The TIPPING+ Project Journey

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Abstract This chapter introduces and provides the research background of the several contributions of this book. It does so first by briefly reviewing the previous conceptual developments that over the course of two decades eventually led to the EU-funded project TIPPING+. The goal of the project was to improve our understanding of the enabling conditions and complex processes for fast structural sustainable transformations in coal and carbon intensive regions (CCIRs) using the notion of *positive tipping points* as a boundary concept able to bring together the insights of various social science and interdisciplinary perspectives. The main challenge facing these regions is understood not only as sectoral energy transitioning challenge; but the extent to which multiple socio-economic, political and cultural dimensions for full-systems transformations are taken into account. Second, it presents some of the conceptual and methodological proposals generated by the project and argues for ontological and epistemological diversity and to understand equity and justice as a key drivers and outcomes of positive tipping points. As a research journey, however, the TIPPING+ project did not search for a destination. Instead, it looked for a point of departure, for an opportunity space in which different disciplines, researchers and interests could jointly develop their own ideas and start their own new research ventures.

Keywords The TIPPING+ project · Tipping points · Coal and carbon intensive regions · Sustainability transformations · Earth System Justice

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1 Introduction

The TIPPING+ project[1] was a 3-and-a-half-year EU project (2020–2023) that emerged from the identification of the specific unmet research need to address tipping points from a interdisciplinary social science approach. The theoretical and operational background of the TIPPING+ proposal was based on two decades of previous EU research efforts and in particular the MATTISSE, ADAM, GSDP, GREEN-WIN and IMPRESIONS projects.[2] In all these interdisciplinary efforts , the exploration of transformative visions and narratives played a key role as it was assumed that deliberate systems' transformations most often require, in the first place, alternative ways of framing socio-political, biophysical and economic realities. In particular, and during the MATISSE and ADAM projects, the four-step transition methodology of *scoping, visioning, experimenting, and learning* was further developed and then made operational for dealing with climate challenges in the form of a transformative Policy Appraisal Framework (PAF; Weaver et al., 2006, Fig. 1). It was then, from those discussions, that the idea of *Integrated Climate Governance* emerged with the explicit goal to *support agents' transformations for sustainable development* (Tàbara, 2011):

Visioning was therefore considered of central importance in transformations-oriented research. Consequently, within the GREEN-WIN project, a global dialogue was carried out bringing in empirical cases of win-win strategies at different levels of action (Jäger et al., 2018; Omann et al., 2019). These ranged from the assessment of micro-solutions to address energy poverty in rural areas to macro-economic modelling alternatives, as well as other strategies in diverse domains, such as in coastal adaptation or urban contexts. The aim of the dialogue being to identify a shared vision on 'which kind of economy we want for the kind of world we want'; and at the same time, that it would be based on the lessons learned from the empirical study of feasible and tested options that show both short-term positive effects on sustainable wealth creation as well as on climate adaptation or mitigation. In other words, to develop robust transformative visions and narratives (Hinkel et al., 2020) that were based not only on aspirational goals, but also that could be validated by empirical experiences and insights on systems transformations (see Sato et al. 2018).

In the case of IMPRESSIONS, the challenge focused on how to address the prospect of a world committed to high-end climate scenarios, that is, those that will go beyond the 2–1.5 °C UN Paris global warming threshold. Moreover, it intended to identify what kinds of alternative pathways, governance structures and integrated

[1] https://tipping-plus.eu/publications

[2] MATISSE (Methods and Tools for Integrated Sustainability Assessment; https://cordis.europa.eu/project/id/4059/es), ADAM (Adaptation and Mitigation Strategies: Supporting European climate policy; https://cordis.europa.eu/project/id/18476), GSDP (Global Systems Dynamics and Policy; https://cordis.europa.eu/project/id/266723), IMPRESSIONS (Impacts and risks from high-end scenarios: Strategies for innovative solutions; http://www.impressions-project.eu/), GREEN-WIN (Green growth and win-win strategies for sustainable climate action; https://www.green-win-project.eu/).

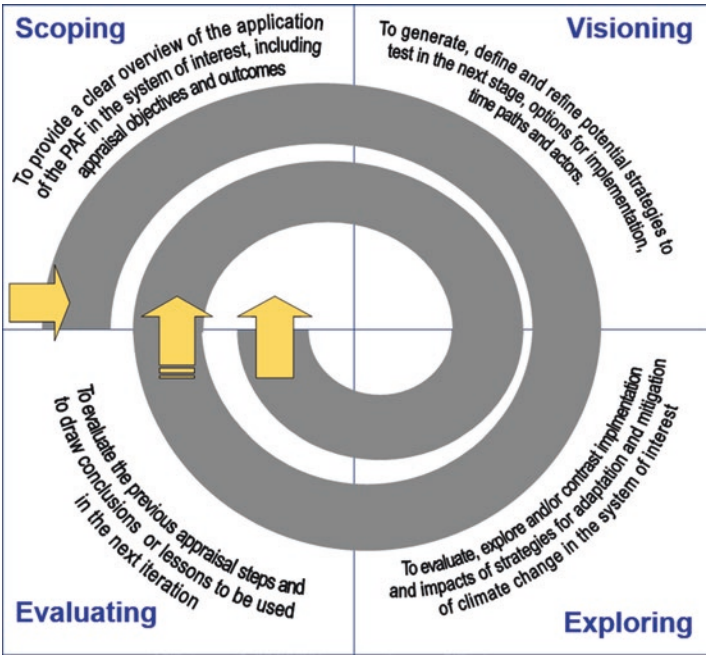

Fig. 1 The policy appraisal framework from the ADAM project (source: Weaver et al., 2006)

assessment interfaces would be needed to avoid the most negative outcomes of such futures. Assuming that conventional solutions would not be enough to address high-end climate change at the required speed and intensity to avoid potential catastrophic outcomes, a central concern was the call for developing science-policy integrated approaches to accelerate positive systemic change. This eventually led to proposing a check-list for transdisciplinary researchers to move towards *Transformative Climate Science* (Tàbara, Jäger, et al., 2018), and relatedly, the idea of positive tipping points emerged by acknowledging the fact that in complex social-ecological systems, it was not possible to know a priori whether or when deliberate positive rapid systemic changes able to cope with potentially catastrophic climate change and unsustainability would happen. It was recognised that robust solutions able to deal with to those high-end climate futures could not be fully known beforehand until explicit and situated transformative capacities aimed at developing such solutions were implemented in particular places and contexts. This, in turn, led to an original interpretation of the conditions for positive tipping points that moved towards a perspective focused on capacities (Fig. 2), and again, of those particular capacities to support *Transformative Climate Governance* (Hölscher & Frantzeskaki, 2020).

Therefore, an important aspect of the definition of positive tipping points in social-ecological systems, according to the IMPRESSIONS project, was that a

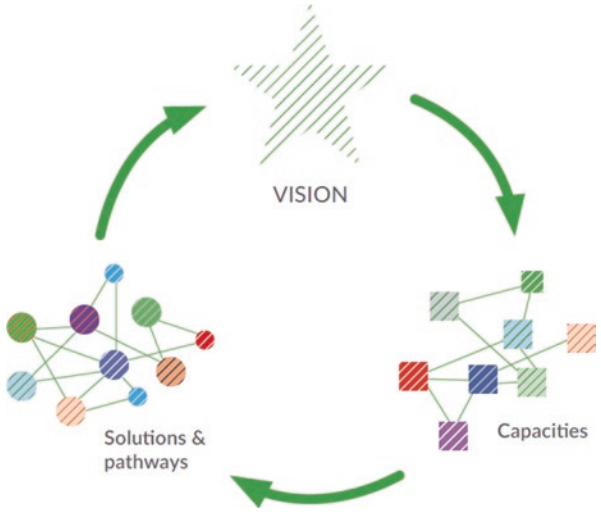

Fig. 2 Transformative solutions as emergent outcomes of transformative capacities derived from alternative visions of social-ecological systems

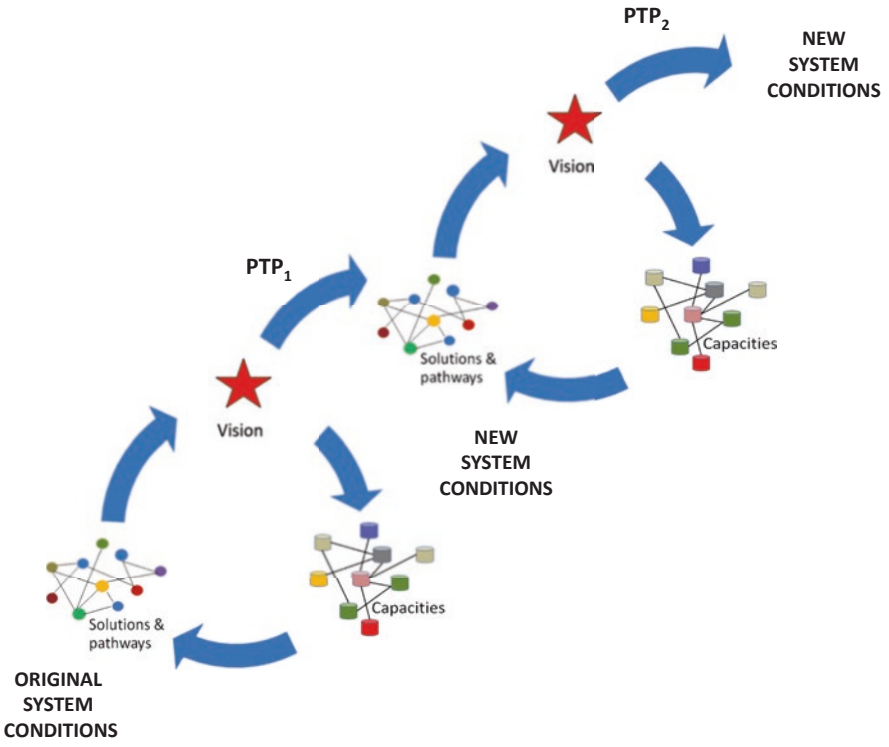

Fig. 3 Tipping points focusing as emerging outcomes of transformative visions, capacities and systems of solutions eventually changing original system conditions (source: Tàbara et al., 2018)

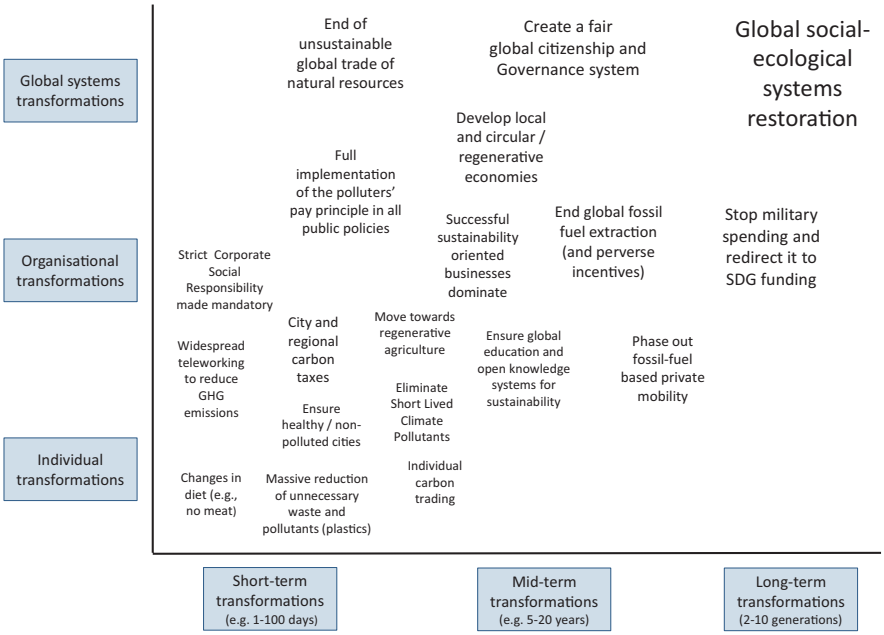

Fig. 4 The landscape of transformative solutions. Accelerating deliberate systemic change require combinations of multiple transformative solutions operating at different social and temporal scales (source: http://www.highendsolutions.eu/page/transformative_solutions)

tipping point would lead to fundamentally different configurations of the original social-ecological systems (Tàbara, Frantzeskaki, et al., 2018; Fig. 3).

Moreover, it was argued that the acceleration of deliberate transformations towards more sustainable development pathways would require *combinations of multiple systems of transformative solutions* able to move from additive to multiplicative strategies on systems' reconfigurations. Those outcomes would entail synergising the multiple wins and positive effects occurring at different scales of social action, from individual, organisational and systems levels; and also, to consider multiple time and space interlinkages, from short- and mid-term temporal scales to long-term ones (Fig. 4 shows some the possible examples, not tested, and were provided only for illustrative purposes):

Last but not least, the TIPPING+ project was also inspired by many years of interactions with the Transformations Community, collaborations that especially started with the series of international Transformations Conferences originally catalysed by Professor Karen O'Brien at Oslo University. In this line, the TIPPING+ project also co-convened the Transformations Conference 2021 (online, due to the pandemic) precisely on 'Enabling Tipping Points in an Uncertain World'.[3] An important concern of the Transformations Community has been to explore how to

[3] https://www.transformationscommunity.org/conference-2021

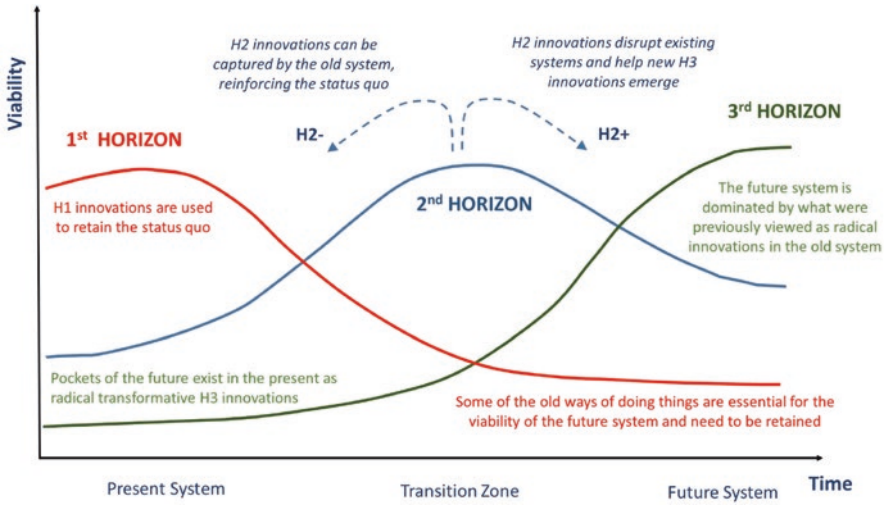

Fig. 5 The three Horizons methodology applied by the Transformations Community to explore alternative configurations of knowledge systems to address global challenges such as climate change (source: Fazey et al., 2020)

connect transformative changes at individual and organisational levels with large systemic ones (O'Brien, 2018) with especial emphasis placed on the management of knowledge systems. For instance, at the Transformations Conference 2017, held at the University of Dundee, the Three Horizons methodology was applied to explore the kinds of emerging knowledge systems needed to address global challenges such as climate change, as represented in Fig. 5 (Fazey et al., 2020).

However, and out of these broad conceptual approaches and theoretical discussions, it was clear that empirical research on the required conditions and processes leading to sustainable fast decarbonisations was still lacking. And the TIPPING+ project was to address this task by focusing on the identification of narratives as well as structural conditions for the fast decarbonisation of Coal and Carbon Intensive Regions (CCIRs).

2 Defining and Researching Positive Tipping Points: The TIPPING+ Approach

Tipping points are widely used and apparently widely 'understood' by many audiences. And in this sense, they operate as a boundary concept that helps to attract different disciplines and practitioners too. However, there are multiple understandings of tipping points as they are defined and used very differently by different social and natural science disciplines, which may lead to an overuse of the term (Milkoreit 2022). Moreover, the notion of Social-Ecological Tipping points (SETPs) integrating both biophysical and social interactions and feedbacks (see Franzke

et al., 2022; Tàbara, 2023), and entailingl fundamental changes in original social-ecological system's conditions and relationships, made such discussions even more challenging.

Due to the fact that SETPs are the result of multiple complex processes and dynamics, it was assumed that positive tipping points cannot be fully predicted whether or when they will occur. However, in TIPPING+, we also assumed that the emergence of positive SETPs can deliberately be induced by tipping interventions (e.g., towards sustainable decarbonisation; Tàbara et al., 2024). In the context of regional decarbonisation, positive tipping points were defined as those relatively small additional actions or policy interventions that at one moment trigger and accelerate large, beneficial and self-propelling processes of deliberate qualitative change in a given social-ecological system (Tàbara et al., 2021). In particular, TIPPING+ identified two types of tipping points relevant for policy. On the one hand, *sectoral tipping points*, with are limited to deliberate changes within a particular domain of action, such as mobility or energy consumption, but which do not demand major and cross-cutting reconfigurations in power structures, individual worldviews or cultural beliefs. And on the other hand, *full-systems tipping points*, which also entail cross-scale and more profound and institutionalised changes in individual behaviours, economic organisations, power arrangements, knowledge systems, social-ecological interactions as well as in cultural values and identities. This can be represented in Figs. 6 and 7, in which sectoral tipping points relate mostly to *transitions tipping points* whilst the latter has to do with *transformations tipping points.* In both cases, these deliberate tipping processes result from the building of prior changing conditions and capacities derived from targeted deliberate interventions, and that at one threshold point, a relatively small additional action or disruptive event flips a social-ecological system towards a new sustainable trajectory or system's basin of attraction:

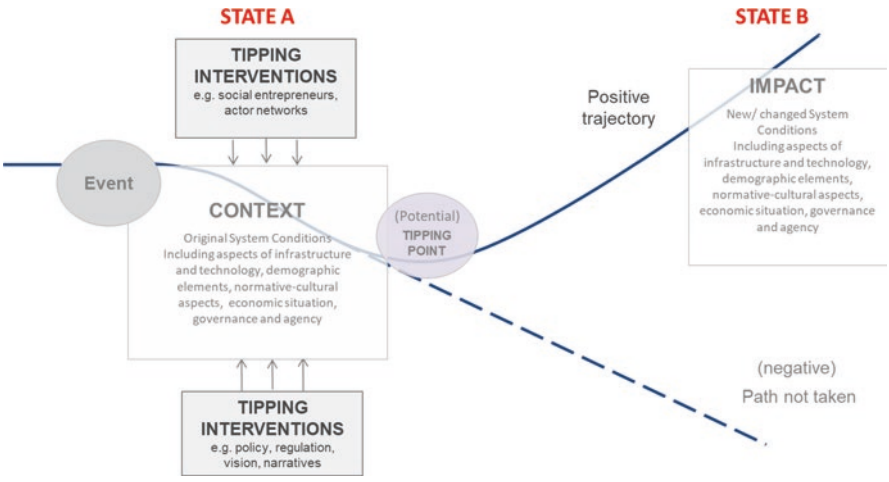

Fig. 6 Sectoral tipping point as trajectory discontinuity (source: Mey & Lilliestam, 2020)

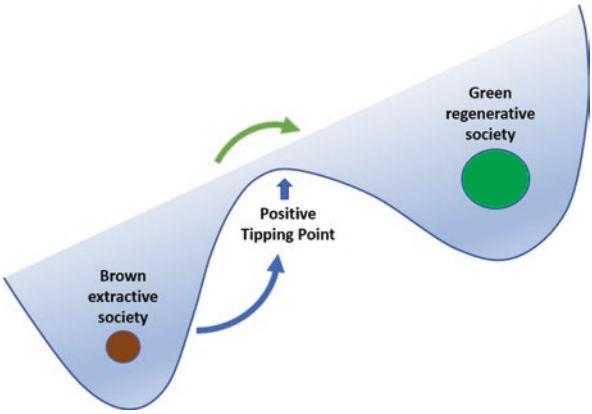

Fig. 7 Full system's tipping point, as a move toward a new basin of attraction (source: Tàbara, 2021. In search of a safe and just corridor for humanity. What kinds of transformations, agents and levers? Presented at the Earth Commission Working Group on Transformations, Global Common Alliance, 27th May 2021)

Tipping points necessarily refer to phenomena that occur over time. Hence, how temporal scales and dynamics are conceptualised is crucial in the research of deliberate positive tipping points in specific regional contexts. Concisely, the study of such phenomena can focus on three critical moments or stages in their development: (1) the building of the transformative conditions and capacities for systemic change that eventually enable and induce the emergence of desirable new system conditions; (2) the moment at which, provided that a critical window of opportunity for transformation exists, a sensitive intervention (Farmer et al., 2019) or tipping event (endogenous or exogenous) may trigger the tipping of a complex system toward its deep reconfiguration ; and (3) the passage of the system's dynamics toward new basins of attraction which in turn can provoke further effects on other systems. This complex phenomenon can be represented in a simplified form in Fig. 8.

Therefore, the governance of positive tipping points in CCIRs (Mey & Lilliestam, 2020) entails identifying four types of phenomena: (1) the social, political and economic contexts where potential abrupt changes may occur; (2) the possible tipping events that may accelerate or trigger fast structural change, such as closing a coal mine; (3) the feasible and more just interventions required to transform the system towards a desirable dynamic state and bring it towards a tipping point; and (4) the different kinds of impacts or courses of action after the tipping point. All these aspects are interrelated in the way that a tipping event or process qualitatively disrupts the initial social and economic structures of a region. However, and as pointed out by Eder and Stadelmann-Steffen (2023), current literature on tipping points does not yet adequately integrate, conceptualize or measure the role of the political with regard to social tipping processes. They argue that current research has conceptualised *the political either as context that provides the rules of the game or as part of the system that may tip itself* and trigger tipping cascades. Moreover, they contend that political complexity requires distinguishing between *policy* (as the set of political institutions), *politics* (in terms of decision-making processes) and *policy* regarding particular goals, interests and solutions and so they apply these ideas to

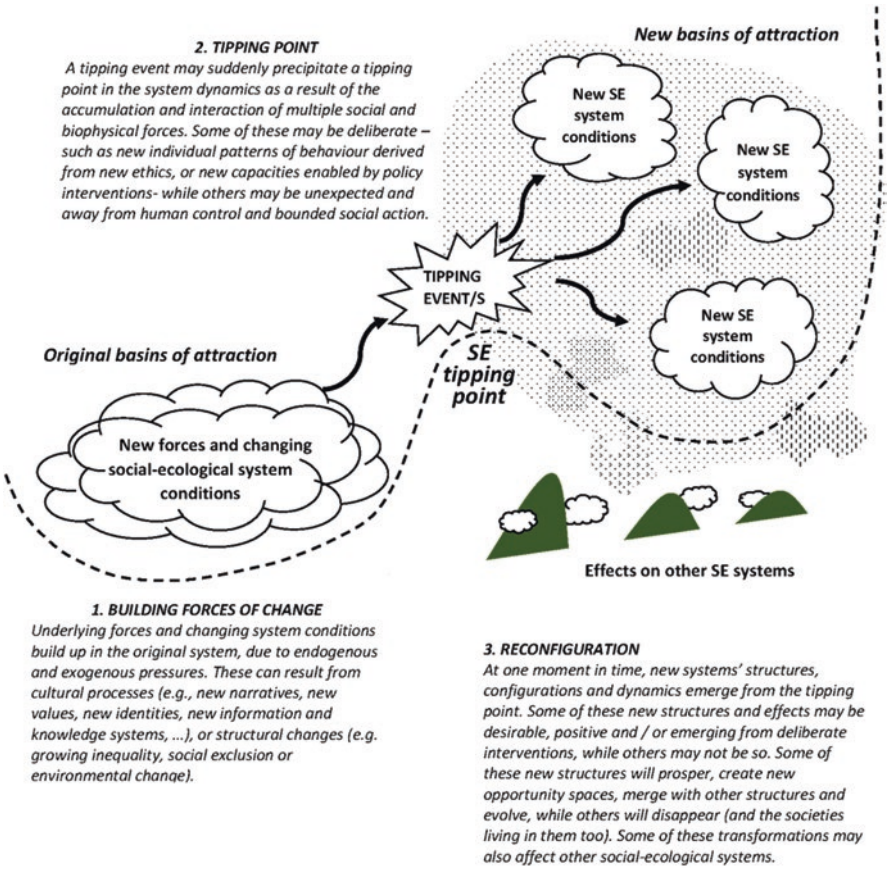

Fig. 8 Dynamics of social ecological tipping points (SETPs). In a given moment in time, tipping events accelerate the underlying forces of change and eventually provoke the emergence of new systems' reconfigurations and move its dynamics toward new basins of attraction (source: https://council.science/current/blog/enabling-positive-tipping-points-towards-global-sustainability-in-uncertain-times/)

examine the phase-out of nuclear energy in Germany and Switzerland. Hence, the political sphere can be understood as a domain that triggers social-ecological tipping points or as an element that can tip itself (Eder & Stadelmann-Steffen, 2023; see also Fesenfeld et al., 2022).

An important aspect of the cross-analysis of the empirical findings in TIPPING+ had to do with the study of narratives, and an adapted framework proposed by Lieu et al. (2020) was applied across the case studies to describe the dynamics of three main kinds of narratives within the different CCRIs (Mangalagiu et al., 2023; Martínez Reyes, 2022) as follows: (1) on-stream pathways, whereby dominant perspectives on the socio-energy pathways prevail; (2) off-stream

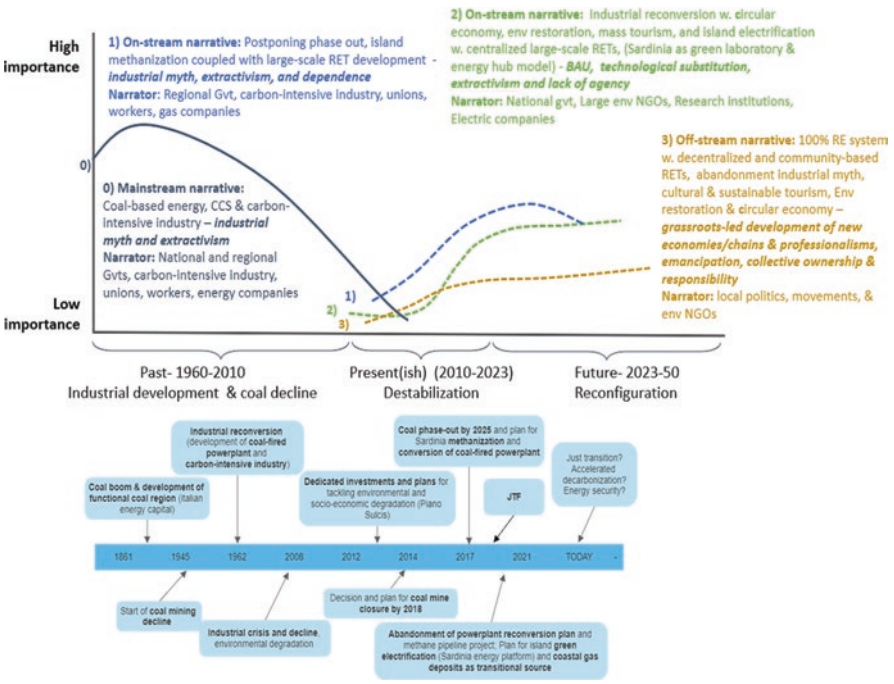

Fig. 9 Analysis of narratives and structural events in the Sulcis (Italy) case study (source: Biddau & Sarrica, 2022)

pathways, that depart from the mainstream socio-energy pathway and are open to social equity and technological innovations; and (3) transformative pathways, that are fundamentally different from previous mainstream pathways and include social dimensions and equity issues in the new socio-energy regimes. Figure 9 illustrates how this framework was translated and applied for the case of Sulcis in Italy:

Last but not least, the TIPPING+ project also engaged with various methodological discussions related to how to carry out research on tipping points in interdisciplinary contexts (see for an alternative perspective in this volume Hodbod et al., 2024). Among other contributions, these had to do with positionality. Researchers and change agents looking to identify and 'discover' potential positive tipping points in regional development processes may need to reconsider their own ideas, beliefs and attendant practices regarding the recognition and personal adherence to different ontological, epistemological and normative positions that affect the way they define, approach and assess their systems of reference. For this purpose, a simple methodology to assess positionality was proposed at early stage of the project and represented in Fig. 10.

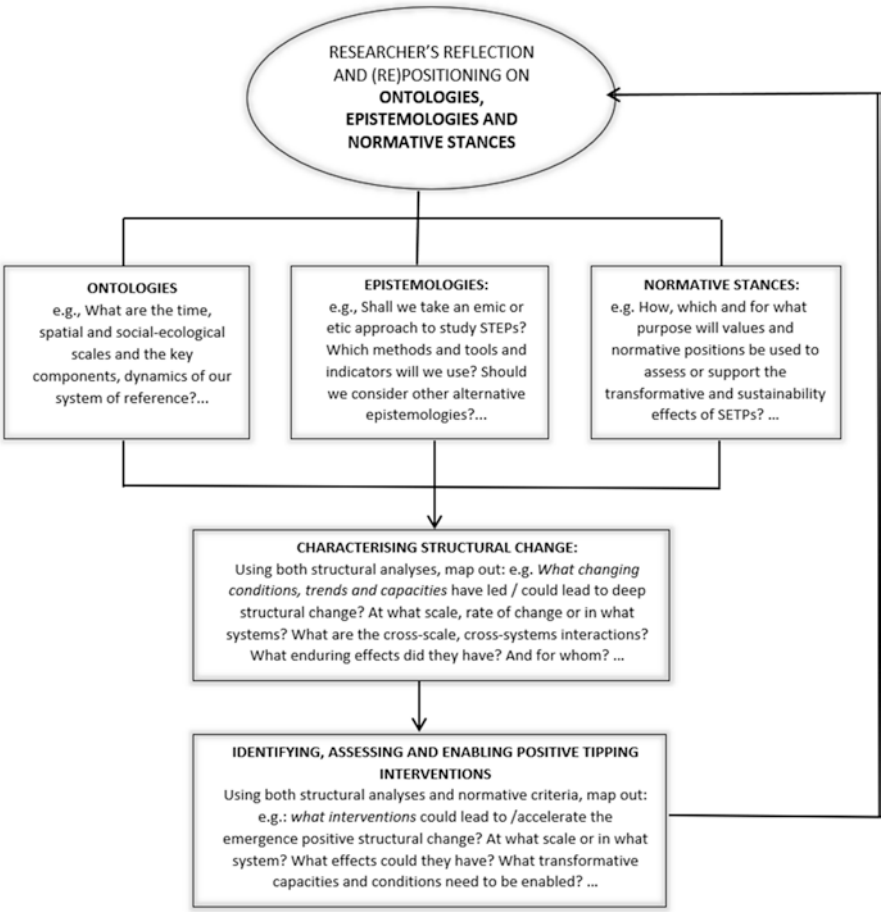

Fig. 10 The characterisation and enactment of positive tipping points depend on researchers' positionality, that in turn depends on critical ontological, methodological and normative questions (source: Tàbara et al., 2021).

3 The Multi-dimensional Challenge of Rapid Decarbonisation of Coal and Carbon Intensive Regions (CCIRs)

The regional energy transformation processes supported by EU and national policies and funds have created a window of opportunity for the reconfiguration of coal and carbon intensive regions (CCIRs) in a way that can be aligned with sustainable development goals. Such regions have in recent decades been affected by an array of negative trends, regarding loss of local jobs, population ageing, migration, lack of services as well as poor environmental quality conditions. In these socially

complex contexts, systemic inertia, aversion to change and immobilism has often been paramount. To overcome this, several factors that have to do with realising the multiple dimensions that affect deliberate and fast change at the regional level need to be taken into account. These have to do not only with injecting structural funds to trigger technology innovations, but also with many other more intangible, cultural and perceptual dimensions related with the collective construction of meaning and action (see Apostoli Cappello, 2024; Cots et al., 2024; Sarrica et al., 2022, 2024; Van der Leeuw, 2024) and that affect the willingness and the capacities of different local agents and communities to collaborate actively in transformative governance processes. Harmonised policies need to consider all these cultural, identity, inequality and perceptual dimensions in order to foster the potential of local populations to contribute to systemic change in their own terms, which may eventually be expressed in more diversified, inclusive and resilient development pathways.

An important objective of the TIPPING+ project was then to underline the need to engage social scientists in the exploration of tipping points, given that this field had thus far been dominated by the natural sciences. Thus, the project wanted to underline the fact that tipping points occur as complex phenomena derived from multiple and intertwined socio-economic, political and cultural dynamics. These have to do, among others, with many structural factors, dimensions and disciplines including: (1) demography and human geography; (2) social psychology, ethnography and community studies; (3) governance and public policy science; as well as (4) economic, resource and distributional issues, for which a single work package was dedicated within the project (Fig. 11). Hence, from an interdisciplinary social science approach based on allowing for epistemic diversity, it was grounded on the recognition that no single approach or discipline would be sufficient to address the

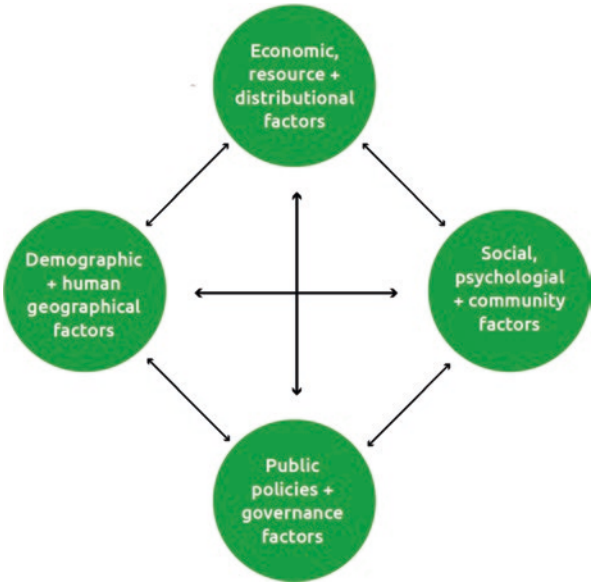

Fig. 11 The TIPPING+ approach. Exploring tipping points dynamics and processes in coal and carbon intensive regions from different social science perspectives

large complexities of the research on social-ecological tipping points. Instead, multiple and different perspectives, methodologies and social science concepts would be needed; and this was especially relevant when trying to go beyond explaining socio-technological transitions from a unifying master s-curve framework so a more nuanced understanding of full-systems transformations could be developed; one that would, for instance, allow for alternative and more ecologically-coupled notions of time and would not assume single end-point or equilibria, given that social justice systems are never in equilibrium and are always changing, sometimes in dramatic ways and even in opposite directions.

The various cases included in this volume, without providing an exhaustive systematic treatment, show such diversity of approaches, methodologies and understandings of tipping points from various social and interdisciplinary perspectives. In this way, Marco Grasso and Daniel Delatin Rodrigues (2024) focusing on city of Civitavecchia in Italy provide a framework for the analysis of practices of destabilisation and disruption carried out by 'agents of transformation (ATs)' and argue that no single AT but many are needed for tipping a system toward a deliberate socio-energy trajectory. Also in Italy, Elena Apostoli Cappello uses an ethnographic approach to trace the dynamics in the construction and changes in the systems of meaning, and applying the notion of cultural 'energyscapes' examines how local communities can—or cannot, or are not willing to—participate in large EU decarbonisation policies. Francesc Cots and colleagues (2024) also explore the role of symbolic icons and identities in the processes of rapid decarbonisation of former mining regions, noting that after a tipping event, diversification may not only occur within the economy but also at the level of cultural identities yielding the possibility for the emergence of transformative 'project identities'. Ismael et al. (2024) examine the relationships between narrative changes and network dynamics in Indonesia and identify two main tipping narratives involving different kinds of actors and network configurations, hence opening a space for mutual learning between both. Jan Frankowski et al. (2024) explore, using a macro-economic framework, to which extent implementing carbon taxes can be considered a tipping intervention in accelerating decarbonisation in two areas of Poland and Greece, and reveal that to be qualified as such they need to be combined with other interventions and coordinated under a broader transformations policy narrative. Anna Sveinsdóttir and Brigt Dale (2024) present how a series of tipping events resulted in the rapid reframing of the dominant narrative of the future of the Lofoten islands region in Norway, from being mainly formulated around petroleum extraction to becoming a reference of 'green islands'. While, also in Norway, Veland et al. (2024), using a qualitative perspective, look at the processes and implications that are leading the closing down of the only coal power plant and the last remaining Norwegian-operated coal mine in Norway on Svalbard, together with the larger geopolitical implications of that. Also in the Arctic, Hansen and Tàbara (2024) elaborate the idea of tipping narrative confrontations, provided that whilst Greenland contains vast of fossil fuels deposits and keeping them in the ground is arguably one of the most efficient and fastest strategies to limit global GHGs as to avoid a climate catastrophe, Greenland materials are also needed to develop and provide alternative resources for the global green energy

transition—underlying the need to harmonise natural resource with Earth System Justice ethical principles, and in ways that consider the rights, needs, worldviews and institutional traditions of local communities. Last but not least, Lukash and Namoniuk (2024) explore the possible low-carbon energy scenarios that could emerge from the systemic shock generated by the Ukrainian war. They note that such structural convulsion did not only show some of the vulnerabilities of high-intensive, centralised and dependent energy systems but also the need to accelerate the building of more resilient low-carbon infrastructures in the face of potential global change and interdependencies, the effects of which go also beyond Ukraine.

All these cases also underline the importance of considering the role of justice as a key driver for the emergence of positive tipping points in structural low-carbon sustainability transformations as well as a main outcome of them. Early gains in justice at the regional level can create the necessary transformative conditions for achieving positive tipping points at larger scales, and may also help to trigger chains of positive changes in other regions. Addressing inequalities and providing early mutual gains derived from tackling climate crisis are likely to help regional agents to support energy and climate policies, and function as demonstrators for other regions, showing that just transformations are not only possible but desirable. On the one hand, this means considering and extending generally accepted dimensions of *justice* in energy transformations that include *distributive justice* and that relates to the equitable distribution of resources, benefits or costs of transformations; *recognition justice*, that regards the fair representation and inclusion of gender, ethnicity, youth or other disadvantaged groups; and *procedural justice*, aimed at guaranteeing that people can influence actual decision. Making processes by setting inclusive ground rules of participation, including access to relevant information and the selection of criteria used in the organisation of such engagement processes. But in addition to these, also *capability approaches* that emphasise the need to foster explicit *means and enabling conditions*, such as political or community power of agents to influence decarbonisation decisions, in a way that can be relevant to climate mitigation, adaptation or more broadly, by fostering tipping processes towards systems' transformations. Whilst on the other hand, there are other perspectives and dimensions of *injustice* that need to be considered, provided that the relationships between justice and injustice are not symmetrical. For example, *intersectional injustice* occurs when multiple social characteristics or conditions overlap and affect negatively certain groups, revealing the need to apply equity policy interventions beyond those applied to the general population. Likewise, *epistemic injustice* happens when the knowledge or expertise claims of certain groups are disregarded, ignored or misrepresented, as with indigenous knowledge or non-expert people. All in all, a holistic approach to justice—and attention to injustice—in regional decarbonisation processes is needed, that go beyond compensation for the loss of existing power or economic positions of certain sectors, and that addresses much broader systems' transformations in terms of redistributions of rights, harms/benefits and responsibilities. Hence, a very difficult challenge is how to place these multiple justice criteria and dimensions that occur at the level of on European regional decarbonisation processes and move towards *transformative justice* within in the broader

context of global environmental challenges and risks. These comprise the need to avoid trespassing Planetary Boundaries—thus contributing to and ensuring a safe and just corridor for humanity—and that entail adopting transformations-oriented understandings of justice that also consider intergenerational, intragenerational, as well as inter-species dimensions of justice (Gupta et al., 2021; Gupta, Liverman et al., 2023).

4 Final Remarks

Looking back, as a research journey, the TIPPING+ project did not search for a destination. Instead, it looked for a point of departure, for an opportunity space in which different disciplines, researchers and interests could develop their ideas and start their own new research ventures. Entering in such a complex field in a moment when researchers were being hit at the very first month of work by over 2 years of the Covid pandemic, and then followed by the Ukrainian war, did not help... The project was confronted with many uncertainties that had to be addressed in ways that had not been tested before—including the online organisation of the International Transformations '21 Conference. The lack of face-to-face interaction also impeded at many instances the possibility to address and reconcile the existence of different expectations and perspectives among researchers and to carry out the required personal interactions with stakeholders. Under these conditions, in practice, this meant that TIPPING+ could not attempt to find a 'definite answer' to the role of tipping points in accelerating regional decarbonisation processes; nor to arrive to a definition of social-ecological tipping points that could be used accross all contexts, methodologies, modelling exercises or disciplines. In contrast, it simply constituted an opportunity space to initiate many different debates—whilst providing some seminal examples of empirical research on possible future developments in an extremely difficult field of social interdisciplinary research.

This notwithstanding, an important overarching message that came out from the TIPPING+ project is that the challenges of just energy transitions in CCIRs are not just about energy transitioning; but about understanding how to deal with full-systems societal transformations that include multiple socioeconomic and cultural dimensions as well as profound changes in governance mechanisms, individual capacities, economic arrangements and even collective and cultural visions about the kind of just societies we want to live in, e.g., more socially, open and resilience-oriented or not. The corollary and derivative policy questions from this position therefore were: how far regional/national/EU policy makers do wish to go towards enacting full systems transformations (transformative tipping points)? Or else, do they want to limit themselves to implement sectorial, partial approaches to energy transitions (sectoral tipping points; with all the risks and potential inequalities and rebound negative effects that the latter may entail)?

As for future research, tipping points, as a heuristic conceptual device whose purpose is to help explain, articulate and operationalise policy narratives about the

acceleration of deliberate systemic change, also need to be explained. And in such complicated interaction between concepts and realities, it is important to acknowledge that positive tipping points in CCIRs will have to look at the formation of validated narratives and careful assessment of the diverse, distributed and place-based decarbonisation strategies which could eventually be creative and engaging. In such endeavour, justice in its multiple notions and dimensions will have to consider how regional decarbonisation can also reduce poverty, enhance equity, and create sustainable forms of wealth and social welfare, and also explore how local processes of positive structural change can be linked to global processes in a way that also consider broader issues such as Earth System tipping points and distributional issues (Gupta, Prodani et al., 2023; Lenton et al., 2022). Tipping points research requires addressing multiple domains and scale interlinkages at the same time, so no one-size-fits-all solutions or single pathways of solutions are to be expected; but only multiple adaptive, possibly regenerative and flexible ones that may emerge from situated social learning processes in a way that fulfil local visions and values, and are able to create the necessary transformative conditions and capacities for rapid systemic change (see Olson & Moore, 2024). Moreover, such a research challenge also entails the acknowledgement that inter and transdisciplinary sciences have also their limits, and that the transformations-oriented knowledge derived from them first needs to be built on the rigorous application of methods and concepts generated by well-established disciplines as well. Indeed, in the future, many different disciplines may come up with new definitions and methodologies to understand tipping points that contrast with the ones created or used in TIPPING+; or utilise the positive tipping points concept to explain or to deliberately transform reality in many other different ways. In fact, we can only hope this to be case, so we can further understand how to accelerate positive deliverable transformations toward a sustainable world.

References

Apostoli Cappello, E. (2024). Situated knowledge and energy transformations: a socio-anthropological exploration. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Biddau, F., & Sarrica, M. (2022). Tipping dynamics, psychosocial patterns, and lock-in mechanisms in Sulcis coal and carbon-intensive region (Italy). In A. Martínez Reyes, et al. (Eds.), *Case study key findings, deliver 5.2, "Enabling positive tipping points towards clean-energy transitions in coal and carbon intensive regions", European Horizon 2020 TIPPING+ project*. https://tipping-plus.eu/home

Cots, F., Tàbara, J. D., Fosse, J., & Codina, G. (2024). Exploring the role of identities and perceptions of the future in a post-coal mining region. The demolition of Andorra coal-fired cooling towers (Spain) as a tipping point. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Eder, C., & Stadelmann-Steffen, I. (2023). Bringing the political system (back) into social tipping relevant to sustainability. *Energy Policy*. https://doi.org/10.1016/j.enpol.2023.11352

Farmer, J. D., Hepburn, C., Ives, M. C., Hale, T., Wetzer, T., Mealy, P., Rafaty, R., Srivastav, S., & Way, R. (2019). Sensitive intervention points in the postcarbon transition. *Science, 364*(6436), 132–134.

Fazey I., Schäpke N., Caniglia G., Hodgson A., Kendrick, I., Lyon, C., Page, G., Patterson, J., Riedy, C., Strasser, T., Verveen, S., Adams, D., Goldstein, B., Klaes, M., Leicester, G., Linyard, A., McCurdy, A., Ryan, P., Sharpe, B., … Young, H. R. (2020). Transforming knowledge systems for life on Earth: Visions of future systems and how to get there. *Energy Research & Social Science, 70*, 1–18. https://doi.org/10.1016/j.erss.2020.101724

Fesenfeld, L. P., Schmid, N., Finger, R., Mathys, A., & Schmidt, T. S. (2022). The politics of enabling tipping points for sustainable development. *One Earth*. https://doi.org/10.1016/j.oneear.2022.09.004

Frankowski, J., Sokołowski, J., Michas, S., Mazurkiewicz, J., Kleanthis, N., & Antosiewicz, M. (2024). Assessing the labour market effects of a carbon tax as a tipping intervention in economies undergoing coal phase-out: the cases of Poland and Greece. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Franzke, C. L. E., Ciullo, A., Gilmore, E. A., Matias, D. M., Nagabhatla, N., Orlov, A., Paterson, S. K., Scheffran, J., & Sillmann, J. (2022). Perspectives on tipping points in integrated models of the natural and human Earth system: cascading effects and telecoupling. *Environmental Research Letters, 17*(015004). https://doi.org/10.1088/1748-9326/ac42fd

Grasso, M., & Rodrigues, D. D. (2024). Social tipping processes in the transformation of Civitavecchia's socio-energy system. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Gupta, J., Liverman, D., Bai, X., Gordon, C., Hurlbert, M., Inoue, C. Y. A., Jacobson, L., Kanie, N., Lenton, T. M., Obura, D., Otto, I. M., Okereke, C., Pereira, L., Prodani, K., Rammelt, C., Scholtens, J., Tàbara, J. D., Verburg, P. H., Gifford, L., & Ciobanu, D. (2021). Reconciling safe planetary targets and planetary justice: Why should social scientists engage with planetary targets? *Earth System Governance*. https://doi.org/10.1016/j.esg.2021.100122

Gupta, J., Liverman, D., Prodani, K., Aldunce, P., Bai, X., Broadgate, W., Ciobanu, D., Gifford, L., Gordon, C., Hurlbert, M., Inoue, C. Y. A., Jacobson, L., Kanie, N., Lade, S., Lenton, T., Obura, D., Okereke, C., Otto, I. M., Pereira, L., Rockström, J., Scholtens, J., Rocha, J., Stewart-Koster, B., Tàbara, J. D., Rammelt, C., & Verburg, P. (2023). Earth System Justice needed to identify and live within Earth System Boundaries. *Nature – Sustainability*. https://doi.org/10.1038/s41893-023-01064-1

Gupta, J., Prodani, K., Bai, X., Gifford, L., Lenton, T., Otto, I., Pereira, L., Rammelt, C., Scholtens, J., & Tàbara, J. D. (2023). Earth system boundaries and Earth system justice: Sharing our ecospace. *Environmental Politics*. https://doi.org/10.1080/09644016.2023.2234794

Hansen, A. M., & Tàbara, J. D. (2024). Confronting local and global tipping narratives: Green energy development in the arctic and why Greenland is not for sale. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Hinkel, J., Mangalagiu, D., Bisaro, A., & Tàbara, J. D. (2020). Transformative narratives for climate action. *Climatic Change*. https://doi.org/10.1007/s10584-020-02761-y

Hodbod, J., Milkoreit, M., Baggio, J., Mathias, J. D., & Schoon, M. (2024). Principles for a case study approach to social tipping points. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Hölscher, K., & Frantzeskaki, N. (Eds.). (2020). *Transformative climate governance. A capacities perspective to systematise, evaluate and guide climate action*. Palgrave Macmillan. https://link.springer.com/book/10.1007/978-3-030-49040-9

Jäger, J., Kammerlander, M., Hinkel, J., & Bisaro, S. (2018). Green-win narratives. GREEN-WIN project. https://www.green-win-project.eu/resource/green-win-narratives

Lenton, T. M., Benson, S., Smith, T., Ewer, T., Lanel, V., Petykowski, E., Powell, T. W. R., Abrams, J. F., Blomsma, F., & Sharpe, S. (2022). Operationalising positive tipping points towards global sustainability. *Global Sustainability, 5*, e1. https://doi.org/10.1017/sus.2021.30

Lieu, J., Sorman, A. H., Johnson, O. W., Virla, L. D., & Resurrección, B. P. (2020). Three sides to every story: Gender perspectives in energy transition pathways in Canada, Kenya and Spain. *Energy Research & Social Science, 68*, 101550. https://doi.org/10.1016/j.erss.2020.101550

Lukash, O., & Namoniuk, V. (2024). Post-war development energy scenarios for Ukraine. points. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Mangalagiu, D., Witajewska-Baltvilka, B., Lieu, J., & Martinez Reyes, A. (2023). Full project knowledge integration report with results, procedures and recommendations. Deliberable D7.2. Enabling positive tipping points towards clean-energy transitions in coal and carbon intensive regions, European Horizon 2020 TIPPING+ project. https://tipping-plus.eu/home

Martínez Reyes, A. (2022). Case study key findings, deliverable D5.2, enabling positive tipping points towards clean-energy transitions in coal and carbon intensive regions, European Horizon 2020 TIPPING+ project. https://tipping-plus.eu/home

Mey, F., & Lilliestam, J. (2020). Policy and governance perspective on tipping points. A literature review and analytical framework. TIPPING+ deliverable 3.1. https://tipping-plus.eu/sites/default/files/deliverables/D3.1%20Literature%20Review%20WP3.pdf

Milkoreit, M. (2022). Social tipping points everywhere?—Patterns and risks of overuse. *WIRES Climate Change,* e813. https://doi.org/10.1002/wcc.813

O'Brien, K. (2018). Is the 1.5°C target possible? Exploring the three spheres of transformation. *Current Opinion in Environmental Sustainability, 31*, 153–160. https://doi.org/10.1016/j.cosust.2018.04.010

Olson, P., & Moore, M.-L. (2024). Transformations, agency and positive tipping points: A resilience-based approach. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Omann, I., Kammerlander, M. Jäger, J., Bisaro, A., & Tàbara, J. D. (2019). Assessing opportunities for scaling out, up and deep of win-win solutions for a sustainable world. *Climatic Change,* 1–15. https://doi.org/10.1007/s10584-019-02503-9

Sarrica, M., Cottone, M., Brondi, S., & Bonaiuto, M. (2022). D2.1. Report with literature review advancing the state of the art on research on tipping points from the perspective of social psychology and anthropology, Horizon 2020 project Tipping +, available at https://tipping--plus.eu/home

Sarrica, M., Cottone, P. F., & Biddau, F. (2024). Tipping points. Deep roots and contemporary challenges in psychology. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Sato, T., Chabay, I., & Helgeson, J. (Eds.). (2018). *Transformations in social-ecological systems*. Springer Nature.

Sveinsdóttir, A., & Dale, B. (2024). Realizing alternative energy futures in the Arctic: From the promise of a petroleum future to imagining Lofoten as The Green Islands. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Tàbara, J. D. (2011). Integrated climate governance and sustainable development. In C. C. Jaeger, J. D. Tàbara, & J. Jaeger (Eds.), *European research on sustainable development. Transformative science approaches for sustainable development* (pp. 91–109). Springer and European Commission. https://link.springer.com/chapter/10.1007/978-3-642-19202-9_8

Tàbara, J. D. (2023). Regenerative sustainability. Towards a relational model of possibilities for the emergence of positive tipping points. *Environmental Sociology, 9*(4). https://doi.org/10.1080/23251042.2023.2239538

Tàbara, J. D., Frantzeskaki, N., Hölscher, K., Pedde, S., Lamperti, F., Kok, K., Christensen, J. H., Jäger, J., & Berry, P. (2018). Positive tipping points in a rapidly warming world. *Current Opinion in Environmental Sustainability, 31*, 120–129. https://doi.org/10.1016/j.cosust.2018.01.012

Tàbara, J. D., Jäger, J., Mangalagiu, D., & Grasso, M. (2018). Defining transformative climate science in the context of high-end climate change. *Regional Environmental Change, 19*(3), 807–818. https://doi.org/10.1007/s10113-018-1288-8

Tàbara, J. D., Lieu, J., Zaman, R., Ismail, C., & Takama, T. (2021). On the discovery and enactment of positive social-ecological tipping points. Insights from energy systems interventions in Bangladesh and Indonesia. *Sustainability Science*. https://doi.org/10.1007/s11625-021-01050-6

Tàbara, J. D., Mangalagiu, D., Frantal, B., Mey, F., Maier, R., Lilliestam, J., Sarrica, M., Mandel, A., Lieu, J., Cottone, P., Veland, S., & Martínez-Reyes, A. (2024). Towards transformative emergence. Research challenges for enabling social-ecological tipping points toward regional sustainability transformations. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Van der Leeuw, S. (2024). Tipping points emerge in the interaction between narrative and reality. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Veland, S., Antunes Nogueira, L., & Steiro, V. D. (2024). Tipping away from coal? Exploring narratives and tipping dynamics in the phaseout of coal on Svalbard. In J. D. Tàbara, A. Flamos, D. Mangalagiu, & S. Michas (Eds.), *Positive tipping points towards sustainability: Understanding the conditions and strategies for fast decarbonization in regions*. Springer.

Weaver, P. M., Haxeltine, A., van de Kerkhof, M., & Tàbara, J. D. (2006). Mainstreaming action on climate change through participatory appraisal. *International Journal on Innovation and Sustainable Development, 1*(3), 238–259. https://doi.org/10.1504/IJISD.2006.012425