to shed light on the differences and similarities among them. Table 1 presents an overview of these approaches along with illustrative examples for each of the categories.

Table 1. Overview of sociopolitical approaches to transformation. Source: Own elaboration

Strategies of conversion		Strategies of control	
They aim to tackle the (assumed) root causes of contemporary social-ecological crises.		They aim to control the effects—either directly or indirectly—of contemporary social-ecological crises.	
<b>Modernization</b>	Adjustment of specific elements of the current prevalent institutional framework.	<b>Adaptation</b>	Strengthening the capacity of social subsystems to cope with stresses and shocks.
	Examples: Green growth, European Green Deal, German “Energiewende”		Examples: Urban resilience planning, soil nutrient management
<b>Refoundation</b>	Break with hegemonic development model and search for radical alternatives.	<b>Intervention</b>	Interference with geo-physical and biochemical earth processes to reduce negative effects.
	Examples: Degrowth, Ubuntu, Buen Vivir, commons-based approaches		Examples: Geoengineering, planetary management, synthetic biology

### 2.1.1 Strategies of conversion

Strategies of conversion involve social and political approaches to transformation that address global environmental crises, such as climate change and biodiversity loss, as well associated societal problems, by *tackling their (assumed) root causes* and changing—to varying degrees—elements of the predominant societal structures, practices and imaginaries. However, since the assumed causes of the problem, as well as the nature and scope of the desired change vary considerably between approaches, a further distinction is necessary. On the one hand, there are more reformist strategies of *modernization* and on the other, more radical visions of societal *refoundation*.

*Modernization* strategies seek to address the socioecological crises by selectively adjusting specific elements of predominant structures and institutions. It largely relies on currently prevalent paradigms and development models. Rather than fundamentally altering existing structures—such as liberal democracy or market capitalism—or cornerstones of the modern lifestyle—such as individualism, consumption or prosperity—programs dedicated to sustainable modernisation aim to utilise and adapt these structural institutions in terms of an ecological renewal (Adloff & Neckel 2019). Specifically, modernization strategies primarily trust in market-based instruments (e.g., carbon pricing, emissions trading, financialization of nature), technological innovations (e.g., renewable energy, energy-efficient buildings, electric mobility) and behaviour-related solutions (e.g., awareness raising, information campaigns, and calculation of individual carbon footprints) to bring about the desired change. Today, strategies of modernisation are championed by many large inter- and transnational organisations like the Organisation for Economic Co-operation and Development (OECD, 2011), the United Nations (United Nations Environment Programme [UNEP], 2011), and the World Bank (Hallegatte et al., 2011), but also political institutions at various levels such as the European Union (European Commission, 2010).

Prominent examples of modernization strategies are the concept of a *green growth*, the German *Energiewende*, and the *European Green Deal*. The European Green Deal, for instance, is a package of policies, measures, laws and investments promoted and coordinated by the European Commission aiming at drastically reducing CO<sub>2</sub> emissions in the European Union and achieving a net-zero emissions economy by 2050. To achieve this, a wide array of measures is employed, including market-based instruments such as emission trading schemes and carbon taxes, information campaigns and investments in the development of green technologies, all of which while fostering the competitiveness of the European economy and sustaining further economic growth. Typical of ecological modernization strategies, the European Green Deal neither challenges the incumbent institutional structure nor the existing development model. Instead, it operates on the assumption that the current economic system, along with its associated practices, structures and imaginaries, provide the appropriate framework to address the ongoing social-ecological crises. The underlying premise is that current social, political and economic regulations and institutions can be sufficiently adjusted to address environmental challenges without fundamentally transforming the system itself.

*Refoundation strategies*, on the contrary, aim to tackle the assumed causes of global environmental change by breaking with currently prevalent social forms and hegemonic development models and searching for radical alternatives. Examples are *Buen Vivir*, *Ubuntu*, *commons-based approaches* and *degrowth*. Different to modernization approaches, visions of refoundation are often strongly rooted in social movements, civil society initiatives, and critical academic discourses. These actors have criticized modernization strategies for failing to address the deeper structural causes of environmental degradation, such as the growth-oriented capitalist economic model and the unequal distribution of resources and power. They argue that, therefore, the conception of transformation as ecological modernization is insufficient for confronting the ecological, social, and economic challenges posed by the current global crises. Based on this diagnosis, debates have emerged both in the Global North and the Global South advocating for transformation as a process of structural change towards a non-competitive and non-growth based social order and radically redefined human-nature relationships (Adloff & Neckel 2019).

*Degrowth* serves as a compelling example of refoundation strategies, encompassing both a social movement and an interdisciplinary research field aimed at addressing the current multiple crises through a fundamental restructuring of capitalist economies and the socio-economic and cultural relationships they foster (Latouche, 2009; D'Alisa et al., 2014). As the term implies, degrowth advocates challenge the paradigm of growth-based economies, particularly the notion that increasing GDP is an adequate measure of well-being and quality of life. In addition, based on empirical evidence, proponents of degrowth reject the idea of absolute decoupling between economic growth and ecological impact, arguing instead for a substantial reduction in material and energetic throughput in affluent economies of the Global North. This shift seeks to establish an environmentally sustainable post-growth society rooted in the principles of justice, democracy, and well-being (Fitzpatrick et al., 2022). Importantly, the critique inherent in refoundation strategies like degrowth extends well beyond the economic domain. Especially in non-Western paradigms such as *Buen Vivir*, decolonialism, and *Ubuntu*, these strategies call for a fundamental rethinking of social relations, dominant rationalities (e.g., Western, utilitarian approaches), and human-nature relationships. Rather than advocating for incremental reforms within existing institutional frameworks, refoundation strategies thus pursue a radical transformation of the prevailing system, targeting its underlying structures, practices, and imaginaries.

### 2.1.2 Strategies of control

Within the social and political discourse on social-ecological transformation, not all approaches are oriented towards the causes of the ecological crisis. Instead, some approaches attempt to address global environmental change along with its related societal problems, by *controlling its effects*, and changing societies and communities accordingly. These strategies of control primarily strive to develop tools, knowledge and infrastructures to preserve social subsystems, either in anticipation of or in

reaction to disasters, rather than trying to prevent those disasters altogether. Like strategies of conversion, strategies of control encompass a wide range of approaches, making it useful to further distinguish between those emphasizing *adaptation* and those sketching possibilities for *intervention*.

*Adaptation* strategies aim to adjust to actual or expected effects of ecological crises such as climate change. This implies a rather *indirect* way of controlling its effects, that is, by increasing the capacity of social subsystems to cope with them. Using the climate crisis as an example, there are both incremental notions of adaptation and more transformative approaches. The former involve mostly marginal changes and reorganization in specific sector's infrastructure, institutions and practices, without causing major systemic disruptions. Often, these can be conceptualised as extensions of actions and practices that are already reducing the negative impacts of variations in climate and extreme events (Kates et al., 2012; Zant et al., 2024). As incremental approaches to adaptation do not directly address the causes of climate change, it can be argued that they pursue resilience rather than genuine sustainability (Adloff & Neckel, 2019). The notion of resilience describes the capacity of an ecological or social system to react to immediate stresses and shocks, as well as to their socio-economic and geopolitical consequences, by changing some aspects while maintaining its original structures and mechanisms (Berkes et al., 2002; IPCC, 2022).

While incremental adaptation strategies consider only proximate causes of risks without tackling the structural causes that generate the vulnerability of a system, more recent, so-called transformative adaptation approaches try to go beyond this. With reference to climate change, they explicitly aim to foster the potential for wider transformations and open new and more inclusive development pathways as well as a more sustained reduction of climate vulnerability (Engbersen et al. 2024; Few et al. 2017). However, the distinction between incremental and transformative adaptations is not always straightforward, and they are often difficult to categorize as strictly one or the other. For instance, incremental adaptations sustained over a long enough time, can lead to transformational cumulative effects. Practical examples of climate change adaptation strategies can be found in the agricultural sector. Facing increasing stresses such as droughts, heatwaves and floods due to climate change, specific measures have been introduced including soil nutrient management, adjustment in tillage practices, crop selection and rotation, changes in water management and agricultural diversification—all of which are aimed at enhancing resilience to future environmental shocks (Anderson et al. 2020; Hellin et al. 2023).

*Intervention* strategies aim to *directly* mitigate the effects of global environmental change by modifying geo- and biophysical processes to reduce or prevent these impacts. Unlike localized measures, these strategies often have a global scope and can produce irreversible consequences. A prominent example is geoengineering, which involves deliberate human intervention in Earth's biogeochemical systems to counteract global warming. Geoengineering encompasses two primary categories: Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM). CDR focuses on extracting CO<sub>2</sub> from the atmosphere through techniques such as afforestation, direct air capture, and ocean fertilization, aiming to reduce greenhouse gas concentrations. SRM, on the other hand, involves radiation interventions designed to cool the planet, such as injecting aerosols into the stratosphere to reflect sunlight back into space.

Despite the significant uncertainties and potential irreversible consequences associated with these technologies, geoengineering has gained growing attention and financial support from governments, research institutions, private companies, and philanthropic organizations. However, geoengineering and similar interventions raise profound ethical and political concerns. They risk undermining democratic processes by framing climate policy decisions as technical necessities best handled by experts, by passing the inclusive deliberation and debate that are essential to democratic governance. Furthermore, the reliance on technological solutionism—the belief that complex societal and ecological problems can be effectively solved through technology alone—risks oversimplifying the interconnected nature of the climate crisis and ignoring critical social, political, and cultural dimensions.

## 2.2 Academic approaches to transformation

In addition to the political-strategic approaches, also academic discussions on social-ecological transformation have received increased attention in the past years. Unlike sociopolitical strategies, academic approaches primarily focus on analytical-descriptive frameworks aimed at analyzing, evaluating, and explaining past and present processes of societal change (Brand, 2014). Nonetheless, normative-prescriptive elements and assumptions are also embedded in these approaches, albeit to varying degrees.

Despite the diversity of academic contributions, most share several key features: (a) an emphasis on profound, wide-ranging societal change that extends beyond incremental adjustments or isolated policy interventions; (b) a recognition of transformations as non-linear, complex processes occurring within dynamic and multidimensional systems; and (c) the understanding that technological innovation, while necessary, is insufficient on its own to achieve social-ecological transformation, which also demands social and cultural innovation (Brand & Wissen, 2017).

To systematize the extensive body of scholarly work on social-ecological transformation, we have categorized these contributions into five theory clusters, summarized in Table 2 alongside key information about each. Before delving into a detailed discussion of these clusters in Section 2.2.2, the following section introduces four analytical classification criteria to help understand, assess, and compare these approaches.

Table 2. Overview of academic approaches to transformation. Source: Own elaboration.

	<b>Transition studies</b>	<b>Social metabolism</b>	<b>Socio-ecological systems</b>	<b>Applied social science approaches</b>	<b>Critical theories</b>
<b>Key publications</b>	Geels (2002); Grin & Schot (2010)	Haberl et al. (2011); Fischer-Kowalski (2011)	Holling (2001); Ostrom (2009); O'Brien (2012)	Shove et al., (2012); Leach et al., (2007); Beck et al., (2021)	D'Alisa et al., (2014); Perreault et al., (2015); Brand & Wissen, (2021)
<b>Disciplinary background</b>	Innovation studies; management studies	Social ecology; systems theory; ecological economics	Ecology; environmental economics	Sociology; science & technology studies; development studies	Political economy; critical theory; postcolonial studies; political ecology
<b>Focus of analysis</b>	Innovation; multi-level governance	Socio-metabolic regimes; historical developments	Resilience; adaptation; system dynamics; resource management	Social practices and structures; imaginaries and discourses	Power relations; inequalities
<b>Methodological strategy</b>	Case study; institutional analysis	Material flow analysis	Modelling; accounting	Empirical social research	Critical and historical analysis and deconstruction

<b>Example of research centres and networks</b>	Sustainability Transitions Research Network (STRN)	Institute of Social Ecology (SEC) at Alps Adria University	Stockholm Resilience Centre	Social, Technological and Environmental Pathways to Sustainability Centre (STEPS) at the University of Sussex	Research & Degrowth (R&D)
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### 2.2.1 Classification criteria

To highlight commonalities and differences among academic conceptions of transformation, four analytically relevant differentiation criteria have been identified: (a) the social ontology, (b) the main driver of change, (c) the controllability of change, and (d) the trajectory of change. For each criterion, we outline key characteristics derived from a comprehensive review of the literature. This approach clarifies the underlying assumptions within and across various theories, shedding light on the diverse perspectives that shape scholarly understandings of social-ecological transformation.

#### Social ontology

Social ontology refers to the foundational understanding of society that underpins any engagement with transformation. At its core, the concept acknowledges that *what* is to be transformed is, ultimately, society itself—or at least specific aspects of it. This understanding of society may be explicitly articulated or implicitly embedded within the theoretical framework. When implicit, an underlying conception of society still informs the approach, shaping its basic assumptions and theoretical considerations even if unexpressed. Three main conceptions of society can be distinguished in this context: methodological individualism, methodological holism, and methodological rationalism.

The fundamental premise of *methodological individualism* is that society does not exist as an independent entity but is merely the aggregation of individual decisions and behaviors. This perspective raises questions about how and why individuals make specific decisions or act in certain ways. Societal structures and systems, while acknowledged, are considered secondary and typically regarded as contextual backdrops or sources of information for individual decision-making. Key concepts associated with this view include behavior, rationality, action, individual agency, and information (Elster, 1989; Boudon, 2003).

In contrast, *methodological holism* suggests that society exists as an entity and can only be analyzed in its totality. In this view, the whole is greater than the sum of its parts, as the relationships and interactions among individual components (e.g., individuals or institutions) are shaped by overarching societal structures and systems rather than by the components themselves. Key terms tied to this perspective include social structure, social systems, functional systems, and historical development (Durkheim, 1982; Giddens, 1984). This approach emphasizes the primacy of collective phenomena over individual actions in understanding social dynamics.

*Methodological relationalism* offers a third perspective, asserting that society cannot be fully understood either as a whole or as the sum of its parts. Instead, it focuses on the intermediary structures and processes that exist between individuals and societal systems. These intermediary elements include formal and informal social relations, institutions, organizations, and networks (e.g., social capital and actor-networks). Relational approaches highlight the situated and contingent nature of social dynamics, emphasizing the importance of context-dependent processes and interactions. Core concepts associated with this framework include relations, situations, processes, practices, and norms

(Emirbayer, 1997; Bourdieu, 1990). Unlike individualistic and holistic approaches, rationalism accentuates the dynamic interplay between micro- and macro-level social phenomena.

### Driver of change

In addition to maintaining a particular concept of society, academic approaches to transformation also rely on assumptions about *who* or *what* is capable of effecting societal change. Broadly speaking, three categories of "actants"<sup>2</sup> driving transformation can be distinguished: technical innovations, institutional changes, and new ideas (Schneidewind & Augenstein, 2016).

Social change has historically been closely associated with technical innovations. For instance, some trace the rise of capitalist societies to the invention of the steam engine, while the achievements of modernity are often attributed to technological progress and the power of instrumental reason. In this context, factors influencing innovations such as investment in research and development, access to resources, human capital, and governance, are viewed as critical drivers of social change (see Mokyr, 1990; Rosenberg, 1982; Bijker, 1995; Hughes, 1987).

However, one could argue that technological progress is contingent upon the institutional framework in which it operates. For example, new technologies may struggle to prevail if incumbent actors restrict market access or investment opportunities due to their entrenched positions of power. Moreover, institutional frameworks are shaped by decisions made within specific structures and processes. As a result, sustainable and lasting societal change can only occur in environments where institutional decisions—such as those related to governance, laws, contracts, or conventions—can be made effectively (see North, 1990; Acemoglu & Robinson, 2012; Scott, 1995; DiMaggio & Powell, 1983). In line with this reasoning, some academic perspectives emphasize institutional changes as the primary driver of transformation.

Nevertheless, both technological and institutional changes are often catalyzed by the emergence of *new ideas*. It is through the diffusion of new visions, values, or ideas that the boundaries of what is possible are expanded, thus creating space for broader forms of change (Tarde, 1998). The steam engine, for example, was not just a technological innovation but also linked to the idea of a new production model. Similarly, institutional regulations are frequently shaped by new ideas that generate the "will to transform." Crucially, new ideas are rarely the product of a single individual; instead, they emerge from collective processes, functioning as social forces that drive change (see Kuhn, 1970; Foucault, 1972).

### Trajectory of change

In addition to identifying what is to be changed and who or what triggers this change, any comprehensive theory of transformation must also address *how* this change unfolds. Specifically, social change can be characterized as incremental, radical, or dynamic, each representing different patterns of transformation.

*Incremental change* refers to gradual, steady shifts in society's norms, values, and practices. It involves small adjustments or improvements to existing systems, policies, or practices over time, often pursued through reformist approaches. In this trajectory, stability is preserved while specific issues or challenges are addressed within the existing framework (see Streeck & Thelen, 2005; Mahoney & Thelen, 2010).

In contrast, *radical change* entails a fundamental and comprehensive shift in societal structures, ideologies, and power dynamics. This form of change challenges and often replaces the core aspects of the existing social order, typically through revolutionary or disruptive means. Radical change affects most, if not all, dimensions of society and establishes a new system that is markedly different from the previous one (see Marx, 1867; Della Porta & Diani, 2006).

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<sup>2</sup> The term actant, used in the sociological context of the Actor-Network Theory, describes any entity that can be a source of action. An actant is not necessarily a human entity, but it includes plants, animals, natural forces as well as human artifacts.

*Dynamic change*, on the other hand, emphasizes the complex and nonlinear nature of societal transformation. This perspective highlights the existence of critical junctures, where small changes can trigger significant, sometimes unpredictable, shifts in the social order. Dynamic change also draws attention to the importance of trajectories and attractors—factors that can guide the course of societal evolution and shape the direction of future transformations. This approach underscores the dual nature of change, as it can unfold in both abrupt and incremental ways, driven by the interplay of complexity and critical tipping points within the transformation process (see Grin et al., 2010; Castellani & Hafferty, 2009).

### **Controllability of change**

In contrast to traditional historical concepts of social change, academic approaches to social-ecological transformation are particularly concerned with the degree to which current processes of change can be controlled or planned to achieve pre-established normative goals. This raises the critical question of whether normative ideas of transformation can be fully implemented as envisioned, or whether the inherent contingency of these processes renders forward-looking planning unfeasible. In this context, three types of control over transformation can be distinguished: full control, limited control, and low control.

The first stance, which assumes *full control*, suggests that those tasked with implementing transformation projects have substantial authority over social change processes. Deviations and unforeseen incidents are expected to be addressed through adjustments, bringing the transformation in line with the desired objectives. Under this view, even large structural shifts are considered within the realm of possibility. Full control typically aligns with a top-down approach to governance, where decisions are centralized and actively enforced (see WBGU, 2011).

A second perspective posits that while those implementing transformation projects exert some influence over social change, the complexity of the issues at hand significantly limits their ability to shape outcomes fully. This position can be described as *limited control*. The underlying premise is that social change involves multiple interconnected factors and a diverse array of actors, making it difficult to address all dimensions comprehensively. While governing bodies can initiate and guide change, the dynamic and unpredictable nature of complex social systems may lead to unintended consequences—such as negative feedback loops—or resistance from various stakeholders, due to differing system logics. Nonetheless, effective governance, informed by a deep understanding of these complexities, can still yield substantial desired changes by targeting small but critical leverage points that may be amplified through positive feedback loops (see Wilke, 1989).

A third viewpoint suggests that transformation plans can only be implemented under specific conditions and with considerable difficulty, implying *low control*. Two main reasons are often cited for this: first, the inherent contingency and unpredictability of social change processes require that transformation plans be continuously revised or, in some cases, even abandoned; second, entrenched structures and power dynamics within social fields often present significant obstacles, causing transformation plans to either be abandoned or diluted to the point that the original goals can no longer be achieved. From this perspective, social change is seen as more dependent on a few contingent, disruptive events that are difficult to control, thus only partially aligning with normative transformation visions (see Blühdorn et al., 2020).

### **2.2.2 Theory clusters engaging with transformation**

The following section presents five theory clusters, identified through an extensive review of the academic literature on social-ecological transformation and grouped based on shared family resemblances. Some of these clusters are more established and coherent, such as transition studies and social metabolism, while others—particularly applied social science approaches and critical

approaches—are more loosely connected, often only sharing common methodological, theoretical, or normative orientations.

After introducing the clusters, each will be discussed in relation to the four classification criteria outlined in paragraph 2.2.1 (Chapter 2). However, this process is inherently complex due to the heterogeneity within the clusters, which encompasses variations both among coexisting research fields and communities, as well as shifts between early theoretical positions and subsequent developments. Consequently, a definitive, clear-cut classification based on the ideal-typical positions presented is often not achievable. In this context, Table 3—which seeks to outline characteristics for each theory cluster—should be interpreted with caution, acknowledging the nuanced and dynamic nature of these frameworks. Nevertheless, these differentiating features provide a valuable foundation for systematically reflecting on how various academic approaches interpret the nature and dynamics of transformation, highlighting both key distinctions and areas of convergence.

Table 3. Overview of theory clusters and classification criteria. Source: own elaboration.

	Transition studies	Social metabolism	Socio-ecological systems	Applied social science approaches	Critical theories
Social ontology	Relational	Holistic	Holistic (Resilience) Individualistic (Transformative adaptation)	Relational	Holistic
Main driver of transformation	Technical innovation (Transition management) Institutional change (Multi-level)	Institutional change	New ideas	New ideas	New ideas
Trajectory of change	Incremental (Transition management) Dynamic (Multi-level)	Dynamic	Dynamic (Resilience) Radical (Transformative adaptation)	Incremental	Radical
Controllability of change	Limited	Low	Limited (Resilience) Full (Transformative adaptation)	Limited	Limited

### Transition studies

The cluster of transition studies constitutes a well-established interdisciplinary research field that examines the societal and institutional dimensions of transitions, as well as the role of technological and social innovation (Grin et al., 2010; Köhler et al., 2019). Approaches within this cluster draw on diverse

disciplines, including innovation studies, management studies, science and technology studies, economics, sociology, environmental science, and policy analysis. This interdisciplinary perspective is considered essential for comprehending the complex nature of societal change. Typically, transition studies take a rather long-term view, investigating both historical transitions—such as the Industrial Revolution—and contemporary shifts like the ongoing shift towards sustainable energy systems—, which can span decades or even centuries.

A central theoretical framework within transition studies is the *multi-level perspective*, which posits that transitions towards sustainability typically emerge from societal "niches," spread to the level of "regimes" (i.e., institutional structures), and ultimately influence "landscapes" (i.e., social, political, economic, and cultural contexts) (Geels, 2002). While radical innovation is thought to originate mainly within niches, changes at the meso-level of regimes tend to occur more incrementally, influenced by path dependencies and lock-in effects. The interaction between these three levels is crucial for sustainability transitions, which are defined as "long-term, multidimensional, and fundamental transformation processes through which established sociotechnical systems shift to more sustainable modes of production and consumption" (Markard, Raven, & Truffer, 2012, p. 956). Another important approach within this cluster is *transition management*, which seeks to apply insights from transition research to guide the governance of specific reform processes (Loorbach et al., 2017). Transition management emphasizes collaboration and learning among actors, advocating for governance that shapes cultures, structures, and innovations to accelerate transitions toward sustainability and resilience. Given the complexity and uncertainty of transition processes, traditional command-and-control strategies are viewed as ineffective.

In relation to the classification criteria introduced in the previous section—social ontology, driver of change, trajectory of change, and controllability of change—transition management and the multi-level perspective (MLP)—two of the main approaches within transition studies—offer distinct but complementary perspectives. In terms of social ontology, transition management conceptualizes society as a complex system, emphasizing the interconnectedness of various social, economic, and environmental subsystems, with a focus on governance structures and institutional frameworks. Similarly, MLP views society primarily as an institutional field, or regime, where established practices, technologies, and norms define how social systems operate. While transition management underscores the importance of institutional change as the primary driver of change—such as changes in governance structures, regulations, and policy frameworks—, MLP puts more emphasis on technological innovation. Such innovations are seen as the focal point for transformative change, though they interact with broader institutional structures and external socio-political and economic factors that may either support or impede their spread. Transition management assumes that the trajectory of transformation is dynamic, with the process unfolding in complex, often unpredictable ways. Change is viewed as non-linear, influenced by the interplay of various social, political, and technological factors. The trajectory of change is thus contingent on the interactions and feedback loops between institutional and socio-ecological systems, and therefore, it is not entirely foreseeable. In contrast, MLP often assumes that change within established regimes happens gradually, particularly due to the presence of path dependencies and lock-in effects that tend to slow down radical transformation. MLP argues that transitions occur incrementally, starting with innovations in niches that slowly penetrate and destabilize regimes. However, the pace and extent of change can vary, with some changes being more rapid (e.g., when new technologies disrupt existing systems) and others unfolding more slowly over time. In transition management, the controllability of change is seen as limited. While governance bodies and other actors can influence the course of transformation through policy and strategy, the complex and dynamic nature of the systems involved means that full control is impossible. MLP instead assumes that transformation is subject to varying degrees of control. In some cases, control may be more limited, while in other contexts—such as *strategic niche management*—there may be a higher degree of control, particularly when innovation is deliberately nurtured through targeted policies and investments to accelerate its diffusion.

Overall, the key strength of transition studies lies in its ability to conceptualize and describe transformation as a process, offering rich insights into the dynamics of change over time. By analyzing

how shifts unfold through interactions across different levels of society—niches, regimes, and landscapes—this field provides a robust framework for understanding the mechanisms driving long-term societal transformations. However, this strength is closely tied to one of its limitations: the field's reliance on ex post analysis. Most studies focus on historical transitions that have already occurred and, more specifically, on cases deemed successful, such as the Industrial Revolution or the energy transition in certain contexts (Geels 2019). This retrospective orientation creates a gap in theoretical tools for analyzing ongoing transformation efforts or understanding the reasons behind the frequent failure of such initiatives.

### Social metabolism

The concept of social metabolism, primarily associated with social ecology, draws an analogy between the way living organisms metabolize nutrients and how human societies extract, process, consume, and waste resources. A key methodology in studying socio-metabolic interactions is Material and Energy Flow Analysis (MEFA), which tracks resource inputs, transformations, and outputs in a society (Haberl et al., 2021). By examining the nexus between resource stocks and flows, researchers can assess whether societies are operating within ecological limits or exceeding them. Social metabolism, especially when applied to historical analysis, traces patterns of resource use, energy consumption, and waste production across different societies and time periods. This historical perspective provides valuable insights into the evolution of human-nature relations and the environmental impact of societal development (Haberl et al., 2016). Prominent transformation approaches in this family include *social ecology* and *metabolic rift*.

The social ecology approach provides a distinct perspective on the relationship between society and its environment. Its understanding of society is rooted in a clearly articulated social ontology, drawing from Niklas Luhmann's sociological theory of social systems (Hausknost et al., 2016). Society is conceptualized in a holistic way as a self-referential system that interprets and interacts with its environment through language and communication, rather than only through material or quantitative exchanges. This mediation through semantics distinguishes social ecology from other systems theories that often analogize social and ecological systems or adopt a purely quantitative lens focused on material flows. Regarding the driver of change, the social ecology approach emphasizes the structural and communicative dimensions of social systems. Rather than attributing transformation to external factors such as technological or institutional innovations, it highlights the role of internal system logics and language-mediated interactions in shaping societal responses to environmental pressures. While material flows and resource use are analyzed through tools like Material and Energy Flow Analysis (MEFA), the focus on semantics suggests that transformation depends on how societies interpret and assign meaning to their ecological contexts. In terms of the trajectory of change, the social ecology approach posits that transformation is fundamentally dynamic. Change unfolds through the complex interplay of self-referential subsystems that are resistant to external control due to their distinct functional logics. This dynamic nature reflects the non-linear, emergent characteristics of transformation processes, where outcomes cannot be easily predicted or directed. The approach also has a clear stance on the controllability of change, assuming that direct control over societal transformation is inherently low. Because social systems operate based on their internal logics, external interventions—particularly top-down strategies—often fail to achieve their intended goals. Instead, transformation efforts must be selective and indirect, focusing on setting enabling conditions such as regulatory frameworks, incentive structures, and targeted policies. These measures aim to influence practices in ways that align with desired transformation outcomes without assuming full control over the process.

In sum, the social metabolism approach excels at identifying and analyzing the systemic patterns of resource use and environmental interaction, offering practical avenues for targeted regulations and incentive structures. However, its reliance on abstract models of material and semantic processes often sidelines the role of social actors, presenting a significant limitation in addressing how transformative change is deliberately initiated and sustained. In response, newer approaches within this framework increasingly incorporate transdisciplinary and participatory methods to engage social actors actively in

transformation processes (Haberl et al. 2016). Despite these advances, the theoretical relationship between social systems and individual actors remains underexplored, leaving a critical gap in fully understanding and operationalizing transformative change.

### Socio-ecological systems

The concept of Socio-Ecological Systems (SES) offers a comprehensive framework to analyze the complex and reciprocal relationships between human societies and natural environments. It emphasizes the interdependence of social and ecological systems, recognizing that human actions significantly impact ecosystems, which in turn influence societal outcomes. Central to SES theory is the concept of adaptability, highlighting the capacity of both social and ecological systems to absorb disturbances, reorganize, and continue functioning amid change. The framework also incorporates cross-scale interactions, illustrating how localized actions can cascade into broader systemic effects, while feedback loops are explored to understand how changes can be amplified or mitigated (Berkes et al., 2002). SES theory frequently employs concepts such as *hierarchy* or *panarchy*, which describe how systems evolve through cycles of growth, collapse, and reorganization (Gunderson & Holling, 2002). This holistic approach informs strategies aimed at promoting resilience and sustainability in interconnected socio-ecological systems.

Within this framework, two transformative approaches stand out: *social-ecological resilience* and *transformative adaptation*. Social-ecological resilience focuses on a system's ability to withstand shocks, adapt, and reorganize without losing core functionality (Olsson et al., 2014; Walker et al., 2004). In contrast, transformative adaptation addresses changes that fundamentally reconfigure both the ecological and social dimensions of a system (Fedele et al., 2019; Kates et al., 2012). Approaches within the SES framework are characterized by an evolving and ambivalent concept of society that reflects varying perspectives on its ontology, drivers of change, trajectory, and controllability. On one hand, classical SES approaches, such as *social-ecological resilience*, conceptualize society as analogous to ecological systems, focusing on quantitative interactions like resource flows and institutional frameworks. These models emphasize incremental or dynamic changes, often driven by feedback loops between social and ecological components and assume limited control due to the complexity of system behaviors. On the other hand, newer SES approaches, such as *transformative adaptation* and *deliberate transformation* foreground the role of societal values, visions, and participatory decision-making, viewing society as the aggregation of individual decisions and actions (O'Brien 2012). These approaches advocate for radical transformation pathways, driven by normative shifts, social movements, and collective human agency, while envisioning greater potential for control and intentional steering of change processes.

The SES framework offers significant strengths in analyzing the intricate interdependencies between human societies and natural environments. Its systemic perspective provides a valuable tool for understanding the complexity of socio-ecological interactions, particularly through concepts such as adaptability, cross-scale interactions, and feedback loops. Additionally, the framework's inclusion of concepts like *panarchy* and *regime shifts* enhances its capacity to explore the dynamics of transformation. However, the SES framework's emphasis on systemic processes often abstracts societal dynamics, sidelining the role of individual agencies and social actors. While newer approaches attempt to address this by incorporating participatory and normative dimensions, in doing so, they tend to abandon the systemic perspective altogether, leading to problematic theoretical inconsistency and fragmentation.

### Applied social science approaches

In addition to the more established theory clusters previously discussed, there are several other seemingly distinct approaches to transformation that, despite their diverse intellectual foundations, share common theoretical and methodological assumptions. These approaches, which have a distinctly social science focus, utilize traditional social science methods to empirically explore processes of change. A prominent example is practice theory (Reckwitz, 2002), but also other frameworks such as

Pathways to Sustainability (Leach et al., 2007) and socio-technical imaginaries (Beck et al., 2021) can be attributed to this cluster.

Approaches in the tradition of practice theories share a perspective that focuses on understanding human activity and social phenomena through the lens of everyday practices (Reckwitz, 2002). At its core, practice theories suggest that our lives are composed of a multitude of practices—routine activities, habits, and actions that we engage in repeatedly. These practices are not isolated but are interconnected and embedded within wider social, cultural, and material contexts. The recognition of these specific contexts is crucial for designing effective sustainability interventions that consider local conditions and realities. In the realm of sustainability, practice theory is helpful to abandon the idea that individuals, with their decisions and intentions, bear the full responsibility of societal transformation (Shove 2010). In this regard, Elizabeth Shove's work offers several relevant insights and contributions. Her approach highlights that practices are fundamental to our daily lives and are also central to shaping our environmental impact. (Un)sustainable modes of action are often the result of certain practices, such as commuting, cooking, or consuming goods, which can have significant ecological consequences. According to Shove et al. (2012), practices are composed of three key elements: materials, competences, and meanings. Materials refer to the physical resources and objects required for a practice (e.g., a car for commuting). Competences involve the skills and knowledge needed to perform the practice (e.g., driving skills). Meanings encompass the cultural and social significance attached to a practice, including its norms and values (e.g., the meaning of owning a car for status). Shove's perspective acknowledges that practices are not static; they can change over time. It underscores the interconnectedness of practices and their potential to reinforce or disrupt one another. For example, a shift toward sustainable transportation practices can impact related practices like urban planning and energy use (Shove & Walker 2010). From a practice theory perspective, to promote sustainability, it is essential to identify pathways for changing or transitioning practices: this might involve shifting the materials used, altering competences, or redefining the meanings associated with a practice (Hargreaves, 2011). Practice theories encourage a systemic view of sustainability: they recognize that sustainability challenges are often deeply embedded in complex structures involving various practices, technologies, infrastructures, policies, and cultural norms. Addressing these challenges requires considering the broader structure in which practices are situated. Practice theories have implications for the design of sustainability policies and interventions: instead of solely targeting individual behaviour change, they suggest that policies should address the material, semantic and structural factors that influence practices (Shove, 2014). This might involve changing regulations, providing alternative materials or technologies, or reshaping cultural meanings.

A second approach is the Pathways to Sustainability framework, developed by the Social, Technological and Environmental Pathways to Sustainability (STEPS) Centre at the University of Sussex (UK), an interdisciplinary research and policy hub that has been stressing the need for research and active engagement addressing critical issues within the field of socio-ecological transformation (Leach et al., 2007). Building on insights from both development studies and science and technology studies, it advocates for a collaborative, transdisciplinary approach, where various types of expertise are brought together to create broader and more open knowledge. Following this approach, scientists and practitioners should take on roles that emphasize facilitation and collaboration rather than just knowledge production. Transformation labs provide examples of how such approaches can empower communities and promote more just and sustainable development. The Pathways approach underscores the importance of considering multiple pathways for achieving sustainability, recognizing that diverse institutional and infrastructural changes are necessary to address various sustainability ideas and values. Furthermore, it emphasizes the need for new forms of deliberation among different actors, considering not only diverse ideas but also differing norms, interests, and practices. Taking politics seriously thus is interpreted as understanding that dealing with diverse contexts and perspectives is inherently political and requires equitable collaboration to make also marginalized perspectives visible. It is thought to involve negotiating among different knowledge systems, interests, and actors, which always also involves power dynamics and inequalities.

Practice theories and the Pathways to Sustainability approach share some commonalities regarding the four classification criteria but also exhibit notable differences. Practice theories are grounded in methodological relationalism: social practices can neither be reduced to social structures nor to individual decisions but are to be situated at an intermediate level. What matters are the relations between social and cultural dispositions, material and technological infrastructure, bodies and sensations, ways of doing and saying and so on. Drivers of transformations of social practices are assumed to be new visions, ideas, norms or values, which are incorporated into daily practices in the context of historical processes of change. Practice theories further assume that because of the latency of the social, processes of change are necessary incremental and controllable only to a limited degree. While acknowledging that political institutions, economic systems, and technical infrastructures shape concrete possibilities, advocates of the Pathways approach stress the agency of actors to create opportunities, often through unexpected alliances or social innovation. This implies an enabling approach (Scoones et al., 2020) that underscores the need for negotiation, contestation, and alliance-building. By embracing diverse knowledge, dominant policy narratives can be questioned and possibilities for change expanded beyond technological and policy fixes. In this vein, also strategic partnerships between activists, state actors, and businesses are thought to be capable of contesting established pathways and creating new opportunities for change. The Pathways approach operates at the meso-level of methodological relationalism. It acknowledges structural limitations, but at the same time identifies possibilities for action, not for single individuals, but in terms of tactical alliances and political coalitions. Correspondingly, drivers of change are located primarily in bottom-up processes, i.e., in new visions and ideas.

### Critical theories

A fifth family of approaches can be found in the academic literature on transformation, encompassing frameworks that critically examine the relationship between society and nature, with a focus on understanding and addressing the deep changes required to build more sustainable and just societies. These approaches are called "critical" because they explicitly challenge existing power structures, economic systems, and cultural norms, which they view as key drivers of environmental degradation and social injustices. Like the applied social science approaches, these critical perspectives do not provide formal theories of transformation in a strict sense, as they do not outline a clear, theoretical process for societal transformation. However, they offer important and influential viewpoints within the broader discourse on socio-ecological transformation. Notable examples of such critical approaches include political ecology, degrowth, and contributions from political economy such as the concept of the "imperial mode of living" (Brand & Wissen, 2021).

*Political ecology* is an interdisciplinary field that critically examines the complex relationships between political, economic, social, and environmental factors (Perreault et al., 2015). Its proponents argue that environmental issues are not solely ecological or scientific but are deeply intertwined with human societies, cultures, and politics. Political ecology places a strong emphasis on power dynamics, focusing on how political institutions and socio-economic inequalities shape the distribution of environmental benefits and burdens and influence environmental change. Specifically, it analyzes how decisions made by governments, corporations, and international organizations often lead to environmental degradation, displacement of communities, and social injustices, particularly affecting marginalized groups. Unlike approaches such as transition management or social-ecological systems, which seek to influence governance processes to foster sustainability transitions, political ecology views governance structures as part of the problem. It emphasizes the need to challenge and resist these power structures while advocating for more equitable and sustainable solutions. While the social metabolism approach focuses on the physical materiality of resource flows, political ecology also addresses the materiality of social structures, emphasizing the reproduction of social relations and highlighting their inherent contradictions.

Critical approaches to transformation like political ecology are characterized by distinct perspectives on the four classification criteria. Regarding social ontology, they typically adopt a holistic view, emphasizing the systemic and structural nature of inequalities embedded within society. The drivers of

change are viewed as being rooted in normative shifts, with political ecology highlighting resistance to entrenched power structures and advocacy for systemic justice, often led by marginalized groups or grassroots movements. In terms of the trajectory of change, these approaches tend to emphasize radical transformations, calling for the disruption of social relations and governance systems that perpetuate inequality and environmental degradation. Finally, with respect to the controllability of transformation, political ecology assumes limited control due to the complex and contested nature of processes of social change.

## 2.3 Concluding remarks

This chapter has examined the multifaceted concept of social-ecological transformation, emphasizing its critical role in addressing the current crisis constellation. It has shown that sociopolitical approaches to transformation reveal a spectrum of strategies that can broadly be subsumed under strategies of conversion and strategies of control. The former range from reformist modernization efforts, such as the European Green Deal, to radical refoundation approaches like degrowth. These approaches underscore the contested nature of transformation, differing significantly in their visions for the scope and depth of societal change. While modernization strategies largely operate within existing institutional frameworks, refoundation strategies advocate for a fundamental rethinking of human-nature relationships and the social order. Similarly, strategies of control, encompassing both adaptation and intervention, highlight diverse pathways for managing the impacts of ecological crises, ranging from incremental resilience planning to large-scale geoengineering projects.

The academic discourse on transformation complements the sociopolitical perspective by offering analytical frameworks to understand and evaluate societal change. The identified theory clusters—transition studies, social metabolism, socio-ecological systems, applied social science approaches, and critical theories—are characterized by a peculiar combination of underlying assumptions on society as well as on the drivers, dynamics, and controllability of social change. Despite major differences, most of them share an understanding of transformation as profound, complex processes of societal change that involve not only technological, but also social and cultural shifts.

This analysis has underscored the critical need for normative clarity and conceptual rigor in the debate on social-ecological transformation. Without a careful examination of the assumptions and implications underpinning different approaches, the term risks becoming a mere buzzword. By systematically exploring their commonalities and differences, this chapter lays the groundwork for a deeper and more nuanced understanding of transformation. It offers a robust foundation for subsequent chapters and contributes to advancing both research and practical interventions aimed at fostering sustainable and equitable societal change.

## 3 The role of science in times of multiple crises

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In the context of the ongoing multiple crises of the environment, society, and the economy, the traditional role of science in society has increasingly come under scrutiny. There are growing calls for the scientific community to contribute more proactively to addressing pressing social and ecological issues. A prime example of this shift is climate change, where science now plays a central role in raising public awareness, shaping policies, and guiding mitigation strategies. Yet, this evolving role of science also raises a set of complex questions, most notably, the tension between scientific imperatives and democratic principles. This tension is often exemplified by the concept of "expertocracy", a model of governance in which decisions are primarily driven by scientific experts, potentially sidelining broader public participation and input, and thereby risking perceptions of undemocratic practices (Bogner, 2021). To mitigate this potential conflict, scholars advocate for a balanced approach that integrates scientific expertise with democratic deliberation (Callon, 2009). This approach emphasizes the need for transparency in communicating scientific findings, the promotion of active and meaningful public engagement, and the inclusion of diverse perspectives in decision-making processes (Callon, 1999; Callon & Rabeharisoa, 2003).

However, such research approaches are increasingly blurring the historical boundary between science and society—a separation that has been maintained for centuries—, resulting in significant epistemological, methodological, and normative challenges. This chapter examines some of these questions along with the proposals to address them. Section 3.1 begins by exploring the distinctions that set scientific knowledge apart from other forms of knowledge, with a particular focus on the (contested) divide between facts and values. Section 3.2 then examines the transformation of science over recent decades, particularly the shift from traditional discipline-based research towards inter- and transdisciplinary approaches. Finally, Section 3.3 introduces the emerging field of transformation research as a concrete example of how science and research can contribute to understanding and shaping profound societal change.

### 3.1 On science, facts, values

Scientific knowledge differs from other forms of knowledge through its systematic, empirical, and objective methods of understanding the world. Rooted in the scientific method, it relies on empirical evidence obtained through observation and experimentation, emphasizing the importance of testable explanations and a consistent and logical formulation of scientific theories and hypothesis. Unlike other knowledge systems that incorporate subjective interpretations or rely on tradition and revelation, science prioritizes objectivity and is open to revision based on new evidence and consistent argumentation. Whether in the natural sciences (e.g., physics, chemistry, biology), social sciences (e.g., sociology, economics, psychology), or humanities (e.g., history, philosophy), scientific knowledge is characterized by its commitment to systematic inquiry, reliance on empirical evidence and/or dialectic reasoning, and a continuous process of refinement and adaptation in response to new information, distinguishing it as a dynamic and evidence-driven pursuit of understanding. Modern science has been founded on the distinction between facts and values, i.e. between descriptive statements about the world (facts) and normative or evaluative statements (values). This distinction is often associated with the works of philosophers like David Hume and later developed in the context of the science and values debate (Is-Ought-Problem). Facts are typically understood as objective and observable statements about the world. They are empirical claims that can be verified or falsified through observation and experimentation. Facts are considered value-neutral and independent of individual perspectives or interpretations (Weber, 2017). Values, on the other hand, refer to subjective judgments, habits, or moral considerations (doxa). These are normative elements that involve subjective opinions, cultural

beliefs, and personal biases. The traditional view, often associated with logical positivism, posited a strict separation between facts and values, suggesting that scientific inquiry could be entirely objective and value-free. This perspective argues that scientific theories could be derived solely from empirical observations without the influence of personal or cultural values. However, this positivist view has been challenged by various perspectives.

Kuhn (1970), for instance, introduced the concept of paradigm shifts, highlighting that scientific theories are often deeply influenced by social, cultural, and historical factors. Feyerabend (1976), in his critique of a monolithic scientific method, emphasized the diversity of scientific practices and argued that there are no fixed rules that universally define science. Against a rather positive view of scientific facts, Ludwig Fleck (1980) argued that scientific facts are not discovered in an objective, value-free manner but are socially constructed within a thought collective ("Denkkollektiv"). The thought collective refers to a community of scientists who share a common set of beliefs, assumptions, and thought patterns. Within this framework, values may come into play at various stages, such as when scientists make decisions about research priorities, select methodologies, or interpret results (Stack, 1969; Putnam, 1981; Putnam, 1998). Following Ludwig Fleck, Bruno Latour (1991; 1999; Latour/Woolgar, 1986) contends that scientific facts are not discovered but rather "assembled" through the collaboration of various actors, including scientists, instruments, and institutions but also non-scientists such as politicians, citizens, or entrepreneurs. This perspective challenges the notion of a secluded science by highlighting the vast network of interactions within which facts and scientific knowledge are assembled or "constructed" throughout society.

While contributions of scholars like Bruno Latour or other sociologists of science such as Karin Knorr-Cetina have challenged the strict separation between facts and values, their perspectives have not been without critique. Critics contend that blurring the lines between facts and values may lead to a relativistic view where all knowledge is perceived as equally valid, undermining the notion of objective truth. While acknowledging the social and contextual influences on scientific inquiry, critics argue that objective truth is possible only on the condition of a clear cut between science and society. For example, Gaston Bachelard, a French philosopher of science, introduced the concept of an "epistemological break" to describe a radical shift in the way knowledge is acquired and constructed in the scientific process. According to Bachelard (1987), this break involves a rupture with common sense and everyday opinions which are viewed as obstacles to true understanding (by claiming that the break is constructed, Bachelard distinguishes himself from traditional positivism). Bachelard argues that scientific inquiry requires a departure from preconceived notions and subjective beliefs, emphasizing the need for a rigorous, objective approach that transcends personal biases and cultural assumptions. The autonomy of science is a prerequisite for this (Bourdieu, 1975).

In summary, there are two principal ways of thinking about the relationship between science and society or facts and values: one acknowledges that science has a social context, but nevertheless insist on an epistemological break between scientific and non-scientific knowledge as a prerequisite for objective truth; the other assumes that scientific facts are "made" in contingent and historic processes in which the connection between scientific and non-scientific factors is to be seen as a prerequisite for objective truth.

### **3.2 The transformation of science: from discipline-based to inter- and transdisciplinary research**

Many of the problems and crises faced by societies cannot be overcome without the contribution of scientific and technical expertise. Modern societies increasingly rely on scientific knowledge and technical artifacts, which serve as a foundation for political decisions and technological innovations that significantly impact people's lives. Consequently, scientific disciplines are evolving beyond their traditional role of addressing purely scientific problems and are now increasingly dealing with real-world

problems. In this sense, the shift has facilitated the transcendence of disciplinary boundaries, leading to research that is increasingly inter- and transdisciplinary.

### 3.2.1 Mono-, multi-, inter- and transdisciplinary research: an overview

Modernity (Wagner, 2012) is characterized by extraordinary scientific advancements, driven by the increasing differentiation of objects of inquiry and fields of interest—especially between the social and natural sciences. This differentiation has extended to methodological approaches, enabling specialized and detailed knowledge that ensure the reliability and robustness of scientific knowledge. This emphasis on specialization has also led to a reliance on *monodisciplinary* research, where research is confined within the boundaries of a single discipline, potentially limiting the scope of inquiry. In contrast, *multidisciplinary* approaches involve parallel investigations by different disciplines addressing the same problem but without integrating their findings into a cohesive understanding. While these approaches can provide valuable insights, they often lack the integration necessary to fully address contemporary challenges and complex problems.

Consequently, significant critiques emerged by the 1960s regarding the isolation of objects of inquiry from their broader contexts. For instance, the issue of nuclear waste disposal revealed that addressing such problems required more than just physics; it also necessitated insights from geology, economics, and the social sciences. As modernization progressed, many societal challenges began to encompass technological and scientific dimensions, revealing the limitations of any single discipline in addressing emergent complex problems comprehensively. Objects of inquiry were no longer "bare," or isolated from their contextual interrelations, but rather "hairy," entangled in explicit or implicit connections extending in multiple directions, as Bruno Latour (1999) has argued. To account for these multifaceted dimensions, calls for disciplinary collaboration and *interdisciplinary* research became more prominent—modernity became reflexive (Beck, 1986). Interdisciplinarity, in contrast to multidisciplinary, goes beyond the parallel investigation of the same object by separate disciplines. It involves not only collaboration on a shared object of study but also a reflexive engagement with the different methodological perspectives each discipline brings. Without such reflexive integration, research risks remaining effectively multidisciplinary, where disciplines operate independently without bridging their epistemological divides. Thus, interdisciplinary research presents a necessary response to the increasing complexity and interconnectedness of modern scientific and societal challenges.

*Transdisciplinary* research goes beyond integrating various academic disciplines by actively involving non-academic actors in the process of knowledge production. This approach has gained increasing recognition for addressing complex global challenges such as climate change and sustainability (Brandt et al., 2013; Groß & Stauffacher, 2014). It is particularly vital for tackling "wicked problems"—issues with diverse, interconnected characteristics that resist simple solutions and require holistic, collaborative strategies. In fact, the multifaceted nature of today's crises highlights the need for methodologies that transcend disciplinary boundaries, as these challenges span scientific, social, economic, and policy dimensions and cannot be effectively addressed within a single field or by scientific expertise alone.

Table 4 presents a comparative overview of some key features of mono-, multi-, inter- and transdisciplinary research, which are, as explained above, primarily distinguished by the extent to which they are rooted in disciplinary frameworks. However, there are other crucial differences between these approaches linked to their research focus, level of collaboration, type of knowledge integration and research objective.

Table 4. From monodisciplinary to transdisciplinary research: an overview. Source: own elaboration.

	Monodisciplinary	Multidisciplinary	Interdisciplinary	Transdisciplinary
Focus	Single discipline	Multiple disciplines	Integration of disciplines	Collaboration with societal stakeholders
Collaboration Level	None (within one discipline)	Limited (disciplines work separately)	High (disciplines interact and integrate)	Very high (includes non-academic partners)
Knowledge Integration	No integration	No integration	Integration of scientific knowledge	Integration of scientific and experiential knowledge
Objective	Depth in one area	Breadth of perspectives	Comprehensive understanding	Practical solutions for societal issues

Monodisciplinary approaches adhere to traditional research paradigms within single, specialized disciplines, focusing on depth within a well-defined field. By contrast, the other approaches progressively broaden the scope, first by incorporating other disciplines and then by engaging stakeholders and societal actors beyond academia. However, the approaches differ not only in their disciplinary scope but also in their degree of collaboration. Collaboration refers to the nature of the research activity, which may involve participation limited to experts within the same discipline, experts from other disciplines, or even non-academic actors, including laypersons and societal stakeholders. Knowledge integration reflects the way insights are synthesized across disciplinary and epistemological boundaries. For instance, while mono- and multidisciplinary approaches focus on addressing the same research object (e. g., climate change) without integrating methodological or epistemological perspectives, interdisciplinary approaches actively seek to reconcile and integrate these differences in methods and disciplinary viewpoints. Transdisciplinary approaches go further by addressing the epistemological boundaries of scientific knowledge itself, synthesizing both scientific and experiential knowledge to create actionable insights that address complex societal challenges. In this context, the transition from Mode 1 science (traditional, discipline-centered knowledge production) to Mode 2 science (context-driven, problem-oriented research) illustrates a paradigm shift toward greater societal engagement (Gibbons et al., 1994). Consequently, these approaches also diverge in their research objectives. While monodisciplinary approaches focus on in-depth knowledge within a single discipline, multidisciplinary approaches are more open and aim to include more perspectives on a given issue. Interdisciplinary approaches go a step further, striving for a more comprehensive understanding by integrating insights from various disciplines. Finally, transdisciplinary research prioritizes societal relevance, explicitly seeking to co-create knowledge that informs practical solutions and facilitates transformative change in response to real-world problems.

### 3.2.2 Historical developments in the conception of transdisciplinarity

The philosopher of science Jürgen Mittelstraß (1992; 2005) presented an early concept of transdisciplinarity, viewing it as a form of scientific research aiming to solve non-scientific (e.g.,

environmental) problems. According to him, transdisciplinarity is a principle of research that enters the scene where it is not possible to define problems and solutions solely in disciplinary or specialist terms. In this sense, research becomes transdisciplinary when scientific disciplines move beyond their traditional scope, engaging with objects and problems that extend beyond their canonical boundaries and necessitate collaboration with other fields. According to this perspective, transdisciplinary research is essentially a form of true interdisciplinarity—an open and cooperative exchange between disciplines to address complex, cross-cutting challenges.

What is crucial, however, is that this early conception of transdisciplinarity—rooted in the classical understanding of science, which strictly separates (scientific) facts from (societal) values—advocates for science to engage with social problems while remaining within the boundaries of scientific inquiry. In other words, science should address societal issues, but non-scientific knowledge should not be incorporated into the research process. Instead, interdisciplinary collaboration should be used to define problems and develop solutions, which would then inform political decision-making. Mittelstraß frames the relationship between science and politics within the “deficit model.” This model assumes that public skepticism or resistance to scientific findings stems primarily from a lack of scientific knowledge or understanding. It suggests that if the public were adequately informed about scientific facts, they would align with and support the scientific consensus.

In the context of science and politics, the deficit model can be understood as a “*linear model of expertise*”. This model assumes a direct, unidirectional relationship between science and policy, in which scientific experts provide objective and unbiased knowledge, while policymakers simply apply this knowledge to make informed decisions. It implies that scientific facts alone can and should guide policy outcomes, reinforcing the notion of a one-way flow of information from scientists to decision-makers. Moreover, this linear conception of science-policy interaction is often accompanied by a tendency to reframe political questions as epistemic ones. This shift can have two significant consequences: first, it may lead to the depoliticization of democratic deliberation (Bogner, 2007), as decision-making authority is increasingly transferred to scientific experts, fostering what can be described as an “*expertocracy*”. Second, it can result in the (false) politicization of scientific processes, as political actors and interest groups strategically engage with science to advance their own agendas (Bogner, 2021).

However, this model has been widely criticized for oversimplifying the complex and dynamic relationship between science and politics (Bijker et al., 2017). Sheila Jasanoff (2003, 2007), building on the work of Latour, Knorr-Cetina, and others, challenges this linear perspective by emphasizing the intricate interactions between scientific knowledge, societal values, and political decision-making. She argues that scientific expertise is not value-neutral but is shaped by cultural contexts, institutional structures, and political considerations. In the real world, the relationship between science and policy is iterative, involving negotiation, contestation, and the *co-production of knowledge*—a concept central to Jasanoff’s work. Co-production recognizes that scientific facts do not exist in isolation but are actively constructed through interactions with social, political, and cultural forces. Rather than treating science as a purely objective endeavor, this perspective highlights how knowledge is shaped collaboratively by scientists, policymakers, the public, and other stakeholders. At the same time, scientific knowledge influences societal values and policy decisions, creating a continuous feedback loop. This co-production framework challenges the traditional linear model by emphasizing the bidirectional nature of science-policy interactions and the role of intermediary structures and actors (Meyer & Kearnes, 2013), such as boundary organizations (Guston, 2001; Miller, 2001), which mediate between scientific expertise and policy processes.

Against this backdrop, “*Mode 2*” knowledge production, as conceptualized by Gibbons et al. (1994), represents a shift away from traditional, discipline-bound approaches (“*Mode 1*”) toward a more context-driven, problem-oriented, and transdisciplinary model. Unlike the academically insular nature of Mode 1, Mode 2 prioritizes societal relevance, active engagement with diverse perspectives, and practical problem-solving (Gibbons, 1999). This shift underscores a broader transformation in knowledge production, emphasizing adaptability, collaboration, and responsiveness to complex real-

world challenges. A key feature of Mode 2 is its co-production of knowledge, where academic researchers work alongside policymakers, industry actors, and civil society to generate socially robust knowledge (Nowotny, 2003). Unlike the rigid, discipline-centric focus of Mode 1—often associated with Mittelstraß's vision—Mode 2 thrives in real-world settings, fostering dynamic and iterative exchanges between scientific expertise and societal needs.

This perspective aligns with the concept of *post-normal science*, introduced by Silvio Funtowicz and Jerome R. Ravetz (1993), which redefines scientific inquiry in contexts of high uncertainty, complexity, and diverse societal values. In such situations, traditional scientific methods are often inadequate due to the absence of clear facts and universally accepted methodologies. Post-normal science addresses issues characterized by ambiguity and multiple perspectives, necessitating decisions that extend beyond scientific evidence to incorporate ethical, social, and political considerations. Central to this approach is the extended peer community, which includes not only scientists but also policymakers, stakeholders, and the public, all contributing to the co-production of knowledge and decision-making. Unlike conventional models that emphasize objectivity and value-neutrality, post-normal science promotes a reflexive and transparent approach to quality assurance, acknowledging uncertainties and contextual influences. By emphasizing inclusivity and participation, this framework seeks to address complex, real-world challenges that transcend the boundaries of "normal" scientific practice.

The above considerations highlight the need for a renewed understanding of transdisciplinarity, moving beyond Mittelstraß' early conception. In fact, transdisciplinary research aligned with concepts such as Mode 2 science or post-normal science not only transcends disciplinary boundaries to tackle real-world, non-scientific challenges but also emphasizes that, particularly in contexts of high uncertainty and complexity (Penker & Muhar, 2015), both problem identification and solution development must be co-produced through the active engagement of non-scientific actors. These may include political decision-makers, entrepreneurs, affected citizens, patients, users, or consumers. Rather than excluding these stakeholders on questionable epistemological grounds, more recent approaches to transdisciplinary research recognize their essential role in shaping knowledge that is both scientifically robust and socially relevant.

In this vein, transdisciplinary research as it is understood and practiced today typically relies on two fundamental components. On the one hand, it aims to combine insights from diverse disciplines and knowledge sources to construct a shared framework for addressing complex problems (*interdisciplinary knowledge integration*) (Hirsch Hadorn et al., 2008). On the other, it involves establishing partnerships between researchers and societal actors to collaboratively manage knowledge integration processes and facilitate social learning (*knowledge co-production*) (ibid.). In line with this, the OECD (2020 pag.9) defines transdisciplinarity as "the integration of academic researchers from unrelated disciplines and non-academic participants in creating new knowledge and theory to achieve a common goal".

### 3.2.3 Three models of societal participation in research processes

If non-scientific actors should participate in research on social problems and solutions, the question arises as to the extent to which this participation should occur. Building on the historical developments in the conception of transdisciplinarity outlined above and the broader shift from mono- and multidisciplinary research to inter- and transdisciplinary approaches, Michel Callon (1999) identified three models that define how laypeople are involving in science.

The first model is the already mentioned "*deficit model*". Trust between laypeople and scientists is crucial in this model. While science asserts an exclusive claim to valid knowledge, it can only do so if society confers that privilege. Thus, any mistrust threatens the relationships and the balance between science and society. The solution to mistrust is intensified educational and informative actions. The legitimacy of political decisions, according to this model, depends on the representativeness of those

speaking for citizens and the resources mobilized, guided by scientific knowledge for foreseeing the effects of actions. Political action involves consultation on goals and explanation of realistic possibilities.

In the second model, the relationship becomes more intricate. It replaces an undifferentiated public of the first model (i.e., the public as a homogeneous and uninformed mass) with differentiated publics based on diverse conditions such as profession, locality, age, and sex. These publics possess specific, concrete knowledge and competencies, derived from experiences and observations, enriching the abstract knowledge of scientists. Thus, scientific knowledge, though universal, is considered incomplete and deficient due to its abstraction and dependence on rare laboratory conditions. The complementary relationship between universal and local knowledge is exemplified in various contexts, such as drug testing, and sociological analyses by laypeople. This model suggests opening discussions and deliberations to enrich scientific knowledge, emphasizing negotiation of opinions and knowledge, with agreement reached through compromise. In this model, non-scientific knowledge is considered to counter the deficiency that abstract scientific knowledge has in relation to real-world problems. This means that non-scientific knowledge is considered, however, as a form of knowledge that is to be integrated and translated into scientific procedures and is therefore not equivalent to scientific knowledge. This is the case, for example, when it comes to inviting (or not inviting) stakeholders or collecting opinions on problems via surveys. Just as model 1, this model continues to maintain a strict separation between science and society (Callon & Rabeharisoa, 2003).

Finally, the third model or "*co-production of knowledge model*," departs from the demarcation obsession seen in Models 1 and 2 by actively involving lay people in the creation of knowledge concerning them. Unlike the exclusive approaches of the first two models, this model recognizes the essential role of non-specialists in knowledge production (Wynne, 1998). The dynamics involve a constant tension between standardized universal knowledge and knowledge accounting for the complexity of singular local situations, fostering a collaborative process where specialists and non-specialists work closely together. The concept of "concerned" groups replaces differentiated or undifferentiated publics, and collective learning occurs as different forms of knowledge (Rabeharisoa, 2017) mutually transform each other. The model emphasizes the active contribution of laypeople or "lay experts" (Epstein, 1995), who become an integral part of a hybrid collective or "epistemic community" (Haas, 1992), challenging the traditional division of tasks within the learned collective. This participatory dynamic not only allows non-scientists to control knowledge concerning their conditions but also contributes to the construction of new identities and fosters a unique relationship between science and the constructed, negotiated identities of the concerned groups (Rabeharisoa et al., 2014). The legitimacy of this joint enterprise depends on the ability of concerned groups to gain recognition for their actions, highlighting the crucial role of financial resources and public involvement in sustaining research and constructing new identities (Callon et al., 2009).

Despite the unquestioned importance of the participation of non-scientific actors in finding solutions for complex societal problems, transdisciplinary and participatory approaches come with several *challenges*. One major critique is that while problem-oriented and context-sensitive research offers significant advantages, its findings often lack generalizability beyond the specific contexts in which they were produced (Pohl, 2011; Rosendahl et al., 2015). This raises concerns not only about the transferability of insights from one case to another but also about the fundamental scientific principle of reproducibility. Additionally, citizen participation in research is frequently criticized for being superficial, often serving more to legitimize pre-existing decisions rather than fostering genuine co-creation. A key question is who should—or must—be involved in participatory processes. These processes must remain open to new stakeholders who may emerge over time, yet they must also address the distinction between invited and uninvited participation. The latter, including protest movements and marginalized voices, often challenge dominant perspectives but tend to be overlooked in policy and planning discussions. Moreover, power imbalances, conflicting interests, and tensions between different stakeholders frequently complicate participatory research (Wehling, 2012). These dynamics can be difficult to reconcile with the scientific objectives of researchers, raising concerns about reflexivity—the challenge of researchers maintaining a critical stance while actively engaging with participants. Their

roles as neutral observers (Model 2) or engaged facilitators (Model 3) require careful scrutiny (Herberg, 2018). Finally, despite the growing body of transdisciplinary research, there remains no unified theoretical framework that comprehensively addresses its epistemological, methodological, and practical dimensions (Pohl, 2014; Ukowitz, 2014; Renn, 2021). Whether such a framework is even necessary continues to be debated (Mittelstraß, 2018).

### 3.3 Transformation research: towards a new research field

As the urgency of addressing social and ecological crises such as climate change and biodiversity has intensified, the call for researchers to partake more actively in crafting concrete solutions to these and other societal problems has increased (Herceau-Milcu et al., 2024). Against this backdrop, transformation research has emerged in the past years as a new research perspective aiming to “study complex and pervasive societal problems and to search and support long-term and fundamental societal change processes and dynamics towards sustainability” (Wittmayer et al., 2018: 9).

While not (yet) constituting an established or closed research field, transformation research provides a shared lens in which various existing research directions and approaches engaging with societal change towards sustainability converge, bringing together a variety of different thematic foci, concepts, methods and frameworks. As of today, the most important research strands linked to transformation research are transition research, specific subsets of social-ecological or sustainability research, social innovation research, resilience research, political or social ecology and ecological economics as well as individual contributions from disciplines like sociology, political science, psychology and future studies (Haum and Pilardeaux 2014, Patterson et al. 2015).

#### 3.3.1 Research goals and types of knowledge

Societal challenges and crises are increasingly recognized as persistent problems, characterized by their complex, systemic, and contested nature (Schuitmaker, 2012). These problems are deeply embedded in societal structures, context-dependent, and involve multiple actors, making simple solutions unattainable. Addressing such challenges requires transformative changes, often referred to as a “great transformation” or sustainability transitions, which entail systemic shifts towards sustainability (WBGU, 2011; Rotmans et al., 2001; Grin et al., 2010). These transformations cannot be achieved through conventional project management approaches but necessitate collaborative and reflective societal learning processes involving diverse stakeholders (Haum & Pilardeaux, 2014; Grin et al., 2010).

As a response to these demands, different research strands have increasingly been pursuing two interconnected research goals. On the one hand, they seek to analyze historical and contemporary societal changes, aiming to *generate a knowledge* base that enhances understanding of transformation dynamics and can inform future action. On the other hand, approaches have emphasized engagement and collaboration, aiming to create actionable insights that *contribute directly to societal change*. This dual focus positions transformation research at the intersection of theory and practice, with both descriptive and transformative ambitions (see WBGU, 2011).

Transformation research generates two primary types of knowledge results: conceptual knowledge and actionable knowledge, each serving distinct but complementary purposes (Wittmayer et al., 2018). *Conceptual knowledge* allows us to describe, explain, and understand systems, transformation dynamics, and processes from various disciplinary perspectives. It encompasses both abstract, universal insights derived from natural and social sciences, as well as contextualized, localized knowledge from the humanities and social sciences. This type of knowledge, often produced by descriptive-analytical research approaches, is typically disseminated through scientific publications, reports, policy recommendations, and public presentations. It provides foundational insights, heuristics, and frameworks that can be further developed or translated into actions by external actors. *Actionable*

*knowledge*, on the other hand, supports decision-making and action in specific contexts by addressing normative, operational, and strategic questions related to solutions. This type of knowledge is often implicit among actors but becomes explicit and actionable through collaborative research processes. Rather than being passively transferred, it emerges through interactive and creative engagement with stakeholders. Actionable knowledge is closely linked to capacity building and empowerment, aiming to provide practical guidance for addressing societal challenges. It aligns with the goals of transformative research, which emphasizes practice-oriented, transdisciplinary collaboration to tackle complex societal questions (see Wiek et al., 2012; Bartels, 2012). While conceptual knowledge contributes to a deeper understanding of transformations, actionable knowledge focuses on enabling real-world applications and solutions, making both integral to the goals of transformation research.

### 3.3.2 Key characteristics of transformation research

Several core aspects characterizing transformation research can be identified, which help to map out some of its central requirements and thereby allow to better demarcate this emerging perspective.

Firstly, transformation research involves an explicit *normative orientation*, as it aims to study and address concrete and pressing societal issues which are connected to radical change (e.g., the decarbonization of the energy sector) (WBGU, 2011). However, while there is broad consensus that addressing the current multiple crises requires fundamental and radical change, the precise nature and implications of this radicality remain contested. Similarly, the normative orientation towards sustainability as an overarching guiding principle is a common denominator within transformation research, even though there is no unanimous interpretation of what sustainability means. While normativity is central to transformation research, it is not necessarily more normative than other fields of research (Grunwald, 2015). What distinguishes it from traditional approaches, such as those in economics or engineering, is its explicit acknowledgment of its own normative foundations.

Secondly, transformation research involves *inter- and transdisciplinary research* approaches that engage with complex real-world problems, which are interdisciplinary by nature. The transformation literature strongly advocates for the inclusion of multiple scientific disciplines and social actors to deepen the understanding of complex problems and explore potential solutions (WBGU 2011, Haum & Pilardeau 2014, Wiek & Lang 2016, Brandt et al., 2013) – though not without controversy (see e.g. Strohschneider 2014). The emphasis on creating transdisciplinary spaces to bring together diverse actors, problem perceptions, values, and types of knowledge to work on pressing societal issues is in line with the conception of transformation as a societal search, learning and experimentation process (Reiig, 2009, Grin et al. 2010). Given the normative and complex nature of sustainability transformations as well as the uncertainty and provisional character of knowledge about these transformations, some scholars have argued for the research processes to be adaptive, interparadigmatic, and abductive (see Avelino, 2011; Schwartz-Shea & Yanow, 2011; Flyvberg et al., 2012; McGowan et al., 2014). This allows researchers to more effectively respond and adapt to evolving problem framings and changing research contexts.

Thirdly, three key aspects of social change are often explored in this new perspective to better understand and support sustainability transformations: the *objects of transformation* (i.e., what is or ought to be changing), the *dynamics of transformation processes* and emergent pathways (i.e., how do processes of change unfold) and the *drivers of transformative change* (i.e., how and by whom or what are transformation processes initiated and supported) (Wittmayer et al., 2018). By addressing and integrating these *research foci*, transformation research aims to provide insights into the nature of radical change, its processes, and the actors involved, offering valuable input for addressing complex sustainability challenges.

Fourthly, in analogy to the two-fold goal of transformation research of contributing to a better understanding of transformation processes and actively shaping and supporting them, two research

approaches can be identified: a more descriptive-analytical approach and a more transformative one (Wiek et al., 2021). This distinction is widespread in sustainability and other transformation-related research, albeit under different terminologies (see Herceau-Milcu et al., 2024). For instance, the German Advisory Council on Global Change (WBGU, 2011) distinguishes between “transformation research” and “transformative research”, while Linnér and Wilbeck (2019) juxtapose “research on transformations” with “research for transformations”. Similarly, Miller (2013) contrasts a “knowledge-first approach” with a “process-oriented approach”, while Feola (2015) speaks of “analytical descriptive research” and “solution-oriented research”.

All these distinctions converge on the idea that transformation can be approached as a research object in two fundamental ways. The *descriptive-analytical approach* is primarily focused on describing, analyzing and explaining existing challenges as well as past processes of social change, providing insights on possible solution strategies through the generation of (mainly but not exclusively) conceptual knowledge. Instead, the *transformative (or transformational) approach* is more solution- and process-oriented, striving to search for and help implement solutions to concrete societal problems. In doing so, it is open to a variety of scientific and non-scientific actors and types of knowledge, which are typically integrated through a transdisciplinary, participatory research design directed towards the co-development of actionable knowledge. While a heuristic distinction between more descriptive-analytical and more transformative approaches is useful, in practice, a strict separation of the two approaches is often difficult, as combinations and overlaps are possible. Therefore, one might think of them as two poles reflecting different approaches to a set of research questions within the broader frame of transformation research (Wittmayer et al., 2018).

Finally, considering the increasing transcendence of traditional boundaries between science and society, there is an ongoing debate on what new *quality criteria* should characterize transformation research. While some argue that clear, incontestable criteria to assess the quality of transdisciplinary research may no longer be available and instead call for an openness to a plurality of definitions of quality (e.g., Nowotny et al., 2003), others stress the importance of identifying and adhering to generalized quality criteria also within transdisciplinary and transformative research approaches (e.g., Schneidewind and Singer-Brodowski, 2013). Some provisional criteria that have been discussed in this context are the scientific and the social impact as well as the trustworthiness or credibility of the research and its results (Bergmann et al., 2005; Schwartz-Shea, 2006; Greenwood & Levin, 2007). Beyond these outcome-related factors, also process-related criteria have been stressed. They include the transparency about research goals, approaches, methods and procedures (Cash et al., 2002; Schwartz-Shea, 2006) as well as the reflexivity employed in the research process. The latter point implies, among other things, critically reflecting on the epistemological and normative assumptions involved, on the relationship between the researcher(s) and the researched and on the social and cultural situatedness of the researcher(s) and the research itself (Finlay, 2002; Schwartz-Shea, 2006; Stirling, 2006).

### 3.3.3 Methods for data collection and analysis

Transformation research employs a range of methods to achieve its primary objectives: describing, analyzing, explaining, evaluating, and supporting sustainability transformations (see Wiek et al., 2016; Wittmayer et al., 2018; Hölscher et al., 2021). Table 5 provides a non-comprehensive overview of social science methods commonly applied in this emerging field. For each method, the table details its alignment with research approaches (descriptive-analytical, transformative, or both) and the type of knowledge it generates (conceptual, actionable, or both). Additionally, it references at least one key publication for further exploration, offering readers a deeper understanding of the method’s application and relevance.

Table 5. Overview of social scientific methods for transformation research. Source: own elaboration based on Wittmayer et al. (2018: 12–15).

Method	Research Approach	Generated type of knowledge	More Information
<b>Data generation - general</b>			
Experiment	Descriptive-analytical Transformative	Conceptual (classic) Actionable (transformation-oriented)	Atteslander, 1984; van den Bosch, 2010
Participant Observation	Descriptive-analytical Transformative	Conceptual	Gupta and Ferguson, 1997; Schöne, 2003; Illius, 2003
Research Diaries	Descriptive-analytical Transformative	Conceptual	Bolger et al., 2003; Sheble & Wildemuth, 2009
<b>Data generation - interview</b>			
Delphi Method	Descriptive-analytical	Conceptual Actionable	Linstone & Turoff, 2002; Müller et al., 2013
Expert Interview	Descriptive-analytical	Conceptual Actionable	Bogner et al., 2002 ; Lurtz et al. 2013; Rüede & Lurtz, 2012; Rückert-John et al., 2013, 2015
Photo Elicitation	Descriptive-analytical Transformative	Conceptual Actionable	Harper, 2002; Bignante 2010; Clark-Ibanez, 2004
Q-Method	Descriptive-analytical	Conceptual Actionable	Watts & Stenner, 2005; Müller & Kals, 2004
<b>Data analysis - general</b>			
Case Study	Descriptive-analytical	Conceptual	Yin, 2008; Gerring, 2004; Flyvbjerg, 2006
Constellation Analysis	Descriptive-analytical	Conceptual	Kröger et al., 2012

		Actionable	
Discourse Analysis	Descriptive-analytical	Conceptual	Hajer, 1995; Allolio-Näcke, 2010
Grounded Theory	Descriptive-analytical	Conceptual	Charmaz, 2006; Reichertz, 2010
Institutional Analysis	Descriptive-analytical	Conceptual Actionable	Moss & Nölting, 2014
Literature Analysis	Descriptive-analytical	Conceptual	Branley, 2012; Bortz & Döring, 200
Meta-analysis	Descriptive-analytical	Conceptual	Glass 1976; Bortz & Döring, 2006
Qualitative Content Analysis	Descriptive-analytical	Conceptual	Mayring, 2000
Social Innovation Biographies	Descriptive-analytical	Conceptual	Butzin & Widmaier, 2016; Butzin et al., 2013
System analysis	Descriptive-analytical Transformative	Conceptual Actionable	Saravanan, 2008; Rotmans & Loorbach, 2009, Findeisen & Quade, 1985; Maas, 2011; Wittmayer et al., 2011

#### Data analysis – actor analysis

Stakeholder and actor-analysis	Descriptive-analytical	Conceptual	Nölting & Daedlow, 2012
Social network analysis	Descriptive-analytical	Conceptual	Rürup et al., 2015; Cantner & Graf, 2006; Marin & Wellman, 2011
Conflict analysis	Descriptive-analytical	Conceptual Actionable	Brighton, 2004; Grimble & Wellard, 1997; Rowley, 1997
Stakeholder Mapping	Descriptive-analytical	Conceptual Actionable	Brighton, 2004; Grimble & Wellard, 1997; Rowley, 1997
Participatory Network Analysis	Descriptive-analytical Transformative	Conceptual Actionable	Debourdeau et al., 2012

#### Participatory methods

Backcasting	Descriptive-analytical Transformative	Conceptual Actionable	Quist & Vergragt, 2006; CarlssonKanyamaa et al., 2008; Quist et al., 2011
Community of practice	Transformative	Conceptual Actionable	Karner et al., 2011a, 2011b, 2013a, 2013b, 2015
Hackatons	Transformative	Conceptual Actionable	Briscoe & Mulligan, 2014
Action Learning	Descriptive-analytical Transformative	Conceptual Actionable	SIMPACT, 2015b
Conservation Theatre	Transformative	Conceptual Actionable	Heras & Tàbara, 2016
Expert Workshops	Descriptive-analytical Transformative	Conceptual Actionable	SIMPACT, 2015a
Focus Group	Descriptive-analytical	Conceptual Actionable	Gibbs, 1997; Pelz et al., 2004
Fuzzy Set	Descriptive-analytical Transformative	Conceptual Actionable	Kok et al., 2014
Indicator Lab	Transformative	Conceptual Actionable	SIMPACT, 2015c
Modelling and simulation	Descriptive-analytical	Conceptual Actionable	Haxeltine et al., 2008; Holtz et al., 2015
Online Communities/ Knowledge Hubs	Descriptive-analytical Transformative	Conceptual Actionable	Nørskov & Rask, 2011; Preece et al., 2004
Visioning	Transformative	Conceptual Actionable	Wiek & Iwaniec, 2013; Davies et al., 2012
Scenario Development	Descriptive-analytical Transformative	Conceptual Actionable	Van Notten et al., 2003

### Participatory frameworks

Living Lab	Transformative	Conceptual Actionable	Schneidewind, 2014; Nevens et al., 2013; Kieboom, 2014
Transition Management	Transformative	Conceptual Actionable	Loorbach, 2010; Wittmayer et al., 2014; Roorda et al., 2014
Transdisciplinary Case Studies	Descriptive-analytical Transformative	Conceptual Actionable	Burandt et al., 2003; Stauffacher et al., 2006
Participatory Action Research	Transformative	Conceptual Actionable	Greenwood & Levin, 2007; Palmer, 2009

The effectiveness of these methods depends on the research focus and how they are applied in practice (see Wittmayer et al., 2018). For example, methods such as constellation analysis can serve dual purposes: describing dominant system configurations while also facilitating exchanges between stakeholders to develop shared problem framings and practical solutions. Often, *multiple methods are combined* to address diverse research goals and perspectives. For instance, system analysis may examine transformation dynamics while identifying niche actors that can promote sustainability, and interviews or literature reviews may provide a general overview of existing knowledge. Participatory methods and frameworks, such as transition management, are particularly valuable in fostering collaboration with stakeholders to develop shared understandings of transformation processes and co-create solutions. Such approaches often integrate theoretical insights with practical actions, bridging conceptual knowledge with actionable outcomes.

## 3.4 Concluding remarks

This chapter has examined the evolving role of science and research in response to the pressing challenges of the 21st century. It began by exploring the competing views on the relationship between facts and values—one advocating for a clear epistemological separation to uphold objectivity, and the other acknowledging the contingent, historical processes that shape scientific knowledge. Both perspectives contribute to an ongoing dialogue about the role of science in society and the conditions required for generating reliable and meaningful knowledge.

The chapter then highlighted the shift from traditional, discipline-based research approaches to more inter- and transdisciplinary paradigms, driven by the need to address complex societal challenges. Increasingly, science is moving beyond solving purely academic problems to engaging with real-world issues such as climate change and sustainability. Interdisciplinary research integrates insights from multiple disciplines, while transdisciplinary research extends this collaboration to include non-academic stakeholders, emphasizing co-production of knowledge to solve societal problems. Despite the potential of these approaches, there remain substantive epistemological, methodological and methodical challenges, especially when it comes to participatory methods in transdisciplinary contexts. These include difficulties in generalizing findings, the risk of superficial stakeholder participation, and unresolved questions about who should participate and how power dynamics should be managed. Additionally, concerns about reflexivity—how researchers balance their roles as neutral observers or

active participants—remain central. Importantly, the absence of a unified theory of trans disciplinaryity reflects ongoing debates about whether such a framework is necessary or achievable.

In this context, transformation research has emerged as a promising new perspective to address social-ecological challenges. Focusing on long-term, systemic shifts towards sustainability, transformation research provides a shared lens for various research strands, approaches, and frameworks. It aims to generate both conceptual knowledge—which deepens understanding of transformation dynamics—and actionable knowledge—which directly supports societal change. Key characteristics of transformation research include its normative orientation, inter- and transdisciplinary methods, and its dual focus on understanding and shaping transformation processes. Methods used in transformation research often blend descriptive and transformative techniques to foster collaboration and practical solutions. The research also emphasizes reflexivity and the integration of diverse actors and knowledge types. However, as Wittmayer et al. (2018) note, the advancement of transformation research within sustainability transformations requires addressing several challenges. These include navigating the plurality of research fields, concepts, and frameworks while clarifying the epistemological and ontological differences across various strands. Strengthening a common conceptual foundation, particularly around key terms like "transformation" and "transformative change," will increase the analytical value of this research. Further, fostering critical self-reflection in research processes and outcomes is essential for enhancing the legitimacy and accountability of transformation research. Finally, to strengthen and refine this emerging field, broader transformations within the scientific system are necessary—especially in terms of funding structures, quality criteria, and academic curricula.

## 4 Conceptual framework

Written by: Elisa Ravazzoli, Cristina Dalla Torre, Lydia Pedoth

This chapter presents a conceptual framework that is useful to analyzing research projects in the following chapter. The framework connects key concepts presented in previous chapters and provides a practical tool for operationalizing them. It frames these concepts as dimensions/categories of analysis applicable to real-world cases, facilitating systematic analysis and observation. These categories will be used to examine the research projects conducted by Eurac Research in the next chapter, enabling a structured analysis of how they conceived and contribute to transformation research.

In the framework some elements refer to how researchers view the nature and origins of the problem they aim to tackle through knowledge production, while other elements focus on how research projects gather and interpret information to generate knowledge (see Figure 1).

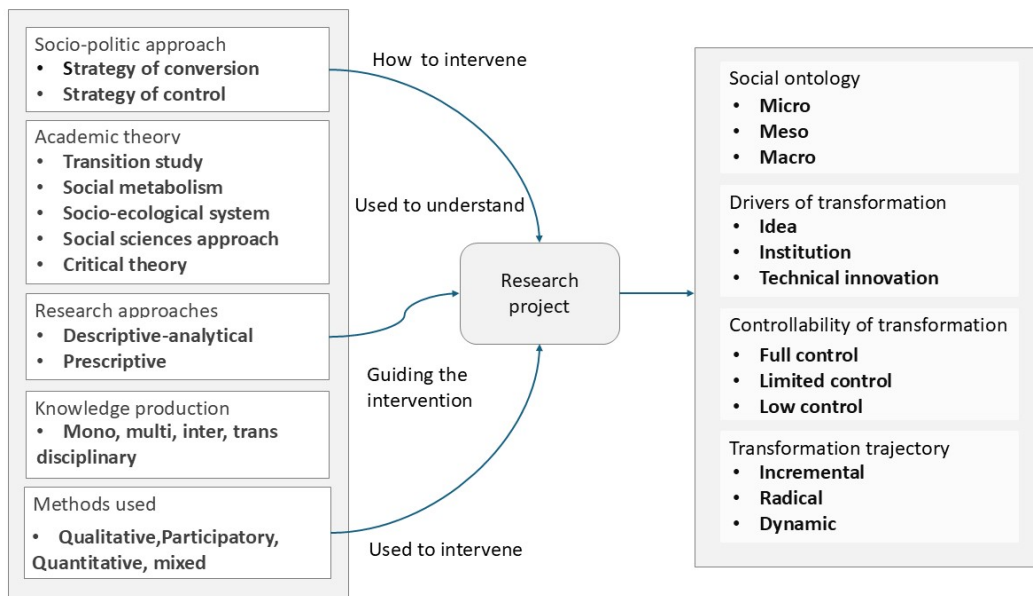


Figure 1 Conceptual framework. Source: own elaboration.

The conceptual framework starts by identifying the type of transformation that e.g. a project aims to achieve (i.e. the socio-political approach), that might support strategies of conversion or of control. Socio-political approaches significantly influence transformation outcomes through academic theories, which offer frameworks explaining how transformations are supposed to happen and for analysing transformations. The research project may adopt either a descriptive approach—focused on knowledge base creation—or a prescriptive approach—aimed at generating actionable knowledge and solutions. Eventually, these choices shape the modes of knowledge production, and the research methods employed in implementing the project, the role of researchers, which are contingent upon the theoretical framework and its associated assumptions. Moreover, the framework examines how research projects conceptualize and address complex socio-political issues. Specifically, the conceptual framework considers the underlying assumptions of the intervention/initiative/research project regarding the definition of the system (i.e. social ontology), the factors driving transformation, the type of control institution can provide to generate transformation, and the speed in which change is happening. Figure 1 explains the elements of the framework and their interconnection.

All elements of the framework (categories of analysis including classification explained in chapter 2) are defined by different approaches, as shown in Table 6. These elements will be used to develop questions for both the workshop and the survey, which will be employed to gather information and analyze Eurac projects (see Chapter 5).

Table 6: Explanation of the elements of the conceptual framework. Source: own elaboration

Categories of analysis	Approaches	Description
<b>Socio-political approaches:</b> the ways in which the project has attempted to deal with the ongoing social-ecological crises	Conversion	address the causes of phenomena considered as problematic (conversion)
	Control	control the effects of phenomena considered problematic (control)
<b>Theory clusters engaging with transformation</b>	Transition studies	examine the societal and institutional dimensions of transitions, as well as the role of technological and social innovation.
	Social metabolism	traces patterns of resource use, energy consumption, and waste production across different societies and time periods
	Socio-ecological system	highlights and analyses the capacity of both social and ecological systems to absorb disturbances, reorganize, and continue functioning amid change.
	Applied social science	utilize traditional social science methods to empirically explore processes of change, e.g., practice theories, pathways to sustainability.
	Critical theories	critically examine the relationship between society and nature, with a focus on understanding and addressing the deep changes required to build more sustainable and just societies.
<b>Academic approach to transformation</b>	Prescriptive	Contribute to a societal transformation
	Descriptive	Understand and analyse transformation processes
<b>Mode of knowledge production:</b> the approach used to produce knowledge	Mono-disciplinary	Knowledge produced by exclusively one single discipline
	Inter-disciplinary	Knowledge produced integrating multiple disciplines
	Multi-disciplinary	Knowledge produced using several disciplines without necessarily integrating them
	Trans-disciplinary	Knowledge produced by integrating knowledge from various fields and stakeholders
<b>Methods:</b> systematic approach employed in research to collect, analyse, and interpret	Quantitative	Understanding phenomena using systematic collection and analysis of numerical data
	Qualitative	Understanding phenomena through non-numerical data

data to answer specific questions or test hypotheses	Mixed methods	understanding phenomena by combining both quantitative and qualitative research methods
	Participatory	method that actively involves stakeholders or community members in the research process
<b>Social ontology:</b> how society is conceived by the project.	Methodological individualism	Society is an aggregation of individual decisions and behaviours. Focus is on behaviour, rationality, action, individual agency and information.
	Methodological rationalism	Society is composed by intermediary elements such as informal social relations, institutions, organizations, and networks. Focus is thus on structures and processes that exist between individuals and societal systems.
	Methodological holism	Society can only be understood. Focus is on overarching social structures and systems.
<b>Controllability of change:</b> the degree of controllability that the project (and its involved institutions) assumes to have on the transformation process it tries to foster	Full control	Institutions have complete authority and influence over the process of social change (steered change).
	Limited control	Institutions have some level of influence and can initiate or guide the process of change, but that transformation involves multiple interconnected factors and actors that lead to unpredictable consequences, drivers, or resistances (triggered change).
	Low control	institutions are assumed to have no influence on the process of social change, because transformation processes are complex, and changes occur spontaneously or due to various decentralized influences (emergent change).
<b>Drivers of change:</b> on what leverages the project intends to trigger transformation	New ideas	Through knowledge enhancement to change existing norms, practices, and values and the relationship between them and the spread of new ideas
	Institutional changes	By changing institutional contexts and specific formal and informal rules
	Technical innovations	By improving technological progress
<b>Trajectory of change:</b> how the project assumes that transformation will take place	Incremental change	Transformation takes place as a gradual and steady progress in societal norms, values, and practices
	Radical change	Transformation occurs as a comprehensive and transformative change in social structures, ideologies, and power dynamics
	Dynamic change	Transformation occurs as a complex, nonlinear nature of societal change

## 5 Exploring the transformative character of Eurac Research projects

Written by: Cristina Dalla Torre, Lydia Pedoth

As discussed in chapter 3, science is called upon to contribute pro-actively to facilitate the societal transformation towards sustainability. While only a few Eurac Research projects explicitly reference phrases like “Social-ecological transformation towards climate just societies” in their title or objectives, many of them may indirectly address and contribute to this theme through their activities and outcomes. Therefore, it is essential to reflect on Eurac’s research practices and systematically organize the diverse methods, approaches, and concepts used across the projects to clarify the vision of societal transformation towards sustainability that researchers aim to achieve. It is also important to reflect on the concrete contribution Eurac Research is making to societal transformation towards sustainability, given the inherent complexity of the term. In fact, to avoid the concept of “societal transformation towards sustainability” to become another buzzword, and to guide research strategically, researchers must use the concept intentionally and be able to navigate the diversity and complexity behind this concept.

This part of the study aims to understand how knowledge in the selected Eurac Research projects is produced in relation to identified problems or solutions surrounding the topic of societal transformation towards sustainability. Specifically, we wanted to examine the foundational concepts and approaches used in research projects, how researchers address the problem, and how these are linked to the methods used as well as reflect on potential, limitations, and applicability of concepts themselves. We selected projects carried out by Eurac researchers as units of analysis. To collect data and reflect on these projects, we employed both qualitative and quantitative methods. First, we designed and organized a workshop to explore the projects qualitatively, stimulate discussion, and test the conceptual framework. Next, we collected data on individual projects through a survey.

This chapter is organized into four sections. Section 5.1 presents the results of the workshop, which applies the analytical dimensions outlined in the conceptual framework and categorizes Eurac projects into distinct types. Section 5.2 details the results of questionnaires submitted to researchers, which gathered detailed information about the selected projects and explored the categories of analysis further. Section 5.3 provides concluding remarks.

### 5.1 Selection of Eurac Research projects

The selection of Eurac Research projects for analysis was based on three main criteria. First, we focused on projects that address societal transformation towards sustainability in relation to global environmental challenges, including climate change, sustainability, adaptation, resilience, transition, and transformation. Second, we included only ongoing projects or those completed within the last five years (2018-2023). Third, we considered projects with a geographic focus on South Tyrol. To identify relevant projects, we utilized the Converis project repository, where Eurac Institutes and Centres are required to update information about their research. We reviewed project descriptions to assess their relevance and ultimately selected 54 Eurac Research projects that met these criteria, despite significant variations in duration, budget, scale, and topics. Finally, we created a database to systematically collect information about these projects, including details such as the institute or center affiliated with the principal investigator (PI), name of the PI, funding program, project duration, objectives, concepts related to transformation, sustainability, resilience, transition, the research approach used, and whether applied research was conducted in South Tyrol.

## 5.2 Workshop

A workshop with the PIs of the selected research projects was held on 30<sup>th</sup> of October 2024 at the Eurac Research premises. In the paragraph below is a description of the workshop structure and the results of the workshop discussion among PIs.

### 5.2.1 Aim and structure of the Workshop

The purpose of the workshop was twofold: firstly, to apply dimensions presented in the conceptual framework (Chapter 4) and examine how research projects relate to these dimensions, thereby testing and validating them for analyzing approaches to transformation. Secondly, we wanted to test whether by grouping projects according to some variables, these share similarities in the way they conceive and contribute to societal transformation towards sustainability. Also, the workshop was organized as an opportunity to enable fruitful, guided discussion and self-reflection on research about and for transformation among Eurac researchers. Researchers are often immersed in their own projects, moving from one task to the next without reflecting on how their work fits into the broader research community, on common challenges and potential solutions, or on what other researchers are doing. They frequently encounter similar problems across different disciplines or topics, but they lack the time to discuss these with colleagues. They also overlook how, together as a research community, it is possible to tackle problems, difficulties, and bottlenecks. Reflecting on one's own research practice and engaging in exchanges with colleagues is an essential part of the research process. This not only fosters critical self-reflection but also enriches collective knowledge and enhances the overall quality of research.

PIs from the 55 selected projects were invited to participate, and 21 PIs or their delegated colleagues took part. Some researchers served as PIs for more than one of the 55 selected projects. However, to ensure in-depth discussions, we asked participants to focus on one or at most, two projects. As a result, the workshop focused on a total of 23 projects out of the 55. The workshop involved 23 people, 21 of whom actively engaged in the discussions, while two contributed to facilitating the workshop and providing logistical support.

The workshop was structured in three main parts. In the first part, participants were introduced to the “Transformation Pathways” project and presented with insights and preliminary findings from the literature review on academic approaches to transformation, as discussed in chapter 2. In the second part, after participants introduced themselves and the projects they would represent and analyze, a project clustering exercise was conducted in plenary, as illustrated in the next paragraph. In the third part, participants discussed and analyzed their projects in groups based on a set of guiding questions, as detailed in section 5.2.3. The following sections will present the results of both the group clustering and the group discussions.

### 5.2.2 Clustering research projects

The objective of the group clustering is to inductively identify groups of projects based on some common characteristics such as: the way in which they deal with social change and the type of socio-political strategy they adopt; the academic approach to change they use; the way in which they do research including the methods used etc. Even if we are aware of the difficulty to generalize mechanisms and patterns across the heterogeneity of the projects selected, this clustering allows us to capture key insights that emerge from the data and better understand how societal transformation towards sustainability is conceived and applied in Eurac research projects.

The first exercise aimed to identify how projects address social change, specifically which socio-political approach and academic approach to transformation projects can be associated to. Research projects—our units of analysis—were examined along two continuous dimensions: the “convert-control

continuum” and the “descriptive-prescriptive continuum”. The two continua represent continuous ranges of values along distinct extremes. Participants were asked to physically position themselves along these continuums, to respond to selected guiding questions (presented in Table 7) and to justify their answers. Facilitators were asked to collect information on how to interpret the answers and identify any potential issues or ambiguities in the questions. This process allowed for cross-checking participants' interpretations and enabled adjustments to their responses.

Table 7. Guiding questions for descriptive-prescriptive and convert-control continuum. Source: own elaboration

Dimensions	Categories and guiding questions
<b>Descriptive-prescriptive continuum</b>	<ul style="list-style-type: none"> <li>• Prescriptive/Normative approach: does your project aim to change the problem/situation by proposing a solution that leads to a desired transformation?</li> <li>• Descriptive/Analytical approach: or does your project aim to understand the problem/situation without a pre-set outcome or direction of transformation?</li> </ul>
<b>Socio-political approach</b>	<ul style="list-style-type: none"> <li>• Convert: does your research aim to address the causes of the problem/ phenomena considered problematic? And if so how:               <ul style="list-style-type: none"> <li>○ By searching for radical alternatives?</li> <li>○ By trying to interfere with geo-biophysical processes?</li> </ul> </li> <li>• Control: or does your research aim to control the effects of the phenomena considered problematic? And if so how:               <ul style="list-style-type: none"> <li>○ By selectively adjusting part of the existing socio-economic system?</li> <li>○ By increasing resilience and adaptability to the system?</li> </ul> </li> </ul>

## Results

It became clear that many participants found it challenging to position their projects on the *prescriptive-descriptive continuum*, as most of the projects included both aspects: they aim to understand the processes and phenomena defined as problematic, without a predetermined direction of transformation, and contributing to solutions aimed at addressing the identified problem. Facilitators suggested positioning projects based on their predominant focus: if the project is primarily about understanding the phenomena and offering policy recommendations, it should be categorized as descriptive; if the project focuses on testing a solution (e.g. demo-sites), with the understanding of the problem serving to develop the prototype/solution, then it should be categorized as prescriptive.

Building on these results, we could reflect that whether a project is prescriptive or descriptive depends on the level of knowledge regarding the problem, topic or phenomena. While much of the sustainability science emphasizes the urgency of making actionable research to bridge the science-policy-practice gap, and we now have considerable knowledge on the causes and technical solution for global environmental and climate change, there is still a need —especially in the field of social sciences— to gather knowledge on societal, economic, cultural processes that drive social-ecological transformation. Therefore, being descriptive or prescriptive depends on the current level of knowledge within the specific discipline or group of disciplines addressing the problem.

Similarly, with the *convert-control continuum*, researchers struggled to position themselves, especially when they saw other projects addressing what they considered effects, while for their own project viewed it as the cause. For example, one project focused on the effects of flooding, treating it as the cause, while others considered flooding as the effect of climate change. This difference refers to differing problem definitions across projects. Facilitators addressed this by asking researchers to come back to their own project's problem definition and decide whether it addressed the causes or effects,

independent of how other projects defined the issue. Hence, the focus was not the topic per se, but how the topic was with respect to the problem definition of the project.

From this evidence we could reflect that social-ecological transformation hides complexity. Projects conceive the same problematic phenomena in different ways: problems are diverse, research approaches are different as they approach problems from different perspectives, at varying levels, and with different assumptions. Societal transformation towards sustainability starts with the definition of the problem, which per se is complex, as it results from a cause-effect chain. Facilitators concluded that it would have been useful to dedicate some more time at the beginning of the exercise to explicitly define each project's problem.

The result of the discussion on the proposed questions was the clustering of the project into four groups (see Table 8):

- 1) **Prescriptive research on causes** (Group I). Applied research projects that aims to transform knowledge on causes into action by not only elucidating why problems occur but also guide decision-makers on how to effectively address them.
- 2) **Prescriptive research on effects** (Group II). Applied research projects that aims to transform knowledge on effects into actions by not only elucidating the effects of certain problems but also guide decision-makers to reduce adverse impacts.
- 3) **Descriptive research on causes** (Group III). Applied research projects that focus on systematically observing and documenting the causes of specific phenomena thus identify patterns and trends.
- 4) **Descriptive research on effects** (Group IV). Applied research projects that focus on systematically observing and documenting the effects/ impacts of specific phenomena.

Table 8. Cluster of research projects. Source: own elaboration

GROUP I- Prescriptive research on causes	GROUP II – Prescriptive research on effects
<ul style="list-style-type: none"> <li>• Adaptive housing</li> <li>• Montagne Vitali</li> <li>• European tourism sustainability monitoring</li> <li>• Impetus</li> <li>• Fulfill</li> <li>• Zeraf</li> </ul>	<ul style="list-style-type: none"> <li>• Adaptation South Tyrol</li> <li>• ADAPTNOW</li> <li>• JustNature</li> <li>• XRiskCC</li> <li>• Varcities</li> <li>• Beyond Snow</li> </ul>
GROUP III- Descriptive research on causes	GROUP IV-Descriptive research on causes
<ul style="list-style-type: none"> <li>• Sustainable Tourism Observatory of South Tyrol</li> <li>• Social-ecological mentalities</li> <li>• Climate change integration in the multilevel governance of Italy and Austria</li> </ul>	<ul style="list-style-type: none"> <li>• EUCRA</li> <li>• Return</li> <li>• Nexogenesis</li> <li>• Roles</li> </ul>

### 5.2.3 Transformative character of research projects

After projects were clustered into groups, participants were invited to sit at the table corresponding to the specific cluster of the project they represented. At the table, participants were asked to discuss the research approach used in the project by answering guiding questions (See Table 9). The questions relate to the dimensions of the conceptual framework (Chapter 4).

Table 9. Questions guiding the discussion and exchange, according to the dimensions of the conceptual framework.  
Source: own elaboration

Dimensions to be considered	Guiding questions
<b>Controllability of transformation</b>	Do you think that societal transformation towards sustainability in the field of your research can be planned and steered intentionally, or that it depends on conditions that can hardly be controlled?
<b>Drivers of transformation</b>	What are the crucial elements for a successful transformation in the area covered by your project? What can hinder transformation?
<b>Trajectory of transformation</b>	Does your project assume that transformation takes place rather slowly and gradually, rather in a radical manner or in a disruptive one? Or else?
<b>Social ontology</b>	What is your project intervening on (e.g., individual's behaviors, productive sectors; institution and governance, formal and informal institutions, society as a whole)? What gets transformed?
<b>Research approach</b>	How is research done in your project?
	Do you use specific theoretical approaches in your research project? Do any of them deal with the concept of transformation explicitly?
	What specific methods are used in your research projects?
<b>Role of the researcher</b>	How do you see your role as researcher in the transformation process? In how far is this influenced by the funding scheme of your project?
<b>Potentials and limitations</b>	What are the potentials and the limitations of projects?

#### Results

At the end of the discussion, participants were asked to synthesize the main discussion focusing on each dimension considered as well as to draw some conclusions on possible convergences and divergences among projects. Below is a synthesis of the discussion reported by each project cluster.

Table 10. Synthesis of the discussion reported by each project cluster. Source: own elaboration

### Group I - prescriptive research on causes

<b>Controllability of Transformation</b>	The group acknowledges that while transformation can be planned, it cannot be fully controlled due to various unpredictable factors.
<b>Drivers of transformation</b>	Key positive elements supporting transformation include policy support, examples, people's mindset and motivation, new technologies, and the time needed for maturity. Conversely, negative elements such as consumption habits, tax systems, greenwashing, tradition, power structures, and scattered knowledge can hinder transformation.
<b>Trajectory of transformation</b>	The group believes transformation can occur both gradually and disruptively, depending on the context. The mindset often favors gradual change, while adaptation to events can be quick and disruptive. Technologies and methods can facilitate both gradual and disruptive changes.
<b>Social ontology</b>	The projects in this group aim to intervene in various domains, including individual behavior, productive sectors like tourism and construction, policymakers, and society. The transformation targets designers, policymakers, productive sectors, and individual behaviors.
<b>Research approach</b>	Research in the project employs theoretical approaches from social sciences, stakeholder engagement, and psychology. Specific methods include U theory, real lab, building simulation, and life cycle analysis. These approaches and methods are used to understand and foster transformative change.
<b>Role of the Researcher</b>	Researchers see themselves as facilitators of change, they aim to support stakeholders in overcoming resistance and adopting new practices. This role is influenced by the funding scheme of their projects.
<b>Potential and Limitations</b>	The research has the potential to understand and foster transformative change by leveraging interdisciplinary methods and stakeholder engagement. However, it faces limitations due to the unpredictable nature of transformation and the varying resistance from stakeholders
<b>Synthesis</b>	
<b>Convergence among the Projects</b>	Projects share the belief that transformation can be planned but not entirely controlled. They emphasize the importance of interdisciplinary research and recognize that stakeholders often resist change and engage in greenwashing, which tends to reproduce business-as-usual behaviors. Despite these challenges, research projects are seen as crucial boosters of change, driving transformation through innovative methods and stakeholder engagement.

**Divergence among the Projects**

Projects differ on the timing of transformation, which varies by research topic. There is no consensus on whether transformation should be gradual or disruptive, as this depends on the methods and technologies employed. Also, the intervention level varies, reflecting the diverse backgrounds and research fields of the projects, which determine the methods used to foster change.

**Group II - prescriptive research on effects**

<b>Controllability of transformation</b>	The group agrees that transformation can be both planned and steered
<b>Drivers of transformation</b>	Elements that create a supporting environment for change are financial factors, political will, stakeholder understanding, a robust legal framework, future vision and planning, accountability, and engagement.
<b>Research approach</b>	Theoretical approaches include just transition, resilience, and social return on investment. Methods employed in the research involve impact chains, interviews and workshops to understand context and engage stakeholders, stated preference surveys, choice modeling, and statistical analysis and models, which aid in knowledge transfer and managing uncertainty.
<b>Role of the Researcher</b>	Researchers play multiple roles in the transformation process: transferring the will of the community, providing knowledge, acting as facilitators between different parties, and conducting critical analysis. Their involvement varies from direct engagement with local people to facilitating collaboration and offering knowledge without bias.

**Synthesis**

<b>Convergence among the Projects</b>	Projects converge on the importance of stakeholder understanding, financial factors, and political will as crucial elements for successful transformation. They focus on topics like climate change adaptation, including extreme events, nature-based solutions, and the well-being and health of citizens. These shared themes highlight the collective commitment to addressing significant global challenges through transformation.
<b>Divergence among the Projects</b>	Differences arise in the roles of researchers, with some directly engaging with local communities, others facilitating collaboration with minimal bias, and some solely providing knowledge. Additionally, methods vary between qualitative approaches, such as interviews and workshops, and quantitative methods like surveys and statistical analysis. These divergences reflect the varied strategies and tools used to foster transformation, influenced by the specific contexts and objectives of each project.

#### Group IV - Descriptive research on causes

<b>Controllability of transformation</b>	The group believes that transformation can be steered to some extent, particularly within specific sectors, but it cannot be fully controlled due to the possibility of unintended consequences.
<b>Drivers of transformation</b>	Respect for different social interests, strong institutional leadership and coordination, active participation, robust information, and adequate funding.
<b>Trajectory of transformation</b>	The transformation process is typically slow but can be accelerated by disruptive events.
<b>Social ontology</b>	The project aims to intervene in productive sectors, institutional governance, and society, targeting transformations across these areas.
<b>Research approach</b>	Research is conducted using various theoretical influences and empirical analysis, both quantitative and qualitative. Methods include monitoring and document analysis. The approach emphasizes stakeholder involvement despite potential conflicts of interest and provides knowledge whose usage and beneficiaries need further clarity.
<b>Role of researchers</b>	Researchers see their role as socially responsible, providing sound analysis, new ideas, and participating in public debate, although funding is easier to obtain for mainstream topics.
<b>Synthesis</b>	
<b>Convergence among the Projects</b>	There is a shared vision of the researcher's role as contributing to knowledge and generating innovative ideas. Although transformation was not explicitly mentioned in all projects, the implicit objective was to achieve transformative outcomes. The consensus is that transformation is a slow, gradual process with the potential for disruptive events to catalyze change.
<b>Divergence among the Projects</b>	Projects diverge in their specific focus areas, methodologies, and the degree of stakeholder involvement. Some projects concentrate on different topics, use varied research methods, and have stronger stakeholder engagement than others. These differences reflect the diverse approaches and contexts within which each project operates, highlighting the multifaceted nature of transformative research.

#### Group IV - Descriptive research on effects

<b>Controllability of transformation</b>	The group concurs that transformation can be partly planned and steered intentionally through systems thinking and project design. However, it is also partly uncontrollable due to varying uptake and participation levels.
<b>Drivers of transformation</b>	Key elements for a successful transformation include time, knowledge, awareness, capacity for engagement, and stakeholder involvement. Hindering factors are missing agency, lack of stakeholder engagement, research projects not addressing practical demands, and lacking mandates.
<b>Trajectory of transformation</b>	Transformation is generally slow due to its complexity, though a more disruptive approach would be beneficial.
<b>Social ontology</b>	The project aims to transform institutions and governance by influencing policies and decision-making processes, as well as enhancing people's practices, particularly their capacity to engage and interact with technology.
<b>Research approach</b>	Theoretical approaches include risk concepts, transformative adaptation, stakeholder engagement, energy transition, and socio-technical and socio-ecological transitions. Methods used are mainly qualitative, such as workshops and interviews. Interdisciplinary research is seen as both an opportunity and a threat, with systemic thinking adding to the complexity.
<b>Role of researchers</b>	Researchers provide information, bring people together, and raise awareness of urgency and complexity, influenced by funding schemes.
<b>Synthesis</b>	
<b>Convergence among the Projects</b>	Projects agree that successful transformation requires awareness, commitment, motivation, agency, and a mandate. A common issue is that research sometimes lacks a mandate, as some projects are initiated by researchers rather than being driven by policymakers' specific needs. There is a consensus on the distinction between transforming research and transforming society, although they are interlinked. Interdisciplinarity is both an opportunity and a threat, and the complexity involved in transformation is acknowledged as difficult to manage and measure.
<b>Divergence among the Projects</b>	Differences arise in assumptions about what drives transformation. Some projects believe socio-technical transition fosters socio-ecological transformation, while others do not make specific assumptions, focusing instead on understanding underlying complexities. Additionally, projects operate at different scales, with some targeting policies and societal changes, while others focus on individual behaviors and practices. These variations reflect diverse strategies and scopes in addressing transformative change.

Table 10. Summary of Convergence and Divergence Points, and the Role of Researchers as Reflected in Discussions Across the Four Project Groups. Source: own elaboration

Project grouping	Group I – Prescriptive research on causes	Group II – Prescriptive research on effects	Group IV - Descriptive research on causes	Group III - Descriptive research on effects
<b>Convergence points</b>	<p>Societal transformation towards sustainability can be planned but not entirely controlled.</p> <p>Importance of interdisciplinary research and recognition that stakeholders often resist change and engage in greenwashing, which tends to reproduce business-as-usual behaviours</p> <p>Research projects are seen as crucial boosters of change, driving transformation through innovative methods and stakeholder engagement.</p>	<p>Importance of stakeholder understanding, financial factors, and political will as crucial elements for successful societal transformation towards sustainability.</p> <p>Topics like climate change adaptation, including extreme events, nature-based solutions, and the well-being and health of citizens.</p> <p>Commitment to addressing significant global challenges through transformation.</p>	<p>Researcher's role as contributing to knowledge and generating innovative ideas.</p> <p>Although transformation was not explicitly mentioned in all projects, the implicit objective was to achieve transformative outcomes.</p> <p>Transformation is a slow, gradual process with the potential for disruptive events to catalyse change.</p>	<p>Successful societal transformation towards sustainability requires awareness, commitment, motivation, agency, and a mandate.</p> <p>Research sometimes lacks a mandate, as some projects are initiated by researchers rather than being driven by policymakers' specific needs.</p> <p>Distinction between transforming research and transforming society, although they are interlinked.</p> <p>Interdisciplinarity is both an opportunity and a threat, and the complexity involved in transformation is acknowledged as difficult to manage and measure.</p>
<b>Divergence points</b>	<p>Timing of transformation, which varies by research topic.</p> <p>No consensus whether transformation should be gradual or disruptive, as this depends on</p>	<p>Roles of researchers, with some directly engaging with local communities, others facilitating collaboration with minimal bias, and some solely providing knowledge.</p>	<p>Specific focus areas</p> <p>Methodologies</p> <p>Degree of stakeholder involvement</p>	<p>No consensus about what drives transformation: some projects believe socio-technical transition fosters socio-ecological transformation, while others do not make specific assumptions, focusing instead on</p>

Transformation pathways

Bridging research, practice and governance

	<p>the methods and technologies employed.</p> <p>Intervention level varies, reflecting the diverse backgrounds and research fields of the projects, which determine the methods used to foster change.</p>	<p>Methods vary between qualitative approaches, such as interviews and workshops, and quantitative methods like surveys and statistical analysis.</p> <p>Varied strategies and tools used to foster transformation, influenced by the specific contexts and objectives of each project.</p>	<p>understanding underlying complexities.</p> <p>Projects operate at different scales, with some targeting policies and societal changes, while others focus on individual behaviours and practices.</p> <p>These differences reflect diverse approaches and scopes in addressing transformative change.</p>
<p><b>Role of the researcher</b></p>	<p>Consensus: Researchers see themselves as <b>facilitators of change</b>, they aim to support stakeholders in overcoming resistance and adopting new practices.</p>	<p>Diverse: Researchers play <b>multiple roles</b> in the transformation process: transferring the will of the community, providing knowledge, acting as facilitators between different parties, and conducting critical analysis.</p>	<p>Diverse: Researchers <b>provide information</b>, connect people and organizations, and <b>raise awareness</b> of urgency and complexity of treated topics.</p>

## 5.3 Questionnaire

Following the workshop, a questionnaire was distributed to the PIs of the selected projects to collect information about each individual project. The goal of the questionnaire was to collect detailed information about the selected projects directly from the principal investigators (PIs). The questionnaire was intentionally designed to be concise, focusing on gathering project-specific information that were not readily available in the project description or key data.

### 5.3.1 Aim and structure of the questionnaire

The questionnaire was structured according to the dimensions of analysis presented in the conceptual framework (Chapter 4). It was divided into two parts. The first part collected basic information about the research projects, such as project name, funding scale (European, national, regional, or other), scope of application (national, regional, or transnational), and funding category (applied research, pure research, or consulting). The second part focused on the collection of information about the project's epistemology and ontology (see the conceptual framework in chapter 4). PIs were asked to reflect on their projects by considering the distinction between prescriptive and descriptive approaches, the sociopolitical approach to transformation, the academic theories used to understand social change, the methods employed by the project (qualitative, quantitative, mixed, participatory approach), and the methodological approach employed (inter-mono-multi-transdisciplinary). Additionally, the survey explored dimensions related to social ontology, trajectory of change, drivers of change, and controllability of change.

### 5.3.2 Preparation of the dataset for data analysis

Information on the dimensions of the conceptual framework was captured using predefined categorical variables, while other aspects, such as the theoretical framework underlying the project and the methodologies employed, were explored through open-ended questions. This approach was necessitated by the challenges of pre-classifying the methods, as a binary categorization into broad categories such as quantitative or qualitative would have been overly simplistic and insufficiently descriptive. The data from the open-ended questions were converted into categorical variables, for example the descriptions of the methods used were classified into qualitative, quantitative, mixed methods. During the phase of variable transformation and the integration of additional variables derived from available project information, continuous bilateral communication was maintained with the PIs to ensure data accuracy and validation.

After receiving all completed questionnaires, a secondary verification was conducted to ensure their completeness. During the data cleaning phase, it was identified that the questionnaire for one project had been completed twice, as it was distributed to two contact persons, both of whom submitted responses. These duplicate responses were subsequently merged into a single entry. Furthermore, one project was excluded from the analysis because most of the questionnaire fields could not be completed, due to the project's technical focus, which did not align with the theme of social-ecological transformation. After cleaning and validation, 37 responses were retained for the quantitative analysis.

## 5.4 Results

The results of the dimensions analysed through the questionnaire are presented below.

## 5.4.1 Characteristics of the sample projects

### Funding scale

Of the 37 selected projects, 22 are funded by EU programs (e.g., Interreg, Horizon, DG Echo, Life+, JPI Climate AXIS), 5 by regional sources (e.g., L14, Eurac internal funds, consultancies, TN), 2 by national funds (PNRR in Italy, GIZ in Germany), and 3 by other sources (e.g., mixed funding, private foundations like Cariplo).

### Scale of application of the research project

26 of 37 projects have a transnational scope, including EU and Interreg projects. 9 focus on regional applications (e.g., South Tyrol and other regions), while 2 operate at the national level (Italy or neighboring countries).

### Funding type

@31 of 37 projects focus on applied research, producing case studies, guidelines, policy recommendations, and tools for practitioners. 3 are pure research, exploring fundamental concepts without direct applications, while 3 are consultancies with predefined scopes and outputs assigned by external agencies.

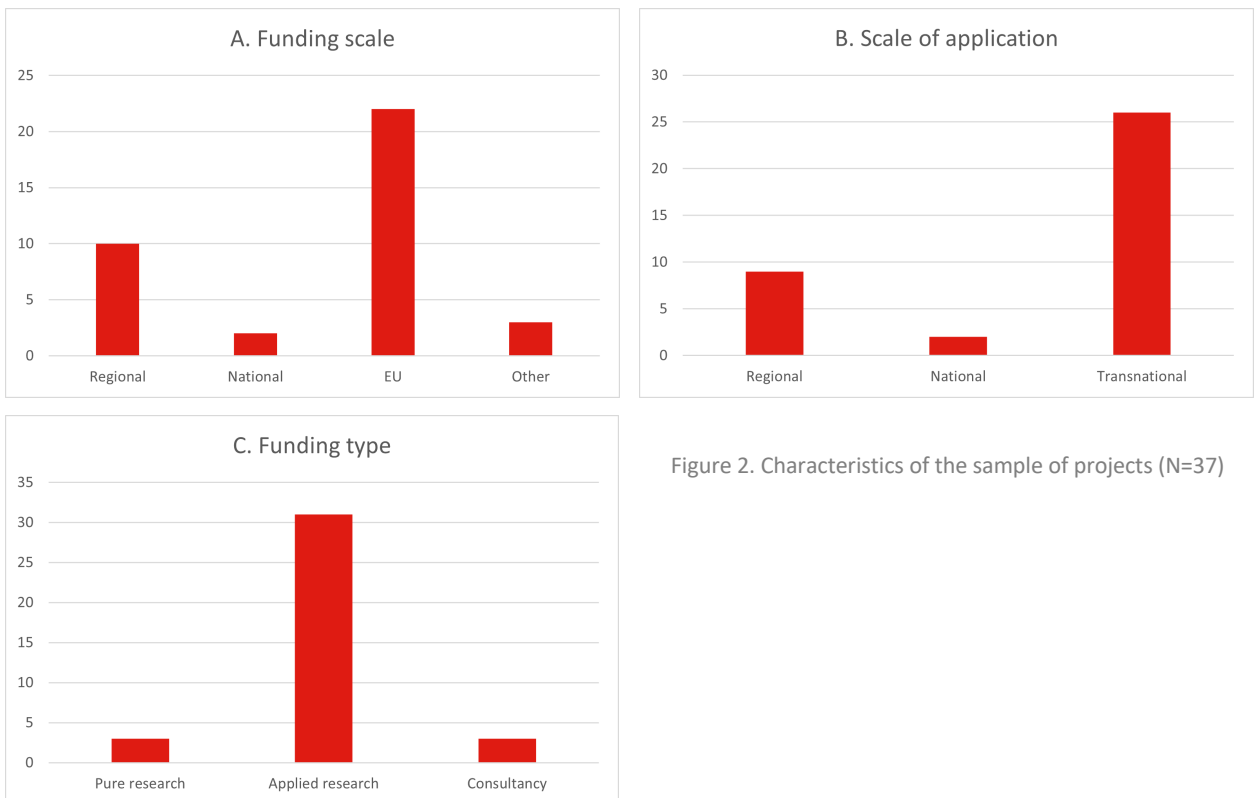


Figure 2. Characteristics of the sample of projects (N=37)

## 5.4.2 Distribution of Eurac Research projects according to the elements of the conceptual framework

### Social ontology

Most projects (17 of 37) focus on how formal and informal institutions interact in relation to the problematic topic or phenomenon (methodological relationalism). 9 projects examine the level of individual decisions and behaviors, either of single citizens, organizations or specific productive sectors (methodological individualism). 7 projects investigate large social structures and systems (methodological holism). 4 projects could not be assigned to any specific category of social ontology.

### Trajectory of transformation

Research projects are based on different assumptions on how social-ecological transformation occurs. Most projects (23 of 37) assume that transformation unfolds as a gradual and steady progress in societal norms, values, and practices. 9 projects, however, posit that transformation follows a radical or disruptive trajectory, driven by comprehensive and transformative changes in social structures, ideologies, and power dynamics. 5 projects assume that transformation follows a dynamic trajectory, reflecting the complex and nonlinear nature of societal change.

### Controllability of transformation

Projects differ in their assumptions about the controllability of transformation. Nearly all project (34 of 37) assume a limited degree of controllability of transformation, meaning that institutions involved in the project have some level of influence and can initiate or guide the process of change. However, they also recognize that transformation involves multiple interconnected factors and actors, leading to unpredictable consequences, drivers, and resistances. 2 projects assume a full controllability of transformation, meaning that institutions have complete authority and influence over the process of social change. 1 project assumes a low degree of controllability over transformation, meaning that institutions are assumed to have no influence in the process of social change, as transformation processes are complex and driven by spontaneous or decentralized factors. Further investigation into the correlations between the trajectory and controllability of transformation would be valuable.

### Drivers of transformation

Most research projects (22 of 37) identify knowledge enhancement as a key lever for transformation, aiming to change existing norms, practices, and values and the relationship between them and the spread of new ideas. 9 projects identified institutional changes as leverages of transformation, meaning that transformation happens by changing institutional context and specific formal and informal rules. 6 projects focus on leveraging technical and technological innovations to drive transformation.

New ideas are regarded as the most significant driver of transformation, even though many projects also focus on technical and policy aspects. This may reflect the belief that technical innovations help promote new ideas. Similarly, while some projects do not solely rely on institutional change, they emphasize new perspectives on the role and functioning of institutions in driving societal transformation towards sustainability.

### Socio-political approach

Each project begins with a distinct overall objective related to the problem it aims to address. 15 out of 37 projects adopt control as a socio-political approach, thus aiming at addressing the effects of phenomena considered problematic. Another 15 projects adopt a convert approach, aiming to address

the causes of the phenomena considered problematic. 7 of 37 projects employ a mixed approach, with no clear predominance of one over the other.

### **Descriptive or prescriptive approach**

Most research projects (24 of 37) adopt a prescriptive approach, thus intending primarily to contribute to a societal transformation with some degree of normativity and pre-set direction of the wished transformation that the project contributes to reach. While these projects do generate knowledge to support solution creation, this aspect is secondary to their focus. 13 projects, on the other hand, adopt a descriptive approach, intending primarily to understand and analyse transformation processes. This does not imply that these projects do not offer any recommendations for addressing the identified problem.

### **Theory clusters engaging with transformation**

Most of the selected projects (17 of 37) do not use a specific theory of social change in the research. Upon reviewing the qualitative replies provided to this question, some participants mentioned methods that referred to guiding research on transformation, but without a specific theoretical framework on how transformation or social change is supposed to happen. Among the 20 projects that did identify a theory, the majority (7 projects) refer to the social ecological systems framework, exploring the intricate connections between human societies and the natural environment and theorizing that system go through cycles of growth, collapse, and re-organization. 4 projects use relational approaches, while 3 projects use theories deriving from transition studies. Finally, 6 projects reference to other theories that were not categorized in the conceptual framework.

### **Methods**

An open-ended question about methods was included in the questionnaire, and the responses were subsequently categorized as quantitative, qualitative, or a combination of both. Most projects (23 of 37) use a mix of quantitative and qualitative methods, while 8 projects rely solely on quantitative methods, and 6 projects use only qualitative methods.

It is important to note that many projects identified as employing mixed methods typically imply the co-presence of various methodological approaches across different work packages or project phases. However, it is often unclear whether these methods are truly integrated into practice. Distinguishing between the mere co-presence and actual integration of methods is crucial, yet our analysis could not confirm the latter in most cases. This ambiguity underscores the need for further research to understand how different projects operationalize and manage the interplay between multiple methods. Specifically, it is essential to investigate whether and how these methods are combined and integrated into a cohesive approach. During the data collection phase, including the category "multi-methods" within the project analysis framework would have been beneficial. This category would specifically refer to projects where different methods are employed in parallel, without an explicit attempt at integration.

### **Use of participatory methods**

Most projects (24 of 37) adopt a participatory methodology, using approaches such as workshop or citizen science, where research participants are empowered and regarded as knowledge producers. wherein these projects, research also contributes to the empowerment of participants in addressing the problem at hand. 13 projects, however, do not deploy participatory research methods. Instead, they rely on secondary data collection, or primary data collection that does not involve active human participation, or primary data collection that involves human participation but entailing a passive role (e.g., through interviews or questionnaires). This data was derived from secondary data (i.e., the project description in Converis) rather than from responses to the questionnaire.

### **Methodological approach**

Projects have different methodological approaches. Most projects (18 of 37) adopt an interdisciplinary approach, meaning that researchers from different disciplines work together in the project, on the same activities/topics, in an integrated way. 15 projects adopt a transdisciplinary approach, meaning that the project has partners from outside academia (e.g., public authorities) contributing to the research (i.e., just as recipients of policy recommendations or dissemination events). 3 projects adopt a multidisciplinary approach, meaning that the project involved researchers from different disciplines that work in the project but on different activities/topics. 1 project adopts a monodisciplinary approach, meaning that the researchers in the project have the same disciplinary background.

On a clarification note, many projects claim to be interdisciplinary based on the diverse backgrounds of their researchers. However, a researcher's background does not always correlate with their role in the project. We did not distinguish between projects involving closely related or very different disciplines, nor did we differentiate within social sciences or between social and natural sciences. Therefore, it is unclear if true integration of disciplines occurs, as more detailed knowledge of each project is needed beyond the scope of this study.

### **Transformation addressed explicitly**

As a final question in the questionnaire, we asked whether transformation was addressed explicitly or implicitly in the project. Most projects (17 of 37) address transformation implicitly, meaning that the project deals with concepts linked to transformation (e.g., resilience, climate change adaptation). 15 projects address transformation explicitly, meaning that transformation is among the project objectives, and it is mentioned explicitly. 5 projects could not be categorized within this dimension.



Figure 3. Distribution of Eurac Research projects (N=37) according to the elements of the conceptual framework

## 5.5 Discussion

The paragraph discusses the findings from the workshop and questionnaire on the role of research in sustainability transformation processes, the approaches employed, and the normative concepts and analytical approaches used in Eurac projects.

The study has shown that while contributing to socio-ecological transformation is a central goal for many researchers, most projects do not explicitly address this aim, often engaging with the concept only in an implicit way. This reflects the complexity of understanding what transformation is, what should be transformed, by whom, under which conditions, and the challenges that the process brings about. Consequently, most projects do not employ a specific theoretical framework to guide their transformative objectives, i.e. a theory of change, of how and why a certain intervention will be successful (Horcea-Milcu et al. 2024). This highlights the critical importance of explicitly defining the problems that science endeavors aim to address and outlining how science intends to address them.

This relates to the challenge researchers face in positioning their research objective along the conversion-control continuum, struggling to determine whether the project tackles the (assumed) root causes of contemporary socio-ecological crises or/and controls the effects—either directly or indirectly—of contemporary social-ecological crises. This difficulty can be attributed to the fact that convert and control strategies are often combined, and it is closely linked to the problem definition: the same problem (e.g. water floodings) may be considered a cause (i.e. of ecosystem destruction) or an effect (i.e. of wrong planning as well as of raising frequency of extreme events due to increased concentration of GHG) for different research projects, depending on the perspective from which the project enters.

The role of science oscillates between being both descriptive – i.e., providing a robust understanding of the issues at hand and synthesizing existing knowledge— and prescriptive— i.e., proposing actionable solutions. Researchers are asked to understand complex processes deemed problematic while also contributing to impacted oriented solutions, being both knowledge providers and solution seekers. This is in line with the statement that sustainability science evolved following a research agenda that deals with the complexity of change through the research process of advancing concepts and theories. As it has been addressed by Horcea-Milcu et al. 2024 there is a tension between a descriptive-analytical and a more transformative mode of sustainability science (Wiek and Lang 2016 in Horcea-Milcu et al. 2020).

Researchers engage in projects at various scales, ranging from regional to transnational, and leverage drivers such as the enhancement of new ideas, institutional change, and technological innovation. These efforts span disciplines including sociology, economics, and engineering. Consequently, diverse methodological approaches, such as interdisciplinary, transdisciplinary, and participatory methods, are used. As noted in literature: “Sustainability scientists advocate for multi-, inter-, and transdisciplinary research to create more inclusive knowledge production processes” (Max-Neef 2005; Hadorn et al. 2008; Jahn et al. 2012; Lang et al. 2012; Scholz and Steiner 2015 in Horcea-Milcu et al. 2020).

Reflecting on how involved researchers interpret various dimensions within their projects, it appears that certain values—such as being prescriptive, interdisciplinary, or transdisciplinary—are increasingly seen as desirable, to the point of almost becoming "trends" in research. This trend is likely influenced by the expectations of funding schemes, where categorizing a project within these dimensions may enhance its perceived value. Conversely, approaches like monodisciplinary tend to be undervalued. Similarly, the concept of participation varies widely, with different degrees of involvement—such as consultation—being labeled as participatory, even when the depth of engagement varies significantly. Engaging in interdisciplinary and transdisciplinary work and with participatory research approaches and techniques necessitates competence and degree of self-reflection, which are often missing in research practices. While our project was not designed to delve deeply into these distinctions, this is undoubtedly an area for future investigation. Additionally, categorizing large projects proved challenging due to their

complexity, as many include multiple work packages with different objectives, methods, and stakeholders. Even when focusing on Eurac's role, these projects often defy simple categorization. Furthermore, involving researchers from non-social science disciplines in this analysis was difficult, as they may not typically engage with concepts like participation or transdisciplinary, making it harder for them to adapt to this evaluative framework.

In conclusion, discussions with PIs of projects directly or indirectly involved in transformation research revealed the need to address more effectively the gap between science, society and policy in order to promote a fully informed society and to develop policies that can reduce the costs associated with transformation.

## 5.6 Concluding remarks

Reflections on the role of research and researchers in supporting societal change towards sustainability, prompted by the analysis of selected Eurac research projects. While the goal of contributing to societal transformation towards sustainability is a central goal for many research projects and the researchers involved, most projects do not explicitly address this goal, and often only implicitly address the concept. Additionally, a significant number of projects do not employ a specific theoretical framework to guide their transformative objectives, i.e. a 'theory of how and why a certain intervention will be successful' (Horcea-Milcu et al. 2024). This highlights the critical importance of explicitly defining the problems that science aims to address and how science intends to address them.

There is also increasing pressure to adopt interdisciplinary and transdisciplinary approaches. However, the complexity inherent in research demands specialized skills to effectively collaborate with stakeholders from diverse knowledge domains and practical backgrounds, as well as to recognize and avoid reproduction of knowledge hegemonies in these collaborations (Turnhout 2024). Engaging in interdisciplinary and transdisciplinary work necessitates a degree of self-reflection within the scientific community—a process initiated at Eurac also thanks to the "Transformation Pathways" project. The related activities such as the workshop have received very positive feedback. This opportunity for reflection has brought forth important questions regarding the definition of "good" science: is it merely about aligning with the objectives of a funding call, or does it involve proposing innovative solutions that extend beyond the call's expectations (Turnhout 2024)? Furthermore, it is crucial to consider the extent to which research should be directed toward practical solutions, a level of critical reflection that is seldom required by funding bodies.

Another key consideration is the evaluation of research's usefulness. Research should not be measured solely by its immediate impact on policy, but rather by its potential to be operationalized in subsequent phases that align with the research's ultimate goals. Strategic design both at the level of the single research project, as well as across research projects is therefore essential, ensuring that each project contributes meaningfully to a broader research agenda or problem-solving framework. This necessitates recognizing the diversity of researcher profiles and expectations, acknowledging that not every researcher profile needs to be involved in every phase or needs to forcefully conduct participatory science. This way of thinking acknowledges the existence of different epistemologies about what science is and therefore how it should be made (i.e., distinguishing between Mode-2 and Mode-1 science (Horcea-Milcu 2022)). Additionally, this prompts a reassessment of the prevailing positivist approach in research, as well as the increasing dominance of transdisciplinarity. This type of questioning sheds light on the existing tension between giving priority to accountability towards society or towards science within transformative sustainability research (Horcea-Milcu et al. 2024). Instead, a pluralistic approach to research should be embraced, allowing for a diversity of methods and a deeper exploration of the underlying assumptions guiding various approaches.

Future avenues for research and reflection within Eurac's projects should focus on enhancing research practices and producing additional knowledge. The goal is not to completely transform or overhaul the way research is conducted, but rather to reflect on, clarify, and make our work more strategic and efficient. This involves optimizing the use of available resources, creating greater synergy between research outputs and their respective phases.

Creating opportunities for reflection, such as workshops or dedicated projects, could provide valuable spaces for these discussions. Establishing regular moments for this type of critical reflection could significantly contribute to improving the overall quality and impact of our research efforts.

## 6 Challenges and future direction for transformation research based on empirical evidence

Written by: Elisa Ravazzoli, Cristina Dalla Torre, Lydia Pedoth

This chapter, building on the findings presented in Chapter 5, aims to present some challenges faced by researchers at Eurac Research who are engaged in transformation research. Furthermore, it delineates potential avenues for future research that could enhance researchers' better understanding of transformative processes as well as practical implementation. Transformation research aims not only to challenge existing paradigms but also to create innovative pathways to change, being inherently complex.

### 6.1 Challenges for Research

- **Clear definition of the problems.** Dealing with social-ecological transformation is extraordinarily complex as diverse problem definitions and research approaches can lead to varying interpretations of the same phenomena. It is important to clearly define the problems within each project and assess whether they were addressing causes or effects.
- **Clear frameworks.** Adopting academic theory and clear framework is difficult as concepts most of the time overlaps, so is relevant to select which concept of transformation to use and use comprehensive frameworks or methodologies that effectively integrate socio-ecological transformation into research design.
- **Interdisciplinary integration.** Transformation research often spans multiple disciplines, such as sociology, economics, and environmental science. This complexity can lead to difficulties in integrating diverse epistemologies and methodologies, making it challenging to develop a cohesive framework for understanding transformation processes.
- **Acquisition of skills.** The complexity inherent in research demands specialized skills to effectively collaborate with stakeholders from diverse knowledge domains and practical backgrounds, as well as to recognize and avoid reproduction of knowledge hegemonies in these collaborations.
- **Methodological differences.** Transformation research frequently employs participatory action research or post-normal science. These approaches prioritize inclusivity and co-creation with stakeholders but may challenge conventional scientific rigor and objectivity, creating a tension between maintaining scientific standards and being responsive to societal needs.
- **Pluralistic approach to research.** The engagement of transformative researchers in brokering social processes can create a paradoxical situation where their accountability to society may compromise their scientific integrity. Researchers may feel pressured to produce results that satisfy societal demands, potentially leading to compromises in methodological rigor or objectivity. Instead, a pluralistic approach to research should be embraced, allowing for a diversity of methods and a deeper exploration of the underlying assumptions guiding various approaches.
- **Potential conflicts between process vs. output orientation.** Transformative research often emphasizes process-oriented approaches, focusing on collaborative knowledge production and

social engagement. Meanwhile, traditional scientific paradigms may prioritize output-oriented goals, such as publishing in high-impact journals or achieving specific research milestones.

- **Challenge in providing actionable Knowledge.** There is an increasing demand for research that produces actionable knowledge. Researchers often struggle to translate their findings into actionable policies or practices that align with socio-ecological transformation goals. This disconnect can result in research that is theoretically sound but practically disconnected from transformative action.
- **Measurement of Impact.** Quantifying the impact of transformation efforts can be difficult, as impacts may not be immediately apparent or easily measurable. Transformation impacts go beyond visible effects on policy to involve changes in behaviors, culture and values, which are not easy to analyse. This complicates the assessment of research effectiveness.

## 6.2 Future research development

- **Enhancing reflexivity in research practices.** Foster a culture of critical reflection within research by creating dedicated spaces for discussion, such as workshops, can significantly improve the quality and impact of research efforts. Study the perspective of individual researchers' strategies, the different roles and how they navigate existing conflicts helps to better understand how to help them mobilize the transformative power of research.
- **Collectively building competencies on transformative research.** Enhance individual capabilities, develop attitudes and skills and competence for engaging with stakeholders, thus transforming through research process and not through outputs, can generate impacts that conventional research methods would not be able to achieve.
- **Peer review processes and reality checks.** To increase the validity and quality of transformative research, it is crucial to establish robust peer review processes that not only serve as a quality control mechanism but also fosters a culture of constructive criticism. This culture is essential for refining research methodologies and outcomes, can help identify potential biases and gaps in research, thereby increasing higher standard of quality, credibility and relevance of findings. Furthermore, incorporating feedback from a broad network of experts ensures that transformative research aligns with real-world challenges, enhancing its applicability and acceptance among stakeholders.
- **Implementing rigorous transdisciplinary methods.** Foster a structured and reflected process that is based on profound knowledge of the conditions that govern transdisciplinary discourses. Such process knowledge needs to be theoretically sound, empirically tested, and methodologically reproducible.

## 7 Exploring transformation towards sustainability at the practice level in South Tyrol

Written by: Cristina Dalla Torre, Benedetta Oberti, Vittoria Zadra, Elisa Ravazzoli

The focus on research projects provides valuable insights into theoretical frameworks and methodological approach useful to understand transformation. However, it often overlooks the perspectives faced by organizations, initiatives, and individuals (i.e. entities) working on the ground. Gaining deeper insights into their perspectives, motivations, challenges, and collective action is crucial for a comprehensive analysis of societal change. Furthermore, this exploration not only enriches our understanding of transformation but also highlights the importance of collaboration between research and practice. Engaging with these entities allows for a more holistic approach to societal transformation, ensuring that policies and strategies are informed by lived experiences and practical knowledge.

Paragraph 7.1 describes the process of mapping the different organizations, initiatives and individuals based in South Tyrol that are engaged in topics related to societal transformation towards sustainability (e.g., climate action, sustainability, environmental protection and justice). Paragraph 7.2 presents the methodology used to examine the motivations behind the collective actions of these organizations and individuals and to identify the factors that influence their understanding of transformation. A special focus is given to the network organization Climate Action South Tyrol. Finally, paragraph 7.3 discusses the results obtained from a workshop with self-selected participants.

### 7.1 Selection of South Tyrolian entities

To select entities in South Tyrol that work on topic related to societal transformation towards sustainability, we began by conducting a web search for South Tyrolean entities that have led or participated in events and projects related to climate action, sustainability, environmental protection and justice over the past five years. We also consulted colleagues for additional inputs. This process led to the identification of 51 entities which were then screened based on the following criteria: 1) Voluntary-based entities (e.g., non-profit organizations, associations, collectives, activists' movements, informal groups) of private nature and not in the public sector. 2) Working on topics such as: climate action, sustainability, environmental protection and justice. Following this additional selection process, 46 entities were ultimately retained, while five that did not meet the criteria were removed from the dataset. Many of the entities mapped are members of network organizations, such as Climate Action South Tyrol and the South Tyrol Sustainability Network.

To collect information about the selected entities, we created a dataset. Information about the following categories was collected: name of the entity; contact person information such as name, email and telephone number if present; brief description of aim of the entity and the type of activities it conducts; scale of action i.e., the level at which the entity operates, distinguishing among local scale (i.e., municipal level or lower), district scale (i.e., supra-municipal, valley or district), provincial (i.e., concerning the Autonomous Province of Bolzano), regional (i.e., concerning the region Trentino Alto-Adige); affiliation i.e. whether the organization is a provincial section of bigger organization acting at national or international level; type of organization, distinguishing among single organization with citizens as members, network of organizations, and individual initiative i.e. single citizen. We have not distinguished entities according to organizational forms as recognized by the law, nor among formal and informal organizations. In the case of network of organizations, all the organizations part of the network were listed in the dataset.

The distribution of the selected entities according to the category **scale of action** is illustrated in Figure 4. 6 out of 46 are district-level entities, working mainly in districts and neighbourhoods of Bolzano. 14 entities operate at the local level, at municipal level or below, and 14 entities work mainly at provincial level. The remaining 12 entities are provincial branches of larger d entities operating at national or international level.

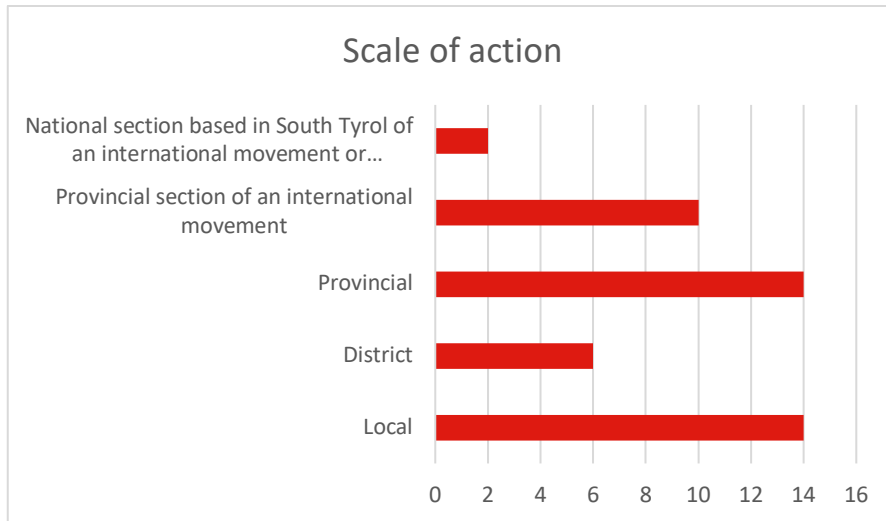


Figure 4. Distribution of selected entities according to the scale of action (N=46). Source: own elaboration

The distribution of the selected entities according to the type of organizations is illustrated in Figure 5. 7 entities were categorized as networks of organizations. These are: Climate Action South Tyrol, Rete dell'Alto Adige per la Sostenibilità, Dachverband für Natur- und Umweltschutz, Ambiente e Salute, Gemeinwohl Ökonomie, Global Forum South Tyrol, Spazio Autogestito 77. Thirty-seven organizations were categorized as single organizations, and two as individual initiatives.

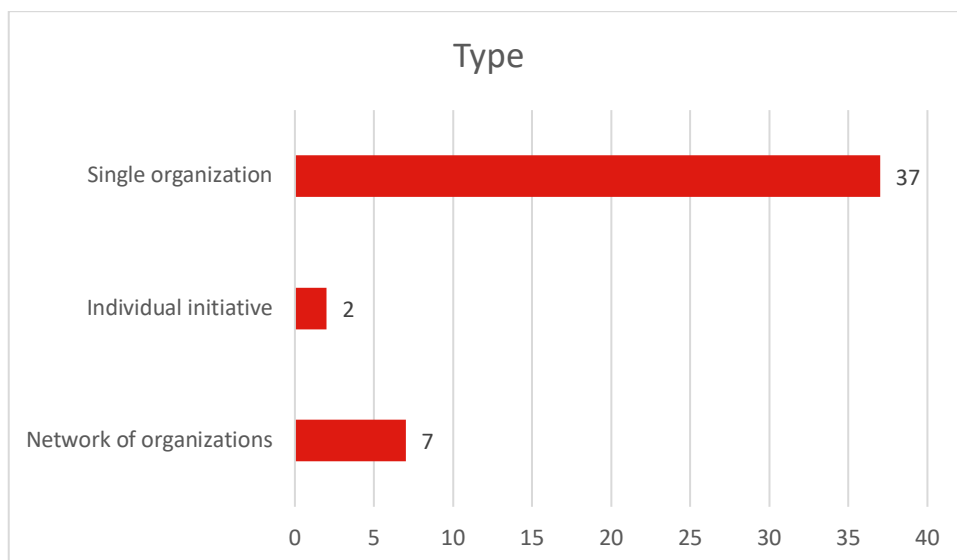


Figure 5. The distribution of selected entities according to the organizational type (N=46). Source: own elaboration

## 7.2 Workshop

To explore the deeper meanings and assumptions that drive entities in collective actions for social-ecological transformation, we designed and organized a workshop. The workshop was held on May 12<sup>th</sup> during the Klimacamp South Tyrol (See **Box**). It was designed primarily for individuals and representatives of organizations participating to the Klimacamp South Tyrol, with a focus on those engaged in climate activism. A total of 13 people attended the workshop. Many participants identified themselves as members of Climate Action South Tyrol, organizers of the Klimacamp, or independent activists speaking on their own behalf.

### 7.2.1 Aim and structure of the workshop

The workshop had three main objectives: first, to investigate how these entities conceptualize transformation; second, to facilitate fruitful discussions and self-reflection on activism for transformation; and third, to test the framework developed in the project and conceptualize transformation using a systems thinking approach. Additionally, it aimed to bridge the gap between science and practice, foster synergies with entities, and provide them with a tool for self-reflect on their collective action.



Figure 6. The context of the workshop.

The workshop was designed and structured to encourage active participation. It lasted two hours in the morning and followed an engaging session titled “How to start a revolution”, led by a Belgian activist. Participants were very motivated to gather tools and instruments to reflect on the transformation they

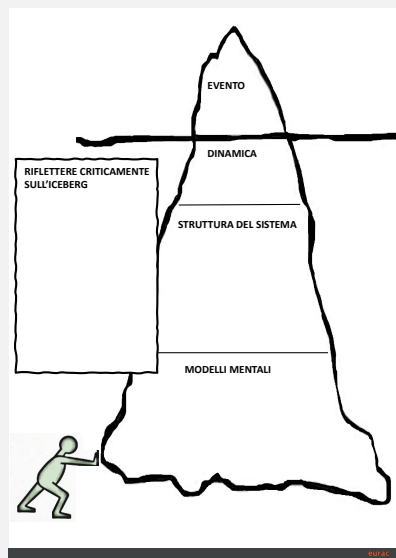
want to facilitate and achieve. The workshop was conducted in a very informal and comfortable setting to enable meaningful participation. It was held in a circle beneath a wooden structure in the center of a festival grounds, with benches, rugs and blankets, in the municipality of Vöran – Verano. Participants were free to join by calling out the title of the workshop loudly, inviting anyone nearby to participate. Tea, coffee, and snacks were available to help refresh or energize attendees. We took a few minutes to allow people to settle in before starting. The workshop began with a welcome session and an introductory activity in which participants shared their names, organizational affiliations, and sustainability goals. To encourage creative thinking, Dixit cards were used to inspire unique and out-of-the box responses.

This was followed by a structured reflection, which adapted the iceberg model of systems thinking (See Box) to the framework dimensions developed within this project (explained in Chapter 2). Participants were provided with the template shown in Figure 7 and were guided by Eurac researchers in filling it out. To simplify the process, we formulated questions to operationalize the dimensions of the Transformation Pathways framework and connect them to the levels of the iceberg model (See

Table 11).

### Push the iceberg method

The "Push the Iceberg" method is a participatory modelling approach grounded in Systems Thinking, aimed at fostering a shared and deep understanding of sustainability issues—environmental, social, and economic—within groups, organizations, or communities. This method utilizes the iceberg metaphor, which illustrates that visible events (the tip of the iceberg) are only a small part of a more complex reality that includes underlying trends, systemic structures, and mental models.



The iceberg model comprises four levels of knowledge:

1. **Events:** The easily observable occurrences that capture our attention.
2. **Trends:** Changes over time that require data analysis to understand their progression.
3. **System Structures:** The feedback loops and interdependencies that complicate cause-and-effect relationships within social systems.
4. **Mental Models:** The underlying beliefs and assumptions that shape how individuals and groups perceive and react to changes.

Figure 7. Example of template for reporting thoughts during the workshop

Table 11. Linking iceberg model level to transformation pathways dimensions and related attributes, operationalized into workshop questions and guided options. Source: own elaboration

Iceberg model level: general question	Workshop question and guided options	Transformation Pathways dimension and related attributes
Event / Trend: <i>what is going on?</i>	What is the event or ongoing dynamic that has prompted your organization to act, and how have you felt called to engage, either as an organization or as individual citizens?	Problem
Structure of the system: <i>What has influenced the event or trend? How do you intervene in the system?</i>	What are the elements or forces at play that are driving this change or trend, and at what level has your organization decided to intervene?	Ontology
	Individual behaviors, production sectors	Methodological individualism
	Institutional policies, relationships between formal and informal institutions	Methodological rationalism
	Society, public opinion, and the system as a whole	Methodological holism
	What activities and projects is your organization implementing, and at what scale? What tools and methods is your organization using to influence change and promote social and ecological transformation?	Drivers of transformations
Mental models: <i>What assumptions, beliefs and values you hold about the transformation?</i>	How does your organization perceive the process of social and ecological transformation towards sustainability, climate neutrality, and environmental justice?	Trajectory
	Gradual: small changes can only be achieved gradually through many small actions	Incremental change
	Radical: Many small but coordinated actions can create the conditions for significant change.	Radical change
	Disruptive: With a bit of luck or favorable coincidences, even a small individual action can lead to major changes.	Dynamic change
	Do you believe that the social and ecological transformation your organization aims to achieve can be:	Controllability
	Planned and guided	Full control (steered change)
	Activated, triggered, influenced	Limited control (triggered change)
	Impossible to control	Low control (emergent change)

Participants engaged in a series of questions designed to uncover the events and trends driving their actions, the underlying forces at play, and their mental models regarding social and ecological transformation (See structure of the workshop in Annexes). We asked to first reflect on the question individually or in pairs, and then to share the response in the circle. The workshop concluded with a

reflection on the relevance of using systems thinking and such dimensions to for deeper understanding and strategic action both among the different entities, as well as between entities and Eurac Research.



Figure 8. Workshop participants reflecting individually or in pairs on the iceberg

## The Klimacamp Alto Adige



The [Climate Camp South Tyrol](#) is a volunteer-driven and self-funded initiative that brings together people of all ages to share knowledge, attend workshops, and develop ideas for creating a more sustainable society. With a focus on climate change and sustainability, the event aims to inspire action and build hope for a better future. The 2024 edition was the second, following the first held in 2023. The five-day event features lectures, speeches, music, yoga, and community-cooked meals in a campsite setting. Participants are encouraged to bring their own camping gear, including cutlery, water bottle, and plate, and to contribute to the organization of the camp either with time contribution and/or with a financial contribution, according to own

possibilities.

The camp operates on the principle that everyone contributes a little to collectively shape the experience. Various working groups coordinate tasks such as cooking, dishwashing, cleaning, childcare, running the bar, taking care of the programme. A care team ensures a comfortable atmosphere and addresses any issues that may arise. Whispered translation is available for multilingual participants during lectures and workshops.

The program includes contributions from the participants themselves, that include activists, researchers, practitioners, policymakers. The workshops and other activities aimed at fostering dialogue and action on climate-related issues, including discussions on the intersectionality of climate crisis and social justice, practical training for non-violent civil disobedience, and creative explorations of social and ecological transformations, all designed to inspire participants to collaborate and innovate in addressing the urgent challenges posed by climate change.

The 2024 edition featured a collaboration with the ["By design and by disaster"](#) conference, co-produced with students from the Master in Eco-Social Design at the Free University of Bolzano, having a topic and reflected in the conference title: "Power in Transformation", that was closely connected with the objectives of the Climate Camp.

Image from: [https://klimacamp-altoadige.bz/home\\_it/](https://klimacamp-altoadige.bz/home_it/)

## Climate Action South Tyrol

Climate Action South Tyrol (CAST) is an alliance of activists and over 70 organizations committed to climate protection, climate resilience, and social justice. The alliance engages in educational activities in schools, organizes conferences and social media campaigns, creates climate assessments, and conducts educational work at local festivals and events. The primary goal of the project is to provide information about the climate crisis, raise awareness, and motivate people to act. More information at: <https://climateaction.bz/>. According to its members, as it was mentioned many times during the workshop, one of the core aspects of CAST is the Clima Show.

### **Clima Show by CAST**

The Clima Show is an awareness-raising project on the climate crisis in the Trentino-Alto Adige region, presented as a one-hour multi-vision show. The show was launched in 2023 in German and had 11 replicas attended by around 1.200 participants and aims to inform citizens about the effects of climate change in the region and the actions everyone can take to counter it. The show consists of two parts: an introductory part that presents scientific facts about the climate crisis, enriched with interviews with experts, film scenes, and in-depth videos; and a second part that illustrates possible solutions in key sectors such as energy, construction, mobility, biodiversity, and food. The main objective is to provide accessible information on the climate crisis, raise public awareness, and motivate people to take concrete action to protect the environment, considered a common good to be preserved. The project is led by Climate Action South Tyrol. In 2024, the project is expanding with the development of an Italian version, tailored to a new target audience. To support this, CAST is creating collaborations with other organizations and networks active in the Province of Trento. In addition to translating the content, the concept is being reimagined to include data and information from the entire Trentino-Alto Adige region, with a view to shared responsibility and increased collaboration between the two Provinces composing the Trentino-Alto Adige Region.

## **7.2.2 Results from the iceberg model workshop**

The results of the workshop are reported in two ways: an aggregated summary, reporting the insights from all participants, and a more in-depth analysis, focusing on the specific perspective of the network organization Climate Action South Tyrol. The information collected during the workshop was analyzed to identify common themes that emerged from the participants' responses to the questions posed. Thematic analysis is useful for identifying patterns of meaning, known as themes, within qualitative data (Morin et al. 2021; Herzog et al., 2019). This method of analysis helped us understand what the participants deemed important, how they categorized their experiences and perceptions, and how they interconnected various topics. Additionally, the thematic analysis was complemented by discourse analysis, which allowed us to examine the participants' responses within the socio-cultural context (Herzog et al. 2016).

The information was analyzed following the order of the questions asked to the participants during the workshop. For each question, we looked for themes that emerged most frequently or were particularly relevant due to their uniqueness. Below we recall the questions posed:

1. What is the event or ongoing dynamic that has prompted your organization to act, and how have you felt called to engage, either as an organization or as individual citizens?
2. What are the elements or forces at play that are driving this change or trend, and at what level has your organization decided to intervene (i.e., individual, institutional, societal)? What activities and projects are your organization implementing, and at what scale? What tools and methods are your organization using to influence change and promote societal transformation towards sustainability?
3. How does your organization perceive the process of societal transformation towards sustainability towards sustainability, climate neutrality, and environmental justice (i.e., gradual, radical, disruptive)?
4. Do you believe that the societal transformation towards sustainability your organization aims to achieve can be: planned and guided, triggered and activated, or impossible to control?

## 7.2.3 The perspective of South Tyrol climate activists on societal transformation towards sustainability

### Events or dynamics that triggered climate activists to act and engage in action

Participants cite various events and dynamics that motivate them, or the organizations they belong to, to act. One trigger mentioned is engaging in discussions with others or having the opportunity to exchange ideas about climate issues, which opened their minds to new perspectives and approaches. For example, having conversations with people from the Global South who have already experienced climate change impacts, or moving to a more sustainable and environmentally conscious city, were cited as influential experiences. Another trigger is the increase in climate action and awareness, along with witnessing positive grassroots and organized movements. One participant mentioned Greta Thunberg and the Fridays for Future movement as inspirations that made them realize change is possible.

Additionally, participants highlighted the growing awareness of the consequences of personal behaviors on the climate crisis. For instance, one participant mentioned that breaking their iPhone and having to replace it, instead of repairing it, made them reflect on the capitalist, consumption-driven world we live in, which lacks a circular economy. Another participant noted the prevalent use of cars despite the availability of less polluting transportation alternatives.

Participants also mentioned the impact of significant policies and global climate conferences on their motivation to support climate action and transition. For example, one participant highlighted how the approval of the Green Deal or attendance at the UN COP influenced them. Another participant referred to a climate document from South Tyrol which they found lacking in substance, underscoring the need for more decisive actions.

Other participants pointed to factors such as increasing consumerism, overproduction of non-essential goods, waste-generating production systems, individualism, and the concentration of power and wealth. They emphasized that these factors often prioritize profit over climate justice. Additionally, participants noted an increasing general perception of climate change effects, such as rising summer temperatures and extreme events.

Finally, the increasing availability of information and data on climate change and the effectiveness of climate actions were cited as motivators. Participants emphasized that the growing dissemination of scientific evidence and data by researchers has been influential in raising awareness and driving informed action.

### Factors that have influenced the event or trend, and how the activists intervene in the system

Participants are divided on the levels at which the elements and forces driving change occur: the micro level (individual behavior and the production sector), the meso level (institutional policies and relationships), and the macro level (society, public opinion, and the system).

Those emphasizing the micro level highlight that individual behavior is significantly influenced by knowledge of the problem and awareness of positive and negative actions to address it. Additionally, they note the crucial role of emotions, which can sometimes be more effective than mere information dissemination. Participants suggest various strategies to encourage appropriate individual behavior and combat ignorance and emotional disconnect. These strategies include promoting direct engagement and participation, organizing information dissemination events, using effective tools, and leading by example. These approaches can foster grassroots changes and enhance personal responsibility.

Those emphasizing the importance of the meso level highlight the critical role of climate policies and institutions, both formal and informal, and the relationships between them. Participants underscore the

significance of local cooperation and projects as catalysts for systemic policy changes. Consequently, they stress the importance of forming alliances among organizations and institutions, unifying efforts, lobbying, and educating decision-makers to promote sustainable practices within communities and institutions.

Finally, those emphasizing the relevance of the macro level underscore the characteristics of local, national, and global systems as the most critical elements driving change and shaping the current situation. Participants highlight overarching societal trends and features of the economic system, such as the dominance of capitalism, overconsumption, GDP growth imperatives, globalization, the global North-South divide, and the concentration of power. There is a general sentiment that economic priorities often overshadow climate and environmental concerns. In this context, participants underline the importance of shifting societal norms toward valuing environmental sustainability, reducing consumerism, and challenging existing economic paradigms. This can be achieved through widespread education, advocacy campaigns, and promoting alternative models of happiness and consumption.

### Trajectory of transformation

When asked how they envision the societal transformation towards sustainability, climate neutrality, and environmental justice, participants are divided into three perspectives: gradual, radical, and disruptive transformation. From the answers given, we could observe that participants provided answers about how they perceive transformation to happen as a process and as an outcome.

Those that expressed that transformation will be gradual emphasize the necessity of maintaining system stability and ensuring that everyone remains engaged without feeling alienated by the changes or overwhelmed by the needed habit changes. They argue that rapid change could cause fear and prevent people from finding a new equilibrium. A gradual transformation is seen to prevent anyone from perceiving the change as counter to their interests and needs. However, these participants also acknowledge the urgency of achieving significant and impactful change. They believe that while the transformation process should be gradual, the result should be substantial and meaningful. Thus, graduality is viewed as a characteristic of the transformation process, but the ultimate outcome should still be radical and significant.

Participants who position themselves in favor of "radical transformation" emphasize that the current system is no longer functioning effectively, necessitating a significant systemic overhaul. They argue that only radical change can bring about the necessary transformation, as conservative or incremental changes will not suffice. One participant notes that radical change does not imply destabilization but rather the establishment of a new stability. Another participant underscores that radical transformation can only be achieved through coordinated efforts in policy and the economy.

Those who believe that the transformation will be disruptive emphasize that significant changes are often triggered by unforeseen and powerful events. In this case, responses describe how the transformative process will occur, rather than how participants think it should happen. For instance, one participant cites the example of COVID-19, which accelerated progress in some environmental areas. However, participants also acknowledge that a certain level of graduality is necessary to ensure that everyone is included in the process and to make sure that the transformation induced by disruption is stable, permanent, and sustainable over time.

To conclude, some participants suggest that we should not think in rigid compartments; change can occur in gradual, radical, and disruptive ways. They emphasize that multiple approaches can be employed simultaneously to achieve the desired transformation.

This question and the responses we received were valuable for further testing this analytical dimension. We found that it was easier for participants to conceptualize transformation as a process rather than a

result. It was also interesting to explore the interpretations and semantic fields participants associated with this type of transformation.

### **Controllability of transformation**

Most participants feel that while transformation cannot be fully planned or controlled, it is not entirely beyond influence. They believe that transformation can be triggered or shaped to some extent. For instance, some participants think that although individuals and organizations may not hold the power to enact systemic changes directly—since this power resides with economic and political entities—they can still exert pressure, advocate, and propose ideas. By proposing ideas, they believe that organizations and individuals can influence those, economic and political entities, who can facilitate transformation.

Other participants emphasize that education and information dissemination can raise awareness and knowledge among citizens, encouraging more sustainable behaviors. While it may not be possible to fully control people's actions, their behaviors can be guided. This aligns with one participant's view that, although the transformation process cannot be controlled, it is significantly influenced by its starting conditions.

A slightly different perspective is offered by one participant who describes transformation as a "wicked problem", implying that there isn't a single clear path. They note that it's often difficult to determine the steps needed to move from point A to point B, and the outcome is uncertain.

### **Focus on the perspective of Climate Action South Tyrol**

Participants from Climate Action cited various events and dynamics that motivated them to act. For instance, they mentioned the "Clima show" and workshops about the climate issue, as well as European initiatives like the Green Deal and the PNRR (the Italian National Recovery and Resilience Plan), other European initiatives which aim to boost investment in renewable energy, and all the agricultural-photovoltaic policies. Additionally, they highlighted the influence of more general climate policies and plans, as well as the influence of Greta Thunberg and the Fridays for Future movement. Furthermore, they noted the lack of climate awareness and the insufficiency of climate transition policies in Alto Adige.

Regarding the system's structure and the elements and forces that drive change or trends, participants emphasized the importance of participation, collectivization of processes, information, and cooperation. They also mentioned the political level (both local and national), policymakers, local and international cooperation, and European projects and departments. One participant pointed out that organizations have different internal structures and activist cultures, which can lead to a lack of engagement in intersectoral dialogues. They suggested that in South Tyrol there is a need for more listening to the needs and perspectives of all organizations and for organizing more shared events.

Another participant highlighted that the system is dominated by capitalism and the paradigm of growth and growth-based indicators such as the gross domestic product, whereas there is a need for indicators related to improved socialization, education, and research to support action. Leading by example was also stressed as important. This approach contrasts with the prevailing individualism and self-centered paradigm. A participant emphasized the importance of reaching people through information and emotion, as demonstrated by the Clima show. They believe it is crucial to engage with people concerned about climate protection and justice and to put pressure on politicians to achieve effective climate plans, laws, and measures.

Finally, regarding mental models, participants from Climate Action, despite some nuances, all shared the idea that the transformation should be gradual to ensure stability, even though the ultimate change needs to be radical. The change should occur step by step. One participant added that there is a need

for gradual change to prevent fear and resistance stemming from perceived threats to interests and traditions. Another participant mentioned that while building alliances between organizations (one of the goals of Climate Action) is generally a gradual process, it can sometimes become disruptive as events accelerate the pace of change.

All participants from Climate Action believe that organizations can activate, influence, and guide the process of change and transformation. For example, one participant stressed the importance of good examples and role models as potential actions organizations can take to trigger transformation.

### 7.3 Concluding Remarks

The chapter explored how local organizations conceive transformation and examine the motivations behind the collective actions of these organizations, using the workshop as a format. The significance of information and education was emphasized repeatedly, underscoring their critical role in facilitating transformation by raising awareness. Responses from participants in the workshop varied significantly. Some noted that information on societal changes is now more accessible, highlighting the increased availability of climate data and insights into the effects and causes of climate change. However, others highlighted that many individuals remain uninformed and lack access to critical information around key thematic like climate change, circular economy, food system, clean mobility sustainable behaviors etc. This suggests that information exists in silos, creating an asymmetry between those who have access to certain types of information and those who do not. The latter group faces the consequences of ignorance, which manifests as a reluctance to change, while those with access to information may leverage it for profit amid growing climate instability.

It also emerged that addressing the science-society-policy gap is crucial for fostering a fully informed society and for developing policies that can mitigate the costs associated with transformation. As noted by Termeer et al. (2017), transformative adaptation requires not only technological innovations but also enabling social, institutional, and governance factors that drive the transformative process. Participants perceive a significant gap between civil society and decision-makers such as politicians and influential economic actors. This disconnect fosters a sense of powerlessness among ordinary citizens, as the ability to effect meaningful change seems concentrated in the hands of a few. Such a divide hinders societal transformation since the priorities of those in power often do not align with the needs and values of broader society.

Furthermore, participants highlight a pressing need for a paradigm shift in society. Many believe that the current system—characterized by capitalist and individualist logics—cannot coexist with a fair and sustainable world. The difficulty of reconciling capitalism and individualism with sustainability is evident in numerous studies that emphasize the need for systemic change to address climate challenges effectively (Colloff et al., 2021).

In summary, fostering effective transformation strategies requires a comprehensive approach that addresses the gaps within the society-policy-practice interface. This can be achieved through collaborative efforts that involve diverse stakeholders, integrate various knowledge systems, and enhance the dissemination of information on climate change.

## 8 The role of governance: insights from an analysis of the Climate Plan for South Tyrol

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The chapter examines the theoretical approaches to transformative governance that have emerged in the scientific literature such as *governance for* transformation, *governance of* transformation, and *transformation of* governance. It seeks to understand the challenges, barriers, and opportunities a system encounters in this transformative process. To provide concrete examples, the chapter analyses the case of South Tyrol, an Autonomous Province with special powers that has committed to becoming climate neutral by 2040 through its recently approved Climate Plan and investigate whether and how this transformative governance process is being implemented in practice, offering insights into the dynamics of this ambitious transition.

### 8.1 Transformative governance: some theoretical insights

Transformative governance is an evolving concept in the scientific literature that refers to governance systems and processes that enable significant, systemic change towards sustainability and resilience. It is characterized by its focus on deep structural changes, innovation, and adaptive management to address complex and interconnected global challenges such as climate change, biodiversity loss, and social inequality. Transformative governance is defined by its ability to enact significant changes in policies, institutions, and practices to achieve sustainability goals. It involves inclusive and participatory decision-making processes, fostering innovation, and ensuring equitable outcomes.

Transformative governance requires rethinking traditional governance structures and embracing more flexible, adaptive, and integrative approaches. The literature on transformative governance provides a rich array of theoretical insights (Visseren-Hamakers et al., 2021), practical frameworks and case studies (Janssen et al., 2022; Roll et al., 2022; Asadzadeh et al., 2023). It highlights the necessity of systemic, inclusive, and adaptive approaches to governance that can address the multifaceted challenges of climate change and sustainability. These works collectively underscore the importance of integrating various sectors and levels of governance, fostering stakeholder participation, leveraging innovative financial and technological tools, and maintaining flexibility to adapt to new information and changing conditions.

According to this strand of literature, key principles of transformative governance include inclusivity and participation, adaptability and flexibility, integration and coordination. Inclusivity and participation relate to the need of involvement of diverse stakeholders, including marginalized groups, in decision-making processes to ensure that various perspectives and knowledge systems are considered. Adaptability and flexibility pertain to the development of governance systems that can adapt to changing conditions and new information, allowing for iterative learning and continuous improvement. Integration and coordination refer to promoting cross-sectoral and cross-level coordination to address complex and interconnected issues holistically (Visseren-Hamakers et al., 2021).

Implementing transformative governance faces several challenges (Jensen et al., 2020), such as resistance to change from established institutions, power dynamics, and vested interests. Additionally, there is often a lack of capacity and resources to support transformative initiatives, and the complexity of sustainability issues can make it difficult to identify and implement effective solutions. Case studies highlight the importance of local context and the need for tailored approaches that consider specific

socio-economic and environmental conditions (Janssen et al. 2022; Roll et al. 2022, Asadzadeh et al. 2023).

For transformative governance to be effective, supportive policies and institutional frameworks are essential. This includes creating enabling environments for experimentation and innovation (e.g. through research and development funding, adopting supportive policies that allow for piloting innovative solutions, etc.), providing incentives for sustainable practices, and ensuring that policies are coherent (i.e., horizontal coherence within sectors, and vertical coherence between local, national, and international policies,) and aligned with sustainability goals (). In summary, transformative governance represents a paradigm shift that emphasizes the need for systemic change, inclusive participation, adaptability, and innovation to address the complex challenges of the 21st century.

Analytical and theoretical approaches to transformative governance have significantly evolved in the scientific literature, reflecting a multidisciplinary interest in understanding and facilitating profound systemic changes (Rijke et al., 2013; Clements et al., 2023). These approaches generally revolve around different facets of governance and transformation, such as the purpose of governance, i.e. governance for transformation, the structure and processes of governance systems, i.e. governance of transformation, and the changing nature of governance itself, i.e. transformation of governance.

The *governance for transformation* approach (Folke et al., 2005; Frantzeskaki et al. 2018; Meadowcroft, 2009; Patterson et al., 2017) focuses on how governance systems can be designed or reformed to achieve specific transformative goals, such as sustainability, resilience, or social justice. Key themes include the following aspects: a) strategic governance: emphasizes long-term planning, visioning, and strategic interventions to guide societal transitions towards desired futures; b) adaptive governance: highlights the importance of flexibility, learning, and adaptability in governance systems to respond to dynamic and uncertain environments; c) participatory governance: stresses the inclusion of diverse stakeholders in decision-making processes to ensure that transformation efforts are equitable and democratic; d) collaborative governance: involves multi-level and multi-sectoral collaborations to pool resources, knowledge, and capabilities for transformative outcomes.

The *governance of transformation* perspective (Burch et al. 2019; Ostrom, 2010) examines the governance structures, processes, and mechanisms that manage or steer transformation processes. It involves several aspects and investigation paths.

1. First, institutional analysis, which explores how institutions, i.e., rules, norms, and practices, shape and are shaped by transformation processes. This includes the role of formal and informal institutions in enabling or constraining change.
2. Second, policy integration which looks at the coordination and alignment of policies across different sectors and governance levels to support coherent transformation efforts.
3. Third, governance networks which study the interactions and relationships among various actors (government, private sector, civil society) involved in transformation processes. It focuses on network dynamics, power relations, and the distribution of responsibilities.
4. A fourth aspect is the regime theory, which explores how existing regimes (established systems of practices, rules, and technologies) can be transformed or replaced by new regimes that support sustainability and resilience.

The *transformation of governance approach* (Avelino & Wittmayer, 2016; Voß & Bornemann, 2011) considers how governance itself must transform to effectively address complex, global challenges. Key aspects encompass: a) reflexive governance, which promotes self-critical and self-reflective governance

practices that continuously reassess and adapt governance structures and processes in response to emerging challenges and knowledge; b) transition management, which aims at guiding and managing long-term transition processes through iterative cycles of visioning, experimentation, and learning; c) polycentric governance, which advocates for multiple, overlapping centres of decision-making authority, which can enhance resilience and innovation in governance systems; d) systemic change, which focuses on understanding and influencing the interconnectedness and interdependencies within governance systems to facilitate holistic transformations.

In summary, analytical and theoretical approaches to transformative governance cover a wide array of perspectives that address different dimensions of governance and transformation. These approaches collectively contribute to a deeper understanding of how governance systems can be designed, managed, and transformed to navigate and shape complex societal changes.

In the context of climate change, traditional governance approaches have often been incremental and reactive, focusing on immediate needs and short-term solutions. However, the growing urgency of the climate crisis necessitates transformative approaches that go beyond incremental changes to fundamentally alter systems, structures, and behaviours (Novy-Barlow, 2022). Does South Tyrol offer favourable conditions for streamlining transformative governance in times of climate crisis? Is South Tyrol fit for these transformative challenges? The following section provides some insights and highlights current hindrances.

## 8.2 A case study: the “Piano Clima Alto Adige 2040”

Both Autonomous Provinces of Trento and Bolzano have adopted their own climate initiatives and have the ambition to play a crucial role in the fight against climate change, although climate change is not a subject matter *per se* and, as such, it is not included in the Autonomy Statute’s catalogue of provincial competences. Nonetheless, mitigation and adaptation measures are transversal to several fields both of provincial exclusive and shared competence, such as urban planning, transport, landscape, flora and fauna protection, forests and agriculture, tourism.

Competences in the climate related fields have been exerted to some extent through a few provincial legislative acts and provincial ordinances (Alberton et al., 2022). The Autonomous Province of Bolzano has not issued a specific legislative act on climate change. Instead, an overall, cross-cutting vision on climate action was conceived in 2011, i.e., the “Climate Strategy - South Tyrol Energy 2050”, lately revised. The provincial Agency for Environment and Climate Change played a coordinating role for the provincial administrations involved. The revision process included a public participatory phase<sup>3</sup> and the publication of an independent technical study on the potential scenarios for South Tyrol toward climate neutrality (Sparber et al., 2022). The revised “Climate Plan South Tyrol 2040”, was presented by the Provincial Government in 2022 together with the announcement of the climate neutrality target by 2040<sup>4</sup>. The Plan presents a comprehensive and forward-thinking plan to address climate issues, engage stakeholders, and transform South Tyrol into a sustainable region for future generations. The Plan is part of the “Everyday for Future” sustainability strategy, aiming to achieve climate neutrality by 2040 through reducing greenhouse gas emissions and promoting renewable energy sources. It aims to transform Alto Adige into a sustainable reality for young and future generations in social, ecological, and economic aspects. It is part of a broader strategy to make South Tyrol a region of social well-being with a clear political vision in relation to climate issues. The document mentions various planning tools and strategies, including a government program for the 2018-2023 legislative term, a regional development strategy for 2021-2027, and a Smart Specialization Strategy. It also highlights laws and programs related to housing, agriculture, forestry, tourism, energy, waste management, water utilization, mobility, and

<sup>3</sup> Info available at the Autonomous Province of Bolzano/Bozen website (<https://www.klimaland.bz/it/piano-clima-energia-alto-adige-2050/>).

<sup>4</sup> See: <https://news.provincia.bz.it/it/news/giunta-provinciale-neutralita-climatica-dell-alto-adige-entro-il-2040>.

territorial planning. The plan is continually adjusted to respond to new developments and challenges, emphasizing the importance of societal engagement for its success.

To ensure the success of the initiative, citizen involvement is crucial, leading to the establishment of the “Council of citizens for climate” and the “Forum of stakeholders” to gather diverse perspectives and ensure transparency in decision-making processes. The document acknowledges the climate crisis as a significant challenge requiring decisive action and radical lifestyle and operational changes.

Governance in the Climate Plan 2040 plays a crucial role in shaping the transformation towards sustainability through various mechanisms and strategies. The key aspects of governance that influence this transformation are discussed below.

1. **Inclusive and Participatory Decision-Making.** The plan emphasizes the importance of involving a wide range of stakeholders, including local governments, businesses, and the public, in the decision-making process. This participatory approach ensures that diverse perspectives and knowledge systems are incorporated, leading to more comprehensive and widely accepted solutions.
2. **Adaptive and Flexible Frameworks.** Governance in the plan supports adaptive management practices that allow for flexibility and responsiveness to new information and changing conditions. This is essential for dealing with the dynamic and unpredictable nature of climate change and ensures that policies can be adjusted as needed to stay effective and relevant.
3. **Cross-Sectoral Integration.** The plan promotes coordination across various sectors such as energy, transportation, agriculture, and industry. This integration is vital for addressing the interconnected nature of sustainability challenges and avoiding siloed approaches that can lead to inefficiencies and conflicting outcomes.
4. **Resource Allocation and Capacity Building.** Effective governance in the Alto Adige Climate Plan involves ensuring that adequate resources are allocated for the implementation of sustainability measures. This includes financial investments as well as efforts to build the technical and managerial capacity of institutions involved in the plan. Continuous training and education initiatives are also part of this approach to enhance skills and knowledge.
5. **Innovation and Technological Advancement.** The plan supports innovation and the adoption of new technologies as key components of transformative governance. By fostering research and development, and incentivizing the deployment of cutting-edge solutions, governance structures help accelerate the transition to a more sustainable future.
6. **Equity and Social Justice.** Ensuring that the benefits of climate measures are distributed equitably and that vulnerable groups are protected from adverse impacts is a fundamental aspect of the Plan’s governance. This focus on equity and social justice helps build broader support for sustainability initiatives and ensures that no community is left behind.
7. **Monitoring and Transparency.** Governance frameworks in the Plan include robust mechanisms for monitoring and evaluating progress towards sustainability goals. Transparent reporting and the use of clear, measurable indicators help track the effectiveness of policies and allow for adjustments as needed. This transparency also helps maintain public trust and engagement.

By integrating these elements, governance in the Alto Adige Climate Plan 2040 would likely not only guide the region towards achieving its sustainability goals but also ensure that the transformation process is inclusive, adaptive, and resilient. The combination of inclusive participation, cross-sectoral

coordination, resource allocation, innovation, equity, and robust monitoring creates a comprehensive approach to governance that is essential for sustainable development. Nonetheless, the Plan, while ambitious and well-structured, has several gaps in its transformative governance (*infra*).

### 8.3 Concluding remarks

This chapter explored what theoretical approaches to transformation governance have emerged in the scientific literature considering the climate crisis. Aiming at understanding the challenges, hindrances and opportunities a multi-layered system encounters in this transformative process, the cases of South Tyrol were presented. The Autonomous Province, holding special legislative and administrative powers, has set itself the goal to become climate neutral by 2040 in its recently approved Climate Plan, which adheres to the core principles of transformative governance – inclusivity and participation, adaptability and flexibility, as well as integration and coordination. Nonetheless, the Plan, while ambitious and well-structured, has several gaps in its transformative governance. The main concerns lie in the following areas:

**Citizen and Community Engagement.** Although the Plan involves stakeholders, the active participation of citizens and local communities could be enhanced further. There is a need for more effective tools to ensure continuous and meaningful public engagement, which is crucial for the adoption and success of the proposed measures.

**Adaptive Capacity and Flexibility.** The Plan could benefit from a greater focus on adaptability and flexibility. Proposed solutions might require dynamic adjustments in response to unforeseen changes in climatic and socio-economic conditions. The current governance structure may not be sufficiently agile to respond quickly to such changes.

**Intersectoral Coordination.** While the Plan promotes an integrated approach, coordination between different sectors and government levels could be strengthened. Sectoral policies sometimes operate in isolation, creating inefficiencies and potential conflicts between objectives. Better alignment of energy, transportation, industrial, and agricultural policies is essential for effective transformative governance.

**Resources and Capacity.** Implementing climate measures requires adequate resources and technical expertise. Insufficient funding and a lack of skilled personnel can hinder the Plan's progress. Additionally, continuous investment in training to enhance the skills and management capacity of the involved institutions is necessary.

**Innovation and Technology:** Although the Plan recognizes the importance of innovation, it could place more emphasis on research and the development of new technologies. The current strategy might not sufficiently incentivize the adoption of emerging technologies that could accelerate the transition to sustainability.

**Equity and Social Justice.** As mentioned above, transformative governance must also consider equity and social justice as climate measures can have differential impacts on various communities and socio-economic groups. Ensuring that benefits are distributed equitably and that no group is disproportionately disadvantaged will be crucial for the long-term success of the Plan. It is therefore imperative that the commitment to equity and social justice, which the strategy identifies as a fundamental aspect of its governance, is followed up on.

**Monitoring and Evaluation.** While monitoring is already an integral part of the Plan, the transparency and frequency of progress evaluations could be improved. Adopting clear and measurable indicators and regularly communicating results to the public are essential to maintain trust and stakeholder commitment.

Therefore, addressing these gaps is essential to strengthen the transformative governance process initiated by the Climate Plan South Tyrol 2040 and ensure the achievement of its climate goals by 2040.

## 9 Conclusion

Eurac Research states in its mission that “Through interaction between a variety of disciplines, our research addresses the greatest challenges of the future: keeping societies healthy, fostering intact environments, promoting sustainable energy and developing well-functioning political and social systems.” Researchers at Eurac Research are committed to find solutions to complex problems of our society and generating societal impacts. Aligned with Eurac Research’s mission, the project aimed to build a knowledge base that would support researchers in understanding the approaches and the various interpretations of transformation that can support and contribute to societal changes. While the project did not directly address questions such as “how much can we, as applied researchers, actually contribute to social-ecological transformation” or “what is realistically feasible to bring about concrete change”, or “how can we contribute to support transform in the agricultural sectors in South Tyrol”, it laid the groundwork for strategic transformative research actions. The following two paragraphs outline project’s key findings and potential directions for future research.

### 9.1 Key findings

These findings are particularly useful for researchers at Eurac Research and others working in applied fields who aim to better understand and contribute to support social-ecological transformation.

**Conceptual and methodological clarity regarding transformation.** The project has classified how transformations toward sustainability have been conceptualized across various academic traditions and political discourses. This aims to improve conceptual clarity by shedding light on major differences and commonalities. In terms of sociopolitical debates, we subsumed the wide spectrum of existing approaches under two broad categories: strategies of conversion and strategies of control, with the former aiming to address the root causes of the current social-ecological crises and the latter seeking to control their effects. In academia, we identified five main theories clusters engaging with social-ecological transformation: transition studies, social metabolism, socio-ecological systems, applied social science approaches, and critical theories. We described these clusters along the lines of four key classification criteria uncovering their underlying assumptions on society as well as on assumed drivers, dynamics, and controllability of transformation processes. The project has highlighted the increasing shift from traditional, discipline-based research to inter-and transdisciplinary approaches, which are essential for addressing complex societal challenges. Transdisciplinary research typically combines interdisciplinary knowledge integration with the co-production of knowledge involving scientific and non-scientific actors. Despite the potential of these approaches, significant epistemological and methodological challenges remain—particularly in participatory transdisciplinary research—which must be carefully navigated. This underscores the need for greater transparency and reflexivity throughout the research process to ensure both rigor and legitimacy.

**Conceptual framework useful for analytical purposes.** The project has developed a framework useful for analysing Eurac Research projects. The application of the framework has provided valuable insights into how transformation is addressed within Eurac Research, enhancing our understanding of the critical role that research—particularly social science-based research—plays in driving transformations. Furthermore, it has highlighted the key approaches and methods employed in current research practices at Eurac Research. The framework can be used by future researchers to compare and evaluate how various approaches and methods are used in applied research projects that study and/or wants to contribute to social-ecological transformations. The framework has also been adjusted to investigate how organizations (i.e. activists Climate Action South Tyrol) perceived and aimed to contribute to societal transformation, thus being a useful to better comprehend the science-policy-practice interface.

**Insights from the analysis of research, practice and governance.** The application of the framework to existing Eurac Research's projects reveals that while many projects aim to contribute to socio-ecological transformation, most do so implicitly and lack a specific theoretical framework. Researchers at Eurac Research often navigate between descriptive and prescriptive roles, facing challenges in understanding change while proposing actionable solutions. They also encounter difficulties in positioning their work along the conversion-control continuum. Although diverse methodological approaches are employed, there is an urgent need for effective interdisciplinary and transdisciplinary practices to bridge the science-society-policy gap and enhance informed decision-making.

The application of the framework to local organizations actively engaged in driving concrete change underscored the critical role of clear, understandable, and readily available information (on climate change, environmental pressure, social inequalities) that can support socio-ecological transformation. It revealed that information is often generated in silos and by referring to sectors, creating barriers and resistance to systemic change. Accessible information is essential for fostering an informed society and developing effective policies for transformation. The emphasis on information accessibility and interdisciplinary approaches highlights critical areas for policy development, particularly in bridging the science-society-policy gap to support informed decision-making.

Finally, the chapter on policy has investigated the theoretical approaches to transformation governance by focusing on the Autonomous Province of Bolzano-Bozen (South Tyrol). The Climate Plan aspires to reach climate neutrality by 2040 through inclusivity, adaptability, and intersectoral coordination. However, despite its ambitious framework, several gaps in transformative governance were identified. First, the plan could enhance citizen and community engagement by implementing more effective tools for meaningful participation. Second, it should also focus more on adaptability to respond to changing climatic and socio-economic conditions, while improving intersectoral coordination to align policies across sectors. In addition, more resources and technical expertise are needed for successful implementation, alongside a stronger emphasis on innovation and technology development. Lastly, ensuring equity and social justice in climate measures, along with improved monitoring and evaluation processes, will be crucial for the Plan's long-term success.

Overall, the project has established a common foundation that enables researchers who are not familiar with the concept of transformation to gain a clearer understanding of its complex nature and applicability in research. It has provided a valuable tool—a common framework—for analysing transformation, particularly within the research domain that facilitates effective comparisons across various Eurac projects. By studying a selection of Eurac research projects, it has highlighted existing gaps in research at Eurac Research, the challenges faced by researchers while also offering insights for future research development. Ultimately, this project has fostered connections among researchers, encouraging reflection on their work and challenges while promoting opportunities for interdisciplinary dialogue across Eurac Research.

Besides concrete positive outcomes, the research has several limitations. First, the literature review was neither exhaustive nor systematic; this may have resulted in significant contributions being overlooked. The complexity and diversity of theories and approaches mean that some important works may not have been included, particularly if they are from niche areas or emerging research. Additionally, categorizing the various approaches and theories into well-defined categories was difficult to achieve due to the interdisciplinary nature of the subject matter. Many theories may overlap or intersect, making it difficult to assign them to singular categories without oversimplifying their contributions. Second, the analysis of the projects revealed that the clustering Eurac Research project into four groups was quite difficult to achieve; many projects did not prioritize transformation as a primary goal, making it challenging to classify them effectively using the established categories. This reflects the implicit nature of many projects' contributions to socio-ecological transformation and highlights difficulties in aligning diverse theories and methodologies. Third, the analysis of the Klima Plan was conducted using textual analysis without interviews with the individuals who drafted the plan. While textual analysis allows for a systematic examination of the written content – identifying key themes, strategies, and framework – it restricts a deeper understanding of why certain decisions were taken and nuances

behind the decision-making processes; thus, potentially undermining insights that could have been gained from direct engagement with key stakeholders

## 9.2 Future research perspectives

In line with existing literature on transformation research and based on the key findings of the project, several potential future directions emerge that could be relevant for our research context:

**Empirical application of transformation concepts.** There is a need for empirical studies that apply different concepts of transformation and existing theories in real-world cases. Future research should analyze and facilitate transformation in certain sectors of our society (e.g., food system transformation). This requires not only implementing transdisciplinary collaborations but also embraces a culture of risk-taking in research, focusing on transformative projects, socially innovative experiments that implement alternative practices to challenge unsustainability as well as apply for research funding programs that valorize TD approaches.

**Transdisciplinary knowledge co-production.** Future research should explore the mechanisms and structures that facilitate transdisciplinary knowledge co-production among academic and societal actors. It should investigate how researchers engage in transdisciplinary projects i.e., how they manage conflicting goals, different roles, the tensions between outputs-oriented research versus process-oriented research, as well as individual desires and strategies. More importantly, researchers need more training to develop competences and attitudes for effectively engaging with societal stakeholders and do transformative research.

**Science-policy-society interface.** Future research should further provide practical indications on how to foster mutual understanding and collaboration among researchers, practitioners, and policymakers. Facilitating an active exchange of personnel between scientists and policy institutions by developing fellowship programs or joint research initiatives could be key. Additionally, there is a need to further build trust in science and continuously integrate scientific findings into policy and practice.

**Information access.** Research should investigate how access to information (e.g., on climate change, environmental stress, social inequalities) and existing knowledge affects the capacity of organizations to engage in transformative practices. This includes exploring barriers to information flow and identifying strategies to improve knowledge dissemination, which is essential for fostering informed decision-making and effective policy development.

By embracing these future research perspectives, researchers can further enhance their contributions to socio-ecological transformation. Developing a strategic plan outlining how Eurac Research intends to contribute to socio-ecological transformation—e.g., identifying objectives, activities and projects that meaningfully contribute to a broader research agenda, fostering synergy among researchers addressing similar topics and challenges, while recognizing the diversity of researchers—could be key to significantly amplifying the impact of transformation research at Eurac Research.

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## 12 Annex

### 12.1 List of selected Eurac Research projects

	Name of the project	Duration	Link to project Website	Funding Program	Eurac Lead Institute	Project Aim
1	Climate change integration in the multilevel governance of Italy and Austria	October 2020- Dec 2023	<a href="https://brill.com/edcollbook-oa/title/62097">https://brill.com/edcollbook-oa/title/62097</a>	Provincial LG14	Institute for Comparative Federalism	Subnational Governments as strategic players in the integration of climate change considerations in policy sectors
2	ADAPT NOW	November 2022 - October 2025	<a href="https://www.eurac.edu/en/institutes-centers/center-for-climate-change-and-transformation/projects/adaptnow">https://www.eurac.edu/en/institutes-centers/center-for-climate-change-and-transformation/projects/adaptnow</a>	Other EU Funding (EU funding / Project)	CCT	Strengthening the adaptive capacity of highly affected and disposed territories through the implementation and evaluation of available climate adaptation and risk mitigation management tools and practices
3	ADAPTATION ST	January 2023 - June 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/adaptation-st">https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/adaptation-st</a>	Other Province BZ funding (Province BZ funding / Project)	CCT	Achieving a climate-resilient society: 1) understanding and identifying climate risks, 2) identifying adaptation needs and developing cross-sectoral adaptation measures

4	<b>ADAPTIVE HOUSING</b>	January 2023 - December 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/adaptive-housing">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/adaptive-housing</a>	Excellence Science (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	Investigating the role of adaptive behavior in ensuring comfort in low-energy homes in the face of global warming. The main objectives are to (a) investigate the potential effects of overheating in low-energy homes and (b) propose guidance for the design and operation of adaptive and resilient low-energy houses.
5	<b>ALPERIA_CLIMRISK</b>	September 2022 - February 2023	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/alperiaclimrisk">https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/alperiaclimrisk</a>	Private organisations (Other projects /Project)	CCT	Assisting ALPERIA and an external consultant in completing a climate risk study for ALPERIA's principal assets and business domains in accordance with the EU Taxonomy.
6	<b>ALPINE CHANGEMAKERS BASECAMP</b>		<a href="https://www.cipra.org/en/cipra/international/projects/current/alpine-changemaker-network/basecamp-2023?set_language=en">https://www.cipra.org/en/cipra/international/projects/current/alpine-changemaker-network/basecamp-2023?set_language=en</a>	Stiftungen (Other projects /Project)	Institute for Regional Development	The ACB serves as a true laboratory for new linkages between knowledge and learning, a bridge between individuals from many cultures and backgrounds, and an incubator for change. It provides roughly 20 young and ambitious individuals the opportunity to build and execute their own future ideas for a pleasant life in the Alps with like-minded people.
7	<b>ARTEMIS</b>	September 2021 - September 2023	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/artemis">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/artemis</a>	Excellence Science (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	ARTEMIS aims to explore if and how smart cities might improve urban system environmental performance.
8	<b>ARV</b>	January 2022 - December 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/arv">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/arv</a>	Societal Challenge (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	The overarching goal is to show and validate appealing, resilient, and economical solutions for Climate Positive Circular Communities that will greatly accelerate deep energy renovations and the implementation of energy and climate measures in the construction and energy industries.

9	<b>BEYOND SNOW</b>	November 2022 - October 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/beyondsnow">https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/beyondsnow</a>	Alpine Space 2021-2027 (EUTC / EU funding / Project)	Institute for Regional Development	Increasing the socio-ecological climate resilience of STDs; Identification of future climate, - socioeconomic scenarios, vulnerability indicators and main transition models for STDs to elaborate a innovative Resilience Adaption Model for Alpine STDs
10	<b>Biodiversity Monitoring South Tyrol</b>	January 2019 - December 2026	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/biodiversity-monitoring-south-tyrol">https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/biodiversity-monitoring-south-tyrol</a>	Internal funding EURAC (Project)	Institute for Alpine Environment	To show the development of South Tyrol's overall biodiversity, focusing on species groups that respond directly to environmental and land use changes.
11	<b>PSP</b>	Aug 2022 - May 2023	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/psp">https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/psp</a>	Public institutions (Other projects /Project)	Institute for Regional Development	To support in the elaboration and finalization of the plan, in the design of the participatory process and stakeholder involvement as well as in the preparation of the environmental report for the purposes of the SEA of the plan.
12	<b>BOSCO CLIMA</b>	Dec 2020 - Dec 2023	<a href="https://www.fondazioneccariplo.it/it/news/ambiente/strategia-clima-i-territori-che-si-aggiudicano-il-bando.html">https://www.fondazioneccariplo.it/it/news/ambiente/strategia-clima-i-territori-che-si-aggiudicano-il-bando.html</a>	Fondazione Cariplo	Institute for Regional Development	The main idea of the project is to provide interventions to manage the region's forest heritage, reduce its hydraulic susceptibility, strengthen the local ecological network and implement a climate and weather data collection system.
13	<b>CLAIMES</b>	July 2019 - June 2022	<a href="https://www.uibk.ac.at/projects/claimes/project/">https://www.uibk.ac.at/projects/claimes/project/</a>	Public institutions (Other projects /Project)	Institute for Alpine Environment	The primary goal is to gain insight into how climate change impacts the functioning of alpine lakes and thus the supply of ecosystem services.
14	<b>CRISP</b>	August 2021 - May 2023	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-earth-">https://www.eurac.edu/en/institutes-centers/institute-for-earth-</a>	GIZ (German Development Cooperation)	CCT	Development of specific Climate Risk Planning & Managing Tool for Development Programmes in the Agriculture & Food Sector

			observation/projects/crisp			
15	<b>Conflicts and Affects in Times of Climate Crisis</b>	April 2023 - December 2023		Internal funding EURAC (Project)	Center for Advanced Studies	Finding out which ecological lines of conflict cross the population in South Tyrol and what kind of affects are related to it.
16	<b>Discourses about climate change and other crises</b>	January 2023 - December 2024	Coming soon. In the meantime: <a href="https://www.eurac.edu/de/institutes-centers/center-for-advanced-studies/research-group/societal-discourses">https://www.eurac.edu/de/institutes-centers/center-for-advanced-studies/research-group/societal-discourses</a>	Internal Funding (EURAC)	Center for Advanced Studies	To examine how local media frames water-related issues in the context of the climate crisis and understand potential conflicts over water in South Tyrol.
17	<b>Ecological Mentalities</b>	October 2023 - December 2024		Internal funding EURAC (Project)	Center for Advanced Studies	The project aims to identify ecological mentalities in the South Tyrolean population. Quantitative data will be collected from a randomized sample and analyzed by means of cluster and PC analysis in order to significantly distinguish between different dispositions in social space.
18	<b>ENERGY TRANSITION SOUTHTYROL</b>	January 2022 - December 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/energy-transition-southtyrol">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/energy-transition-southtyrol</a>	n.s.	Institute for Renewable Energy	Development of sustainable energy models to assist Southtyrol through the process of energy transition
19	<b>EUCRA</b>	November 2022 - June 2024	<a href="https://www.eurac.edu/de/institutes-centers/center-for-climate-change-and-transformation/projects/eucra">https://www.eurac.edu/de/institutes-centers/center-for-climate-change-and-transformation/projects/eucra</a>	Public institutions (Other projects /Project)	CCT	comprehensively assess and evaluate current and future climate change impacts and risks on environment and on society in Europe

20	<b>EUSALP AG8</b>	January 2023 - December 2026	<a href="https://www.eurac.edu/en/institutes-centers/center-for-climate-change-and-transformation/projects/eusalp-ag8">https://www.eurac.edu/en/institutes-centers/center-for-climate-change-and-transformation/projects/eusalp-ag8</a>	Public institutions (Other projects /Project)	CCT	improving cross-border cooperation between Alpine States, identifying common goals, and implementing them more effectively through trans-national cooperation.
21	<b>ETSM2030</b>	January 2023 - December 2025	<a href="https://www.etsm2030.eu/about">https://www.etsm2030.eu/about</a>	SMP-COSME-2021-TOURSME (COVID-19 Recovery Through Sustainable Tourism Growth and SME Support)	Center for Advanced Studies	ETSM2030 aims at establishing a network of tourism SMEs (SMTEs) to increase sustainability monitoring by co-creating and co-implementing Sustainable Innovations Projects (SIP) and by boosting participation in relevant sustainable certification schemes, in particular the EU Ecolabel and EMAS (Eco-Management and Audit Scheme).
22	<b>FULFILL</b>	October 2021 - September 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/fulfill">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/fulfill</a>	EU H2020	Institute for Renewable Energy	The planned FULFILL project aims to employ the idea of sufficiency to investigate the role of lifestyle changes and civic engagement in decarbonizing Europe to accomplishing the Paris Agreement targets.
23	<b>Climate Change and Transformation Blog Series on Imagining Futures</b>	September 2023 - open end	<a href="https://www.eurac.edu/en/blogs/imagining-futures">https://www.eurac.edu/en/blogs/imagining-futures</a>	Internal funding Eurac Research	Center for Advanced Studies	Foster interdisciplinary collaboration within Eurac Research, ensure knowledge transfer to an interested lay audience, raise awareness of various research areas on the topic, provide a platform for researchers to make their concerns and research visible
24	<b>IMPETUS</b>	October 2021 - September 2025	<a href="https://www.eurac.edu/en/institutes-centers/institut-fuer-erneuerbare-energie/projects/impetus">https://www.eurac.edu/en/institutes-centers/institut-fuer-erneuerbare-energie/projects/impetus</a>	Societal Challenge (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	Translating climate change commitments into concrete, tangible actions and aligning various governance levels and adaption policies in Europe; contribute to the acceleration of Europe's climate adaption strategy

25	<b>INFINITE</b>	November 2020 - April 2025	<a href="https://infinitebuildingrenovation.eu/">https://infinitebuildingrenovation.eu/</a>	Competitive Industries (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	INFINITE aims to increase the market uptake of industrially manufactured kits for complete building envelopes for deep renovations through a competitive, reliable, stakeholder-accepted and life-cycle based sustainable approach that contributes to the decarbonisation of the EU building stock
26	<b>JUSTNature</b>	September 2021 - February 2026	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/justnature">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/justnature</a>	Societal Challenge (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	The objective is to mobilize nature-based solutions by enabling a fair transition to low-carbon cities based on the right to ecological space. This includes the right to clean air and indoor and outdoor thermal comfort for human health and well-being, as well as vibrant biodiversity and ecosystems.
27	<b>KINETIC</b>	October 2022 - September 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/kinetic">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/kinetic</a>	JPI – URBAN EUROPE	Institute for Renewable Energy	The KINETIC project seeks to establish an international partnership of cities and specialists for an integrated approach to assessing Positive Energy District (PED) deployment, as well as to generate capacity building for local communities in order to co-create realistic transformation plans.
28	<b>LocalIRES</b>	May 2021 - April 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/localres">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/localres</a>	Societal Challenge (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	Empowering local renewable energy communities for energy system decarbonization; delivering new digital tools boosting structural change
29	<b>LTEK2030+</b>	April 2021 - March 2022	<a href="https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/projects/ltek2030plus">https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/projects/ltek2030plus</a>	n.s.	Center for Advanced Studies	The project's aim is to outline a tourism development scheme for 2030+ in South Tyrol, depicting a more sustainable and ecologically friendly development.

30	<b>MARGISTAR</b>	September 2022 - September 2026	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/margistar">https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/margistar</a>	COST (EU funding / Project)	Institute for Regional Development	The MARGISTAR forum reflects collaboratively on natural, environmental, social, and economic inter-relationships and interactions in mountainous areas; Main goal is to develop transformation methods and innovative processes for the revitalization of marginalized mountain areas (Link O14), especially to synthesize and co-create alternative and effective routes to sustainability.
31	<b>NEST</b>	November 2022 - October 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/nest">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/nest</a>	Public institutions (Other projects /Project)	Institute for Renewable Energy	Aims to connect the main laboratories, university research groups, and national research bodies, identifying interdisciplinary skills in order to develop technologies for the conversion and use of renewable sources, (following objectives towards carbon neutrality that Italy aims to reach by 2050) and focusing on civil, industrial and transport sectors.
32	<b>NEST Part 2</b>	October 2022 - December 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/nest-part-2">https://www.eurac.edu/en/institutes-centers/institute-for-regional-development/projects/nest-part-2</a>	Public institutions (Other projects /Project)	Institute for Regional Development	Achieving a more sustainable food system poses a variety of challenges. How then may the transformation of our food system in South Tyrol be designed?
33	<b>NEXOGENESIS</b>	September 2021 - September 2025	<a href="https://www.eurac.edu/de/institutes-centers/institut-fuer-erdbeobachtung/projects/nexogenesis">https://www.eurac.edu/de/institutes-centers/institut-fuer-erdbeobachtung/projects/nexogenesis</a>	n.s.	CCT	The NEXOGENESIS project seeks to contribute in the creation of policies that address the interconnectedness of the water-energy-food-ecosystem (WEFE) nexus in order to properly manage resources and minimize user disputes.
34	<b>PARATUS</b>	October 2022 - September 2026	<a href="https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-">https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-</a>	Horizon Europe (EU funding / Project)	CCT	Promoting disaster preparedness and resilience by co-developing stakeholder support tools for managing the systemic risk of compounding disasters

			safeguard-research/projects/paratus			
35	<b>Philosophical talks about autonomy and sustainability</b>		<a href="https://www.linkedin.com/posts/elisapiras1_la-perniciosa-influenza-delloccidente-activity-6991337896964198400-Z-cH/?trk=public_profile_like_view&amp;originalSubdomain=it">https://www.linkedin.com/posts/elisapiras1_la-perniciosa-influenza-delloccidente-activity-6991337896964198400-Z-cH/?trk=public_profile_like_view&amp;originalSubdomain=it</a>	Internal Funding (EURAC)	Center for Advanced Studies, Center for Autonomy Experience	Antonella Salomoni and Niccolò Pianciola address the topic of academic and research freedom in post-Soviet Russia before and after the outbreak of the war in Ukraine. They will discuss the main legislative measures introduced in universities and secondary education institutions and recent phenomena of intellectual emigration. A specific focus will be on Memorial, the most relevant non-governmental organisation in Russia, recently dissolved by the Russian Supreme Court.
36	<b>PLENTYLIFE</b>	November 2022 - October 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/plentylife">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/plentylife</a>	2021 – 2027 (Life+ / EU funding / Project)	Institute for Renewable Energy	Planning and dedicated capacity building to Enable small and medium-sized municipalities to develop and monitor sustainable strategies for the Transition to clean energy
37	<b>Rethinking -- Conference Series</b>	March 2019 -- ongoing	This year's edition: <a href="https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/news-events/rethinking-encounters">https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/news-events/rethinking-encounters</a>	Internal funding EURAC (Project)	Center for Advanced Studies	The conference series "Rethinking" aims at addressing questions regarding different societal topics together with representatives from academia, politics, business and society and at stimulating a discussion about the transformation of dominant thoughts and practices.
38	<b>RETURN</b>	December 2022 - November 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/return">https://www.eurac.edu/en/institutes-centers/institute-for-alpine-environment/projects/return</a>	PNRR (Piano Nazionale di Ripresa e Resilienza)	CCT	A more thorough understanding of anthropogenic, ecological, and environmental risk factors, and how they relate to climate change effects; strengthen research chains at national level and promote their participation in strategic European and global value chains

39	<b>RISK PERCEPTION REVIEW PAPER</b>	November 2019 - April 2021	<a href="https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/risk-perception-review-paper">https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/risk-perception-review-paper</a>	Internal funding EURAC (Project)	Center for Global Mountain Safeguard Research	The GLOMOS Team completed a research study examining available literature on risk perception with regard to climate change and its impact on mountain areas globally, to provide an in-depth and comprehensive understanding of the factors influencing risk perception in mountain regions.
40	<b>ROLES</b>	April 2022 - August 2025	<a href="https://jpi-climate.eu/project/roles/">https://jpi-climate.eu/project/roles/</a>	JPI Climate - SOLSTICE	Institute for Renewable Energy	How can digitalisation of energy systems at the urban scale have socially inclusive impacts? With this in mind, our consortium conducts intensive local fieldwork, extensive collaborative analysis, reflexive engagement with stakeholders, all to come up with pathways of digitalisation for deep decarbonisation
41	<b>SAFEGUARDING MOUNTAINS</b>	January 2020 - December 2021	<a href="https://www.eurac.edu/de/institutes-centers/zentrum-zum-schutz-und-erhalt-von-gebirgsraeumen/projects/safeguarding-mountains">https://www.eurac.edu/de/institutes-centers/zentrum-zum-schutz-und-erhalt-von-gebirgsraeumen/projects/safeguarding-mountains</a>	Internal funding EURAC (Project)	Center for Global Mountain Safeguard Research	Building transformative Resilience in mountain regions worldwide, to safeguard Mountain SES
42	<b>SYMBIOSYST</b>	January 2023 - March 2026	<a href="https://www.symbiosyst.eu/about/">https://www.symbiosyst.eu/about/</a>	Horizon Europe (EU funding / Project)	Institute for Renewable Energy	SYMBIOSYST aims to explore innovative systems to overcome the notion of solar energy production and agriculture as two separate sectors and find a new synergy where land & crops and photovoltaics can form a mutually beneficial relationship.
43	<b>STOST</b>	January 2019 - December 2024	<a href="https://sustainabletourism.eurac.edu/">https://sustainabletourism.eurac.edu/</a>	Internal funding EURAC (Project) -- Part of Eurac "Leistungsvereinbarung" with the Province	Center for Advanced Studies	Contribute theoretically to the conceptualisation and measurement of sustainable tourism; support local DMOs and the provincial government in the development and design of strategies, measures and management processes (i.e. evidence-based policymaking)

44	<b>The Art of Uncertainty. Trans- and interdisciplinary explorations of utopian and dystopian futures</b>	n.s.	<a href="https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/research-group/culture-art-and-thought">https://www.eurac.edu/en/institutes-centers/center-for-advanced-studies/research-group/culture-art-and-thought</a>	n.s.	Center for Advanced Studies	1) it aims to generate inter- and transdisciplinary approaches to current global challenges and contribute to their academic discussion; 2) strives to make an impact on the local South Tyrolean civil society and decision makers by raising awareness about relevant topics and issues;
45	<b>TRANSALP</b>	January 2021 - December 2022	<a href="https://www.eurac.edu/en/institutes-centers/center-for-sensing-solutions/projects/transalp">https://www.eurac.edu/en/institutes-centers/center-for-sensing-solutions/projects/transalp</a>	European Commission under the UCPM-2020-PP-AG programme	CCT	Provision of multi-hazard storm risk assessment and effect prediction methodologies adapted to civil protection authorities in transboundary mountain zones.
46	<b>UNU CLIMATE RESILIENCE INITIATIVE</b>	August 2021 - December 2030	<a href="https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/unu-climate-resilience-initiative">https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/unu-climate-resilience-initiative</a>	Internal funding EURAC (Project	Center for Global Mountain Safeguard Research	adapt to climate-induced extreme weather events and how to ensure climate-resilient development.
47	<b>VARCITIES</b>	September 2020 - February 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/varcities">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/varcities</a>	Societal Challenge (Horizon 2020 /EU funding /Project)	Institute for Renewable Energy	The vision of VARCITIES is to implement real, visionary ideas and add value by establishing sustainable models for increasing H&WB of citizens (children, women, young people, middle age, elderly) that are exposed to diverse climatic conditions and challenges around Europe (e.g. from harsh winters in Skelleftea-SE to hot summers in Chania-GR, from deprived areas in Novo mesto-SI to increased pollution in Malta) through shared public spaces that make cities liveable and welcoming.

48	<b>WAVE</b>	April 2022 - December 2024	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/wave">https://www.eurac.edu/en/institutes-centers/institute-for-renewable-energy/projects/wave</a>	Provincial P.-L.P. 14. Research projects (Province BZ funding /Project)	Institute for Renewable Energy	The project's goal is to create and test a methodological framework to aid decision-making in the planning of energy renovation interventions for a real estate asset (buildings, infrastructures), allowing for the achievement of energy efficiency and sustainability goals while minimizing costs.
49	<b>X-RISK-CC</b>	November 2022 - October 2025	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/x-risk-cc">https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/x-risk-cc</a>		CCT	X-RISK-CC helps risk managers and policy makers across the AS to manage the combined risks of climate-related extremes by developing local action and transnational guidance.
50	<b>ZERAF</b>	February 2023 - January 2027	<a href="https://zeraf-technology.eu/">https://zeraf-technology.eu/</a>	Innovative Europe (Horizon Europe / EU funding / Project)	Institute for Renewable Energy	Seeks to lower the carbon impact of EU buildings. ZERAF transforms opaque building facades from static thermal barriers to thermal modulators by utilizing new materials and dynamic thermal management technologies.
51	<b>AXIS Consortium UNCHAIN</b> (Eurac Project)	September 2019 - August 2022	<a href="https://jpi-climate.eu/programme/axis/">https://jpi-climate.eu/programme/axis/</a>	JPI Climate AXIS program of the EU	CCT	The main goal is to further develop the concept of climate risk assessment with impact chains, which has been developed by Eurac Research for 10 years
52	<b>AQUA MOUNT</b>	March 2021 - August 2022	<a href="https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/aquamount">https://www.eurac.edu/en/institutes-centers/center-for-global-mountain-safeguard-research/projects/aquamount</a>	Provincial P.-L.P. 14. Mobility (Province BZ funding /Project)	CCT	Improvement of decision-making processes for current water management and future adaptation within the context of changing climate- and socio-economic conditions of water scarcity

53	<b>M_RISK</b>	October 2020 - December 2022	<a href="https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/mrisk">https://www.eurac.edu/en/institutes-centers/institute-for-earth-observation/projects/mrisk</a>	Provincial P.-L.P. 14. Research projects (Province BZ funding /Project)	CCT	The project aims to bridge the gap between nature and law via multidisciplinary research and improved understanding. To handle responsibility concerns on the mountain in criminal law appropriately, it is necessary to study which alternative categories may be used. The projects ultimate output seeks to create a 'risk culture' among the population and increase its resilience towards mountain hazards.
54	<b>ADO</b>	October 2019 - September 2022	<a href="https://ado.eurac.edu/">https://ado.eurac.edu/</a>	Alpine Space 2014-2020 (EUTC /EU funding /Project)	Institute for Earth Observation	The project objective is to establish an Alpine Drought Observatory (ADO), building on the findings of previously funded projects, and to derive recommendations for improved risk prevention and more efficient drought management, specifically for the Alpine region. The ADO will be a transnational alpine operating system with a web interface (e.g., WebGIS, regular reports) for data access and impact-oriented indices for monitoring droughts and their consequences.

## 12.2 Agenda of the workshop on research projects

**Workshop Agenda (30.10.23, 10-15.00, Seminar Room 1-2):**

**General facilitation:** Cristina

**Corner + Table facilitation:** Cristina, Lydia, Christoph, Felix

**Workshop Goals:**

- enable fruitful and guided discussion and self-reflection about research on/for transformation among researchers at Eurac
- test and validate the dimensions for analysing the approaches to transformation

**Concept:** the workshop is conceptualized in two parts, a first one dedicated to exploring some dimensions and how the selected projects relate to the dimensions. This part aims to create homogenous clusters of projects according to some dimensions, and to enable discussions on the questions among projects that share some similarities. The second part of the workshop, in the afternoon, is organized to enable fruitful discussions and self-reflection about research and transformation among researchers at Eurac

**Material:** tape, flipcharts, pens, registration sheet and table, projector & computer, badges, final PPT, snacks, water, tea, coffee

### Agenda

**10.00-10.10: Welcome and registration**

**10.10-10.45: Introduction**

- Welcome to the workshop, general objective and Agenda – Cristina
- Who is here: round of presentations by each participant: Name, Institute (5 mins) – all
- Introduction on CCT (5mins) – Marc
- Introduction on Pathways project (5mins) + Workshop specific objectives – Lydia
- Presentation of WP1 activity (15 mins) – Felix
- Introduction to the workshop activity (5 min) – Cristina
- Q&A

**10.45-12:30: Discussion rounds**

Questions:

1. Descriptive – prescriptive continuum (Y axis):

- MQ: Does your project primarily intend to understand and analyse transformation processes? I.e.: Is it focused on understanding and describing problems without actively participating in the development of solutions?
- MQ: Does your project primarily intend to contribute to a societal transformation? I.e.: Is it focused on actively participating in the development of solutions in view of already existing descriptions and concepts of problems?

## 2. Convert – control continuum (X axis):

- MQ: Does your research aim to address the causes of the phenomena considered as problematic?
  - SQ: By selectively adjusting parts of the existing socio-economic system?
  - SQ: By searching for radical alternatives?
- MQ: Does your research aim to control the effects of the phenomena considered as problematic?
  - SQ: By increasing resilience and adaptive capacity of the system?
  - SQ: By trying to interfere with geo- and biophysical processes?

Activity: the questions are asked one after the other.

1. As the first question is asked participants reply by positioning themselves physically on the line put on the floor where the continuum is displayed. At the two extremes of the continuum stands a flipchart that reports the main questions (MQ). Participants are asked to motivate their choice, and they can move according to the choice of the others.

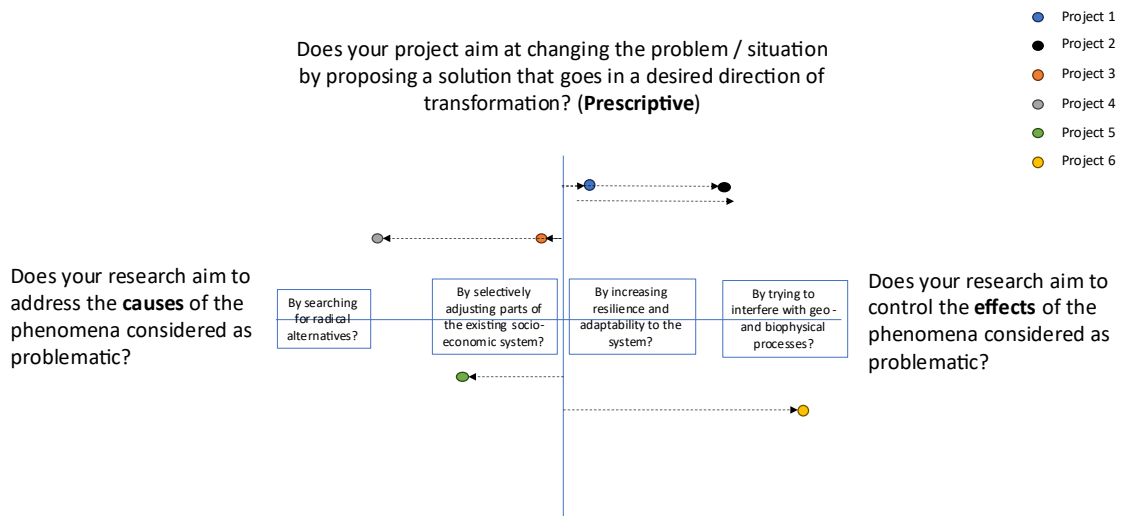
Does your project aim at changing the problem / situation by proposing a solution that goes in a desired direction of transformation? (**Prescriptive**)



- Project 1
- Project 2
- Project 3
- Project 4
- Project 5
- Project 6

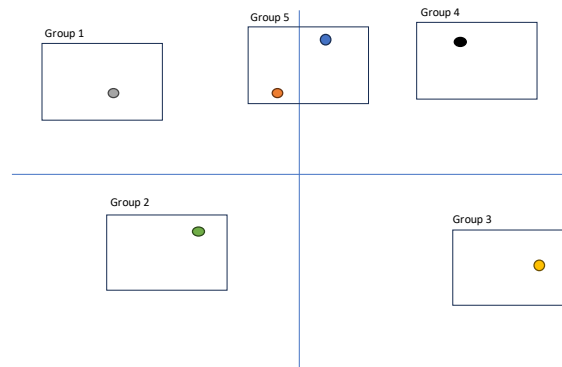
Does your project aim at understanding processes and phenomena that is defined as problematic, with no pre-set outcome/idea of the direction of transformation? (**Descriptive**)

2. When the second question is asked, participants are asked to keep the y axis point and move left or right to reach the desired x point that corresponds to their choice.



Does your project aim at understanding processes and phenomena that is defined as problematic, with no pre-set outcome/idea of the direction of transformation? **(Descriptive)**

This way four quadrants are formed and ideally also four/five groups are formed:



## 12.30-13.30: Lunch

### 13.30-14.15: Table discussion

**Activity:** Workshop team invites participants to sit at the table corresponding to the previous exercise and explains the objective of the group discussion.

Please assign the roles among yourselves at the table.

First, do a presentation round of each project is done at the table: **What is the topic of your project and what role does the concept of transformation play in it?**

Then, please discuss your project focusing on Eurac role/task in it, according to following questions:

1. Do you think that transformation in the field of your research can be planned and steered intentionally, or that it depends on conditions that can hardly be controlled? [controllability]
2. What are the crucial elements for a successful transformation in the area covered by your project? What can hinder transformation? [drivers]
3. Does your project assume that transformation takes place rather slowly and gradually, rather in a radical manner or in a disruptive one? Or else? [trajectory]
4. What is your project intervening on (e.g., individual's behaviours, productive sectors; institution and governance, formal and informal institutions, society as a whole)? What gets transformed? [ontology]

5. How is research done in your project?
  - a. Do you use specific theoretical approaches in your research project? Do any of them deal with the concept of transformation explicitly?
  - b. What specific methods are used in your research projects?
6. What are the potentials and limitations of your research approach when it comes to understanding or fostering transformative change?
7. How do you see your role as researcher in the transformation process? In how far is this influenced by the funding scheme of your project?

### 14.15-14.30: Synthetizing the discussion

Activity: The group reaches a synthesis on the discussion held writing on the reporting template (Table 12).

- On what aspects were there **divergences** among the projects at the table? What questions were they related to?
- On what aspects was there **convergence** among the projects at the table? What questions were they related to?
- (optional) What would be the name of your group?

Table 12. Reporting template

Reporting template:
Who was at the table? _____
On what aspects where there <b>divergences</b> among the projects at the table? What questions were they related to?
On what aspects was there <b>convergence</b> among the projects at the table? What questions were they related to?
(optional) Let´s be creative now: what would be the name of your table?
_____

### 14.30-14.50: Reporting in plenary

Activity: Each rapporteur presents the synthesis of the table in 5 minutes.

### 14.50-15.00: Conclusion and next steps

Activity: Pathway team explains what the next steps are: WP2 will provide instruction on data collection through project factsheet, WP1 will provide a report; then information will be combined to implement an archetype analysis that will allow us to cluster projects into specific types/with specific path;

## 12.3 Structure of the questionnaire on research projects

The questionnaire aimed to explore various aspects of research designs using open-ended and multi-option questions. The survey was organized in a three-column table across three Excel sheets: one for the survey questions, one with instructions, and one with drop-down menu options for certain questions. Each Excel sheet contained two tables to accommodate situations where a project contact person was responsible for more than one project. Participants were required to fill in the survey with the project's name and their own name as the project contact person. After completing the survey, they had to save the file as "Surname\_Pathways" and return it via e-mail to the address from which they received it.

Here below all the questions asked and the related response options are reported.

The first question was related to the **prescriptive or descriptive approach** and participant had to choose between two answer's options:

- The project primarily intend to contribute to a societal transformation (prescriptive)
- The project primarily intend to understand and analyse transformation processes (descriptive)

The second question aimed at investigating the **socio-political approaches to transformation**, offering these options:

- The project aims to address the causes of phenomena considered as problematic (conversion)
- The project aims to control the effects of phenomena considered problematic (control)

The other four blocks of questions wanted to investigate the academic theories related to transformation. These were divided into four categories, and each of the questions had four answer options (including "not applicable").

**Social ontology:** "Which social aspects or groups are particularly relevant for your project?"

- Individual decision and behaviors
- Formal and informal institutions
- Large social structure and systems
- Not applicable

**Controllability of transformation:** "Does your project assume that transformation can be planned and steered intentionally, or that it depends on conditions that can hardly be controlled?"

- Institutions have complete authority and influence over the process of social change
- Institutions have some level of influence and can initiate or guide the process of change, but that transformation involves multiple interconnected factors and actors that lead to unpredictable consequences, drivers, or resistances.

- In the project, government authorities are assumed to have no influence on the process of social change, because transformation processes are complex, and changes occur spontaneously or due to various decentralized influences.
- Not applicable

**Drivers of transformation:** “How does your project intend to trigger transformation?”

- Through knowledge enhancement to change existing norms, practices, and values and the relationship between them and the spread of new ideas
- By changing institutional contexts and specific formal and informal rules
- By improving technological progress
- Not applicable

**Trajectory of transformation:** “Does your project assume that transformation happens slowly and steadily, or quickly and disruptive?”

- Transformation takes place as a gradual and steady progress in societal norms, values, and practices
- Transformation occurs as a comprehensive and transformative change in social structures, ideologies, and power dynamics
- Transformation occurs as a complex, nonlinear nature of societal change
- Not applicable

The last question with multiple options asked whether the project addressed transformation explicitly or implicitly; participants could also select the option “neither of them”.

The two open-ended questions investigate the methods applied to the project and the applied academic theories to transformation.

<b>Name of the project</b>		
<b>Project referent</b>		
<b>Prescriptive / descriptive</b>	<i>Does your project mainly have a prescriptive or a descriptive approach?</i>	Choose one of the following options
<b>Socio-political approaches on transformation</b>	<i>Does your project mainly address causes or effects of global environmental change?</i>	Choose one of the following options
<b>Academic theories to transformation</b>	<i>What theory is applied to understand social change?</i> <i>(open question)</i>	Please specify here
<b>Social ontology</b>	<i>Which social aspects or groups are particularly relevant for your project?</i>	Choose one of the following options
<b>Controllability of transformation</b>	<i>Does your project assume that transformation can be planned and steered intentionally, or that it depends on conditions that can hardly be controlled?</i>	Choose on of the following options
<b>Drivers of transformation</b>	<i>How does your project intend to trigger transformation?</i>	Choose one of the following options
<b>Trajectory of transformation</b>	<i>Does your project assume that transformation happens slowly and steadily, or quickly and disruptively?</i>	Choose one of the following options
<b>Methods</b>	<i>What methods are applied in your project?</i>	Please specify here
<b>Role of transformation</b>	<i>Is transformation addressed explicitly or implicitly?</i>	Choose one of the following options
<b>Are there any comments? Feel free to add something</b>		

Figure 2. Structure of the survey

## 12.4 Workshop structure with organizations

### **Welcome and introduction:**

Pick an illustrated card that reminds you of the theme of social and ecological transformation. Share with the group your name, what your organization is (if relevant) and its goal or your goal concerning the transformation towards sustainability, climate neutrality, and justice. You can add a thought that the card stimulated in you.

### **Introduction to the workshop:**

In the next hour, step by step, I will guide you through reflection with a series of questions. To do this, we will use the iceberg, which is an image to represent reality as a system of interconnected elements. Above the water is what is visible, while below are all those invisible elements that are fundamental to changing what is visible in the desired direction.

### **EVENT or TREND**

What is the event or dynamic currently happening that triggered your organization to act? What made you feel called upon, either as an organization or as an individual citizen?

### **SYSTEM STRUCTURE**

What are the elements/forces at play that determine this change/trend and on which your organization has decided to intervene, and at what level?

- Behaviors of individuals, sectors of production
- Policies of institutions, relationships between formal and informal institutions
- Society, public opinion, and the system as a whole?

With what activities and projects does your organization intervene?

With what tools and methods is your organization trying to intervene in the change to promote social and ecological transformation?

### **MENTAL MODELS**

How does your organization think that social and ecological transformation towards sustainability, climate neutrality, and environmental justice occurs?

- Gradual: Small changes can only be achieved gradually through many small actions.
- Radical: Many small but coordinated actions can prepare the conditions for a big change.
- Disruptive: With a bit of luck or through favorable coincidences, even a small individual action can lead to big changes.

Do you think that the social and ecological transformation that your organization aims to achieve, at the level and on the elements, you have inserted in the iceberg, can be:

- Planned and guided
- Activated, triggered, influenced
- Impossible to control

### **CRITICALLY REFLECT ON THE ICEBERG**

Looking again at the activities and methods of your organization, what are their potentials and limitations?

Is there anything else that emerged after this reflection on what you could do and with whom? Is there any organization that you now feel closer to than before?

### **Conclusions**