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Academic working papers for the conceptual framing of Transition Super-Labs

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Abstract

This deliverable is part of Task 2.4, "Conceptual Framing of the TSL Approach for Regions," within WP2. It presents two working papers that discuss our experiences implementing Transition Super-Labs in four European regions. These reflections aim to further develop the TSL concept and provide insights for future practical applications.

Project Partners

Organisation	Country	Abbreviation
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Table of Contents

Table of Figures

Executive Summary

To accelerate the transition to climate neutrality, the TRANSFORMER project has developed a methodology focused on systemic transformation at the regional level: the Transition Super-Lab (TSL) approach. In a TSL, living lab methodologies are adapted and employed to collaboratively develop, with key stakeholders from academia, industry, government, and civil society, a portfolio of large-scale cross-sectoral solutions for accelerating the shift toward climate neutrality.

This deliverable presents two working papers that reflect on our experiences of implementing TSLs in four European regions and discuss the further conceptualisation of the TSL approach. The first working paper (Annex I) examines the most challenging aspects of developing a portfolio of solutions at a regional scale, with a focus on stakeholder involvement and governance issues. The second working paper (Annex II) explores our experiences in implementing Transition Super-Labs, providing a comprehensive overview of the TSL process and presenting solutions developed to address the main challenges.

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Introduction

The urgency to address climate change is critical due to its escalating threats, such as extreme weather events, rising sea levels, and biodiversity loss (IPCC, 2021). The complexity of this issue demands more than incremental changes; it requires a profound shift in how we manage energy, resources, and production systems. Conventional methods have proven inadequate for this scale of challenge. To achieve climate neutrality, we need entirely new, innovative approaches that revolutionise our current practices. This calls for creative solutions and bold strategies capable of driving systemic change quickly and effectively (Bresciani et al., 2024; Directorate-General for Research and Innovation, 2018; IPCC, 2021).

In the two-year Horizon Europe project "TRANSFORMER"[1], we address this challenge by developing a concept based on adapting and applying enriched living lab methodologies (co-creation, experimentation, and evaluation). These real-world testing environments where researchers, businesses, and users collaborate to develop and refine innovative solutions through iterative experimentation and feedback are called "living labs" (Hossain et al., 2019). However, these living labs usually focus on local transitions and single topics, such as sustainable mobility (Hossain et al., 2019; von Wirth et al., 2019). Our focus is on creating a portfolio approach of cross-sectoral solutions (experiments), aiming to achieve a large-scale, systemic transition across entire regions. This is what we call the Transition Super-Lab (TSL) approach (see Figure 1).

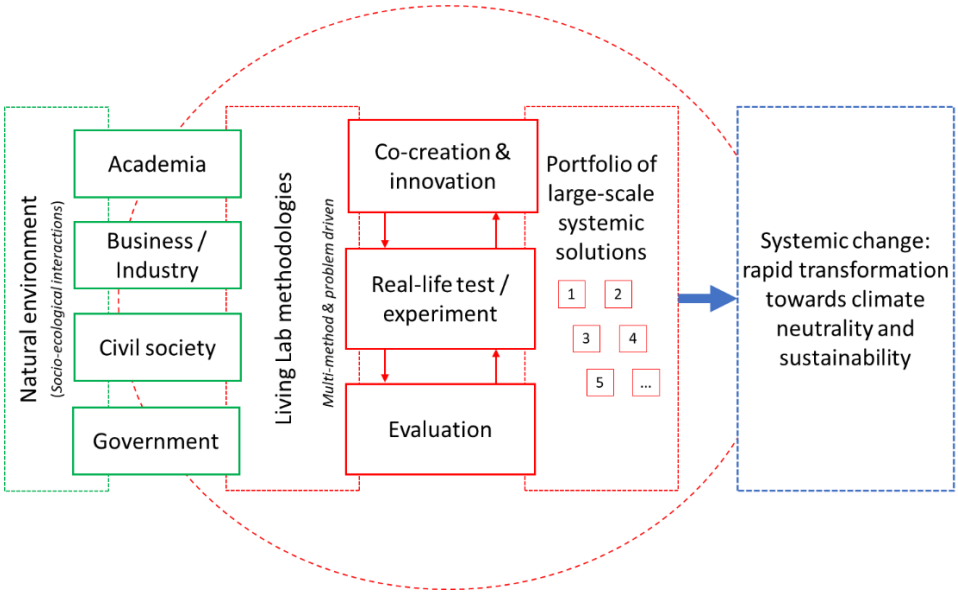

Figure 1: Elements of a Transition Super Lab. Source: own design adapted from Deliverable 2.1.

[1] TRANSFORMER – Designing long-term systemic transformation frameworks for regions. Accelerating the shift towards climate neutrality. [HORIZON-CL5-2021-D2-01-14]. Project duration: Sept. 2022-August 2024.

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We have developed and implemented these TSLs in four European regions (see Figure 2): Emilia-Romagna (Italy), Lower Silesia (Poland), the Ruhr Area (Germany), and Western Macedonia (Greece). This deliverable presents two working papers that reflect on our project experiences to further conceptualise the TSL approach. These papers aim to provide initial insights that will contribute to ongoing academic debate and reflection. Based on this discussion, the working papers will be refined and subsequently submitted to scientific journals.

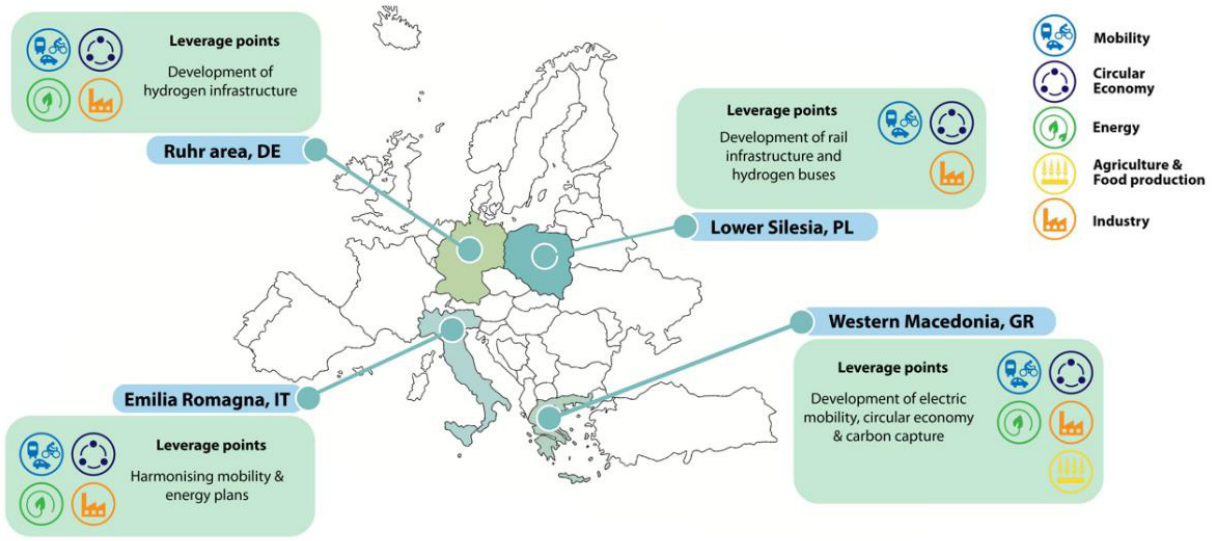

Figure 2: The four TRANSFORMER TSL regions and their topics of interest. Source: own design (taken from the project proposal and slightly adapted).

The first working paper (Annex I) examines the most challenging aspects of developing a portfolio of solutions at a regional scale, with a focus on stakeholder involvement and governance issues arising from broadening the thematic and territorial scope of living labs. The second working paper (Annex II) explores our experiences in implementing a Transition Super-Lab, providing a comprehensive overview of the TSL process and presenting solutions developed to address some of the main challenges. The following chapter offers a brief summary of the two working papers and provides an outlook on future research and experimentation.

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Outlook

The two working papers focus on the Transition Super-Lab (TSL) approach that aims at developing–together with affected stakeholders–a portfolio of cross-sectoral solutions (experiments), aiming to achieve a large-scale, systemic transition across entire regions. Based on our experience of implementing TSLs in four European regions–Emilia-Romagna (Italy), Lower Silesia (Poland), the Ruhr Area (Germany), and Western Macedonia (Greece)–we reflected in our working papers on our experiences and lessons learned of implementing TSLs to further conceptualise this approach.

The first working paper (Annex I) examines the most challenging aspects of developing a portfolio of solutions at a regional scale: stakeholder involvement and governance. We show that broadening the thematic and territorial scope of living labs adds complexity not only in knowledge and resource management, but also presents significant challenges in engaging stakeholders and enabling their participation in co-creation processes.

The second working paper (Annex II) explores our experiences in implementing a Transition Super-Lab, providing a comprehensive overview of the TSL process and presenting solutions developed to address some of the main challenges. This encompasses assessment frameworks, methods for stakeholder identification and co-creation, as well as a blueprint for TSL governance arrangements. All these lessons learned are condensed into the Transition Super-Lab Roadmap, which provides a detailed description of all necessary activities to implement and manage a TSL.

While we clearly see the potential of the TSL concept, we also critically reflect in both working papers on the complexity of the approach and the challenges we faced. In this regard, the TRANSFORMER project has clearly proven that having a diverse group of practitioners and academics in the consortium is highly beneficial for aligning ambitious conceptual considerations with feasible implementation strategies. This will be essential for the successful continuation of the experiment, where we will implement the developed solutions in real life and co-create additional connected projects with a growing coalition of supporting stakeholders. The monitoring and assessment frameworks that we developed will allow for critical reflection on this experiment and will support the further conceptualisation of the TSL.

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Additionally, we want to highlight the exceptional collaboration with the consortium partners and their significant contributions. Having this diverse group of practitioners and academics in the consortium was highly beneficial for aligning ambitious conceptual considerations with feasible implementation strategies, thereby conceptualizing the Transition Super-Lab approach.

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Annex: overview of working papers

Annex I: Regions as the missing layer to accelerate sustainability transitions? Promises and challenges of Regional Transition Labs

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Annex II: How to Implement a Transition Super-Lab: Lessons Learned from an Experiment

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Regions as the missing layer to accelerate sustainability transitions? Promises and challenges of Regional Transition Labs

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Abstract
This article presents an analysis of the characteristics and ambivalences of conducting experimental transition governance on the regional scale. The analysis aims to make a relevant contribution to the scientific debate about the role of different geographic/spatial scales when experimenting and appropriating sustainable practices beyond local implementations.

Keywords: Regional Transition, Regional Living Labs, Sustainability, Experimental Governance

Introduction

Over the course of the last decade, scholars have demonstrated the relevance of a spatial perspective in theories of sustainability transitions (Coenen and Truffer, 2012; Hansen and Coenen, 2015; Morais Mourato and Wit, 2021; Uyarra et al., 2017; Wolfram and Frantzeskaki, 2016). One of the main critiques of these literatures towards the larger body of sustainability transition research is that most previous studies had concentrated on the national scale as their explicit or implicit unit of analysis, thereby remaining blind to dynamics on the supranational e.g. transnational, global) and subnational (e.g. regional, local) scales (Köhler et al., 2019; Markard et al., 2012: 961; Schwanen, 2018).

Since this critique was originally posed in the early 2010s, this research gap has been partially addressed regarding the supranational scale (Krauss and Krishnan, 2022), or addressing the role of transnational linkages in transitions (Hansen and Nygaard, 2013)). The subnational scale has been addressed predominantly by focusing on cities and neighborhoods (e.g., Gajewski and Knippschild, 2024; Geus et al., 2022; Hodson and Marvin, 2010; Wolfram, 2016; Wolfram and Frantzeskaki, 2016). One relevant branch in the urban transition literature has focused on 'Urban Living Labs' (ULL) (e.g., Collier and Connop, 2020; von Wirth et al., 2019; Voytenko et al., 2016; Wirth et al., 2020). However, regions as arenas for sustainability transitions and practices of experimentation are still less empirically studied and remain under-conceptualized with few exceptions (e.g., Bours et al., 2022; Koschatzky et al., 2022; Mura et al., 2021).

However, regions – here understood as subnational geographic units – have a lot of potential for addressing issues related to sustainability transitions. Regions are the geographical scale where a significant and diverse set of societal systems interact (e.g., transportation system or food system) (Hansmeier et al., 2022). In other words, the diversity and heterogeneity of the regional scale make a significant difference compared to a neighborhood or city scale, and therefore, regions offer different opportunities for testing, learning, and appropriating across sectors, land use types and social milieus. When it comes to achieving climate neutrality, for instance, regions often include connected rural as well as peri-urban and urban spaces. Indeed, many of the distinct dynamics producing greenhouse gas emissions (GHG), such as commuting, lie in the intersections and -actions of these types of spaces (Koschatzky et al., 2022). Given the plurality and diversity of human activities on regional scale, understanding the role of regions for experimentation in sustainability transitions constitutes a relevant research gap. To address this gap, this paper demonstrates that experimental governance on regional scale shows very specific requirements and characteristics in terms of organizing effective knowledge exchange and questions of governance.

Applying the living lab concept on regional scale comes with a set of promises, yet also presents ambivalences, which result from the misleading assumption that the principles of local transition would similarly apply on regional scale. The objective of this paper is to characterize regional experimentation and highlight the particular ambivalences. We show untapped potentials and strategies for cross-sectorial transition governance on regional scale.

Conceptually, our work is nested in co-evolutionary and relational theories of urban experimentation and transition governance. We apply definition of urban living labs as well as conceptual foundations of regions as dynamic, socio-spatial assemblages to capture the spatiality of sustainability transition governance at a subnational level (Coenen and Truffer, 2012; Hansen and Coenen, 2015; Maucorps et al., 2023; Morais Mourato and Wit, 2021; OECD, 2023; Uyarra et al., 2017; Wolfram and Frantzeskaki, 2016).

To empirically underpin the conceptualizations of this paper, we draw on data from the EU funded Horizon Europe project TRANSFORMER (duration 9/2022-9/2024). This project develops and experimentally implements a region-based Transition-Super-Lab (TSL) approach. This approach applies a co-creative methodology for advancing a transition toward climate neutrality in regions. The co-creative methodology is based on the living lab approach including stakeholders representing the quadruple helix model (civil society, academia, business, and government) (Carayannis and Campbell, 2009; Voytenko et al., 2016). However, it goes beyond classical living lab methods aiming for the development of a portfolio of solutions in order to inform the transformation of multiple socio-technological regimes simultaneously at the regional scale. Four real-life TSLs were implemented in European regions – the Ruhr Area (Germany), Emilia Romagna (Italy), Lower Silesia (Poland) and Western Macedonia (Greece). What is unique about TRANSFORMER is the explicit focus on simultaneously transforming more than one societal system (e.g. transportation and industrial production, and the food system) to accelerate the reduction of GHG emissions.

This paper is structured as follows: In the next section, we conceptually develop an understanding of regions as arenas for living lab lead sustainability transition experiments. This is followed by a section describing and reflecting on the methodology used for this study. Next, empirical insights of the TRANSFORMER project are systematically discussed and conclusions are elaborated.

Towards an understanding of regions as arenas for sustainability transition experiments

The regional scale in the context of sustainability transitions

As regions are a geographical scale, in order to gain an understanding of what role regions can play in the context of sustainability transition experimentation, it is important to start from a clear understanding of what geographical scales are. Coenen et al. (2012: 972) define geographical scales as territorial units "at which significant relationships exist between actors: these relationships acquire a dynamic of their own through repeated interaction and that dynamic is distinctive from interactions at different scales" (Coenen et al., 2012: 972). This definition is in line with the widely spread social constructivist understanding of the production of scale (Marston, 2016; Moore, 2008).

Regions are generally considered continuous areas on this planet's surface that share common features or structures. In a colloquial use, the term region or the attribute regional is usually used to describe circumstances or processes that affect more than the local context but are located below or beyond the national level. The term region is defined and interpreted differently depending on the scientific, political, cultural or socio-economic context. There is a consensus in geographic literature that there are no 'universal regions', but that regions are multi-characteristic and purpose-specific constructs. Regions are formed under empirical-analytical or normative-programmatic aspects as well as according to principles of similarity or interconnectedness (Sinz, 2018: 1975–1976).

Now, what does this mean for regions in the context of sustainability studies? In principle, regions can be constructed from an analytical-empirical perspective as spaces where certain processes of sustainability transitions take place and are situated. This can be a helpful perspective to empirically study spatial organization of sustainability transitions, or specific aspects thereof. In this article, however, we take up the normative-programmatic concept of region. From this perspective, regions are understood as 'activity or program regions'. Activity or program regions are formed through the actions of people (individuals and groups) and social organizations (e.g. companies, associations, local authorities) and their interactions. This conception of activity regions is based on a constructivist understanding of regions and serves to form socio-economic structures in spatial terms (Blotevogel, 2005). Modern administrative territorial units also are also seen as activity and program regions (Sinz, 2018: 1979). In other words, we understand regions as the geographic scale where activities and actions of regional living labs take place. Through these actions, the regional scale is actively performed. For instance, in TRANSFORMER, this is done by declaring the climate neutrality of regions as the main goal of all living lab actions, thus, directing actions of the living labs towards the regional scale.

Locating experimental living lab methods for sustainability at the regional scale

Socio-technical experimentation has developed into an integral research field in transition studies, since it is considered a way of instigating early niche formation in the context of sustainability transitions (Köhler et al., 2019: 9; Schot and Geels, 2008; Sengers et al., 2019). Experimenting in niches has been established as a key concept in transition theory frameworks such as Strategic Niche Management and Transition Management. Niches are considered as "protected spaces that allow (for) the experimentation with the co-evolution of technology, user

practices, and regulatory structures" (Schot and Geels, 2008: 537). Creating spaces for temporary explorations of alternative futures that allow for learning and experimenting are necessary conditions for societal change (Avelino et al., 2017). In fact, to experiment means acting in order to sort out what this action might lead to (Schön, 1983). When considering transitions-in-the-making (instead of past transitions), experiments then provide a means by which urban actors seek to navigate and co-create visions and solutions for the future (Bulkeley et al., 2018).

One prominent organizational form of sustainability experimentation are the use of living lab methodologies. Hossain et al. (2019: 976) define a living lab as "a physical or virtual space in which to solve societal challenges, especially for urban areas, by bringing together various stakeholders for collaboration and collective ideation." Living labs cover a wide range of contexts, including local innovation initiatives initiated by citizens, as well as the development efforts of citizens, businesses, non-profit organizations, and other stakeholders. Generally, inspired by design thinking methods they provide a space for development, testing, and validation through co-creation. Living labs serve as a platform for collective innovation and growth, offering valuable insights and serving as a testing ground for new products, services, systems, and solutions (Leminen et al., 2012).

Predominantly, this experimentation has been applied to urban spaces, i.e. cities and neighborhoods, as ULL (Ehnert, 2023; von Wirth et al., 2019). Over the last decade, a first 'wave' of ULL was conducted as temporary and reversible interventions into socio-spatial contexts. These new forms of spatially embedded transition experiments evolved for example in the form of reconfiguring streetscapes and public space (Bertolini, 2020) exploring the effects of nature based solutions (Frantzeskaki, 2019) or exploring social innovations in ULL (McCormick et al., 2018), among many other examples. ULL are intervention and learning spaces that facilitate temporary experimentation about sustainability solutions in urban contexts. ULL were described as localities that allow different urban actors to design and test socio-technical or socio-ecological innovations. Co-creation, experimentation and learning are essential elements of working in ULL (Collier and Connop, 2020).

More recently, ULL have proliferated widely in the European policy and research sphere (Wirth et al., 2020), yet, have also been **criticized for lacking more rigorous evidence about their actual effects as well as being overly focused on the neighborhood to city scales, while largely overlooking other settings and scale levels.** In fact, previous work in regional studies, although aiming to feature regional perspectives, presented studies with a rather disembedded view on city scale examples of experimentation and ULLs. For example, Fastenrath and Coenen (2021) present a valuable framework to unpack the principles and institutional structures of governance experimentation, yet their spatial frame of reference is the city of Melbourne. Hence, previous work on sustainability experiments and living labs has not yet explicitly addressed the particular role of the regional scale.

Promises and challenges of applying experimental living lab methods on the regional scale

Over the course of the last 10 to 15 years, living lab methods have been consistently applied and tested, especially in the urban context. Thus, by now we have a fairly good understanding of their co-design principles, possible impacts and limitations (Hossain et al., 2019; Leal Filho et al., 2023). The principle for a well-functioning living lab that is most relevant to this discussion of broadening living labs to engage regions as their spatial unit for action is

proximity, which has two important, closely linked dimensions: firstly, the proximity between stakeholders and the thematic scope of the living lab (thematic proximity), and secondly, the proximity between the stakeholders and the territory that is the spatial unit for action (territorial proximity).

(1) The thematic proximity between stakeholders and the topic of the living lab requires the participants to be substantially knowledgeable about the thematic issues (e.g., mobility or energy solutions) discussed in order to be able to co-create solutions that have impact and value. This may include technical, legal and economic aspects that vary considerably between different socio-technical regimes. In the literature on living labs, thematic proximity is mostly referred to as user focus or user involvement/engagement (e.g., Dekker et al., 2021; Hossain et al., 2019; Steen and van Bueren, 2017). In economic geography, Boschma (2005) uses the term 'cognitive' proximity.

(2) The territorial proximity requires an identification of stakeholders with, and a profound understanding of, the geographical space of action and a leadership-ownership constellation, which means that the stakeholder group should have the **capacity and legitimacy to implement and test the solutions** in the regional territory. In the literature on living labs, this aspect is also discussed as geographic embeddedness, or experimentation in real-life environments (Hossain et al., 2019; Voytenko et al., 2016). Testing and iteration loops are an essential part of what makes living labs 'laboratories', generating impacts into what works and what does not work in the territorial unit. Both forms of proximity are therefore essential to the co-creative idea and solution development of the stakeholder group.

When geographically broadening the living lab methodologies to the regional scale, this proximity is stretched and there is a potential for losing the effectiveness of living lab co-creative 'magic'.

(1) When **thematic proximity is stretched** by not developing a stand-alone solution, but by developing a portfolio of interconnected solutions including different socio-technical regimes from a cross-sectorial perspective, this requires that the stakeholder group needs to include a wide range of knowledge domains including detailed technical and administrative knowledge. Ensuring a high level of knowledge in the discussion is especially important when it comes to advancing sustainability transitions on a regional scale.

Moreover, by aiming for the development of a portfolio of interconnected solutions for achieving a region's sustainability transition goals, a regional perspective also implies to get experts from different societal systems, including their diverse technical and social knowledge fields together and – at best – talking to each other in a way that co-creative processes are possible. This can be a major challenge for finding innovative solutions (Nooteboom, 2000).

(2) Broadening the **territorial proximity** of a living lab to the regional scale means – in order for a living lab methodology to function – that it is necessary to ensure the **legitimacy of the idea development process and implementation** as well as to build the **capacity for action** within this larger territorial scope**.** So, how is building the capacity for action to test and implement solutions on a regional scale different from a smaller scale?

A living lab taking a region as the geographic unit for furthering sustainability tends to affect larger numbers of people than local living labs. This makes the question of ensuring the legitimacy of who participates in the idea creation working sessions more complex. At the regional scale, it is even less viable to include all people who are affected by the solution development and future portfolio, in comparison to more local living labs. Focusing on the legitimacy of participation in the idea development process means focusing on achieving 'just

transitions' in terms of including the voices of those stakeholder groups negatively affected by transitions, the interests of marginalized groups, and producing sustainability for current and future generations (Newell and Mulvaney, 2013; Wang and Lo, 2021). Legitimacy logics embrace conflict and contradiction as necessary parts of democratic deliberation. With regard to living lab governance, this especially affects early stakeholder consideration, the inclusion or exclusion, e.g., of marginalized groups, as well as subsequent problem framing and agenda setting. On the other hand, it is an explicit aim of a regional living lab to develop cutting-edge portfolio of solutions to really push forward the possibility of a regional sustainability transition. This would, however, entail to select stakeholders carrying specific knowledge and capacities to stimulate the co-evolution of novel outcomes. For instance, transition management studies have traditionally focused on pioneers and front-runners to be included in transition experiments, because of their inherent capacities to co-develop alternative sustainability agendas (Loorbach, 2010).

Establishing the **capacity for action** entails a knowledge and a power aspect: The knowledge about a region's sustainability transition needs and potentials and the power to implement and test ideas within the regional territory. When broadening the capacity of action from a local to the regional scale, it becomes much more difficult to ensure the accessibility and substantial knowledge stakeholders need about a whole region instead of only their neighborhood or city. In short, stakeholder groups in ULL depend on the inclusion of citizens living in the neighborhood or city in question. These stakeholders have a close-up knowledge about this space due to their daily interactions. They are experts for this space (Steen and van Bueren, 2017). However, the discussion of regional sustainability solutions requires a level of understanding of transition needs and potentials that one does not usually accumulate by simply residing in the region.

Regarding the power aspect of the capacity for action in the regional territory, it is essential to motivate stakeholders to participate in the regional living lab. This entails engaging with existing regional networked governance and working with the different organizations institutional frameworks (Weller and Tierney, 2018) that are relevant to the thematic goals of the lab. Regions have long-served and therefore relatively stable and rigid networks and modes of organizing, including strict rules and norms as well as established modes of organizing and regional planning through a continuous cycle of projects. This continuous cycle of projects is also referred to as 'projectification' (Torrens and von Wirth, 2021). This can be a significant impediment to operating a living lab at the regional scale. Project logics are defined by limited and fixed (financial and time) resources and, therefore, focus on efficient (and effective) processes of stakeholder management throughout the project (Brulin and Svensson, 2012: 11). However, experimentation, which is essential to a living lab methodology, provides a flexible, temporary and provisional space that enables a generative multiplicity of alternative practices or structures to be tested allowing for learning processes and 'failure' to evolve (Dekker et al., 2021). Even though experiments as well as projects have a temporary nature and a significant focus on learning from experience, project and experimental logics show a tension especially along the line of efficiency vs. creativity. Projects on the other hand have a strong emphasis on achieving predefined goals through iterative steps, risk mitigation management and monitoring of performance indicators (Torrens and von Wirth, 2021). With regard to stakeholder engagement, this tension becomes relevant when thinking about stakeholder selection as well as modes of configuring stakeholder collaboration. Project logics encourage lead project managers to limit the number of stakeholders and build on existing networks to reduce

transaction costs (Eskerod et al., 2015; Imset et al., 2018). Instead, experimentation logics suggest stakeholder management to be agile and adaptive according to the requirements of the experiment.

Another challenge is to effectively deal with opposition, which tends to be more complex to manage on the regional scale than on a more local scale. This opposition can come in form of significant veto players, like large companies and business groups that still have significant political influence and can fundamentally hinder transition processe (Balthasar et al., 2020). In this context, it is important to emphasize that the "potential for policy change decreases with the number of veto players, the lack of congruence (dissimilarity of policy positions among veto players) and the cohesion (similarity of policy positions among the constituent units of each veto player) of these players" (Tsebelis, 1995: 289). Therefore, the upscaling of living labs to a regional level and with a focus on a comprehensive systemic transformation might impose a serious challenge as this will very likely increase the number of veto players that reduce political congruence and cohesion.

Additionally, building the territorial capacity for action on a regional scale also depends on the availability of resources for the living lab process, for the co-creation of the portfolio as well as the testing and implementation. On a regional scale, this very well might mean larger amounts of resources than on a more local scale.

In short, **the broadening of living labs to the regional scale potentially endangers the proven conditions for success of a living lab**. So, why risk this? Sustainability transitions have different phases. During the emergence phase when the system to be transformed is still stable and only changes slowly through optimization, radical innovations are still in their experimentation phase. In the acceleration phase, there is a destabilization of the old system and an accelerated build-up of new structures. This is followed by the institutionalization and stabilization of the new regime, with a simultaneous breakdown and phase-out of the old regime (Hebinck et al., 2022). For the acceleration phase, Markard et al. (2020) identify two challenges: the challenge of system transformations (especially hindered by lacking complementarity between multiple innovations and changes in the system infrastructure) and the challenge of interactions between adjacent systems, which have a stabilizing effect on the status quo and thus hinder the transformation of the old regime. In other words, broadening the geographical scope of living labs to fit the regional scale opens up a perspective of focusing on the transformation of multiple societal system simultaneously and can enable synergetic and cross-fertilization forces. Broadening the scope of living labs to fit the regional scale is intended to accelerate transition by focusing on a specific bottleneck: cross-system alignment of transition processes to harness the 'magic' of co-creation for the acceleration phase.

For the purpose of this paper, we differentiate between the dimensions of thematic and territorial broadening of living labs, their conditions for the success of living lab methods and their potential for impact on sustainability transitions. The thematic and territorial broadening are, of course, partially interconnected. Since a broader territorial scope allows the possibility to include more thematic variety in terms of the variety of societal systems or sectors. Nevertheless, for gaining a conceptual understanding of the effects it is helpful to differentiate these dimensions.

Conditions	ULL	Regional TSL
Cognitive proximity (Boschma, 2005) of stakeholders with thematic scope of co-creative efforts	Higher → Comparatively easy knowledge transfer/ management → Narrower thematic scope usually focusing on a single, stand-alone solution	Lower → Comparatively complex knowledge transfer/ management → High potential for cross-sectorial fertilization and synergies through creation of interconnected portfolio of solutions
The proximity of stakeholders with the geographic space of action	Higher (Lower diversity of stakeholders, less possibility of veto players) → Possibility for clear-cut stakeholder management and relatively simple governance arrangements.	Lower (Higher diversity of stakeholders, more possibility of veto players) → Comparatively complex stakeholder management and governance arrangements needed
Resources needed	Only limited resources are needed for process organization and implementation/testing of solutions; however, a smaller geographic scale also often shows a lower availability of resources.	Larger amounts of resources are needed for process organization and implementation/testing of portfolio of solutions.
	→ Good conditions for success of LL methods, but comparatively lower potential for impact on sustainability transition	**→ Difficult conditions for success of LL methods, but higher potential impact on global transition**

Table 1: Comparing characteristics and conditions of ULL and Regional TSL.

Table 1 highlights the trade-off of broadening the geographic scope of living lab methodologies and its potential for impact on sustainability transitions. Broadening the thematic as well as the territorial scope of a living lab increases its potential for generating impact on sustainability transitions. Broadening can positively affect the potential impact of living labs on sustainability transitions, however, at the same time it reduces the likelihood for successful co-creation within living labs. Broadening the geographic scope implies setting a sustainability goal for a larger geographical area, thus potentially increasing the impact of the living lab.

So, the question here is: **What is needed to broaden the scope of living labs to the regional scale (to reach for higher impact potential) to overcome the challenging conditions for a successful co-creative living lab effort?** What does this broadening mean in concrete terms? Do we have to change and adapt living lab methodologies to fit the regional scale? And if so, in what ways? To answer these questions, we will discuss the empirical insights of the TRANSFORMER project after a brief presentation of the methods used in this study.

Methods

We base this study on empirical evidence from the EU-funded Horizon Europe project TRANSFORMER (duration 9/2022-9/2024). This project implemented regional transition labs to accelerate the transition to climate neutrality in four European regions: the Ruhr Area (Germany), Emilia Romagna (Italy), Lower Silesia (Poland) and Western Macedonia (Greece). The regional characteristics of the four TRANSFORMER TSLs are very diverse: the size of the region (e.g., population), the number and diversity of stakeholders (e.g., networks and veto players), and of course their economic resources, as well as their competitiveness and

innovation capacity. These political and socio-economic structures, especially existing political-administrative frameworks and the position of our partners within them, largely determined the governance-arrangements for the TSL.

The empirical data from the project comes in two forms:

1. 15 selected documents which have been produced during the first year of the TRANSFORMER project (e.g., meeting minutes, deliverables, and workshop documentations). The first year of the project was the phase where work in the four regions was systematically initiated and stakeholders were analysed and contacted. As a consequence, the analysis was limited to documents from this phase. Moreover, not all available materials produced in this phase were included, but only documents were selected which specifically refer to governance and learning processes of living lab methodologies on the regional scale.
2. Transcriptions of four semi-structured interviews conducted in November 2023 about the stakeholder coalition phase with representatives from each of TSLs to complement the information in the documents (all data sources are listed in Table 2 in the Annex).

Project partners had limited capacities for collecting and compiling data. This also influences the quality of the data interpreted for this study. The data was analyzed using qualitative content analysis (Kohlbacher, 2006) using Maxqda software.

What is specific about the author team of this paper, is that two of the authors have been part of the coordination team of the TRANSFORMER project. This produces a specific type of positionality regarding the relationship between author and research field. This affects not so much the document data, but it did frame the interaction in the semi-structured interviews in terms of the project relationship. Moreover, it is not possible to interpret data with a completely unbiased mind when being part of a project's day-to-day business. Therefore, we tried to aim for a reflexive engagement with the data (Corlett and Mavin, 2018). It also helped that the third author of the team was able to provide an outside perspective.

Confronting the challenges: Governance and learning processes – Lessons from the TRANSFORMER project

The first year of the TRANSFORMER project was characterized by initiating the TSLs through a set of interconnected activities: the formation of the regional stakeholder coalition, a vision building for the transition goals and the development of the portfolio of interconnected transition projects. For constructing a portfolio of interconnected solutions in a co-creative process to **broaden the thematic scope of a living lab methodology**, the first step in the TRANSFORMER project was to define a vision as the transition goal of the region for accelerating the transition towards regional climate neutrality. This vision development, however, did not prove to be a straightforward process because of competing logics and motivations within the TSLs. From a conceptual perspective, the aim was to have an open-ended process for defining the thematic scope of the TSLs: However, without at least some idea about what will be discussed within the co-creative workshops it is difficult to ensure that people with the right expertise about the topic are at the table.

In practice, all four TSLs did not start the vision development from scratch. The general themes of the TSLs were already defined internally by the project partners directly involved in TRANSFORMER during the proposal stage. In the Ruhr Area, for deciding on the general topic

of the TSL, the local project partner conducted a discussion round with mostly stakeholders from the different municipalities which are part of the region. It was decided to aim for a general thematic focus on hydrogen as part of the region's future green energy transition. Hydrogen is a rather cross-sectorial aspect because it can be used in the transportation of goods, mobility, as well as in industrial production (e.g., steel manufacturing) (Löhr and Chlebna, 2023). For both regions, Emilia Romagna and Lower Silesia, the decision on the topic of the TSLs were made internally by lead partner organizations in the respective regions during the proposal stage. Emilia Romagna's regional authority as lead partner opted for a focus on the harmonization of sustainable mobility in the region. In Lower Silesia, the topic of railway transport issues was identified as a critical factor influencing GHG emissions of the Copper Valley region. In contrast, in Western Macedonia, the predefinition of the TSLs thematic framing was even a bit more fine-grained than in the others, as they built on three already roughly outlined transition projects on sustainable mobility through hydrogen and sustainable mobility through electrification and carbon capture and storage in agriculture.

When the project started, these different degrees of predefining the thematic scopes of the TSLs caused differences regarding the strategies to build the stakeholder coalitions. For all four TSLs, the starting point for identifying stakeholders was to include organizational stakeholders from all four categories of the quadruple helix: academia, business, public administration and civil society (Esashika et al., 2023). However, it turned out that the more open the thematic scope of the possible discussions for starting the co-creative process by joint vision building, the more difficult it was to determine who should be at the table. For instance, the coalition building for the Ruhr Area was not a straightforward process because the topic of hydrogen is very popular in this region and there is a plethora of organizations and local networks involved (Cerniauskas et al., 2021). This made it difficult to choose whom to include to further the aim of developing of an impactful portfolio of the transition projects. In case of the more concrete and predefined transition projects of Western Macedonia, it was much clearer who should be the stakeholders for each of the transition projects that were envisioned, and then the stakeholders for the TSL coalition were brought together from all of these projects to start with. However, in this case, the challenge then lay in focusing the stakeholder group not just on their particular transition projects, but also to adapt a regional perspective and 'think bigger' in terms of adapting a transition perspective for the entire region.

Beyond the above-discussed difficulty to delineate who needed to be part of the coalitions to bridge the relative thematic distance of the stakeholder coalition and the general aim of the TSL at the regional scale, there were additional factors regarding the broadening of **territorial proximity** causing friction at this step of building stakeholder coalitions. **Ensuring the legitimacy of the co-creative effort** in the first year of TRANSFORMER was very much characterized by forming the stakeholder coalitions, especially regarding the inclusion and exclusion of stakeholders. It was very clear from the beginning that all TSLs had to operate within existing political structures. A TSL cannot and should not replace democratic procedures and processes within a region. However, it can be an innovative way of approaching sustainability transition goals and, thus, complement existing political processes. In short, the four TSLs were operating in existing economic and political networks with the aim to avoid an imbalance of (political and economic) forces, thus preventing an inclusive transformation process. Regarding the inclusion of stakeholders from all four categories of the quadruple helix, identifying suitable stakeholders from academia, business, and politics/administration was managed by the local lead partners with the first step of undertaking a regional stakeholder

analysis. After identifying valuable potential stakeholders, the biggest difficulty was to motivate the stakeholders to participate in the TSL co-creative workshops. This issue was more difficult in the TSLs starting from a wider thematic scope (e.g., Ruhr Area) and less problematic with a narrower thematic scope and more concretely defined transition projects, as in the case of Western Macedonia. The concrete identification of the stakeholders with the preselected transition projects helped to motivate stakeholders to participate in the workshops.

At the stage of coalition formation for vision building **veto players** did not play a prominent role, but just did not participate in the TSL process. For instance, due to the importance of the lignite-based energy production in Western Macedonia, the lignite production plant company is a key stakeholder for a regional transition to climate neutrality. However, even though they were repeatedly invited to join the TSL, they decided not to get involved. Selecting and gathering the support of stakeholders which are actually capable of implementing set of solutions in the region also is part of establishing the necessary **capacity for action** (bridging territorial distance).

Nevertheless, the biggest hurdle we encountered – which was not effectively overcome during the first year of TRANSFORMER – was the **inclusion of civil society stakeholders** as part of the coalitions. Including civil society and marginalized groups is crucial for achieving a just transition and for providing political legitimacy and acceptance for the transition (Heffron, 2021; Newell and Mulvaney, 2013). However, in these often normative debates (Ciplet and Harrison, 2020), it remains unclear what civil society truly is and how this extremely diverse group, with competing interests, can effectively be included in transition processes. This is particularly true for non-organized civil society and marginalized groups (Frantzeskaki et al., 2016). This ambiguity made identifying, selecting, and engaging civil society groups within the regional coalitions for transition a challenging task.

In the Ruhr Area, the regional economic development agency *Business Metropole Ruhr* (BMR), which served as the TRANSFORMER project partner and TSL leader, also does not usually work on engaging civil society. Moreover, there was significant skepticism about inviting civil society, especially non-organized civil society and marginalized groups into the conversations. This skepticism stemmed from two concerns: Firstly, hydrogen as an energy source for the region is still quite abstract, and many of the aspects are rather remote to the interests of typical civil society actors. Secondly, BMR has a very specific political positioning within the Ruhr Area, seeing the the region's municipal economic development agencies as their 'clients'. Within this context, there was a dominant perception that engaging civil society in projects often doomed these projects from the start because of a history of civil society blocking the development of ideas and projects. BMR also expressed the fear of 'burning' their existing network contacts when inviting civil society actors to workshops. During the regional stakeholder analysis in the process of coalition building, the project partner did contact organized civil society associations, but their inputs were not seen as particularly helpful. As a result, civil society (both organized and non-organized) was not included in the vision building process in the Ruhr Area. However, a more pronounced effort was made later on to include civil society in the discussions about the concretization of the transition projects.

In Emilia-Romagna, the project partner in the region was the regional authority. The Regional authority itself usually does not engage with civil society actors directly, but does this through their municipalities. There was contact to organized civil society associations on cycling issues in the stakeholder selection process. However, a direct inclusion of a wider spectrum of civil society, especially the inclusion of non-organized civil society, did not happen

within the first year of the project, and was clearly seen as a task for the municipalities and very much a topic-related, somewhat non-deliberative but informative procedure.

In Western Macedonia, civil society was not involved in the stakeholder coalition at the stage where the regional vision for transition was developed. However, the Western Macedonia TSL team identified the civil society groups that could be involved in the TSL. Moreover, the possibility of civil society engagement was discussed in the first co-creative workshop, highlighting the need of creating an energy community of citizens. As in the other regions, the engagement of civil society was postponed to a later stage of co-creation and idea development, when the feasibility aspects related to citizens will be more mature to be presented as arguments for incentivizing them to participate in the TSL initiative.

The project partners in Lower Silesia – the public fund of the Lower Silesian voivodeship, Dumni z Lubina, and the University of Warsaw – primarily involved stakeholders and community representatives in developing solutions for transforming the energy and mobility systems. They chose to include the perspective of non-organized civil society through public opinion surveys, a discrete choice experiment and a survey to develop convenient transport connections for GHG reduction. By using surveys to obtain information about the preferences of unorganized civil society, on the one hand, a degree of representativeness can be achieved, thus, facilitating a regional perspective. The downside of this method is it does not include deliberative or idea generating involvement of civil society. However, public authorities in the region were very interested in the survey's results as a basis for their portfolio development and political positioning.

Conclusively, in all four regions, there was no significant involvement of civil society actors in the vision development and subsequent decision making on what transition projects should be part of the region's portfolio of interconnected transition projects. Involvement was amplified at later stages, in workshops where the concrete transition projects were further developed. One major reason for this very limited civil society involvement lies in the significant **difficulty to overcome the thematic distance** between civil society and abstract regional transition topics. Persuading citizens to participate in such kinds of activities and keeping them engaged is challenging and difficult, since they need to be convinced that there will be tangible outputs that will improve and facilitate their daily lives. Another important reason can be found in the limited capacity for civil society engagement work of the project partners, as their very positioning within the networked governance of the regions made this task rather challenging.

In the first year of the TRANSFORMER project, bridging the **thematic and territorial distance at a regional scale to fit the needs for co-creation** has been a challenging exercise. From this experience, we can distill some workable strategies that had more success than others did. Starting from concrete transition projects instead of a broad and rather loose thematic scope has worked much more successfully (see Western Macedonia), for identifying stakeholders for the coalition as well as to motivate them to participate in the co-creative process. Of course, this strategy does not comply with the goal of creating a significant portfolio for accelerating a sustainability transition for an entire region, but it is a solid first step. In a second step, the thus motivated stakeholder coalition can develop additional solutions for step by step broadening the portfolio of interconnected transition projects. **We call this approach a 'mosaic' strategy.** Similar to constructing a mosaic, this strategy entails starting with a general vision and then concretizing this vision for the region by selecting and adding piece by piece transition projects which connect to the already existing ones. This mosaic strategy also needs to be accompanied

by a flexible and **iterative stakeholder management strategy**, adding and engaging new stakeholders according to the different transition projects and reflecting the transition needs and potentials of the region. In order to retain their focus on regional sustainability transition, both strategies should be driven by reflexive monitoring (van Mierlo et al., 2010). Reflexive monitoring means to monitor whether actions taken in the TSL as a whole align with regional transition goals, i.e. the match between vision (transition goals) and portfolio selection and the critical reflection if the stakeholder coalition is matching the legitimacy goals for the TSL process. In TRANSFORMER, this critical task was mostly undertaken through the academics from the coordination team at Ruhr-Universität Bochum (including authors) and reflexive exchange between the for TSL leading partners. However, we recommend this task to become more localized and institutionalized in future TSLs in form of a reflexive monitoring board.

The capacity for reflexive monitoring requires a specific expertise in various connected fields, such as the capacity of system thinking and an understanding of sustainability transitions, policy analysis, a broad understanding of stakeholder engagement and social inclusion, spatial planning capacity, economic development and innovation management, data analysis and interpretation, evaluation methodologies and risk assessment. For locating people with these capacities, we recommend looking at stakeholders from academia. Moreover, we recommend holding regular reflexive monitoring meetings and to document the process of decision making and reflection to be able to access this information at a later stage. To really have an effect on the TSL process, it is important that the reflexive monitoring board has the capacity to make strategic interventions in the TSL process, for instance, to commission evaluation studies for specific transition projects from engineering experts or to be able to initiate workshop-interventions with stakeholders when the overarching goals of regional sustainability transition gets derailed in the day-to-day 'busy-ness'.

Conclusions

In this paper, we discuss the promises and challenges of placing regions at the center of living lab sustainability transition experimentation. We make a conceptual case for the promises of the regional scale as arenas for fostering cross-sectorial innovation. Taking a regional perspective and developing a regional transition portfolio addresses the issue of overcoming the transition barrier of alignment of societal systems in transformations towards more sustainable futures. However, broadening living lab methodologies to fit the regional scale also implies the challenges of broadening the thematic and territorial scope. This introduces significant challenges related to knowledge and resource management, stakeholder engagement, and the risk that stakeholders may not relate to the solutions or may be unwilling to participate.

In this paper, we present the experiences and insights gained from addressing these challenges in the TRANSFORMER project. Overall, the project had a very limited timeline of two years and also relatively limited resources when considering the spread of budget over 13 project partner organizations. Some limitations and difficulties depicted here can be contributed to this. More resources (time and money) are always good, but there is more to the story than mobilizing funding for regional transition labs. We have shown that operating a living lab methodology at the regional scale requires different strategies and procedures than on a local scale. For one, we show how the development of a regional transition portfolio requires a constant zooming-in and out. Only focusing on the region does not work; local

contexts must be taken into account, but this is only possible if the primary frame of reference is the region. In other words, taking a regional perspective means connecting and allowing for cross-sectorial and cross-community learning.

As the title of this paper asks: Is the region the missing layer for sustainability experimentation? In short, the regional scale is a promising layer for sustainability experimentation. However, it is too early to judge if applying a regional TSL approach can effectively accelerate sustainability transitions. Further experimentation and evaluation are needed, focusing on implementing developed solutions and co-creating additional projects with a growing coalition of stakeholders.

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Annex

Title of Document	Authors	Date of finalization/ event	Document type	Selection criterial for inclusion in this study: Reference to governance and learning processes in TRANSFORMER	No. pages	Data spec. produced this study
Proposal Evaluation Form	European Commission	20.01.2022	Official Document	Refers to a lack of inclusion of marginalized groups in the proposal	4	No
Grant Agreement/Description of Action	TRANSFORMER Consortium	18.05.2022	Official Document	Only DoA part is interesting. Refers to pre-established thematic ideas for the regions	158	No
Minutes: Kick-off meeting of the TRANSFORMER project team on Tuesday, 27 September 2022 (9h00 – 16h00)	TRANSFORMER Consortium	27.09.2022	Minutes	References to stakeholder management in discussions on WP3	8	No
TRANSFORMER Kick-Off - Western Macedonia presentation - ANKO	TSL Lead Western Macedonia	27.09.2022	PowerPoint	Explanation of region	5	No
TRANSFORMER Kick-Off Emilia Romagnia – ITL	TSL Lead Emilia Romagna	27.09.2022	PowerPoint	Explanation of region	12	No
TRANSFORMER Kick-Off Lower Silesia region presentation	TSL Lead Lower Silesia	27.09.2022	PowerPoint	Explanation of region	5	No
01_TRANSFORMER_Task Partner Workshop_agenda	TRANSFORMER Consortium	26.10.2022	Agenda	Implicit conceptual ideas on stakeholder selection	2	No
02_TRANSFORMER Task Partner Workshop_Objectives and tasks of the planned WS	TRANSFORMER Consortium	26.10.2022	PowerPoint	Conceptual ideas of stakeholder selection	6	No
TRANSFORMER 1st Workshop meeting_results	TRANSFORMER Consortium	26.10.2022	Whiteboard	Results of group work on stakeholder selection	1	No
TRANSFORMER_Methodology of WP 2_2022-11-18	Enoll	18.11.2022	PowerPoint	Bringing together vision and stakeholders – learning process	15	No
TRANSFORMER Consortium Meeting in Bologna Minutes	TRANSFORMER Consortium	28.03.2023	Minutes	Stakeholder engagement was the central aspect of this Consortium Meeting	14	No
D3.1 Recommendations for Transition Super-Lab coalitions building, empowering of vulnerable and marginalised groups, and vision process	TRANSFORMER Consortium	31.05.2023	Deliverable	Core document on stakeholder management	78	No
D3.2 Definition of Transition Super-Lab use cases	TRANSFORMER Consortium	31.05.2023	Deliverable	Core document on governance	51	No
D4.1 Super-Lab Roadmap	TRANSFORMER Consortium	29.09.2023	Deliverable	Core document on governance	69	No
D4.3 Toolkit (incl. matchmaking system) for Transition Super-Lab Implementation	TRANSFORMER Consortium	29.09.2023	Deliverable	Core document on governance	18	No
D4.4 Knowledge Hub	TRANSFORMER Consortium	06.11.2023	Deliverable	Core document on governance	34	no
D5.1 Framework for Super-Labs Assessment	TRANSFORMER Consortium	30.06.2023	Deliverable	Core document on learning	54	no
Interview Emilia Romagna	-	24.11.2023	Transcription		26	yes
Interview Western Macedonia	-	27.11.2023	Transcription		25	yes
Interview Ruhr Area	-	27.11.2023	Transcription		22	yes
Interview Lower Silesia	-	08.12.2023	Transcription		23	yes
					630	

Table 2: List of data sources (own compilation).

How to Implement a Transition Super-Lab: Lessons Learned from an Experiment

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1 Introduction

Accelerating the shift to climate neutrality is essential to mitigate the escalating threats posed by climate change. Urgent and comprehensive actions are needed to prevent catastrophic impacts like extreme weather events, rising sea levels and loss of biodiversity (IPCC, 2021). Incremental changes and isolated solutions will not be sufficient to address the urgency and complexity of this historical challenge. It rather requires systemic solutions which rapidly and fundamentally change "the way in which energy, resources, goods and services are produced and used" (Directorate-General for Research and Innovation, 2018). Considering the intricate social, economic, and environmental interrelationships between potential pathways to achieve climate neutrality, this transformation presents a highly complex challenge that requires innovative and comprehensive solutions (Bresciani et al., 2024; IPCC, 2021).

However, many of the concepts and projects aimed at facilitating this transformation often quickly "fall apart when theory collides with technical, environmental and socioeconomic realities" (Directorate-General for Research and Innovation, 2018, p. 165). This has led to an increasing recognition among experts and policymakers that the complexity of such a profound transformation necessitates an approach that allows for the simultaneous development and testing of a portfolio of large-scale cross-sectoral systemic solutions for climate neutrality, in collaboration with affected stakeholders. This concept is central to the Transition Super-Lab approach, which was applied and further developed in the two-year Horizon Europe project "TRANSFORMER"[1]. The core elements of a Transition Super-Lab (TSL) are 1) the adaptation and application of enriched living lab methodologies (co-creation, experimentation and evaluation); 2) large-scale systemic solutions for a rapid transition to sustainability; and 3) a portfolio approach of measures (experiments) and using multiple leverage points for systemic change simultaneously.

This paper focuses on the results and lessons learned from the experiment to develop and implement TSLs in four European regions: Emilia-Romagna (Italy), Lower Silesia (Poland), the Ruhr Area (Germany), and Western Macedonia (Greece). The guiding research questions are: 1) *How can the transition towards climate neutrality be accelerated from a theoretical perspective?* And building upon

[1] TRANSFORMER – Designing long-term systemic transformation frameworks for regions. Accelerating the shift towards climate neutrality. [HORIZON-CL5-2021-D2-01-14]. Project duration: Sept. 2022-August 2024.

that: *2) How can these theoretical perspectives be translated into real-life actions to achieve a systemic transition towards climate neutrality?*

To approach an answer to these questions, we will explain the TSL concept and its theoretical foundation in the following chapter. Key aspects will include theoretical insights from regional and transition studies, focussing on experimentation, cross-sectoral solutions for systemic transformation, and the importance of the regional scale in transition processes. Based on that, we will reflect on the lessons learned from implementing the TSLs in the four European regions (chapter 3) and discuss the further conceptualisation of the TSL approach (chapter 4). We will conclude with a summary of the most important lessons learned and an outlook for further research and experimentation (chapter 5).

The lessons learned described in this working paper are based on the activities conducted during the TRANSFORMER project including numerous workshops, stakeholder meetings, and interviews. These activities and the achieved project results are described in detail in 24 deliverables. They provide the basis for this working paper.[2]

The "lessons learned from an experiment" are intended to support both practitioners who want to learn from the TSL approach to accelerate the transition towards climate neutrality in their regions, as well as researchers who want to critically reflect on their understanding of systemic transformation by exploring the intersection of theoretical approaches and their practical implementation.

2 Accelerating the transition to climate neutrality – theoretical considerations and the TSL concept

To provide a clear understanding of the TSL concept, we begin this chapter by outlining the underlying theoretical foundation based on a non-systematic explorative literature review from transition and regional studies (section 2.1). Building on these theoretical considerations, we briefly describe the TSL concept and highlight the challenges associated with implementing such an ambitious approach (section 2.2).

2.1 Theoretical foundation of the TSL approach

The scientific discourse on transition, innovation, and regional development emphasises several interconnected elements as critical for accelerating the systemic transformation toward climate neutrality: Co-creation and experimentation, cross-sectoral solutions for systemic transformation and the importance of the geographical scale.

A central discourse focuses on the need for **co-creation and experimentation** of sustainability solutions: Co-creation involves engaging stakeholders from the quadruple helix (academia, businesses, civil society and government) in developing and testing new sustainability solutions to ensure they are user-centred and meet actual needs. This collaborative approach allows for real-world experimentation and iterative refinement, which helps to foster greater acceptance and support from all stakeholders. By integrating co-creation and experimentation, a dynamic environment is created that enhances the effectiveness of sustainability initiatives and increases the likelihood of their

[2] Therefore, this working paper contains verbatim quotes from our own deliverables, especially the deliverables D2.1, D2.2, D2.3, D3.1, D3.2, D3.3, D3.4, D4.2, D5.1., and D5.2. They are not highlighted as direct quotes and the origin will only be indicated in a footnote. All authors who contributed to the specific sections of these deliverables included in this working paper, are listed as co-authors.

adoption and implementation (Frantzeskaki et al., 2017; Schönwälder, 2021; Wolfram & Frantzeskaki, 2016) as well as achieving a socially accepted and just transition (Heffron, 2021; Newell & Mulvaney, 2013). These real-world testing environment where researchers, businesses, and users collaborate to develop and refine innovative solutions through iterative experimentation and feedback are called "**living labs**" (Hossain et al., 2019).

Despite the widespread recognition of the importance of co-creation and experimentation for developing effective and feasible sustainability solutions, living labs "often do not provide the resources for diffusion" (Wirth et al. 2019, 250) and are limited to "spatial and sectoral boundaries" (ibid., 233). However, achieving a fast and comprehensive systemic transition requires more than local, small-scale solutions focused on a single sector. It rather requires a **portfolio of** (large-scale) **cross-sectoral solutions** (Dunlop et al., 2021; EIT Climate-KIC, 2019; Löhr & Chlebna, 2023): The underlying assumption of choosing a portfolio approach of experiments is that no single solution will be able to address the complexity of transforming whole regions and societal systems (ibid.).[3] A rapid transformation therefore requires the simultaneous testing of a variety of diverse and inherently different solutions to determine which are the most efficient, especially when interconnected. This means that TSLs are designed to focus on a portfolio of transformative solutions (experiments) and engage multiple leverage points at the intersection of socio-technical regimes simultaneously.

Developing and implementing a portfolio of cross-sectoral solutions leads to the question of the appropriate **geographical scale of the TSL activities**: The significance of the spatial dimension in sustainability transitions is widely acknowledged by both researchers and practitioners (Coenen & Truffer, 2012; Hansen & Coenen, 2015; Maucorps et al., 2023; Morais Mourato & Wit, 2021; OECD, 2023; Uyarra et al., 2017; Wolfram & Frantzeskaki, 2016).[4] In this context, the (sub-national) regional scale is gaining increased attention, as it serves not only as a "link" between the national level where overarching policies, regulations, and frameworks are implemented and the local level where specific sustainability-related projects, such as wind power plants, are permitted and implemented. In this perspective, regions are regarded as geographical spaces wherein significant parts of diverse socio-technical regimes are situated, and holistic solutions can be developed to harvest synergy effects (Löhr & Chlebna, 2023; Wachsmuth et al., 2023): regions are "*large" enough* to develop a portfolio of cross-sectoral solutions to achieve a fundamental systemic transition and, at the same time, "*small" enough* to establish (economic and political) participation and co-creation processes that consider the cultural and social context of transition. Moreover, regions, as geographic spaces for specific transition activities, are—compared to the more abstract national level—more likely to be "closer and more relatable" to citizens and stakeholders. This fosters the development of a "regional identity", which helps stakeholders identify with the transition process and makes the developed and implemented solutions more tangible (Paasi, 1986; Sedlacek et al., 2009).

These aspects—identification with and awareness of the need for a transition, as well as establishing processes for participation—are widely regarded as prerequisites for creating support and acceptance for the necessary fundamental systemic change (Chodkowska-Miszczuk et al., 2022; Flanigan et al., 2021; Gölz & Wedderhoff, 2018, 2018; Leiren et al., 2020; Lutz et al., 2017; Macht et al., 2023; von Wirth et al., 2019; Wirth et al., 2018; Zoellner et al., 2008).

[3] The idea of a portfolio concept in a TSL already guided the project proposal of the TRANSFORMER project and is a verbatim quote from our own deliverable D2.1.

[4] This discussion of the regional scale in the TSL concept evolved throughout the duration of the project and is a verbatim quote from our own deliverable D2.3.

However, this ambitious conceptual TSL approach, focusing on co-creation and experimentation, and cross-sectoral solutions on a regional scale for systemic transformation, leads to numerous challenges when attempting real-life implementation. These challenges will be described in the next section after outlining the core elements of a TSL.

2.2 What is a TSL?

A TSL can be described as a large-scale living lab for systemic transformation. In a TSL, **living lab methodologies** are adapted and applied to develop (co-create) together with all relevant stakeholders from the quadruple helix a vision for regional transformation and a **portfolio of large-scale systemic solutions** for climate neutrality and sustainability. The **systemic transformation** within TSLs mobilises large and diverse communities to innovate for systemic changes that accelerate transition at scale.[5]

This **systemic transformation** can be achieved by developing and implementing a portfolio of connected solutions (e.g., "pilot use cases") which engage **multiple leverage points** at the **intersection of socio-technical regimes** simultaneously to achieve a rapid and more efficient transformation.[6] Therefore, the adaptation of living lab methodologies to a large scale and with a focus on systemic transformation can be regarded as the core characteristics of a TSL (see Figure 1):

1. adaptation and application of enriched living lab methodologies (co-creation, experimentation and evaluation);
2. aiming at large-scale systemic solutions for a rapid transition to sustainability;
3. applying a portfolio approach of measures (experiments) and using multiple leverage points for systemic change simultaneously.

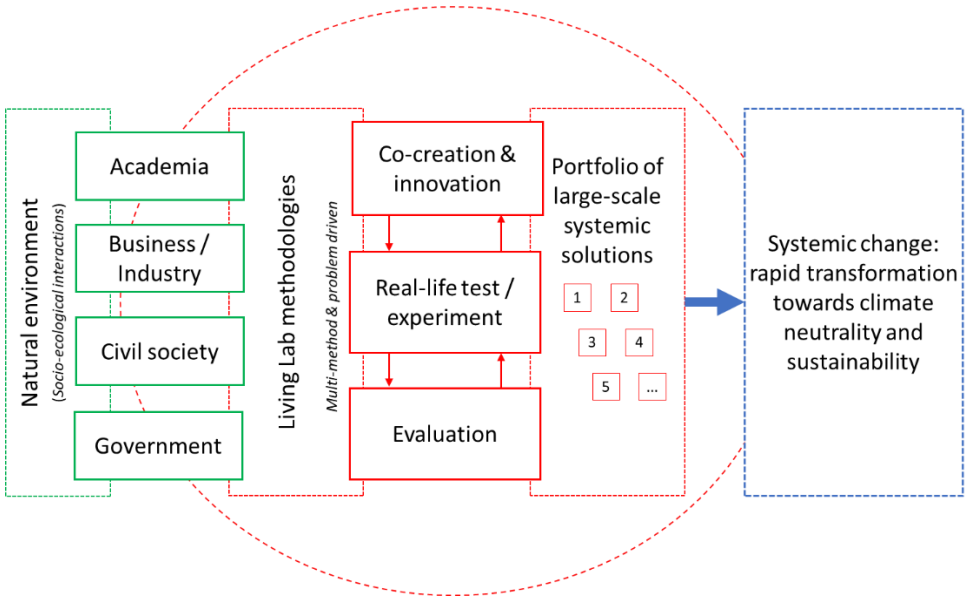

Figure 1: Elements of a Transition Super Lab. Source: own design adapted from deliverable 2.1 (URL not available yet).

[5] The definition and description of the TSL approach in this section was discussed and written jointly by the members of the TRANSFORMER Project Consortium. It is also included in deliverable D2.2.

[6] For example, developing green hydrogen-solutions for simultaneously transforming the mobility and the industrial sector. For a more detailed explanation of leverage points ("levers of change") and the portfolio approach see deliverable D2.1.

This ambitious approach of implementing a TSL is facing numerous **challenges**[7] which need to be addressed in real-life implementation:

- Ensuring a **balanced representation** of different societal groups and enabling all stakeholders to (efficiently and effectively) participate in a large-scale living lab.
- Ensuring that stakeholders are **motivated to participate** over the long time of a systemic transformation, lasting several years or even decades.
- **Integrating existing economic and political networks** in a TSL without creating an imbalance of (political and economic) forces, thereby ensuring an inclusive transformation process.
- Dealing with **individual interests** and **conflicting ideas** among the stakeholders, especially regarding "veto players".
- Creating a **common vision** for a transformation on a regional scale among the variety of different stakeholders.
- Implementing **suitable governance arrangements** for a TSL, operating on different levels of government (local, regional, national) but not (necessarily) within the boundaries of a specific political and administrative unit.
- Identifying, implementing and managing necessary **steps** and **iterative loops** in the TSL process.
- Assessing and measuring the **efficiency** and **effectiveness** of multiple interconnected experiments on complex socio-technical regimes.

However, before addressing these challenges and developing a coalition of supporting stakeholders for the TSL, it is crucial to first reflect on the **transition needs and potentials** of a region, as well as its **transition readiness**, to gain a basic understanding of how to achieve systemic transformation across the entire region. This is the first step in developing and implementing a TSL, which will be described in the next chapter.

3 How to implement a TSL? Theoretical approach and lessons learned.

As we have implemented the TSL concept in four European regions, we can only provide exemplary descriptions of some of the regions due to the limited scope of this paper.[8] Particular focus will be on the challenges we faced and the lessons we learned.
The TSL concept consists of a few main steps for initiating and governing a TSL, some of which may run in parallel or need to be repeated and adjusted in an iterative process:

1) Defining the thematic and geographical scope of the TSL.
2) Building a supporting coalition of stakeholders for the TSL and developing a vision for the transition.
3) Developing pilot use cases and executing action plans.
4) Monitoring, assessing and optimising the impact of the TSL activities.

As we had to develop the concept of the TSL approach while simultaneously executing the different steps and activities due to time constraints, we had to be flexible about the order of the steps and

[7] Most of them have been identified at the very beginning of the project (see deliverable D2.1).
[8] Detailed descriptions of the activities conducted in all the regions can be found in the deliverables D3.1, D3.2, D3.3, and D3.4.

work in an agile and iterative process. This specifically refers to the first step of assessing the transition needs and potentials of the region, which will be explained in the following section.

3.1 Defining the thematic and geographical scope of the

3.1.1 Conceptual considerations for defining the thematic and geographical scope of the TSL

The first crucial step in the TSL process is to **define the thematic and geographical scope of the TSL and assess the transition needs and potentials of the region**. This is a highly connected, iterative process that should start with a general reflection on the geographical boundaries of the TSL. In this regard, regions can be viewed from both a "functional" and a "political-administrative perspective"[9]: functional regions are defined by natural, economic, social, or functional-spatial relationships, such as commuting zones, trade areas, or distinguishable labour markets where interactions are the defining factor, and borders can be fluid (Cörvers et al., 2009; Hansmeier et al., 2022; Koschatzky et al., 2022). Political-administrative regions, on the other hand, are delineated by administrative boundaries, with precise and often legally established borders. States, counties, and cities fall under this category, emphasising governance, jurisdiction, and administrative control. While functional regions highlight interactions and interdependence, political-administrative regions prioritise governance structures (ibid.).

The TSL concept seeks to consider both perspectives: a functional perspective for developing cross-sectoral, systemic solutions (e.g., thinking beyond the borders of a city or county for developing sustainable mobility and energy solutions), while acknowledging that real-life activities must be implemented within specific political-administrative structures and processes. As a result, the geographical scope of a TSL will likely be strongly shaped by existing political-administrative boundaries, such as counties or planning regions (e.g., NUTS 2). However, combining both perspectives can support the creation of functional cross-sectoral governance mechanisms which expand political-administrative structures and processes (such as steering boards or authorities).

This already indicates the iterative nature of the process, as defining the (functional and political-administrative) regional boundaries requires an initial understanding of the transition needs and potentials of a region to determine the main topic (e.g., mobility or the energy sector) that must be addressed for achieving climate neutrality, as this will have a profound effect on defining the geographical scope. Therefore, this first step needs to be an iterative process in which the initiators of the TSL closely review studies, conduct interviews and prepare a SWOT analysis[10] to assess the transition needs and potentials of the region, as well as review existing policy plans and analysing (regional) governance arrangements and processes.

In the following section, we will provide insights into how we conducted this first step of analysing the four TRANSFORMER regions and present two connected assessment frameworks that we developed during the project to support this crucial first step in the TSL process.

[9] The following paragraph about "functional" and "political-administrative perspectives is mostly a verbatim quote from our own deliverable D2.3.

[10] SWOT is an acronym that stands for Strengths, Weaknesses, Opportunities, and Threats. It is a strategic analysis tool used to identify and evaluate the internal and external factors that can impact a project, organisation, or business decision.

3.1.2 Reflections on defining the thematic and geographical scope of the TSL

The first step of defining the themtaic and geographical scope of the TSL and assessing the transition needs and potentials of the region was already partially conducted during the drafting of the project proposal. Due to time constraints within this two-year pilot project, we had very limited capacity to comprehensively reflect on the transition needs and potentials of the four TRANSFORMER regions after the project has started. Therefore, we began working in parallel on several connected aspects: **analysing the capacities of the leading organisation(s) in terms of knowledge, skills, and technology** for setting up working structures that support the implementation of the TSL and **assessing the availability and accessibility of funding** sources and financial capacities that could be leveraged through stakeholder engagement. This significantly defined the feasible scope of the TSL (e.g., how many projects could be developed simultaneously). Additionally, we conducted a **SWOT and PESTEL**[11] **workshop** with project partners from the four regions, during which we reflected on the **transition needs and potentials** of the regions and the importance of the chosen topics (e.g., mobility) prior to the project's commencement in the regions. In parallel, we **analysed the development of greenhouse gas (GHG) emissions** (per capita and per industrial sector) to evaluate the chosen topics and conducted **desk research on regional and national policy frameworks as well as sectoral strategies** (for the case studies, see deliverable 2.3). The outcomes of this iterative reflection process were then discussed with stakeholders in the region in different workshops (e.g., for developing the vision for transition and developing specific projects; see sections 3.2 and 3.3).

However, we realised during this phase that the process only included selected experts. As the TSL concept aims at inclusive co-creation methods, we needed to develop methods to open this process of defining the thematic and geographical scope of the TSL and assessing the transition needs and potentials of the region to other stakeholders. This is crucial to enable stakeholders to engage in an evidence-based discussion and to reflect their understanding of the regions and critically question existing transition narratives and policy objectives. This lesson learned led to the development of two connected frameworks that are intended to support this crucial first step in the TSL process: the Quantitative Regional Assessment Framework for Transition Super-Labs (QRAFT) and the Transition Readiness Assessment Framework.

The Quantitative Regional Assessment Framework for TSL (QRAFT)[12] is a methodology designed to define transition needs and potentials of regions to reduce GHG emissions from a TSL perspective. This framework supports the first steps in the TSL process of identifying the regional challenge and possible topics for transition and developing a vision for transformation.

It is designed as a tool for stakeholders with limited knowledge of their region to gain an evidence-based, data-driven understanding of the importance of different possible TSL vision topics within the region. It also enables knowledgeable stakeholders to question existing transition policies and narratives about their region.

The QRAFT compares regional transition needs (development of greenhouse gas emissions per capita and carbon emissions intensity (CEI) of a region´s economic sectors) and regional transition potentials from a TSL perspective by referring to existing Composite Indices (CI).

[11] PESTEL is an acronym that stands for Political, Economic, Social, Technological, Environmental, and Legal factors. It is a framework used in strategic analysis to assess and monitor the external environment that can impact an organisation or industry. In the TRANSFORMER project, we used SWOT and PESTEL analyses to discuss important factors that may influence the transition in the regions.

[12] The following description was written by RUB and is, to a large extent, also included verbatim in deliverable D6.4.

In the first step, GHG emissions are analysed to identify the trends of the region (development of the CEI for analysing the relation of economic growth and emissions) and to identify the most important sectors that need to be changed (GHG emissions per sector; this is put in context with gross value added (GVA) per sector and employment statistics). For intraregional analysis, selected data (GHG emissions, GDP, CEI) was included on a NUTS 3 level where available.

By narrowing down the analysis to the most important sectors, additional sector-specific quantitative analyses (using indicators from regional and national statistical offices) and qualitative assessments (transition readiness assessment, document analysis, expert interviews) can be conducted.

To gain a preliminary understanding of the transition potentials, several composite indices (CI) are used, focusing on competitiveness, innovation capacity, social progress, and quality of government.

Although the *analysis of the regional needs and potentials* using the QRAFT methodology should be done at an early stage to provide data-driven insights for discussing and defining the region's vision, scenarios, and potential pilot use cases, this analysis for TRANSFORMER TSLs was performed at a later stage when the vision and the pilot use cases of the TSL had already been developed. Therefore, it was used in the TRANSFORMER project as a useful tool to critically reassess the already chosen topics of the four regions and provide a basis for identifying additional topics relevant for the transition. Overall, the QRAFT confirmed that the four TSLs focus on topics that are of key importance for achieving climate neutrality (see deliverables D2.2, D2.3 and D3.4).[13]

The QRAFT methodology is designed as a data-driven tool that should be used in combination with the **Transition Readiness Assessment Framework** developed during the TRANSFORMER project. The transition readiness assessment for the regions was developed and built upon a systemic approach to cross-sectoral transition ecosystem that defines the required elements that a region should have to be characterised as transition-ready. These elements cover aspects related to governance and fusion, openness and greenness, transparency and cross-sectoral collaboration, regulations and economy, infrastructure, technology and tools, as well as civil society and stakeholders. This approach recognises the interconnection and interdependency of the different characteristics that structure a transition-ready ecosystem and emphasises the need of collective effort to drive sustainable transformations and accelerate the transition towards a sustainable and resilient future.

The TSLs are able to use the Transition Readiness Self-Assessment Tool answering a set of qualitative questions on a 1-5 scale to calculate their transition readiness level and identify their weak points. The tool consists of two levels to be used by the regions depending on their data availability: the first one includes a small set of questions that can be easily answered by the TSLs, while the second level includes the full set of questions that require a broader knowledge of different regional aspects. The results provide a transition readiness score (at both total and element level) as well as different graphs that offer regions a comprehensive understanding of their strengths and weaknesses compared to other regions. The analysis allows for a comparative assessment with benchmarks and other regions' transition readiness, highlighting areas of concern that fall below the average performance and providing recommendations related to each element and linked to the transition model/roadmap (see section 4.2) on how to speed up the transition towards climate neutrality.

[13] The QRAFT analysis highlights extremely high GHG emissions in the energy sector in Western Macedonia, prompting a policy shift to phase out lignite. In Lower Silesia, the analysis underscores significant emissions from both the energy and transport sectors. In the Ruhr Area, the high manufacturing emissions and low renewable energy potential point to the need for innovative solutions for climate-neutral manufacturing, especially in steel production. In Emilia-Romagna, the analysis emphasises the crucial role of the transport sector while also suggesting new topics, such as the agriculture sector, for further consideration.

The transition readiness assessment is recommended to be used during the first phase of the transition process as it is a useful step for the creation of possible pathways/scenarios to achieve the TSL's vision. However, it is an iterative process allowing for adjustment of the transition pathways and the pilot use cases during the whole transition process. This continuous learning is crucial for adapting the strategies that were designed to accelerate a successful transition towards climate neutrality, ensuring that the region remains on course to achieve its desired outcomes and maximise the impact of its transition efforts through its transition-focused activities.

Although the transition readiness assessment could have helped the TSLs in identifying their weak points for effectively co-designing transition pathways with the stakeholders during this first phase, due to time constraints within the two-year project, the tool was only available after the TSLs had already developed their pathways. Therefore, it was used later, and its results can be applied by the TSLs after the end of the project to adjust their transition pathways and pilot use cases if necessary. Additionally, it is recommended that the TSLs use this tool in the future as part of an iterative reassessment process to evaluate the effectiveness of their transition-enabling activities and strategies designed to accelerate the transition towards climate neutrality.

3.2 Building a supporting coalition of stakeholders for the TSL and developing a vision for the transition

3.2.1 Conceptual considerations for building a supporting coalition of stakeholders for the TSL and developing a vision for the transition

Based on the analyses conducted in the first step, the TSL initiators need to develop some basic ideas about the vision of the transition and identify ideas for potential transition projects – the so-called pilot use cases (see section 3.3). This is crucial for **identifying relevant stakeholders** for the transition and for creating an engagement strategy to build a supporting coalition for the TSL. However, it is important to remain open to significantly revising the first ideas for the vision and transition projects once additional stakeholders join the TSL.

As a TSL is built on collaborative governance and aims for an inclusive approach, it is essential to invest considerable effort in identifying stakeholders once the vision and potential projects are sketched by the initiators of the TSL. Stakeholders should represent the quadruple helix, with a particular focus on civil society and marginalised groups, who are often underrepresented or not heard in transition processes. This will enhance political legitimacy and might be an essential value proposition for other stakeholders, especially from the government, who often struggle with this endeavour.

The identification of stakeholders should be complemented by a thorough **stakeholder mapping** based on their interests and influence, which will help the TSL to identify potential conflicts and the specific role that each stakeholder should play in the coalition.[14] In this regard, it is of crucial importance to focus on the identification and analysis of existing (economic, political and social) networks and veto players who might support or jeopardise the development of the TSL and the transition process.

The stakeholder mapping will serve as a basis for developing a **stakeholder engagement plan** and a first proposition for a feasible TSL governance arrangement that outlines how the TSL's stakeholders will work together in a lasting and self-sustaining way. Engaging a broad spectrum of stakeholders with

[14] The following paragraph about stakeholder analysis and vision development are partially a verbatim quote or summaries from the deliverables D3.4 and D4.2.

varied expertise, backgrounds, and ideas is crucial. This inclusivity promotes a comprehensive and co-creative approach, fostering innovative solutions that account for distinct stakeholder needs. In this regard, the stakeholder engagement plan should focus on providing a clear value proposition for the different stakeholders and should place particular emphasis on gaining political and institutional support. Since a TSL is not implemented in a political void, this requires careful consideration of the existing, politically legitimised governance arrangements and processes in both the stakeholder engagement plan and the design of the TSL governance. **Building a coalition of supporting stakeholders** for the transition and designing an initial proposition for feasible governance arrangements is a prerequisite for collaborative development with the stakeholders.

The **co-creation of a shared vision** with all relevant stakeholders is crucial in a TSL, as it sets an accepted and unified direction for the transition, guiding stakeholders towards common goals and ensuring alignment in their efforts. This process motivates stakeholder engagement by fostering collaboration and coherence among diverse parties, which is vital for overcoming challenges and achieving a successful transformation. The vision must reflect and balance the transition needs of the entire region, the local communities, and the stakeholders. Therefore, it is essential to combine in the vision development process top-down approaches, where governing bodies ensure that democratically legitimised policies are included in the vision, with bottom-up approaches, where civil society and local authorities ensure that the diverse needs of different stakeholders and communities are represented.

Building a supporting coalition of stakeholders and designing feasible governance arrangements for co-creating cross-sectoral solutions with diverse stakeholders from the quadruple helix on a regional scale presents numerous challenges (see section 2.2). Two of these challenges are particularly important for the TSL governance arrangements: First, ensuring a balanced representation of different societal groups and enabling all stakeholders to efficiently and effectively participate in a large-scale living lab, while also maintaining their motivation to participate throughout the long duration of a systemic transformation. Second, integrating existing economic and political networks into a TSL without creating an imbalance of political and economic forces, while managing individual interests and conflicting ideas among stakeholders, particularly those of veto players (Balthasar et al., 2020), to ensure an inclusive transformation process.

In the following section, we will share our experiences with a particular emphasis on these challenges. They inspired us to develop a blueprint for a TSL governance model that outlines the main roles and responsibilities within a TSL (see chapter 4).

3.2.2 Reflections on building a supporting coalition of stakeholders for the TSL and developing a vision for the transition

As mentioned above, the TSL initiators outlined a **basic vision for the TSL** and the transition, based on their knowledge of the region's transition needs and potentials and considering regional governance processes as well politically legitimised policy goals that could not realistically be disputed; otherwise, developing a vision would have merely been an academic exercise with no realistic chance of real-life implementation. The initial visions of the four TSLs were then discussed in a project-internal workshop at the beginning of the project. However, as we aimed for an open vision development process, we had to reflect on these initial ideas after additional stakeholders joined the coalition.

To co-create a vision for the transition, the TSL initiators started **identifying stakeholders** in an early phase of the project and developed a first basic strategy for **stakeholder engagement and**

involvement. In a project-internal workshop at the beginning of the project, we agreed that a coalition in a TSL should be open for so-called unusual suspects and not just address those who are evidently the leaders or have an established mandate for action in the respective field. Therefore, we conducted an initial **stakeholder mapping** exercise to identify key stakeholders, assess their interests and influence, and evaluate their potential contributions to the TSL.

Regarding **coalition building** and the development of a vision for climate neutrality, the TSLs faced the challenge of achieving a critical mass within the regional coalition while maintaining a manageable size that fosters trust and enables effective collaboration. In the TRANSFORMER project it was proved very useful to address some key stakeholders at the beginning of the process, but then to arrange working groups with further stakeholders according to more specific topics. However, we also clearly realised in this project that a particular challenge for the TSL initiators was the need to open their own networks and adapt their working routines and business culture to include groups from the quadruple helix with whom they usually do not collaborate. This was particularly true for incorporating civil society. Our experiences have shown that these “lock-ins” are a persistent threat to coalition building and vision development. During our project activities, we recognised a tendency to revert to familiar paths or focus too heavily on the political agenda and existing transition narratives, which sometimes resulted in overlooking the transformative and systemic aspects that should be integral to a TSL.

At the same time, in this context, our experience showed that such an inclusive and open **vision development process** can be quite a challenging exercise, because stakeholders may not necessarily be attracted to such broad, general discussions when the value and outcomes are vague. The experience in some of our workshops showed that they may even become critical of the concept as a whole if they feel they are simply investing their time and sharing their knowledge for an unclear goal and undefined benefits. Therefore, we realised that while it is crucial to have an open, participatory, and interactive process to ensure stakeholders' support for the transition, a clear value proposition is essential to motivate their participation in the TSL. Furthermore, our experience has shown that while a vision development process cannot be exclusive in terms of the thematic spectrum and must remain open to ensure no relevant topic or aspect is disregarded, the sooner it becomes concrete, the more targeted the thematic development of a TSL will be, and the greater the incentive for stakeholders to participate. Therefore, in the TRANSFORMER project, it proved useful to work with so-called sub-visions or, in other words, to illustrate the vision with tangible ideas, making the TSL concept as concrete as possible.

Our experience also confirmed our understanding that the vision building process, and the developed vision should not be too static in a TSL. While it is important to agree on a core idea for the TSL vision, some flexibility is needed in considering new topics and involving different stakeholders during the vision-building process to reflect the essential principles of a TSL. Hence, we clearly recognised that a fertile ground for experimenting and initiating transformation requires a flexible and dynamic vision development process that aligns with the reality of a TSL and its context. To support this time-intensive co-creation process, we identified several tools and methodologies, such as the X-Curve Toolkit and Deliberative Forums, which could be useful for conducting these activities (see deliverable D4.2).

Another challenge for both coalition building and vision development that we faced in the TRANSFORMER project is related to **TSL governance** and partially stems from the concept of the TSL itself, as it focuses primarily on the region while simultaneously seeking to apply the bottom-up principle. As we basically understand a TSL as a living lab focussing on the regional level, we recognised that regional authorities are not the only, but the most obvious driving forces behind a potential TSL. They generally have considerable political power and influence, resources, and steering capacities. We

clearly observed this dynamic in Emilia-Romagna, where the TSL is coordinated and promoted by the regional authorities. However, if regional authorities play a leading role in the vision and coalition-building process, a top-down component will inevitably be present, and the TSL risks becoming just another tool for replicating existing (transition) policies and narratives. Therefore, to implement the TSL concept as an inclusive and collaborative governance arrangement, it is essential to integrate the bottom-up perspective by including local actors and initiatives, ensuring that the entire TSL process is genuinely participatory and not merely top-down. Understanding this complexity is essential for developing effective TSL governance and establishing reliable mechanisms to ensure that a TSL functions as a cross-sectoral arrangement for transformation towards climate neutrality. In the two-year TRANSFORMER project, it was understandably not possible to fully develop ideal TSL governance mechanisms in practice. However, as this is a key element for the success of a TSL, we placed particular focus on this issue and developed a TSL governance framework based on our experiences, which will be important for future TSLs (see section 4.2). Two key aspects are essential: Firstly, a TSL requires a working group with clear responsibility for coordinating all TSL activities to ensure that transition projects (pilot use cases, see next section) are aligned with the overall regional transition goals. Secondly, having observed the risk of lock-ins and to avoid the replication of often suboptimal transition pathways, a TSL needs an advisory board to provide more objective reflection on TSL activities. Such a reflexive monitoring board will help avoid thematic lock-ins, ensure that regional and local needs are addressed, and enable relevant stakeholders to participate effectively.

To sum up, two important lessons learned in the project related to coalition building and vision development need to be emphasised: 1) Ensuring balanced representation of different societal groups from the quadruple helix in a TSL. 2) Balancing between a) maintaining an open, flexible and inclusive approach and b) guaranteeing timely actions.

Regarding the balanced representation of stakeholders, we recognised the importance of including all parts of the quadruple helix in the TSL from the very beginning of the project, but the four TSLs encountered difficulties in involving civil society. Initially, there was no specific strategy for civil society engagement; however, as the project progressed, the TSLs began to focus more on this issue by conducting workshops (see deliverable D5.4 for these so-called Transitioncamps) and, in Lower Silesia, even tailoring one of the pilot use cases around the inclusion of citizens through a preference survey. Despite these efforts, engaging civil society proved to be a significant challenge. This was partly due to the strong top-down element in developing and implementing regional TSLs, which distinguishes them from “classical” living labs that primarily focus on the local level. Another important reason is that civil society is a highly diverse group, often rooted in specific local interests (e.g., the needs of their own community, which may compete with those of other communities within the region). Future TSLs will need to address the challenge of including civil society and marginalised groups more explicitly.

Coalition building is a time-consuming process but must begin at a very early stage. Although it is important to invest considerable time and resources in achieving balanced representation, we had to start activities even when not all parts of the quadruple helix were equally represented. In this regard, we adopted a flexible approach in these four regions, which shared common elements such as stakeholder engagement, collaboration, and goal alignment. However, there were also specific differences based on the regional context and requirements. This approach aimed to include additional stakeholders as the TSL evolved and gained traction, allowing each region to tailor its strategy to suit its unique circumstances, ensuring that the coalition-building processes were effective and relevant to their respective challenges. The balance between a) maintaining an open, flexible and inclusive

approach and b) considering the realistically achievable timely implementation of actions was key. This also applies to the development of pilot use cases which will be described in the next section.

3.3 Development of pilot use cases and action plans

3.3.1 Conceptual considerations for developing pilot use cases and action plans

Based on the co-created vision for transition, the coalition of supporting stakeholders will be able to develop specific ideas for actions aimed at the region's transition: the pilot use cases. These are real-life experiments designed to facilitate the achievement of the TSL vision and its objectives through practical implementations, which are characterised by the following aspects:[15]

- Contribution to the goal of climate neutrality (according to agreed visions and scenarios)
- Potential for systemic transformation
- Regional character beyond merely local solutions and expected value for the region
- Experimental and innovative approach (may refer to the pilot use cases' content or the development process)
- Potential for co-creation during the development phase (beyond the initial phase of definition and selection)
- Cross-sectorial approach

When developing pilot use cases, it is crucial to clearly **define their goals, objectives, and targets** to ensure alignment with the transition needs and potentials of the region and the co-created vision. Given that a TSL seeks to develop and implement a portfolio of cross-sectoral solutions, each p**ilot use case** may require a specific **governance arrangement** that could vary significantly from the overall TSL governance, depending on the project's scope and size. In this step, it is essential to clarify the resources and roles of stakeholders and to ensure their alignment with the anticipated outcomes and impacts of the project to guarantee successful implementation.

Specific **stakeholder engagement strategies** that address unique challenges and potential conflicts associated with each pilot use case, as well as a clear value proposition for each group of stakeholders, should be developed and communicated effectively (e.g., by **pilot use case fact sheets)**. Additionally, it is important to note that **refining the TSL governance model** may be necessary after developing and implementing a portfolio of cross-sectoral pilot use cases to ensure continued support for the objectives, indicators, and targets of these use cases.

The **feasibility of the pilot use cases** should be meticulously assessed and constantly evaluated based on defined key performance indicators (KPI) related to their goals, objectives, and targets. This assessment must consider technical and operational factors (e.g., required infrastructure, compatibility with existing systems, availability of trained personnel) as well as legal, economic, social, and environmental factors (e.g., regulations, economic feasibility, and social acceptance). Methods such as cost-benefit and multi-criteria analyses can be used to provide a comprehensive evaluation of feasibility.

Based on the goals, objectives, and targets, as well as the initial feasibility assessment, **action plans** for each pilot use case need to be developed. These plans should clearly outline the specific steps and

[15] The definition of the pilot use cases description of the action plans is mostly taken verbatim from the deliverables D3.2 and D3.4.

activities, milestones, potential risks along with mitigation strategies, the roles and responsibilities of all involved stakeholders, and a robust investment plan. During the implementation and execution of the action plans, continuous monitoring and assessment are necessary to ensure that the goals, objectives, and targets of the pilot use cases are achieved and remain aligned with the overarching TSL vision. In the following section, we will discuss our experiences in developing pilot use cases and action plans, which inspired the creation of the Evidence-Based use case Impact Assessment Methodology (see section 3.4).

3.3.2 Reflections on developing pilot use cases and action plans

In all four TSL regions, processes of pilot use case development were characterised by creativity, critical discussions and openness towards new, unexplored ideas. At the same time, the TSLs are real spaces and ecosystems of actors determined by various conditions that cannot be always influenced by those who are managing the TSL (in this case, the project partners). Such factors are, for example, the political situation, budgetary constraints, and stakeholders' priority-setting in an increasingly complex world with many competing goals and initiatives. What might be a brilliant idea for a pilot use case in theory is not necessarily a potentially successful project in practice.

All pilot use cases in the TRANSFORMER project were developed in several regional stakeholder workshops through co-creation processes, although the degree of co-creation differed from case to case. As already mentioned in the previous section, one challenge was to balance the involvement of the different stakeholders from all parts of the quadruple helix. Due to path dependencies, as well as stakeholders' preferences, interests or availability, it was very difficult in practice to ensure equal participation from all stakeholder groups, even though considerable effort was made to achieve this. At the same time, the project's experience shows that the degree of participation by the different parts of the quadruple helix should make sense according to the goals of the TSL. Just seeking the most equal involvement regardless of the role of potential stakeholders and the significance of their contribution would not be the best decision. In this regard, another challenge was balancing comprehensive stakeholder involvement at different steps in the decision-making process with the need for fast and effective decision-making, which is essential for project development.

TRANSFORMER project partners faced these challenges during the TSL development. Certainly, the short project lifetime was a relevant factor here. With the need to advance as quickly as possible, not all principles of TSL development could be applied in the most ideal way. Our experience shows that to successfully implement a TSL, it is crucial to develop ambitious but still feasible project ideas, that contribute to systemic transformation towards climate neutrality. This can only be achieved in collaboration with stakeholders, and this was precisely what all four TSLs demonstrated, even though they did this in different ways according to the specific circumstances in the respective regions. Therefore, it has proven indispensable to develop a catalogue of some fundamental criteria for pilot use cases (see deliverable D3.2) to ensure that the TSL concept would be sufficiently considered and later implemented through the action plans (see deliverable D3.3).

When it comes to balancing between feasibility and ambitious goals, our experiences have clearly shown that there are several potential conflicts or at least critical moments that cannot be ignored within the debate about TSLs. Is it all about speed or is there an explicit claim for a profound systemic transformation? Both are not always possible at the same time, and it depends on the concrete situation to demonstrate which aspect needs to be prioritised to achieve the best result and not to get lost in idealistic expectations. Is it all about applying as many bottom-up methods as possible and equal

participation by all parts of the quadruple helix or is it more important to find a pragmatic solution that requires political support and decision-making power? Again, both are not always possible at the same time. All these questions are not trivial at all. On the contrary, they need to be addressed through an open and honest debate.

The experience of the TRANSFORMER project shows that such discussions are necessary, and they were very important for the development of the pilot use cases which address a variety of critical topics identified for each region: In Emilia-Romagna, the focus is on harmonising existing mobility and energy initiatives. Lower Silesia prioritises convenient and environmentally friendly transport connections and the development of a framework for integrating public participation in energy-related decision-making using a Discrete Choice Experiment (DCE) method to gather citizen feedback. In the Ruhr Area, the pilot use cases centre on green hydrogen distribution and consumption in industrial processes and the heating sector, as well as aligning existing hydrogen initiatives. In Western Macedonia, the focus includes energy and mobility, agriculture and the circular economy, along with the creation of a transition living lab and dataspace in the city of Kozani.

Based on the outlined pilot use cases, the four TSLs developed their action plans following the ambitious goals of the project. On the one hand, they elaborated on concrete actions that would take place in a short term, some of them even during the project's lifetime. Here, the TSLs demonstrated in detail how individual pilot use cases could contribute to the development of a TSL: which resources are necessary, which stakeholders need to be involved etc. On the other hand, the TSL regions addressed another core claim of the project: long-term implementation and establishment of TSLs. Bringing both aspects together in a constructive way can be quite challenging, especially when there is no role model to follow.

As the action plans are the most concrete aspect of the project, reflecting on their development is important for understanding how to implement a TSL. Our experience of action plan development shows that it is not possible to deliver a universal recipe for accomplishing this task. The four action plans from the TSL regions vary significantly and clearly illustrate how specific regional contexts influence the direction and the focus of an action plan. Furthermore, within the broad topic of climate neutrality, there are many diverse subjects, and TRANSFORMER covered a variety of them. Such a complexity cannot be addressed just by a template or a too schematic approach. Nevertheless, while there is no one-size-fits-all recipe for developing a successful action plan for a TSL, a common structure for the action plans was deemed crucial by project partners. This structure will be a valuable resource to be shared with future TSLs.

In this regard, we realised during the project that the implementation of pilot use cases and the execution of action plans within a TSL require constant monitoring and assessment to ensure successful implementation. To address this need, we have developed the Evidence-Based use case Impact Assessment Methodology, which will be presented in the next chapter.

3.4 Monitoring, assessing and optimising the impact of the TSL activities

3.4.1 Conceptual considerations for monitoring, assessing and optimising the impact of the TSL activities

As mentioned in the previous chapter, it is essential that all TSL activities are continuously monitored, assessed, and optimised. This process includes setting clear benchmarks, key performance indicators (KPI) and milestones, allowing for continuous evaluation and timely adjustments to keep the project on course. Regular reporting and feedback mechanisms (e.g., surveys, questionnaires, and focus groups) are crucial, as they provide insights into the effectiveness of the activities and help ensure that

the project remains aligned with its intended outcomes. This particularly applies to evaluate the success of stakeholder involvement and engagement in the co-creation activities.
The results of the monitoring activities and the lessons learned should be shared with stakeholders, decision-makers, and the public to maintain transparency and accountability. These monitoring results can highlight successes and inform decision-making by pinpointing areas for improvement and necessary adjustments to the transition strategy.
However, since monitoring and evaluating transition processes and the impact of specific projects is a challenging endeavour which can be very resource-intensive, we developed two assessment frameworks: the *Methodology for Assessing the Efficiency and Success of the Transition Process* and the *Evidence-based use case Impact Assessment Methodology* were developed, which are described in the following section.

3.4.2 Reflections on monitoring, assessing and optimising the impact of the TSL activities

As discussed earlier, some TSL activities, such as implementing pilot use cases and executing action plans, could not be completed within the limited timeframe of our project. Consequently, the impact of these pilot use cases will be assessed after their implementation begins. However, based on our experience in developing pilot use cases and action plans, we have developed assessment frameworks that encompass both the evaluation of the TSL approach and the impact assessment of the pilot use cases.
For the assessment of the TSL approach, a **Methodology for Assessing the Efficiency and Success of the Transition Process** was developed based on the four steps of the open innovation process. For implementing the assessment, the TSLs should follow the phases and steps as indicated in the TRANSFORMER cross sectorial transition model that guide the process of the region's transition towards climate neutrality and monitor specific milestones at the end of each phase for measuring the success of the transition process towards climate neutrality (see deliverable D5.2).
TSLs should collect data at each step to quantify milestones, such as stakeholder engagement and identified weaknesses. A first quantification of these milestones to assess the results of the transition process was done at the end of TRANSFORMER project. However, the TSLs should continue collecting data to monitor their transition enabling activities and to develop best practices beyond the project.
The transition of the regions, also considering the potential complexity of some pilot use cases, can be a lengthy process. The ongoing monitoring and assessment of the pilot use cases will facilitate the implementation of the transition process for the regions.
For the impact assessment of the pilot use cases, an **Evidence-based use case Impact Assessment Methodology** was developed. The goal of this methodology is twofold: (1) the improvement of the operational readiness of the pilot actions and (2) the level of fulfilment of the regional needs and priorities through pilot outcomes.
The methodology suggests a six-step approach that TSLs should follow to achieve a structured and comprehensive impact assessment of the pilot use cases: (1) identification of the expected impact categories, (2) KPI identification, (3) baseline scenario definition, (4) TO-BE scenario definition, (5) analysis for impact determination, and (6) conclusions and overall impact determination.
Although TRANSFORMER TSLs discussed the anticipated impacts of each pilot use case and considered which impact indicators from the Evidence-based Use-case Impact Assessment Methodology might be suitable for measuring these impacts, the absence of regional datasets across various sectors related to climate neutrality could complicate the evaluation of some suggested indicators. Along with these

indicators, the TSLs defined more pilot use case-specific indicators during the elaboration of their action plans which were completed in May 2024. Although the first steps of the Evidence-based use case Impact Assessment Methodology took place within the TRANSFORMER project, the analysis of the impact will be completed at a later stage after the implementation of the pilot use cases.
The processes described above should be viewed as ongoing activities that contribute to the reassessment of the different activities of the TSL as well as of the strategic goals, objectives and targets of the pilot use cases.
The results of the assessment of the efficiency and success of the transition process and the Evidence-based use case impact assessment can be combined with the results of the transition readiness assessment to provide an overview of whether the different activities of the transition process improve the regional conditions contributing towards achieving climate neutrality, or if adjustments are needed. This highlights the iterative nature of the TSL process.
During the TRANSFORMER project, we continuously reflected on our experiences and further developed the TSL concept. These results are condensed into a blueprint for implementing a TSL and developing the necessary governance arrangements in a structured approach: the *Transition Super-Lab roadmap* and *TSL governance model*, which will be presented in the next chapter.

4 Further conceptualisation of the TSL approach and enhancing its replication potential

The TRANSFORMER project was an iterative experiment. Based on conceptual insights into systemic transition, the TSL concept was initially developed from a theoretical perspective (see chapter 2). The experience of implementing four TSLs revealed the challenges that arise when establishing a large-scale living lab and how we can address them. The most important outcome of refining and further developing the TSL approach was condensed into the Transition Super-Lab roadmap, which will be presented in the following section. Based on this, we will reflect on one crucial aspect of the TSL implementation and development: the governance arrangements and political legitimacy of the TSL approach.

4.1 The Transition Super-Lab roadmap

The Transition Super-Lab roadmap was developed with the overarching objective of creating a comprehensive, adaptable and replicable framework that would provide support to the regions in their efforts to accelerate the transition to climate neutrality. As the experiences in the TRANSFORMER project clearly have shown, the complexity and urgency of achieving climate neutrality requires integrated approaches and hence, the roadmap provides a comprehensive set of solutions by integrating various learnings and tools. Furthermore, the involvement of stakeholders from the quadruple helix in the TSL process ensures collaboration between government, academia, industry and civil society. The structure of the roadmap is based on four distinctive phases comprising various steps, activities and related milestones (see Figure 2) with a central focus on participation and co-creation.

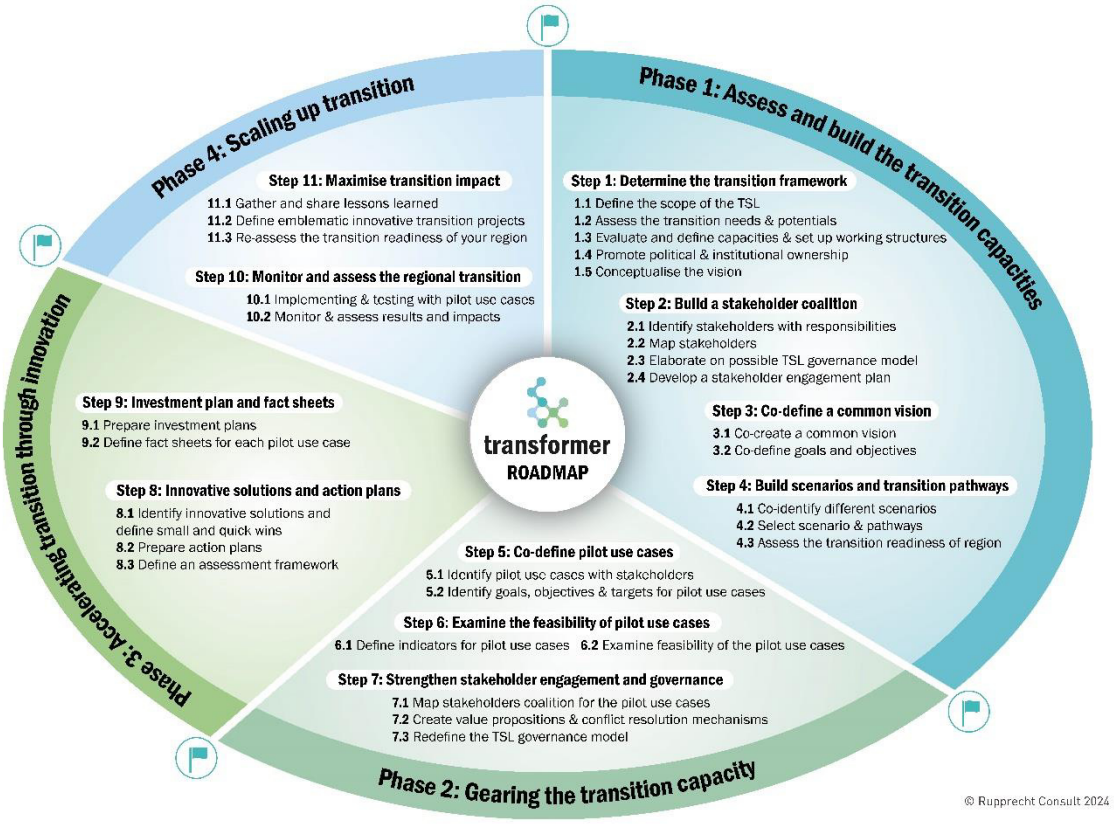

Figure 2: The Transition Super-Lab roadmap. Source: deliverable D4.2.

The primary objective of the **first phase** is to assess and build transition capacities. This phase commences with the initiation of the TSL at the regional level. In this phase, the transition needs and challenges are clearly identified, and the scope and overall framework of the regional transition are defined. An initial governance model is developed and working structures are defined. A TSL strategy is elaborated, including a stakeholder engagement plan with a clear value proposition and potential conflict resolution mechanisms. This serves as a basis for coalition building and the co-creation of a shared vision, including clear objectives, strategic pathways and transition scenarios for the regional transition.

The **second phase** of the roadmap is oriented towards the objective of gearing the transition capacities through the collaborative identification of pilot use cases with relevant stakeholders. Each pilot use case has its own set of goals, objectives and targets. Upon completion of this process, indicators are established, and the feasibility of pilot use cases is evaluated. The stakeholder coalition and the governance model defined in the first phase are reassessed and, if necessary, refined. For the different pilot use cases, stakeholder management strategies including clear value propositions and potential conflict resolution mechanisms are implemented.

The **third phase** of the roadmap is focused on accelerating the transition through innovation. In this phase, the action plans and assessment framework for each pilot use case are developed. Additionally, it sets forth innovative solutions, including small and quick wins, that are aimed to facilitate the acceleration of the transition process. The preparation of action plans represents a crucial step in the transition process, as they define time-bound actions with corresponding potential financial sources. The implementation of the pilot use cases is facilitated by the definition of comprehensive investment plans and detailed fact sheets around pilot use cases.

The roadmap cycle reaches its conclusion with the **fourth phase**, which facilitates the process of scaling up transition. In this phase, pilot use cases are implemented and tested, subsequently undergoing comprehensive monitoring and assessment of the results and impacts. During this process, lessons are continuously collected and shared. This ensures that, on the one hand, successful transition examples are easily replicated, and, on the other hand, potential challenges are addressed. Finally, a reassessment of the region's transition readiness is conducted to ensure that the activities undertaken during the transition process have the desired impact and are supporting the region in achieving its climate neutrality goals.

It is important to view the Transition Super-Lab as an iterative process rather than as a linear, activity-by-activity based-approach. The nature of this blueprint allows TSLs, considering their unique characteristics, to commence their pathways to climate neutrality at any phase or step and to revisit previous steps once progress has been made.

4.2 TSL governance model

Aiming for systemic transformation by co-creating interconnected, cross-sectoral solutions with various stakeholders creates numerous challenges related to governing such a diverse ecosystem. The governance arrangement must be inclusive, balancing the regional sustainability transition with the different local needs of communities. Simultaneously, it must be flexible enough to accommodate existing politically legitimised governance arrangements.

Therefore, in the TRANSFORMER project, we developed a blueprint for a **TSL governance model**[16] that aims at establishing coordination and management mechanisms on two highly connected governance levels, the TSL level and the pilot use case level, to ensure that regional and local transition needs and specific project needs (portfolio approach for systemic transformation) are aligned. On the overarching **TSL level,** the TSL requires a team that coordinates and manages the entire TSL: The **TSL coordination and management team** (see Figure 3). This team must consider the transition needs and potentials of the entire region and local communities, as well as the specific pilot use cases. The main tasks are the control of TSL actions (milestones and completion of tasks) and resources, the development of a value proposition for motivating stakeholders to participate, management of the TSL's stakeholders and strategic decision-making regarding day-to-day business. Another task of the coordination team is the anticipation of

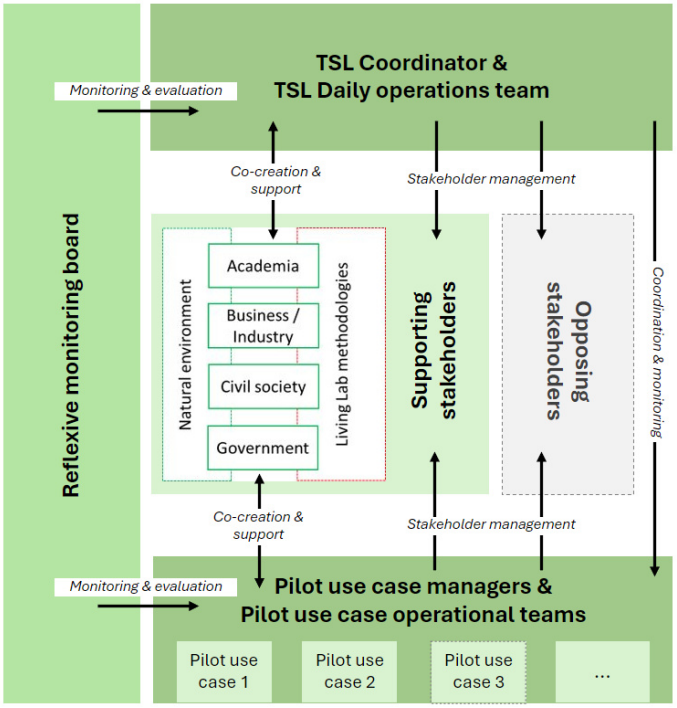

Figure 3: Stylised organigram of TSL governance blueprint. Source: own design.

[16] The following section is a summary or a verbatim quote from deliverable D2.3. For a detailed description of the TSL governance arrangement see deliverable D2.3.

future challenges and hurdles for the transition projects, including the design of strategies for managing veto players in the pilot use cases.

Another important governance body is the **reflexive monitoring board** that has to monitor whether actions taken in the TSL as a whole align with regional transition goals. The monitoring board consistently needs to question if the transition projects (pilot use cases) actually match the expectation of bringing down GHG emissions in the region, and if there is additional action that would be advised to reach this goal or if adjustments should be made. This regards transition-related content such as the monitoring and evaluation of the pilot use cases, but also the TSL processes. The board also advises the TSL coordination team on whether all necessary stakeholders are represented in the TSL's stakeholder coalition.

On the specific **pilot use case level,** a project-specific form of **governance** is required that may significantly differ from the overall TSL governance (depending on the complexity and scope of the project). However, every pilot use case needs to have at least one responsible organisation/person, the **pilot use case manager,** that interacts with the TSL management team. Otherwise, it should have an organisational structure that is suited to the tasks necessary to achieve the project´s objectives.

The most diverse group in a TSL are the coalition of supporting stakeholders, which should be formed with the idea of bringing together all groups from the quadruple helix. This coalition of stakeholders has the task of generating ideas and innovative solutions for the portfolio of transition projects by using living lab methods. Stakeholders from the different pilot use cases of the TSL will be part of this coalition. This coalition should be seen as a constantly evolving network of people and organisations, which are essential in pushing the transition goals of the region forward. Checking if all relevant and necessary stakeholders are part of the TSL coalition is the task of the reflexive monitoring board and the TSL coordination and management team. The pilot use case-specific stakeholder management should be conducted by the pilot use case manager, with the support of the TSL coordination and management team.

A particular group of stakeholders includes those who oppose the TSL or specific pilot use cases. They not only need to be addressed by a specific stakeholder management strategy (implemented by the TSL coordination and management team and/or the pilot use case manager), but in a TSL, the main goal should be to prevent the emergence of such opposition to the transition process and related projects. To ensure this, strategies for gaining political support and social acceptance of the TSL are of key importance. Two elements are considered especially important in this regard: the recognition of politically legitimised governance structures and inclusiveness. A TSL cannot and is not supposed to substitute or be in conflict with existing politically legitimised governance structures within a region, but it should have a complementary function. It needs to be in close coordination and exchange with (if not organised by) politically and democratically legitimised governance bodies of or within the region. The most important aspect of this criterion is inclusiveness. Inclusiveness and working with diverse stakeholders enable different voices to be part of the inception of ideas, thus ensuring a deliberative aspect, and part of decision-making. Inclusiveness also entails a recognition of differences and different values of stakeholders as well as the possibility to strive for an equitable distribution of benefits and burdens of a sustainability transition (Ciplet & Harrison, 2020). Inclusiveness also connects to an important principle of living lab methodologies, which is that diverse minds bring about better ideas. In short, there is the added benefit of a continuous production of ideas and innovative projects for addressing sustainability issues in the region (Caniglia et al., 2021). In our opinion, TSLs have a great potential to support a specific geographic scale, the region, in its trajectory towards a sustainable

future through a continuous process of incentivising, managing and monitoring the regions' sustainability transition.

5 Conclusions

In this paper, we reflected on the lessons learned from the two-year TRANSFORMER project. This pilot project was an experiment focussing on developing, implementing, and testing large-scale living labs for co-creating portfolios of cross-sectoral solutions to accelerate a systemic transition to climate neutrality: the Transition Super-Lab approach. Translating this theoretical concept into real-life actions in four European regions guided the key questions addressed in this paper: *How can the transition towards climate neutrality be accelerated from a theoretical perspective*? And building upon that: *How can these theoretical perspectives be translated into real-life actions to achieve a systemic transition towards climate neutrality*?

Very basically, our experience has shown that translating theoretical approaches into real-life activities requires a balance between ambition and feasibility. Given that the TSL approach is complex and iterative, time was one of the main bottlenecks in this project. Consequently, we had to develop the TSL steps and activities while simultaneously implementing and evaluating them. Additionally, some steps and activities could not be implemented due to time constraints. This must be considered when reflecting on the lessons learned.

Regarding the most important steps in developing and implementing a TSL, we have learned valuable lessons for all of them. Concerning the first step of "*defining the* thematic *and geographical scope of the TSL and assessing the transition needs and potentials of the region*", we recognised that developing innovative assessment frameworks was essential for gaining a deep understanding of the region and its feasible pathways to achieve climate neutrality. The two developed frameworks—the Quantitative Regional Assessment Framework for TSL (QRAFT) and the Transition Readiness Assessment Framework—were designed to provide this understanding and to be accessible to all stakeholders. This is crucial for enabling evidence-based discussions and reflecting on existing transition policies and narratives.

Concerning the second step of "*building a supporting coalition of stakeholders for the TSL and developing a vision for the transition*", our experience has clearly shown that it is essential to invest considerable effort in identifying, analysing, and engaging the stakeholders of a TSL and feasible pilot use cases. Moreover, we realised that a framework for TSL governance needs to be developed to structure the process in the four TRANSFORMER regions and guide potential follower regions in managing and coordinating their TSLs.

Regarding the third step of "*developing pilot use cases and executing action plans*", we have clearly recognised the need to balance ambition with feasibility. Developing and implementing too many pilot use cases simultaneously can jeopardise the ability to manage a TSL and to establish co-creation processes. Initially focusing on a few carefully selected pilot use cases as a foundation for building a coalition and demonstrating achievability is likely to be more successful in the mid- to long-term development of a TSL, and therefore in accelerating the transition to climate neutrality.

Concerning the fourth step of "*monitoring, assessing, and optimising the impact of TSL activities*", we have realised that additional frameworks are crucial to ensure that the goals, objectives, and targets of the TSL and the specific pilot use cases are met. This resulted in the development of the

Methodology for Assessing the Efficiency and Success of the Transition Process and the Evidence-based use case Impact Assessment Methodology.
All the lessons learned from developing and implementing TSLs have been reflected upon and condensed into the Transition Super-Lab Roadmap. This roadmap serves as a blueprint for implementing a TSL and offers a structured approach for conducting all activities, including assessments and necessary iterations.
Finally, this paper itself reflects an important lesson: the value of translating theoretical approaches into real-life actions and sharing these insights. Disseminating experiences and best practices is crucial for building a coalition of transition supporters across different projects and TSLs, thus accelerating the transition toward climate neutrality.

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Annex: List of deliverables providing the basis for the working paper

Deliverable D2.1

Meister, T. (2024): D2.1 Summary of data collection on TSL predecessors. Available at: https://transformerknowledgehub.imet.gr/wp-content/uploads/2024/06/D2.1_Summary-of-data-collection-on-TSL-predecessors.pdf (last access: 27.08.2024)

Deliverable D2.2

Meister, T.; Wiemann, J. (2024): D2.2 Quantitative mapping research report. Available at: https://transformerknowledgehub.imet.gr/wp-content/uploads/2024/06/D2.2_Quantitative-mapping-research-report.pdf (last access: 27.08.2024)

Deliverable D2.3

Meister, T.; Wiemann, J. (in review): D2.3 Regional SWOT analyses as feasibility studies to be used as evidence-base in decision-making for action plan development. Available at: URL not available yet.

Deliverable D3.1

Zalokar, S., Chakroun, M., Domanski, D., Ayfantopoulou, G., Benini, A., Cello, L., Giergiczny, M., Konstantinidou, M., Lemanik, L., Luppino, G., Ptochoulis, P., Pudelko, R., Simeoni, T. (2024): D3.1 Recommendations for Transition Super-Lab coalitions building, empowering of vulnerable and marginalised groups, and vision process (BMR). Available at: https://transformerknowledgehub.imet.gr/wp-content/uploads/2024/06/D3.1_Recommendations-for-Transition-Super-Lab-coalitions-building-empowering-of-vulnerable-and-marginalised-groups-and-vision-process_public.pdf (last access: 27.08.2024)

Deliverable D3.2

Domanski, D., Ayfantopoulou, G., Benini, A., Cello, L., Chakroun, M., Giergiczny, M., Konstantinidou, M., Lemanik, L., Ptochoulis, P., Pudelko, R., Zalokar, S. (2024): D3.2 Definition of Transition Super-Lab use cases. Available at: URL not available yet.

Deliverable D3.3

Domanski, D., Benini, A., Konstantinidou, M., Ptochoulis, P., Pudelko, R., Simeoni, T. (in review): D3.3 Transition Super-Lab ActionPlan (APs per TSL as Annex). Available at: URL not available yet.

Deliverable D3.4

Konstantinidou, M., Ayfantopoulou, G., Astegiano, P., Benini, A., Cello, L., Cerna, V., Domanski, D., Meister, T., Ptochoulis, P., Pudelko, R., Simeoni, T., Zalokar, S. (in review): D3.4 Transition Super-Labs' Lessons Learned. Available at: URL not available yet.

Deliverable D4.2

Juliat, M., Nemsadze, O., Böhler-Baedeker, S., Hussin, H., Meister, T., Wiemann, J., Konstantinidou, M., Astegiano, P., ER, L. (in review): D4.2 Transition Super-Lab Roadmap. Available at: URL not available yet.

Deliverable D5.1

Ayfantopoulou, G., Konstantinidou, M., (2024) D5.1 Framework for Super-Labs Assessment - version 1. Available at: https://transformerknowledgehub.imet.gr/wp-content/uploads/2024/06/D5.1_Framework-for-Super-Labs-Assessment_public.pdf (last access: 27.08.2024)

Deliverable D5.2

Ayfantopoulou, G., Konstantinidou, M. (in review): D5.2 Framework for Super-Labs Assessment - version 2. Available at: URL not available yet.