



# Between transition and transformation: understanding sustainability change through governance, agency, and resilience—a qualitative exploration of complexity in sustainability change discourses

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## Abstract

Despite the growing body of research on sustainability transitions and sustainability transformations, conceptual overlaps and distinctions remain contested. This study investigates how leading scholars in these fields understand agency, governance, and resilience in the context of societal change. Drawing on 15 semi-structured interviews with highly cited transition and transformation researchers, we gather conceptual insights and make tacit knowledge and personal scholarly perspectives visible. The findings show that agency centers on actor roles and collaborations, operates through a dynamic interplay between individual initiative, collective mobilization, and structural conditions. Governance ranges from state-led top-down to participatory bottom-up approaches, at times combining both. Resilience highlights systems thinking and crises as potential catalysts. Beyond and within these themes, scholars reflect on the blurred boundaries between sustainability transitions and sustainability transformations, and on tensions between process-oriented inclusivity and outcome-oriented directionality, as well as their own roles of researchers in transitions and transformations. These complexity-informed perspectives can advance sustainability research and practice, for example in noting towards adaptive and context-sensitive operationalization of concepts. By foregrounding the voices of scholars whose work has shaped the discourses, the study shows that transitions and transformations should not be treated as linear pathways toward predefined outcomes, but as processes unfolding under conditions of uncertainty, where governance must balance directionality with openness.

**Keywords** Sustainability transitions · Sustainability transformations · System change · Sustainability governance

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## 1 Introduction

Research on and for sustainability change processes is on the rise. Sustainability transformations (hereafter transformations) and sustainability transitions (transitions) are two most prominent conceptual approaches emerging in sustainability research fields, which are used to address the growing urgency of fighting present sustainability challenges such as climate change, biodiversity loss, and social inequalities. The literature suggests that obstacles to sustainability change include governance and politics, structural barriers, cultural discourse, resistance from incumbent firms, and the complexity of multisystem interactions (Hausknost 2020). The challenges that threaten the long-term security of societal development conditions are addressed by sustainability science at system, target, and transformative level (Brandt et al. 2013). Despite developments in sustainability science, the knowledge required to manage sustainability change processes is not unanimous.

To conceptualize the processes for sustainability change, various terms have emerged. From a top-down perspective, sustainable development has become a major goal and strategy at the UN level and is reflected in the Sustainable Development Goals (Kotzé et al. 2022), while bottom-up small-scale innovations toward sustainability are gaining visibility in politics, businesses, or other institutions. Ideally, the strategies to address and meet these should be informed by robust knowledge about sustainability change processes and driven by aligned efforts across different disciplines and fields (Studer and Pohl 2024). Many sustainability studies remain focused on isolated elements or technical fixes, without addressing the deeper structural dynamics that sustain unsustainable systems—a central challenge to the governance of transitions (De Haan and Rotmans 2011; Grin et al. 2010). Loorbach et al. (2017) also argue, that such a more fundamental systemic change is needed to facilitate the prevention of the collapse of ecosystems and social structures. Agency and governance towards transformations and transitions as well as system dynamics remain central research themes within these expanding fields.

The literature reveals certain inconsistencies and disagreements in conceptualizing agency, governance and resilience within transformation and transition, for example in the role of agency versus systemic factors (Child and Breyer 2017). While some researchers argue that agency is sufficiently embedded in transition studies, others emphasize the need for greater focus on individual-level agency, behaviors, and motivations (Koistinen and Teerikangas 2021). Patterson et al. (2017) have suggested

scholars to study sources of agency and roles for both state and non-state actors in enabling and supporting transformations as well as what types of institutions and governance arrangements are needed to enable and shape transformations. In addition, the distinction between process- and outcome-oriented understandings of change within the two frameworks reflects underlying theoretical commitments about how sustainability changes unfold and should be governed (Feola 2015). Similarly, the frameworks incorporate different understandings of system dynamics and characteristics, which we look through resilience. That is the starting ground of this study, which provides insights into the conceptual subtleties and differences in terminology and understanding of sustainability change. Our guiding research question here is:

What do expert perspectives reveal about the theoretical and practical dimensions of sustainability transformations and transitions, particularly regarding agency, governance and resilience?

Our underlying premise is that transition and transformation are not mutually exclusive but offer nuanced insights into societal change. We hold the assumption that differences between the concepts may arise from their origins and the associated research communities that use each concept. Drawing on and extending existing approaches (Linnér and Wibeck 2021), we analyze the empirical material to reflect how leading scholars themselves understand the conceptual landscapes, with a focus on agency, governance and resilience.

In summary, this article investigates how leading academic experts conceptualize sustainability transitions and transformations, revealing both convergences and tensions in how agency, governance, and resilience are understood. Drawing on Patterson et al. (2017) as an integrative framing, we examine how scholars articulate sources of agency, modes of governance, and system dynamics that shape and sustain transformative change. Through this lens, the study offers insight into how different research traditions approach the steering and emergence of sustainability processes. The following sections outline the theoretical foundations (Sect. 2), methodological design (Sect. 3), and main empirical findings (Sect. 4), before discussing conceptual frictions and opportunities for advancing sustainability change research; conceptual boundaries, process versus outcomes and academia as mediating form of agency (Sect. 5). The paper concludes by reflecting on broader implications for theory and practice (Sect. 6).

## 2 Theoretical background

### 2.1 Concepts of sustainability transformation and transition

Transformations and transitions are interrelated, but distinct concepts used to analyze and guide large-scale societal change toward sustainability. The theoretical underpinnings of transition and transformation both draw on diverse disciplines and perspectives to address the complex challenges of achieving sustainability in various systems and contexts. Nevertheless, they differ in their disciplinary roots: while transition is connected to the theory of socio-technical transitions and originates in the fields of e.g. technology studies and institutional economics (Geels 2002; Geels and Schot 2007; Geels et al. 2017), transformation has more heterogeneous origins.

Both transformation and transition offer perspectives on how to describe, interpret and support desirable radical and non-linear change (Hölscher et al. 2018; Soininen et al. 2024). Transformation and transition have been used interchangeably and often metaphorically identifying pathways and solutions for sustainability problems and the concepts have moved closer to each other (Hölscher et al. 2018). The differences between the concepts stem to a great degree from the different research communities of origin and using the concepts. Several other conceptual definitions for societal transformation exist (Feola 2015), but here we pinpoint

the key features of the concepts of our focus: transition and transformation (Table 1).

Sustainability transformation encompasses a profound, systemic change that fundamentally redefines societal norms, values, and structures (Brand 2016). Widely used approaches in transformation research are leverage points (Abson et al. 2017; Meadows 1999), three spheres of transformation (O'Brien 2018), and heterogeneous general references to sustainability goals. Leverage point perspective takes a stance on the depth of change—do the places for intervention allow deep or shallow societal change (Abson et al. 2017; Meadows 1999). Heterogeneity of origins is reflected in the difficulty of settling how to measure transformation, and the desirable social endpoint is harder to define than the desirable ecological outcome (Salomaa and Juhola 2020). Transformation requires radical changes rather than simply applying sustainability principles to an existing system (Hammond 2020). In this context, the term "transformation" typically denotes extensive societal changes spanning global, national, or local levels, and including interactions between human and biophysical system components (Hölscher et al. 2018).

By contrast, transitions focus on systemic, incremental yet radical, shifts within socio-technical systems, such as energy, mobility, or agriculture. The multilevel perspective is an analytical framework that conceptualizes transitions by examining the development of niches that challenge existing unsustainable systems and potentially replace or reconfigure them (Geels 2002; Temper et al. 2018). Moreover, understanding transitions further benefits from integrating techno-economic, socio-technical, and political perspectives (Cherp et al. 2018; Turnheim and Geels 2012). In the transition scheme, the existing regime cannot induce transitions by themselves, often they stem from innovations, developed in niches and diffusing the market. This is the reason why transitions research is linked with research on experiments in society, for example on real-world laboratories and pilot projects, which often involve local and participatory elements.

### 2.2 Agency

Both concepts stress the role of human agency and innovation: transformation perspectives emphasize human agency, collective action, and innovation in driving systemic shifts (Westley et al. 2011), transition research links agency to the capacity derived from individual interests and resources, often contextualized within distinct phases of the change process (Bodenheimer and Dütschke 2021; Huttunen et al. 2021).

One important dimension of agency within sustainability transitions and transformations is the evolving

**Table 1** Key features of sustainability transformations and transitions (adapted from Gathen 2026)

| Aspect     | Sustainability transformations                                                                                   | Sustainability transitions                                                                                                      |
|------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Definition | Involves broader, fundamental shifts in societal values, behaviors, and structures to reimagine systems entirely | Refers to long-term, systemic changes in socio-technical systems (e.g., energy, transport) to address sustainability challenges |
| Focus      | Aims for radical reconfiguration of systems and paradigms                                                        | Concentrates on the process of change, emphasizing gradual, multi-dimensional shifts in technology, institutions, and culture   |
| Scope      | Encompasses holistic and cross-sectoral changes at larger scales (e.g. international)                            | Typically addresses specific sectors or domains (e.g., energy systems)                                                          |
| Approach   | Disruptive and transformative, often requiring shifts in power dynamics and deep cultural changes                | Often incremental and guided by governance frameworks like Transition Management                                                |
| Examples   | Transforming societal norms around consumption and equity to create a just and sustainable society               | Transitioning from fossil fuels to renewable energy systems                                                                     |

role of scientists in these processes. Traditionally viewed as external analysts, scientists are increasingly understood as embedded actors who shape, facilitate, and sometimes catalyze change (Scholz 2017). In response to the growing complexity and normativity of sustainability challenges, research approaches such as transformative science conceptualize scientists as process facilitators and co-creators of change (Schneidewind and Singer-Brodowski 2015; Wittmayer and Schöpke 2014). This shift highlights the epistemic transformation underway in sustainability research, whereby knowledge is not only produced for society but co-produced with societal actors through structured, participatory engagement (Jacobi et al. 2022; Seidl et al. 2013). Transdisciplinary methods, including the use of real-world laboratories, institutionalize these interactive learning processes and position science as an integral part of governance frameworks for sustainability transitions (Singer-Brodowski et al. 2018; Wittmayer et al. 2021). These developments underscore that agency in sustainability change is not limited to policymakers or civil society but includes scientists operating within new roles that challenge traditional boundaries between science and practice (Leventon et al. 2021).

### 2.3 Governance

Both transition and transformation traditions have considered how to analyze, understand and potentially shape the governance of societal change (Chaffin et al. 2016; Lange et al. 2013; Smith et al. 2005). Transition governance sees private and public actors essential for changes and typically focuses on the governance in the various sectors of production and consumption, and it produces especially knowledge on disruptive interventions. A notable line of research for governance is transition management (Rotmans and Loorbach 2009) and strategic niche management (Kemp et al. 1998). Governance of sustainability transformation is often linked to participation and equality questions, and inner dimensions are seen as important for achieving transformation. Accounting for the political nature of societal change is important for the governance of transitions and transformations (Patterson et al. 2017). Patterson et al. (2017) further encourage scholars to examine the sources of agency and the roles of both state and non-state actors in enabling and supporting transformations, as well as the types of institutions and governance arrangements needed to shape them across multiple scales. This perspective highlights why agency and governance questions are central for comparing how transition and transformation processes are conceptualized and enacted.

### 2.4 System dynamics and resilience

Transformation and transition are both systemic approaches which make systems and system dynamics central in their exploration. Transition and transformation define the focus systems differently. Transition has been mainly employed to societal subsystems like energy, mobility or cities whereas transformation is more linked to studying social-ecological interactions and large-scale processes (Hölscher et al. 2018). Building on a socio-technical understanding of change processes, various models have been developed to capture specific aspects of change dynamics—for example, the archetype proposed by Gottschamer and Walters (2023) or frameworks addressing disruption and institutional decline (Newig et al. 2019). Complementing these models, researchers have introduced conceptual perspectives such as the resilience of sustainability transitions, which incorporate progress, stability, and adaptability as key dimensions of transition (Schilling et al. 2018).

Notably, the term resilience originates from the discourse on social-ecological transformations, having emerged within the field of ecology. Resilience refers to the capacity to maintain the central functions of systems following a disruption by absorbing or recovering from it (Holling 1973; Folke 2006). Social-ecological resilience has been typically studied within community- or resource-based systems. Nowadays, resilience is treated often as a way of thinking that describes a characteristic of a system (Folke 2006). Change in the context of resilience of social-ecological systems especially focuses on shifts from one system state to another. In this context, the concept of transformation entails systemic change that, much like transition, involves shifts across ecological, economic, and social structures to promote sustainability and long-term resilience (Walker et al. 2004). In literature resilience is treated as both descriptive property and normative aspiration. Importantly, transformations are frequently associated with resilience, particularly in the sense that systems can shift to more sustainable configurations upon reaching critical thresholds or experiencing crises (Folke et al. 2010).

A further significant theoretical dimension concerns should analytical and practical focus be placed primarily on the processes that drive change, or on the outcomes these processes are intended to produce? This debate is pivotal to both the conceptualization and governance of sustainability transitions and transformations. On the one hand, emphasizing the process highlights the importance of inclusive, participatory, and adaptive approaches that engage many stakeholders in cocreating solutions. On the other hand, prioritizing outcomes stresses the need for concrete, measurable results that address pressing environmental and social challenges. This dichotomy is not merely academic but has

profound implications for how policies are designed, implemented, and assessed. The tension is further compounded by the inherent politicization of transformative processes, the necessity of adopting an anticipatory (ex-ante) perspective, and the challenge of balancing the desire for control with the inherently open-ended and evolving nature of such processes (Patterson et al. 2017).

To conclude, the theoretical exploration of sustainability transitions and transformations reveals a rich interplay of concepts, frameworks, and perspectives that converge on the systemic challenges of achieving sustainability. Both approaches emphasize the complexity and multidimensionality of change processes while stressing the importance of human agency, governance, and resilience in navigating these shifts. Following our research question, we will highlight this and provide examples from discourses from the accounts of academic experts.

### 3 Methods

#### 3.1 Research design

The following sections outline the methodological approach adopted for this study to investigate conceptual nuances in depth. Building on the interpretive epistemological stance, the research design, sampling strategy, and data collection process are presented first, followed by an explanation of the coding and analysis procedures. Together, these methodological steps ensure that the study captures both the individual sense-making of leading scholars and the broader structural patterns shaping the discourses on sustainability transformations and transitions from interviewees' accounts.

Our study adopts an interpretive, social-constructivist approach to explore how transformation and transition are conceptualized. Understanding these concepts is situated within the “lifeworld” (*Lebenswelt*) of academic scholarship, where meanings are co-produced, contested, and refined through scientific discourse. Consequently, this research design focuses on gathering reflective, experience-based insights from scholars whose work has significantly shaped these discourses. The empirical strategy combines a systematic literature search for finding the interviewees with qualitative semi-structured interviews. While the interpretive paradigm emphasizes subjective meaning-making, a systematic sampling process enhances credibility by ensuring that selected participants hold recognized authority within this academic field.

Semi-structured interviews allow for consistency across core topics while accommodating the emergence of new perspectives during the conversation. Unlike a literature review of the same authors' published work, semi-structured

interviews enable the emergence of experiential and contextual knowledge, as well as researchers' doubts and uncertainties, which are rarely documented in academic publications.

The interview with Leventon (2023) serves as a good example illustrating this added value. It provided space to reflect on methodological standards and academic practices, such as publication pressures, that would typically remain implicit in written work. The open interview format also created space to address topics the interviewee described as “politically sensitive”, including questions of redistribution of goods and power. These often implicit assumptions underpin scholars' understandings and uses of transformation and transition. Our aim is to clarify and differentiate the conceptual understanding of sustainability transitions and transformations within the academic discourse itself. As a consequence of this sampling strategy, senior Western scholars are disproportionately represented in the sample. This constitutes a limitation, as it risks reproducing existing epistemic hierarchies and privileging already dominant forms of knowledge. At the same time, these scholars represent an epistemic community whose knowledge production, contestations, and meaning-making practices warrant in-depth exploration. Examining their perspectives therefore provides insight into how key concepts within this field are articulated, negotiated, and stabilised.

#### 3.2 Sampling and data collection

Given the study's aim to analyze the academic use and differentiation of transformation and transition, the sampling strategy intentionally targeted leading scholars whose work has demonstrably influenced the field. The Scopus database served as the basis for identifying potential participants. Two search strings were applied within the ‘article title’ category on March 17th, 2023:

- Search String I: *transformati\* AND sustainab\**
- Search String II: *transition\* AND sustainab\**

To operationalize academic prominence, the inclusion criteria combined the number of publications retrieved with an H-index threshold of  $h \geq 15$ . This metric served as a pragmatic proxy for scholarly impact. While acknowledging the known biases of the H-index—including its tendency to favor established researchers—it was preferred over single-number citation counts, which can be even more skewed (Costas and Bordons 2007). A lower threshold was deliberately set to avoid excluding significant mid-career contributors. No geographic restrictions were applied during selection. However, the resulting sample reflects the predominance of transformation and transition scholarship within European and North American contexts, highlighting

an ongoing imbalance in global scholarly visibility. An initial list of 40 potential interviewees was generated and then refined to address duplicate entries. Of all requested, 15 scholars replied positively and were thus interviewed. This sample comprised of six experts identified via the transformati\* search and nine via the transition search. We used 13 interviews of the scientists who gave consent to their names to be published as the core sample. The final sample represents a cross-section of highly visible, thematically relevant voices whose reflections offer rich insight into the meanings, overlaps, and boundaries of transformation and transition within academic debate, but don't represent all researchers within these fields. Importantly, the labels used in Table A (In Supplementary material) should be understood primarily as resulting from the search process and the disciplinary background of the interviewed scholars, rather than as fixed self-ascriptions.

Data collection employed semi-structured interviews, conducted between April and May 2023 via recorded online interviews. An interview guide, informed by a review of relevant literature, included twelve core questions grouped

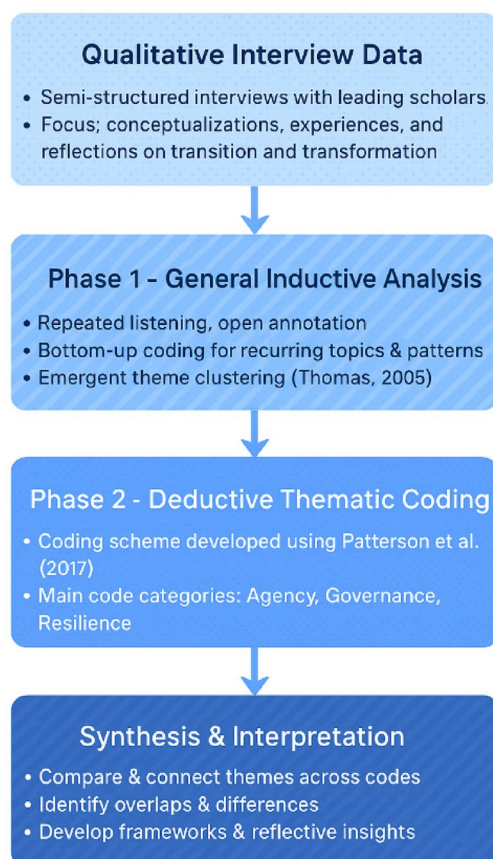
into four thematic areas: *Understanding*, *Success*, *Examples*, and *Outlook* (view Supplementary material C). The design of the interview guide aimed at investigating the researchers' subjective understanding about sustainability transformations and transitions. While the interview guide structured the conversations, its flexible application allowed for probing emergent lines of thought (Brinkmann 2014; Sovacool et al. 2017). This approach not only allowed flexibility for emergent themes but also ensured comparability across interviews (Brinkmann and Kvale 2019; Eagle et al. 2017). It further facilitated the elicitation of subjective theories, making implicit assumptions and individual perspectives accessible for analysis (Helfferich 2011). Interviews averaged 30 min and were transcribed for analysis. The short duration of interviews enabled wider participation of selected interviewees but gives only a partial image of the thinking of the interviewees. For a detailed list of the academics interviewed view the Supplementary material A and B.

This methodological design reflects the study's commitment to grounding conceptual insights in the lived expertise of the scientific community. By focusing on the perspectives of leading scholars, the study provides an interpretively robust basis for understanding how transformations and transitions are framed and differentiated in academic discourse—an essential precursor to any operationalization or application in practice.

### 3.3 Coding and analysis

To guide the systematic analysis of the interview material, the study employed a two-phase coding strategy that integrates both inductive and deductive elements, consistent with a flexible qualitative approach (Saldaña 2016; Thomas 2006). Figure 1 shows the two-phase qualitative analysis procedure employed. In the first phase, the general inductive approach (Thomas 2006) allowed key themes to emerge directly from the data without being constrained by a rigid a priori framework. Through repeated readings and open coding in MAXQDA, recurring statements, shared meanings, and contrasting perspectives were clustered into preliminary themes, ensuring alignment with the interpretivist lens (Braun and Clarke 2006).

To further deepen the analysis and sharpen the conceptual focus, a second, more deductive phase was introduced, drawing on established frameworks for studying transformations and transitions. In phase two, coding was structured by the categories of *Agency*, *Governance*, and *Resilience*. We developed our coding scheme with inspiration from Patterson et al (2017), using their framing to guide the identification of agency, governance, and institutional dimensions in the interview material. As we were interested



**Fig. 1** Two-phase qualitative analysis procedure illustrating the different phases of coding and analysis

in comparing the views on dynamics and characteristics of a system, we chose to operationalize this through resilience. To further systematize this stage, elements of Kuckartz and Rädiker (2022) structured content analysis were applied. This involved iterative steps such as case summaries, memo writing, and the use of MAXQDA functions (e.g. code-relation browser, summary grids) to refine category development and ensure analytical transparency (Supplementary material D–F). The final coding scheme comprises three main thematic areas each with a set of analytical subcodes. An additional meta-reflection category was used to capture cross-cutting reflections on conceptual ambiguity, epistemological positioning, and scholarly self-understanding (Charmaz and Belgrave 2014; Flick 2019). During coding the codes were systematically organized and coded segments compared, enabling the tracing of both converging and diverging interpretations across the expert interviews. The coding was done by one person in each phase, whereas the analysis of the data was conducted and triangulated by all authors and several theories which helped to mitigate interviewer bias.

The qualitatively most notable and the most frequently mentioned category was governance with 114 coded segments. Governance was addressed by each interviewee, and approximately half of the sample engaged substantively with governance. The emerging themes from each code (for codebook view Supplementary material E) were grouped in two directionalities or modes of governance for summary: Regime and policy-driven governance (top-down mode) and polycentric and participatory governance (bottom-up). To add another layer of depth to the analysis, the interview material was reviewed to search for recurring themes of each governance code: Institutional Arrangements, Types of Influence, Power & Politics and Participation & Inclusion. Here the motivation was to capture the role governance was assigned to in sustainability transitions and transformations. For transparency, the Supplementary material G provides a complementary table that links each dimension more explicitly to individual expert perspectives, ensuring traceability. Most of the coded segments related to agency (103 coded segments) were assigned to either actor types and roles, collective agency or individual agency. For the category of resilience (51 coded segments), coding focused on how interviewees conceptualized system stability and adaptability across ecological, social, and technological dimensions, including reactions to stress, the role of crises and tipping points, and the links between resilience, transition, and transformation. Only a small number of interviewees made direct references to resilience. The coding frequencies can be partly due to our research design, but together with the qualitative content analysis they illustrate the visibility of the themes in interviewees accounts.

We don't compare these results to the literature the same authors have written but rather aim to capture the content of discussions. We also made remarks on roles of scientists and epistemological tensions during the coding process; these results we discuss in interplay with literature on these topics. Our two-phase coding design represents a robust approach: the inductive phase ensured openness to the participants' perspectives, allowing nuanced views to surface freely, while the deductive phase added analytical focus on theoretically significant aspects of agency, governance, and resilience. Together, these phases ensured a transparent, systematic, and theoretically grounded analysis of how experts conceptualize sustainability transition and transformation. In our reflexive analysis process scholars' perspectives, particularly regarding agency, resilience and governance were engaged as part of the evolving discourses (Patterson et al. 2017) and reveal theoretical and practical dimensions of sustainability transformations and transitions.

## 4 Results

### 4.1 Expert perspectives on agency, governance and resilience

The interviews revealed diverse perspectives on how sustainability transitions and transformations are conceptualized and operationalized. While the experts acknowledged overlaps between the two discourses, their accounts showed different characteristics in terms of agency, governance, and resilience, as well as broader reflections on conceptual clarity. Rather than producing unified definitions, the interviews highlight a spectrum of positions rooted in professional experiences and disciplinary traditions. The interdisciplinary nature of the field is highlighted by academic Florian Kern as moving across "very different schools of thought from sociology to political science to economics, evolutionary economics and international relations, institutional theories, [and] consumption studies" (Kern 2023). The following subsections outline key themes that emerged across the interviews, framed by Patterson et al.'s (2017) emphasis on agency and governance, and in addition, resilience.

### 4.2 Agency: sources and roles

Across the interviews, agency was a critical element of how sustainability change is conceptualized. Yet, the ways in which experts described its sources and roles varied, reflecting disciplinary backgrounds and professional orientations. Most of the discussion related to agency were on either actor types and roles, collective agency or individual agency. We will follow this scheme. Several participants framed central

actor roles in terms of innovators, niche actors, and local communities, who can experiment with new practices and technologies and gradually scale them into broader societal uptake. This perspective aligns closely with the transitions discourse, which emphasizes incremental, bottom-up processes of change driven by actors working within protected spaces. For instance, Raven (2023) gave a practical example of the movements for renewable energy in Denmark and Germany as initial bottom-up initiatives, which were able to scale up. Another typical actor's role framed and referred to in the material were the powerful: incumbent actors, elites, politicians and economic actors. Politicians can enable both sustainable and unsustainable pathways. A little less mentioned were the marginalized actors: indigenous or marginalized groups, as well as activists and media. Also inherent were institutions, institutionalized actors, government agencies, as well as small businesses and NGOs.

Secondly, agency was referred to as a collective and systemic phenomenon, emphasizing mobilization across wider segments of society. Here, agency was seen as the capacity to deliberately reorient societal priorities, norms, and values, a framing more consistent with transformations. In this view, movements, coalitions, and citizen groups were often positioned as crucial agents, rather than individual innovators or organizations:

I think [...] that people don't talk enough about social movements and transformative change from the bottom up that aren't driven by technology or policy, and they're driven by coalitions of people [...]. They started from the ground up with the social problem.

Benjamin Sovacool, April 2023

It was emphasized that agency is not an individual attribute but a relational and contextual phenomenon, becoming particularly visible in moments of disruption or crisis. When established systems are disrupted, agency can be mobilized through crisis and opportunity but whether this leads to incremental adjustment or deeper transformation depends on the surrounding governance arrangements, on policy and structures for political opportunity (Kern 2023). Agency was viewed as very much influenced by institutional structures, political opportunity spaces, and the ability of actors to form alliances across scales. Some scholars drew attention to the tensions between individual and collective agency, noting that while individuals may act as catalysts, enduring transformation requires broader networks and coalitions to sustain momentum. Yet, the two scales are interlinked, with individual agency mostly viewed as an enabler for collective agency. Here, two operational modes could be identified: relationship-building between actors and cross-sectoral

collaboration. The significant references to shared visions and narratives by transformation scholars aligns more with relationship mode. While scaling-up bottom-up alliances (as brought up by some transition scholars) aligns stronger with the cross-sector collaboration.

Taken together, these perspectives suggest that agency in sustainability change processes cannot be reduced to a single source or level. Rather, it operates through a dynamic interplay between individual initiative, collective mobilization, and structural conditions. Recognizing this plurality highlights both the complementarity and tensions between transition-oriented and transformation-oriented understandings of agency.

### 4.3 Governance: policy, institutions and arrangements

Governance was the most visible theme. Across the interviews, governance was conceptualized primarily in democratic terms, grounded in parliamentary representation, shared power distribution, civic participation, and reflexivity of governance. Two directionalities or modes of governance were apparent.

In the first mode, top-down governance, comparatively more weight was placed on the role of the state, policy and regulatory interventions. Policies may take the form of legislation (including directives), guidelines, distribution of information and financial incentives (Raven 2023). A recurring objective through the perspective of transition studies here is to foster niches and innovations as a seed for changes to the system that can be potentially scaled (Kern 2023; Raven 2023). When analyzed in more detail, this policy-driven governance is seen to unfold through specific mechanisms of actor involvement and institutional design. Kern highlights how public policy can act as both a supportive and destabilizing force, influencing incumbents and newcomers alike:

Public policy can support such transitions through policies, through policy mixes, through governance approaches, [...] but even the most powerful government in the world cannot change it alone [...]. There are a lot of different actors involved, and the interplay between them is crucial.

Florian Kern, May 2023

Building on this perspective, several experts further emphasized the role of institutional arrangements, including formal guidelines, economic conditions, international agreements, financing models, and intermediary actors. The top-down mode portrays governance in relatively hierarchical terms,

with the state and its policy instruments in a position of authority. While the available steering mechanisms are diverse, their sustainability impact ultimately hinges on the orientation and resolve of political actors. At a structural level, Coenen (2023) underscores this by arguing that the climate crisis should be addressed with the same urgency and state-led measures as inflation.

In the second mode, polycentric and participatory governance perspective, the government holds power but delegates and distributes it. Top-down processes are viewed critically, as they have often failed historically (Kemp 2023) and generated resistance among those being told what to do (Abson 2023). Instead, responsibilities should be shared and solutions co-created rather than imposed (highlighted by Abson 2023 and Sovacool 2023). While this mode of governance is collective, interventions should include small-scale experimentation and be experience-based. Such processes require ongoing deliberation and need to be connected to collective agency and shared visions. As stated before, inclusion is treated as a foundational design principle by several researchers. The ethical and moral guideline stated here, identify who is the most vulnerable and ensure these groups are substantively represented in agenda-setting, decision-making, implementation, and evaluation. Without such democratic inclusion, change processes are at risk to backlash and reverse (Wibeck 2023). The visible modes of governance included a range from top-down, often stated, to bottom-up, often participatory, at times combining both and referring to networked and heterarchical arrangements with discursive spaces.

Table 2 presents a synthesized overview of the governance-related challenges and sometimes prerequisites for changes towards sustainability, as viewed by the experts. This condensed representation also highlights cross-cutting issues that emerged consistently across interviews. For example, a prevalent aspect was that balancing power is an essential and should be accompanied by fundamental questioning of “who holds power, where does it sit, how is it facilitated” and an ongoing reflection (Leventon 2023). This discussion is linked with decolonial orientation. Detailed case summaries of expert views on governance are found in the Supplementary material F.

Beyond these normative considerations, the interviews also reveal disciplinary distinctions in how governance itself is framed. Contrasting the use of “governance” between transformation and transition scholars reveals tendencies, though less clear-cut than for agency. The role of technological innovation in change processes is addressed exclusively within transition research (Coenen 2023; Kern 2023; Linner 2023; Raven 2023). Polycentric and participatory elements are emphasized in both streams; however, among transformation scholars they appear more deeply embedded in

**Table 2** Governance of sustainability change processes, synthesized across key dimensions, emerging themes and interpretive synthesis

| Dimension                   | Emerging themes                                                                                                    | Interpretive synthesis                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Institutional arrangements  | Formal policies, economic frameworks, international agreements, funding schemes, and mediating roles               | Institutions shape pathways to change but risk reinforcing incumbency unless inclusivity and adaptability are ensured   |
| Modes of governance         | State-led top-down and participatory bottom-up governance, networked/heterarchical arrangements, discursive spaces | Effective governance requires pluralistic, participatory modes that balance experimentation with legitimacy             |
| Types of influence          | Policy incentives, bans, subsidies, information provision, vision-building, narratives                             | Influence operates through both material instruments (policies, technologies) and immaterial means (stories, discourse) |
| Power and politics          | Distribution of power, elite capture, vested interests, media-driven polarization, short-termism                   | Addressing power imbalances is essential; without reckoning whose voices count, governance risks losing legitimacy      |
| Participation and inclusion | Engaging vulnerable groups, fostering trust, creating collective visions, education, equity                        | Inclusion is a prerequisite for legitimacy and durability of change; exclusion risks backlash and failure               |

the underlying architecture of governance (Leventon 2023; Horcea-Milcu 2023; Pereira 2023).

#### 4.4 Resilience and dynamics of change

The scholars who explicitly referred to resilience thinking, most notably Abson (2023) and Pereira (2023), are closely associated with transformation research. This is unsurprising given the conceptual proximity between transformation and resilience (as noted by Pereira 2023). Where resilience was directly invoked, it served to highlight factors that strengthen systems against disruption. The boundaries of the systems were defined differently, but primarily in relation to social systems. Leventon (2023), for example, employed the notion of a “social tipping point” to describe the dynamics of political polarization, while Kern (2023) examined the social security system. He argued that increasing independence and decoupling of the social system from economic growth could reduce systemic vulnerability and enhance the resilience of the social system to potential dysfunctions. To describe a state of stability reached after a phase of change slows down, he used the concept-specific term “equilibrium.”

Kemp (2023) offered a different perspective on strengthening systems, emphasizing the importance of experience-based learning processes as a means of maintaining stability.

Although resilience was rarely mentioned explicitly, many experts implicitly adopted a resilience perspective through a broader systems-thinking lens. Interviewees' arguments often pointed toward the capacity of social or institutional structures to adapt, reorganize, and persist amid disruption, even if not framed with resilience terminology. Intent was seen as particularly crucial system characteristic for enabling fundamental change (Abson 2023). However, it is also inherently ambivalent, as systems may simultaneously pursue multiple, competing objectives, which can easily generate contradictions or hinder transformation, and similar tensions arise in relation to system stability (Abson 2023). Ecological systems may require accelerated change in order to adapt and remain resilient, whereas social systems often need to slow down change processes to maintain stability (Coenen 2023). Tensions emerged between seeing resilience as maintaining function versus as enabling deep structural change, underscoring the complexity of operationalizing the term across contexts.

#### 4.5 Concluding reflection on agency, governance and system dynamics

Taken together, the empirical results show themes across the three analytical lenses. Unsurprisingly, our results aligned with transitions and transformation discourses. Governance emerges as the dominant theme, followed by agency, while resilience appears more specialized and less mentioned. We followed Patterson et al (2017) in studying understandings of sources of agency and roles for actors in enabling and supporting transformations as well as governance arrangements which are needed to enable and shape transformations. *Agency* discussions cluster around actor roles, inner capacities, and the importance of cross-actor collaboration, which is similar to the findings by Fischer and Newig (2016). The diversity of perspectives on agency reflects its central function in system theories, where change is understood as emerging from the interplay between structure and human action. *Governance* debates range from state-led policy interventions to bottom-up and polycentric participation, complemented by perspectives that foreground power-critical or decolonial orientations. Here it could be interesting to have a closer look to causal mechanisms in the future (Newig et al. 2017). The relative visibility of governance might be surprising, but it reflects that balancing power is crucial for achieving transformations and that leading scholars believe in the capabilities of governance to enable and steer such change (Patterson et al. 2017). Our reflections on system dynamics, through understandings of

*resilience* emphasizing intent, interdependence, and non-linear dynamics, aligning with Patterson et al. (2017) in recognizing the catalytic role of crises as moments that can destabilize existing regimes and open windows for transformation. While acknowledging these, the importance of stability and independence within systems was likewise highlighted, especially in relation to social systems. The disparity between direct and indirect mentions and the frequent adoption of resilience through a broader systems-thinking lens indicates that resilience functions less as an explicitly articulated framework and more as an underlying conceptual lens which principles continue to inform how scholars conceptualize sustainability, especially in academic discussions of transformation.

The findings also demonstrate the interweaving of themes: for instance, governance discussions often touch on questions of agency, and resilience perspectives often depend on governance arrangements to unfold. It also opens space for broader reflection: how do these conceptual strands converge or diverge when seen through the lenses of transition and transformation? And what does this mean for the epistemological underpinnings of the field, the balance between process- and outcome-oriented framings and the role of scholars?

## 5 Transitions ≠ transformations—exploring conceptual frictions and opportunities in system understandings

### 5.1 Conceptual boundaries

Beyond specific debates on agency, governance, and resilience, many experts reflected on the general conceptual fuzziness between transitions and transformations in systems thinking. Some resisted drawing sharp distinctions, instead viewing the concepts as complementary lenses for understanding different dimensions of societal change as a vital element of democracy:

One interesting thing about this field of research is that there is no [...] consensus, and maybe there shouldn't be. [...] In a democratic society, we also need to have this constant discussion about priorities and politics and what the goals and the outcomes would be. [...] there is this constant discussion about what transformation needs and what are the pathways, who are the actors, the drivers. [...] that in itself, it's important [...].

Victoria Wibeck, May2023

Other researchers expressed concern that the proliferation of frameworks risks fragmentation and conceptual inflation, potentially confusing both scholarship and practice. Looking at whether interviewees distinguish between the two concepts, the findings suggest a spectrum of positions rather than a clear divide. Some interviewees explicitly articulated distinctions, often along lines of scope and depth: transitions were often described as changes within socio-technical systems or sectors, whereas transformations were framed as more comprehensive, cross-sectoral, and structural changes affecting entire societal systems. Others conceptualised the two as relational, for example by viewing transitions as pathways or components within broader transformation processes, with transformation representing a more fundamental end state. At the same time, a considerable number of interviewees reported using the terms interchangeably or without a strong commitment to distinguishing them. In contrast, a few interviewees reversed or blurred commonly assumed definitions, for example by describing transformations as changes within existing systems. This ambivalence resonates with the multidisciplinary roots of both traditions, as highlighted in our theoretical review. Importantly, several interviewees highlighted that the distinction between transitions and transformations may be as much a matter of language and disciplinary background as of substantive conceptual disagreement. The two terms were often associated with different epistemological traditions and research communities—transitions with socio-technical and multi-level perspective approaches, and transformations with socio-ecological and resilience-oriented frameworks. In this sense, differences in terminology often reflect “different coexisting tribes with different conceptual approaches” (Kern 2023), rather than fundamentally incompatible understandings of societal change. This also explains why some scholars perceive increasing blurriness between the terms over time.

Overall, the interviews suggest that while a subset of scholars does draw relatively clear conceptual distinctions, a significant proportion either treats the terms as overlapping or views their differentiation as context-dependent and normative. Based on our results, we can confirm the description of Hölscher et al. (2018) that both conceptualizations offer valuable perspectives, and transition has more focus on subsystems whereas transformation is more linked to interactions and large-scale processes. More specific use of the concepts might be useful for the research but seems unlikely given the broadness and ongoing expansion of the field.

## 5.2 System understandings: between steering and emergence

These epistemological tensions between concepts are also visible in how interviewees relate the two concepts to process and outcome dimensions. Transitions are often associated with pathways, mechanisms, and sectoral change processes, whereas transformations are more frequently linked to systemic outcomes, paradigm shifts, and broader societal reconfigurations. However, this distinction is not consistently upheld across the sample, further reinforcing the notion that conceptual boundaries remain fluid and contested.

A recurring theme across interviews concerned the question of how sustainability change can be understood, guided, and evaluated. The distinction between process and outcome, discussed in both transition and transformation research, reflects a deeper epistemological tension about the nature of systems themselves. Scholars differ in whether they view sustainability change as something that can be steered toward defined goals or as an inherently emergent, evolving process that resists precise prediction or control.

How then should sustainability change be understood, guided and evaluated—through the ‘processes’ it unfolds or the ‘outcomes’ it achieves? Many interviewees leaned toward process-oriented perspectives, pointing to the inclusiveness, legitimacy, and adaptability of change as critical to ensuring durable sustainability outcomes. In literature, process-oriented approaches are often linked to learning and inclusion. For these interviewed scholars, focusing prematurely on outcomes risks overlooking the deep system characteristics—such as intent or design—that must be challenged for transformation to take root. This very much aligns with an understanding of systems as complex, adaptive, and continuously unfolding, where interventions can only create conditions for transformation rather than determine its results. Scholars of transformation actively argue for this systems perspective (Feola 2015; Feola et al. 2021; Turnhout et al. 2020).

Focusing on process and/or outcomes are often linked to operationalization, to assessment and evaluation (Salomaa and Juhola 2020). Several experts highlighted that measurable outcomes are important for legitimacy and accountability, yet difficult to capture when transformations are ongoing and dynamic. Other interviewees insisted that the measurability of outcomes is necessary, as transitions and transformations ultimately aim at achieving more sustainable configurations, and without assessing directionality, progress remains uncertain. Some advocated combined approaches that connect process indicators with outcome benchmarks, for example, comparing system performance

at different points in time to evaluate whether change leads to genuine sustainability gains.

In all of this, steering remains a central aspiration of sustainability governance. As Patterson et al. (2017) note, deep societal change requires both anticipatory policy frameworks and an acknowledgment of unpredictability. This duality was echoed by our interviewees, who spoke of the need to balance structure with openness, direction with flexibility. Both perspectives share the aim of fostering systemic resilience and directionality amid uncertainty.

Taken together, these insights suggest that sustainability transitions and transformations are characterized by a persistent negotiation between steering and emergence—between the desire for control and the recognition of complexity (Stirling 2010). Understanding systems in this way means accepting that sustainable change unfolds through iterative, contested, and co-evolutionary pathways rather than linear trajectories—an understanding that calls for reflexive governance and adaptive evaluation approaches capable of navigating this tension.

### 5.3 Academia as mediating form of agency

Variations in understanding the role of science from descriptive-analytical to normative process oriented offer various roles for scientists (Wittmayer and Schöpke 2014). Illustrating the increasingly recognized embeddedness of scientists in sustainability change processes, we briefly discuss roles of scientists which emerged in interviews here. By reflecting on the concepts of transition and transformation, scholars do not simply analyze social realities from a distance; they actively shape the discourses that inform governance, policy, and practice. This dual role of scientists as both observers and participants depicts and shows an epistemic transformation underway in sustainability research (Scholz 2017; Wittmayer and Schöpke 2014).

From an agency perspective, academia represents a mediating form of agency—linking analytical observation with transformative practice. Rather than acting solely as external commentators or activist drivers, scientists navigate between these poles, shaping how sustainability transformations are conceptualized and enacted. Within this spectrum, more traditional transition scholars tend to maintain clearer boundaries between academic analysis and activist engagement, emphasizing that conceptual clarity and cumulative knowledge themselves contribute to systemic change. Several transformation scholars emphasized the continued need for knowledge generation—particularly target knowledge, transformative knowledge of inner dimensions, and deeper process-oriented insights (for example, Abson 2023; Horcea-Milcu 2023; Linnér 2023). Some others argued that the challenge lies less in producing new knowledge than in

mobilizing and transmitting existing insights into societal action. This view aligns with calls for problem-oriented, transdisciplinary research that bridges academic discourse and societal application (Jacobi et al. 2022; Singer-Brodowski et al. 2018; Wittmayer and Schöpke 2014). While navigating between attempts to produce knowledge and action, scientists face multiple conflicts of interest including within university practices and career incentives. Academia needs also to address the power imbalances alike the broader society.

At the same time, the broader literature and expert perspectives highlight the multifaceted role of scientists as knowledge generators, transmitters, and facilitators, as well as other intermediary forms of agency (Gliedt et al. 2018; Kanda et al. 2020; Kivimaa, et al. 2019a, b). Such pluralism within the academic community is not necessarily a weakness but may instead foster the democratic contestation needed for sustainability debates to remain open, legitimate, and adaptive (Linnér and Wibeck 2021).

## 6 Conclusion

This paper examined how leading scholars conceptualize sustainability transitions and transformations through the lenses of agency, governance, and resilience. Agency operates at multiple levels, governance is central to the discourses on transition and transformation, and resilience remains an undercurrent. Our research approach made visible tacit knowledge and personal perspectives from the scholars who shape the discourses. These are visible for example on the emphasis on collective agency over individual agency and the self-critical reflections on conceptual fuzziness.

Rather than converging toward a unified understanding, the findings reveal a field characterized by conceptual plurality and ongoing negotiation. Importantly, the interviews show that these differences are not merely semantic but reflect deeper assumptions about complex systems change—. In this sense, sustainability scholarship operates not around stable definitions, but around productive tensions that shape both analysis and action. Experts consistently emphasized interdependence, nonlinearity, and the catalytic role of crises, while also highlighting the limits of prediction and control. This links to the concept of resilience even where it is not explicitly used. This suggests that transitions and transformations should not be treated as linear pathways toward predefined outcomes, but as processes unfolding under conditions of uncertainty, where governance must balance directionality with openness. The distinction between process and outcome, as well as between steering and emergence, thus reflects a broader systems understanding that is central to both research and practice.

The academic themselves have a role of mediating agency in these transformations and transitions.

These insights carry implications for sustainability scholarship. Rather than seeking conceptual closure, future work should engage more explicitly with the tensions inherent in complex systems and develop approaches that integrate process-oriented and outcome-oriented perspectives. This includes rethinking how concepts are operationalized, moving beyond static indicators toward more adaptive and context-sensitive forms of evaluation. For governance and policy, the findings underline the need for approaches that combine strategic direction with flexibility, and that acknowledge uncertainty as a structural condition rather than a temporary limitation.

At the same time, the study is limited by its focus on academic expert perspectives, which reflect particular epistemic communities, Western established scientists, and may not fully capture how concepts are enacted in wider scientific discourses and in practice. Future research should therefore extend this work by synthesizing and linking conceptual debates more closely to empirical cases, exploring how systems thinking can be operationalized in concrete governance settings, and further developing integrated approaches to facilitate and monitor sustainability change, extended to countries beyond the Western hemisphere.

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## Declarations

**Competing interest** The authors declare no competing interests.

**Ethical approval** The research conducted in this study is in accordance with the ethical standards of the Leuphana University and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

**Informed consent to participate** All interview participants provided oral informed consent prior to participation. The researchers named in the article have additionally given written consent for their mention and were fully informed about the purpose and objectives of the study. All consent forms are securely stored in digital form and can be made available to the editors upon request.

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## References

- Abson DJ, Fischer J, Leventon J, Newig J, Schomerus T, Vilsmaier U, von Wehrden H, Abernethy P, Ives CD, Jäger NW, Lang DJ (2017) Leverage points for sustainability transformation. *Ambio* 46(1):30–39. <https://doi.org/10.1007/S13280-016-0800-Y/METRICS>
- Bodenheimer M, Dütschke E (2021) Lost in transition? Disentangling agency, activities and actor roles. In: IST conference proceedings
- Brand U (2016) How to get out of the multiple crisis? Contours of a critical theory of social-ecological transformation. *Environ Values* 25(5):503–525. <https://doi.org/10.3197/096327116X14703858759017>
- Brandt P, Ernst A, Gralla F, Luederitz C, Lang DJ, Newig J, Reinert F, Abson DJ, von Wehrden H (2013) A review of transdisciplinary research in sustainability science. *Ecol Econ* 92:1–15. <https://doi.org/10.1016/j.ecolecon.2013.04.008>
- Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qual Res Psychol* 3(2):77–101. <https://doi.org/10.1191/1478088706QP0630A>
- Brinkmann S, Kvale S (2019) Interviews: learning the craft of qualitative research interviewing. New Horizons Adult Educ Hum Resour Dev 31(2):65
- Brinkmann S (2014) Unstructured and semi-structured interviewing. In: Leavy P (ed) The Oxford handbook of qualitative research. Oxford University Press, Oxford. <https://doi.org/10.1093/oxfordhb/9780199811755.013.030>
- Chaffin BC, Garmestani AS, Gunderson LH, Benson MH, Angeler DG, Tony CA, Cosens B, Craig RK, Ruhl JB, Allen CR (2016) Transformative environmental governance. *Annu Rev Environ Resour* 41:399–423. <https://doi.org/10.1146/ANNUREV-ENVIRON-110615-085817/CITE/REFWORKS>

- Charmaz K, Belgrave L (2014) Inside interviewing: qualitative interviewing and grounded theory analysis. The SAGE handbook of interview research: the complexity of the craft, pp 347–366. [https://books.google.com/books/about/Constructing\\_Grounded\\_Theory](https://books.google.com/books/about/Constructing_Grounded_Theory)
- Cherp A, Vinichenko V, Jewell J, Brutschin E, Sovacool B (2018) Integrating techno-economic, socio-technical and political perspectives on national energy transitions: a meta-theoretical framework. *Energy Res Soc Sci* 37:175–190. <https://doi.org/10.1016/j.erss.2017.09.015>
- Child M, Breyer C (2017) Transition and transformation: a review of the concept of change in the progress towards future sustainable energy systems. *Energy Policy* 107:11–26. <https://doi.org/10.1016/j.enpol.2017.04.022>
- Costas R, Bordons M (2007) The h-index: advantages, limitations and its relation with other bibliometric indicators at the micro level. *J Informetr* 1(3):193–203. <https://doi.org/10.1016/j.joi.2007.02.01>
- De Haan JH, Rotmans J (2011) Patterns in transitions: understanding complex chains of change. *Technol Forecast Soc Change* 78(1):90–102
- Eagle L, Osmond A, McCarthy B, Low D, Lesbirel H (2017) Social marketing strategies for renewable energy transitions. *Australas Mark J*. <https://doi.org/10.1016/j.ausmj.2017.04.006>
- Feola G (2015) Societal transformation in response to global environmental change: a review of emerging concepts. *Ambio* 44(5):376–390. <https://doi.org/10.1007/s13280-014-0582-z>
- Feola G, Vincent O, Moore D (2021) (Un)making in sustainability transformation beyond capitalism. *Glob Environ Change* 69:102290. <https://doi.org/10.1016/J.GLOENVCHA.2021.102290>
- Fischer LB, Newig J (2016) Importance of actors and agency in sustainability transitions: a systematic exploration of the literature. *Sustainability*. <https://doi.org/10.3390/SU8050476>
- Flick U (1956–) (2019) *Qualitative Sozialforschung eine Einführung* (9. Auflage). rowohlt's enzyklopädie im Rowohlt Taschenbuch Verlag. <https://www.gbv.de/dms/ilmenau/toc/167653640X.PDF> Folke
- Folke C (2006) Resilience: the emergence of a perspective for social-ecological system analyses. *Global Environ Change* 16(3):253–267. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>
- Folke C, Carpenter SR, Walker B, Scheffer M, Chapin T, Rockström J (2010) Resilience thinking: integrating resilience, adaptability and transformability. *Ecol Soc* 15(4):62
- Gathen, L. (2026). *Transition and Transformation in Electric Mobility. Exploring Narratives, Institutional Contexts, Governance, and Agency through a Regional EV Case Study and Conceptual Expert Interviews*. Leuphana University Lüneburg. <https://doi.org/10.48548/pubdata-3615>
- Geels FW (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Res Policy*. [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8)
- Geels FW, Schot J (2007) Typology of sociotechnical transition pathways. *Res Policy* 36(3):399–417. <https://doi.org/10.1016/j.respol.2007.01.003>
- Geels FW, Sovacool BK, Schwanen T, Sorrell S (2017) Sociotechnical transitions for deep decarbonization. *Science* 357(6357):1242–1244. <https://doi.org/10.1126/science.aao3760>
- Gliedt T, Hoicka CE, Jackson N (2018) Innovation intermediaries accelerating environmental sustainability transitions. *J Clean Prod* 174:1247–1261. <https://doi.org/10.1016/j.jclepro.2017.11.054>
- Gottschamer L, Walters JP (2023) The dynamics of sustainability transitions: an archetype for transformation. *Environ Innov Soc Transit* 49:100767. <https://doi.org/10.1016/j.eist.2023.100767>
- Grin J, Rotmans J, Schot J (2010) Transitions to sustainable development: new directions in the study of long term transformative change. In: *Transitions to sustainable development: new directions in the study of long term transformative change*. <https://doi.org/10.4324/9780203856598>
- Hammond M (2020) Democratic deliberation for sustainability transformations: between constructiveness and disruption. *Sustain Sci Pract Policy* 16(1):220–230. <https://doi.org/10.1080/15487733.2020.1814588>
- Hausknost D (2020) The environmental state and the glass ceiling of transformation. *Environ Polit* 29(1):17–37. <https://doi.org/10.1080/09644016.2019.1680062>
- Heinrichs H (2014) *Nachhaltigkeitswissenschaften* (G. 1948–Michelsen, Ed.). Springer
- Helfferich C (2011) Die Qualität qualitativer Daten. In: *Die Qualität qualitativer Daten*. <https://doi.org/10.1007/978-3-531-92076-4>
- Hölscher K, Wittmayer JM, Loorbach D (2018) Transition versus transformation: what's the difference? *Environ Innov Soc Transit* 27:1–3. <https://doi.org/10.1016/j.eist.2017.10.007>
- Holling CS (1973) Resilience and stability of ecological systems. *Annu Rev Ecol Syst* 4:1–23. <https://doi.org/10.1146/annurev.es.04.110173.000245>
- Huttunen S, Kaljonen M, Lonkila A, Rantala S, Rekola A, Paloniemi R (2021) Pluralising agency to understand behaviour change in sustainability transitions. *Energy Res Soc Sci* 76:102067. <https://doi.org/10.1016/J.ERSS.2021.102067>
- Jacobi J, Llanque A, Mukhovi SM, Birachi E, von Groote P, Eschen R, Hilber-Schöb I, Kiba DI, Frossard E, Robledo-Abad C (2022) Transdisciplinary co-creation increases the utilization of knowledge from sustainable development research. *Environ Sci Policy* 129:107–115. <https://doi.org/10.1016/j.envsci.2021.12.017>
- Kanda W, Kuisma M, Kivimaa P, Hjelm O (2020) Conceptualising the systemic activities of intermediaries in sustainability transitions. *Environ Innov Soc Transit* 36:449–465. <https://doi.org/10.1016/j.eist.2020.01.002>
- Kemp R, Schot J, Hoogma R (1998) Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technol Anal Strateg Manag* 10(2):175–198. <https://doi.org/10.1080/09537329808524310>
- Kivimaa P, Hyysalo S, Boon W, Klerkx L, Martiskainen M, Schot J (2019b) Passing the baton: how intermediaries advance sustainability transitions in different phases. *Environ Innov Soc Transit* 31:110–125. <https://doi.org/10.1016/j.eist.2019.01.001>
- Kivimaa P, Boon W, Hyysalo S, Klerkx L (2019a) Towards a typology of intermediaries in sustainability transitions: a systematic review and a research agenda. *Res Policy* 48(4):1062–1075. <https://doi.org/10.1016/j.respol.2018.10.006>
- Koistinen K, Teerikangas S (2021) The debate if agents matter vs. the system matters in sustainability transitions—a review of the literature. *Sustainability*. <https://doi.org/10.3390/su13052821>
- Kotzé LJ, Kim RE, Burdon P, du Toit L, Glass L-M, Kashwan P, Liverman D, Montesano FS, Rantala S, Sénit C-A, Treyer S, Calzadilla PV (2022) Planetary integrity. In: Biermann F, Hickmann T, Sénit C-A (eds) *The political impact of the sustainable development goals: transforming governance through global goals?* Cambridge University Press, pp 140–171. <https://doi.org/10.1017/9781009082945.007>
- Kuckartz U, Rädiker S (2022) *Qualitative inhaltsanalyse: methoden, praxis, computerunterstützung: grundlagentexte methoden, 5. Auflage*. Beltz Juventa
- Lange P, Driessen PPJ, Sauer A, Bornemann B, Burger P (2013) Governing towards sustainability—conceptualizing modes of governance. *J Environ Policy Plann* 15(3):403–425. <https://doi.org/10.1080/1523908X.2013.769414>
- Leventon J, Abson DJ, Lang DJ (2021) Correction to: leverage points for sustainability transformations: nine guiding questions for sustainability science and practice. *Sustain Sci* 16(5):1769. <https://doi.org/10.1007/s11625-021-00991-2>

- Linnér B-O, Wibeck V (2021) Drivers of sustainability transformations: leverage points, contexts and conjunctures. *Sustain Sci* 16(3):889–900. <https://doi.org/10.1007/s11625-021-00957-4>
- Loorbach D, Frantzeskaki N, Avelino F (2017) Sustainability transitions research: transforming science and practice for societal change. *Annu Rev Environ Resour* 42:599–626. <https://doi.org/10.1146/annurev-environ-102014-021340>
- Meadows D (1999) Leverage points: places to intervene in a system—THE Donella meadows project. Academy for Systems Change
- Newig J, Challies E, Jager N, Kochskämper E, Adzersen A (2017) The environmental performance of participatory and collaborative governance: a framework of causal mechanisms. *Policy Stud J*. <https://doi.org/10.1111/psj.12209>
- Newig J, Derwort P, Jager NW (2019) Sustainability through institutional failure and decline? Archetypes of productive pathways. *Ecol Soc*. <https://doi.org/10.5751/ES-10700-240118>
- O'Brien K (2018) Is the 1.5°C target possible? Exploring the three spheres of transformation. *Curr Opin Environ Sustain* 31:153–160. <https://doi.org/10.1016/J.COSUST.2018.04.010>
- Patterson J, Schulz K, Vervoort J, Adler C, Hurlbert M, van der Hel S, Schmidt A, Barau A, Obani P, Sethi M, Hissen N, Tebbboth M, Anderton K, Börner S, Widerberg O (2015) Transformations towards sustainability: emerging approaches, critical reflections, and a research agenda. <https://research-portal.uea.ac.uk/en/publications/transformations-towards-sustainability-emerging-approaches-critic>
- Patterson J, Schulz K, Vervoort J, van der Hel S, Widerberg O, Adler C, Hurlbert M, Anderton K, Sethi M, Barau A (2017) Exploring the governance and politics of transformations towards sustainability. *Environ Innov Soc Transit* 24:1–16. <https://doi.org/10.1016/j.eist.2016.09.001>
- Rotmans J, Loorbach D (2009) Complexity and transition management. *J Ind Ecol*. <https://doi.org/10.1111/j.1530-9290.2009.00116.x>
- Saldaña J (2016) The coding manual for qualitative researchers, vol 14. Sage
- Salomaa A, Juhola S (2020) How to assess sustainability transformations: a review. *Glob Sustain* 3:e24
- Schilling T, Wyss R, Binder CR (2018) The resilience of sustainability transitions. *Sustainability*. <https://doi.org/10.3390/su10124593>
- Schneidewind U, Singer-Brodowski M (2015) Vom experimentellen Lernen zum transformativen experimentieren: reallabore als Katalysator für eine lernende Gesellschaft auf dem Weg zu einer Nachhaltigen Entwicklung. *Zfwu Zeitschrift Für Wirtschafts- und Unternehmensethik* 16(1):10–23. <https://doi.org/10.5771/1439-880X-2015-1-10>
- Scholz RW (2017) The normative dimension in transdisciplinarity, transition management, and transformation sciences: new roles of science and universities in sustainable transition. *Sustainability* 9(6):991
- Seidl R, Brand FS, Stauffacher M, Krütli P, Le QB, Spörri A, Meylan G, Moser C, González MB, Scholz RW (2013) Science with society in the Anthropocene. *Ambio* 42(1):5–12. <https://doi.org/10.1007/s13280-012-0363-5>
- Singer-Brodowski M, Wanner M, Schneidewind U (2018) Real-world laboratories as an institutionalisation of the new social contract between science and society. In: Padmanabhan M (ed) *Transdisciplinary research and sustainability: collaboration, innovation and transformation*. Routledge, pp 53–65
- Smith A, Stirling A, Berkhout F (2005) The governance of sustainable socio-technical transitions. *Res Policy*. <https://doi.org/10.1016/j.respol.2005.07.005>
- Soininen N, Juhola S, Kahiluoto H, Korhonen-Kurki K, Salomaa A (2024) Theories of change in sustainability sciences. In: Halonen T, Korhonen-Kurki K, Niemelä J, Pietikäinen J (eds) *The avenues to sustainability—key lessons from sustainability science*. Gaud-eamus, Helsinki
- Sovacool B, Noel L, Orsato R (2017) Stretching, embeddedness, and scripts in a sociotechnical transition: explaining the failure of electric mobility at Better Place (2007–2013). *Technol Forecast Soc Change*. <https://doi.org/10.1016/j.techfore.2017.05.037>
- Stirling A (2010) Keep it complex. *Nature* 468(7327):1029–1031. <https://doi.org/10.1038/4681029a>
- Studer S, Pohl C (2024) Methodensammlungen für die transdisziplinäre Forschung BT - Handbuch Umweltsoziologie. In: Sonnberger M, Bleicher A, Groß M (eds). Springer, Wiesbaden, pp 563–576. [https://doi.org/10.1007/978-3-658-37218-7\\_18](https://doi.org/10.1007/978-3-658-37218-7_18)
- Temper L, Walter M, Rodriguez I, Kothari A, Turhan E (2018) A perspective on radical transformations to sustainability: resistances, movements and alternatives. *Sustain Sci* 13(3):747–764. <https://doi.org/10.1007/s11625-018-0543-8>
- Thomas DR (2006) A general inductive approach for analyzing qualitative evaluation data. *Am J Eval* 27(2):237–246. <https://doi.org/10.1177/1098214005283748>
- Turnheim B, Geels FW (2012) Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913–1997). *Energy Policy*. <https://doi.org/10.1016/j.enpol.2012.04.060>
- Turnhout E, Metze T, Wyborn C, Klenk N, Louder E (2020) The politics of co-production: participation, power, and transformation. *Curr Opin Environ Sustain*. <https://doi.org/10.1016/j.cosust.2019.11.009>
- Walker B, Holling CS, Carpenter SR, Kinzig A (2004) Resilience, adaptability and transformability in social–ecological systemse. *Ecol Soc* 9(2):5
- Westley F, Olsson P, Folke C, Homer-Dixon T, Vredenburg H, Loorbach D, Thompson J, Nilsson M, Lambin E, Sendzimir J (2011) Tipping toward sustainability: emerging pathways of transformation. *Ambio* 40:762–780
- Wittmayer JM, Schöpke N (2014) Action, research and participation: roles of researchers in sustainability transitions. *Sustain Sci* 9(4):483–496. <https://doi.org/10.1007/s11625-014-0258-4>
- Wittmayer J, Bartels K, Larrea M (2021) Introduction: action research, policy and politics. *Int J Action Res* 17(1):3–4. <https://doi.org/10.3224/ijar.v17i1.01>

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