

Putting sustainability transitions “on the ground”. Three arguments for a stronger integration of spatial planning and sustainability transitions scholarship

Johannes Suitner , Meike Levin-Keitel 

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Abstract

In this paper, we argue that one reason for the insufficient materialisation of sustainability objectives is a manifest gap between the prescriptive system knowledge of transition studies and the variegated local lifeworlds where transformations ultimately happen. Spatial planning offers valuable expertise to operationalise this system knowledge and move from abstract calls for one great transformation to concrete local transformations. We begin by reviewing debates that have already alluded to a polymorphism in sustainability transitions. Then we look at the discourse on planning for sustainability transitions, noting how it is nourished by transition knowledge, while adding significant perspectives on spatiality, implementation and politics. Subsequently, we point to three spatial planning literacies that can add value to sustainability transitions research and the implementation of transitions on the ground: (1) A nuanced view on space that adds a material, functional, legal and cultural dimension to the scalar and institutional geographies of transitions, (2) an understanding of local (state) instruments, formal procedures, property and law,

planning systems and cultures, and (3) future literacy through scenario-thinking, co-creation and experimentation as modes of democratic, sustainable future-making. We hence invite planning scholars to use their specific spatial, instrumental and future literacy to become more involved in sustainability transition debates to aid the local operationalisation of transition knowledge.

Keywords: Sustainability transitions ■ Spatial planning ■ Transformative planning

Nachhaltigkeitstransformation „auf den Boden bringen“. Drei Argumente für eine stärkere Integration von Raumplanung und Transitionsforschung

Zusammenfassung

Ein Grund für die mangelnde Umsetzung von Nachhaltigkeitszielen ist eine veritable Lücke zwischen dem präskriptiven Systemwissen der *transition studies* und den vielfältigen lokalen Lebenswelten, in denen Transformation stattfindet. Die Planungswissenschaften verfügen über wertvolles Fachwissen, um dieses Systemwissen zu operationalisieren und von abstrakten Forderungen nach einer großen Transformation zu konkreten lokalen Transformationen zu gelangen. Wir zeigen in diesem Beitrag, welche Debatten die lokale Vielfalt in Transformationen schon thematisiert haben. Dann blicken wir auf den Diskurs zu Planung und Transformation und stellen fest, dass er sich aus den *transition studies* speist, aber andere Schwerpunkte auf Räumlichkeit, Umsetzung und Politik legt. Wir erkennen darin drei Expertisen mit Mehrwert für die lokale Operationalisierung von Nachhaltigkeitstransformationen: (1) Ein differenzierter Blick auf Raum und Ort, der die skalaren und institutionellen *geographies of transitions* um

✉ **Assistant Prof. Dr. Johannes Suitner**, Forschungsbereich Stadt- und Regionalforschung, Technische Universität Wien, Karlsgasse 11, 1040 Wien, Austria
johannes.suitner@tuwien.ac.at

Prof. Dr. Meike Levin-Keitel, Institut für Geographie und Regionalforschung, Universität Wien, Universitätsstraße 7/5, 1010 Wien, Austria
meike.levin-keitel@univie.ac.at



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materielle, funktionale, rechtliche und kulturelle Dimensionen erweitert, (2) ein Verständnis lokaler (staatlicher) Instrumente, formaler Verfahren, von Eigentum und (Planungs)Recht, Planungssystemen und -kulturen und (3) Zukunftskompetenz, die durch Szenariodenken, Visionierung und Reflexion Transformationspfade transparent macht. Wir laden Planungswissenschaftlerinnen und -wissenschaftler daher ein, sich mit ihrem Raum-, Instrumenten- und Zukunftswissen stärker in den *sustainability transitions* Diskurs einzubringen und so die lokale Operationalisierung von Transformationswissen zu unterstützen.

Schlüsselwörter: Nachhaltigkeitstransformation ■ Raumplanung ■ Transformationsplanung

1 Introduction: Sustainability transitions scholarship and spatial planning research – Relating complementary perspectives on transformative change

While the urgency for rapid transformations towards sustainability is beyond question, sustainability transitions scholars often lament an insufficient materialisation on the ground (Patterson/Soininen/Collier et al. 2021; Rosenbloom/Meadowcroft 2022).¹ Sustainability transitions research offers a wealth of knowledge about socio-technical systems, explanations for their (lack of) sustainability, and the process and governability of their sustainable transformation (Elzen/Geels/Green 2004; Smith/Stirling/Berkhout 2005; Markard/Raven/Truffer 2012). Authors thus argue that knowledge about complex systems, sustainable technologies and desirable futures is sufficient, but that it is not implemented for transformations at an appropriate pace and quality (Engert/Baumgartner 2016; Laurian/Crawford 2016; Markard/Geels/Raven 2020). We suggest that one reason for the veritable gap between “prescriptive” (Turnheim/Sovacool 2020) transition theory and the materialisation of sustainable transformations on the ground is an issue of translation.

Over the past decades, sustainability transitions has established itself as a prominent field of research into sustain-

able development. Building on a broad foundation of systems theory, innovation theory and institutional theories – to name but a selection –, sustainability transitions scholars have developed a profound understanding of complex socio-technical systems (such as energy or mobility), the variables influencing their stability and change, and how sustainability transitions might thus be sparked or deliberately designed (Markard/Raven/Truffer 2012; Loorbach/Frantzeskaki/Avelino 2017). Related concepts such as the Multi-Level Perspective (Geels 2002) have hence developed into ubiquitous notions of sustainable system change that are applied across disciplines and are employed to explain a whole spectrum of phenomena and cases (Markard/Raven/Truffer 2012; Geels 2019).

However, the engagement with transitions from a universal systems perspective sometimes seems to contrast with the reality of the variegated local lifeworlds where transitions and transformations ultimately happen. Transferring the extensive systems-oriented knowledge of sustainability transitions to the local level and operationalising it for very concrete issues of sustainable transformation requires skilful translation work. The focus on agency processes (cf. for instance Frantzeskaki/Castán Broto/Coenen et al. 2017) and the advent of a social practice perspective (cf. Shove/Walker 2007 among others) have already downsized the gap between abstract systems thinking and the concrete “doings” of sustainability. However, the practice turn has not filled the void when it comes to the variegated operationalisation, physical materialisation and actual placement of sustainable transformations. In our view, spatial planning can bridge this gap through its distinct spatial, instrumental and future literacy.

In this paper, we discuss these literacies in detail. We begin with a literature review of the two disciplinary pillars – sustainability transitions and spatial planning – first portraying how the governance of transitions, geographies of transitions and the multi-sector approach to transitions have enabled a more differentiated debate about context-sensitive and, thus, polymorphic transitions. Then we describe how spatial planning increasingly deals with sustainability transitions, while focusing on very distinct notions and themes from its specific disciplinary perspective (Section 2). Consequently, we highlight spatial, instrumental and future literacy as three areas of spatial planning knowledge that can add significant value for understanding and operationalising transitions (Section 3). In conclusion, we thus invite planning scholars to become more involved in sustainability transitions to generate an impactful symbiosis that can aid the local operationalisation of transition knowledge and its application in practice (Section 4).

¹ In this paper, we refer to “sustainability transitions” as a field of research on socio-technical systems and their change towards more sustainable technologies and practices, whereas “sustainable transformations” refers to the sustainability-oriented drastic makeover of material urban (infra)structures and associated practices.

2 Literature review

2.1 Emerging polymorphism in sustainability transitions discourse

Transition studies is an interdisciplinary field, largely rooted in science and technology studies, innovation studies and complex adaptive systems thinking (Grin 2016). In general terms, it is concerned with the long-term, deep-seated, structural and cultural change of fundamental societal systems (Geels 2002; Elzen/Geels/Green 2004; Loorbach/Frantzeskaki/Avelino 2017). Transitions are hence defined as profound (or radical), non-linear change processes that involve a modification of both societal practices and their structural, institutional and discursive embedding (Grin 2016). Transition research is often motivated by persistent (or wicked) societal problems, most prominently, sustainability issues such as resource overconsumption, nature degradation or injustice that are difficult to address through technological fixes alone but call for comprehensive approaches (Farla/Markard/Raven et al. 2012). Thanks not least to its societal relevance, sustainability transitions scholarship has thus developed into a prominent subfield of transition studies in the past one and a half decades (Markard/Raven/Truffer 2012).

Sustainability transitions is characterised by a constantly growing variety of conceptual and empirical contributions from different disciplines, which in their entirety enhance understanding of transition processes, their components' interactions and interdependencies, and their pathways of change from an unsustainable to a more sustainable system state. In most cases, this research is accompanied by a decidedly normative attitude on the part of the researchers, which is why the scientific foundation of sustainability transitions research is often viewed as prescriptive (cf. Turnheim/Sovacool 2020). Not least due to the implicitly normative orientation of the field, some commentators have noticed a lack of engagement with the politics of persistent problems and their resolution (Meadowcroft 2011) – a criticism that has been taken up in recent years, e.g., by introducing power as a concept in transitions (Avelino 2017), reflecting on competing framings of sustainability (Haarstad 2017), or studying resistance and backlash against transition endeavours (Patterson/Paterson 2024).

Another point of criticism has been the lack of engagement with geography, space and place in transitions (Coenen/Benneworth/Truffer 2012; Levin-Keitel/Mölders/Othengrafen et al. 2018), which has recently led to increased attention being paid to local specifics and transitions *in context*. We interpret this as a sign of an emerging polymorphism in sustainability transitions, opening conceptual doors for the concrete operationalisation of calls

for sustainable system change on the local level – a development that we deem necessary for the realisation of sustainable transformations. We want to highlight the following strands of discourse that pave the way to such a shift by contributing to a more context-sensitive perspective.²

Governance of transitions Driven by the dilemma between the uncertainty of transitions and aspirations to deliberately design them, the governance of transitions emerged as another strand contributing to the polymorphism of transitions. Kemp, Rip and Schot (2001) emphasised that sustainability transitions are unlikely to simply happen, they rather require awareness and guidance. Specific transition pathways consequently need to be moulded to fit existing trajectories, resources and opportunities (Kemp/Rip/Schot 2001). Today, the political-institutional contexts of sustainable innovations and the power and agency that facilitate their embedding and implementation are a core concern of research in the governance of sustainability transitions (Newig/Voß/Monstadt 2007). For instance, Hodson, Geels and McMeekin (2017), looking into sustainable mobility in different cities, point out that for successful transition endeavours, the development of new social or technological solutions is often less important than the proper *reconfiguration* of existing sustainable technologies and practices to make them fit in specific places with their unique institutional structures. Such studies have contributed to a more nuanced understanding of why and how transitions succeed or fail in specific socio-technical systems, policy areas and governance contexts.

Transition management emerged as one of the first prominent transition governance approaches. Rooted in Dutch environmental policy, it began in 2001 as an experiment to co-design long-term societal change towards sustainability and developed into a prominent governance model for the concerted efforts of science, policy, business and civil society to transform unsustainable systems (Loorbach 2007). Transition management proceeds through the conceptual phases of a transition process – from pre-development and take-off to acceleration and stabilisation – defining different government roles and tasks for each phase (Kemp/Rotmans 2005). Strategic niche management constitutes an important measure in the pre-development phase of transitions (Kemp/Rotmans 2005). It builds on the multi-level perspective and its interpretation of innovative niches as part and

² It is important to note that these strands are not separate, isolated debates, but interconnected discourses with certain overlaps (e.g., regarding their application of institutional theory for explaining variability in transitions) that together contribute to a more nuanced understanding of the polymorphism of transitions.

parcel of sustainability transitions (Geels 2002). Strategic niche management aims at nurturing innovative potential for the development of sustainable solutions by encouraging, establishing and funding protected spaces and has become a widely employed approach in transition governance (Schot/Geels 2008). This call for promoting niches and experiments has resonated with many in academia and practice, opening the door for labs and experiments as two further transition governance approaches that have received significant attention recently. Both real-world laboratories and experiments start from the assumption that resolving wicked problems demands a trial-and-error attitude of learning-by-doing, and both acknowledge the variability of sectors, institutions and geographies as factors that should go into the design of such interventions (Renn 2018). In experimentation literature, the specifics of place are increasingly prominent, as research explains how such interventions are often rooted in specific local problematisations of sustainability and transformation, and how experimentation is considered a vehicle for putting concrete sustainable innovations “on the ground” in the specific structural and cultural settings of place (Loorbach/Wittmayer/Avelino et al. 2020, Suitner/Haider/Krisch 2024). With these and other accounts, the governance of transitions discourse has added to the notion of local variability in transitions.

Geographies of sustainability transitions For a long time, space and place received no significant consideration as conceptual or analytical categories in sustainability transitions. Put simply, no fundamental distinction was made between the problems and phenomena of sustainable change in, say, urban core areas in contrast to peripheral regions. Some studies differentiated between transition pathways at the level of national economies (cf. for instance Solomon/Krishna 2011), while most analysed specific individual cases of sustainable transformations decoupled from any context beyond technological innovation systems, global market logics and unbound institutional regimes (Binz/Coenen/Murphy et al. 2020). Shove and Walker (2007), while more interested in the politics of transitions, were among the first to point to the relevance of contextual differences for how transitions play out. Coenen, Benneworth and Truffer (2012) later lamented that sustainability transitions research prioritised historical over spatial explanations, criticising that space was either missing as an analytical category or was naively conceptualised through containerised views. They proposed considering the institutional embedding and multiscalarity of transitions for a more spatially sensitive approach. Truffer, Murphy and Raven (2015) further highlighted socio-spatial embedding to explain different degrees of agency for transitions in different places. These and other

papers already hinted at the plethora of studies to emerge in the subfield of geography of transitions in the coming years. A decade later, the geographies of sustainability transitions is a thriving research field with a lively community³ that has aided a differentiated perspective by incorporating a geographical lens focusing on the spaces, places and scales of transitions (Binz/Coenen/Murphy et al. 2020).

Inspired by the significance of cities as arenas and agents of change (Egermann/Ehnert/Wolfram et al. 2024) and the notion that context matters for transitions, urban sustainability transitions emerged in parallel – a distinct strand of discourse informed by urban studies, human and political geography that is focused on unravelling the specifics of sustainable transformations in the urban sphere (cf. Bulkeley/Castán Broto/Hodson et al. 2011; Frantzeskaki/Castán Broto/Coenen et al. 2017, among others). Urban sustainability transitions research has added a more nuanced perspective on the interplay between transition processes and the multi-layered nature of urban space with its locally variegated social, cultural and political characteristics (cf. for instance Reiß/Artmann 2023; Baatz/Ehnert/Reiß 2024). It thus complements the contribution of the geography of transitions by providing a more differentiated understanding of how sustainability transitions unfold in concrete places with their specific governance arrangements, politics and spatialities – first in individual case studies of major cities like London or Berlin (cf. Egermann/Ehnert/Wolfram et al. 2024) and, more recently, in comparative studies (cf. for instance Ehnert/Frantzeskaki/Barnes et al. 2018). With their respective findings on the context-sensitivity of transitions, both the geography of transitions and urban sustainability transitions discourse have pointed to the necessity of translating ubiquitous transition theories into tailored strategies for putting transitions “on the ground”.

Multi-system approaches to transitions Research on multi-system interactions has further extended the polymorphism of transitions by addressing questions of mutual influence between transitions in different socio-technical systems (Papachristos/Sofianos/Adamides 2013; Rosenbloom 2020; Andersen/Geels/Steen et al. 2023). Sandén and Hillman (2011) identified three dimensions of interaction: material assets, organisations and actors, and knowledge and rules. Some scholars concentrate on couplings between systems, where “functional couplings” pertain to resource flows (e.g., energy and materials), while “structural couplings”

³ Cf. <https://www.transitionsnetwork.org/thematic-groups/geography-of-sustainability-transitions-geost/> (13 August 2025).

involve actors, institutions or technologies shared across systems (Konrad/Truffer/Voß 2008). Recent approaches sketch the contours of a multi-system perspective as diverse, layered and evolving (Rosenbloom 2020). Here, systems’ boundaries are reconfigured to take into account the range of different implementations as well as the multi-level approaches through which transitions emerge, like multiple geographical scales. The evolutionary nature of a multi-level perspective stresses the procedural and changing interrelatedness of sectoral transitions.

Understanding multi-system transitions with their interdependencies across sectors is vital, given that sustainability challenges often transcend individual systems. However, most studies focus predominantly on national-level transitions (e.g. Andersen/Geels/Steen et al. 2023; Ohlendorf/Löhr/Markard 2023), while overlooking local dynamics. A few exceptions exist, such as Rosenbloom (2020), who highlights the importance of subnational transitions. However, the spatial dimension and ensuing diversity is not directly addressed in these conceptualisations, although the multi-system approach helps to coordinate sectoral transitions and their (spatial) demands with other systems, while embedding these interrelated and interwoven systems in locally specific contexts. Multi-system transitions therefore present a step forward in explaining place-specific processes (Coenen/Benneworth/Truffer 2012; Chlebna/Martin/Mattes 2023) and show that interactions between socio-technical systems often depend on local contexts.

2.2 Planning for sustainability transitions

When we speak of spatial planning, we refer to the institutional activity responsible for governing the development of settlement areas, infrastructures and open spaces to best cater for societal development (Moroni 2020).⁴ We also refer to it as the scientific discipline that theorises and reflects on this institutional activity to educate future planning experts and improve planning praxis. We hence argue that planning research and planning praxis are two “communicating vessels”. More than in other scientific disciplines, spatial planning – with its focus on real-world problems and their governance to achieve societal stability and navigate change – constantly meanders between analysis and future intervention (Levin-Keitel/Behrend 2023). The boundaries between research and praxis are hence per se blurred – as is now also becoming the case in neighbouring fields that are calling for (or experiencing) a transformative turn

(Wittmayer/Hölscher 2017). This implies that the planning discipline can serve as an adequate entry point to local policy and practice – something sustainability transitions scholarship is craving for to accelerate transitions and create impact – hence putting transition knowledge “on the ground” (Levin-Keitel/Mölders/Othengrafen et al. 2018).

The links between planning and sustainability transitions seem obvious. Sustainability problems are an undisputed and long-known challenge of societal development (Rogers/Jalal/Boyd 2007). They have a reciprocal cause-and-effect relationship with spatial development, as many sustainability problems materialise in spatial structures or are reinforced by existing structures (Naess 2001). Their resolution therefore goes hand in hand with profound spatial transformations. It comes as no surprise that sustainable spatial development has thus for decades been a key theme in local and regional development, urban and regional governance, and urban development policy, as well as a perennial topic in urban and regional research (Healey/Shaw 1993; McDonald 1996; Naess 2001). It is only recently though, that the urgency of the polycrisis and the boom of transformation as a research area, policy discourse and common buzzword have caused a shift in terminology to sustainable (spatial) transformations and transformative planning.

Nourished by transition knowledge, a number of studies have recently addressed sustainability transitions from a planning perspective – also in this journal. Links to sustainability transitions research are typically made by applying established transition studies concepts such as transition management to planning issues (Schröder/Klinger 2024), or by transferring a key question from the sustainability transitions discourse – such as how to accelerate transitions – to spatial planning considerations (von Seht 2024). The focus is often on individual case studies of concrete sustainability problems in specific policy areas such as energy (cf. for instance Eichenauer 2023), although some studies have addressed the interface of sustainability transitions and planning on a more general, conceptual level (cf. Wolfram 2018; Hartl/Harms/Egermann 2024). Likewise, novel transformational concepts or policies such as degrowth (Brokow-Loga/Krüger 2023) or zero land-take (Lacoere/Leinfelder 2023) are often reflected upon in light of specific local conditions or planning policies. With these and other studies, planning research has not just visibly contributed relevant additional insights to the buzzing transformation discourse. Driven by its disciplinary tradition and theoretical grounding, it has also added three significant perspectives on the spatiality, local implementation and politics of transitions.

First, while the geography of transitions, with its relational understanding of space and its emphasis on multi-scalar institutional contexts, has established a general awareness of the geographical variability of transitions, studies of

⁴ In our opinion, the latter would need to include “above minimum societal standards and within maximum ecological limits” as an addendum.

sustainability transitions inspired by spatial planning have further broadened the range of relevant perspectives on the spatiality of transitions. For instance, authors in planning increasingly address the role of place in transitions (Deutz/Jonas/Newsholme et al. 2024; Loeber/Kok 2024; Suitner/Krisch 2024), herewith giving more emphasis to the cultural, cognitive and political aspects of spatiality than the innovation- and institution-oriented geographies of transitions. Others have also discussed concrete issues of land availability and land conflict in transitions (cf. for instance Lacoere/Leinfelder 2023), highlighting how one of the most fundamental concerns of planning research and praxis pertains to the success of just and sustainable transitions.

Second, the literature discussing the governance of transitions has made significant efforts to increase understanding of and design effective procedures for guiding socio-technical systems on their paths to sustainability in specific policy areas, using targeted methods of intervention. However, there has been little consideration of the question of how systemic, innovation-driven conceptions of sustainable change could best be put forward in specific territorial contexts with their specific governance procedures, (hard and soft) instruments, and in line with an established local political and planning culture. Planning research has made important contributions to fill this gap by pointing out the key role of the local state and the specific formal instruments and procedures of spatial planning as variables in local transition efforts (Bush 2020; Eichhorn/Adam/Schürholt et al. 2024; von Seht 2024). Scholars have particularly focused on land-use plans as an instrument for operationalising sustainability transitions (Persson 2013; Calvert et al. 2022), showing how planning instruments and knowledge about their functionality matter for the implementation of transitions.

And third, while the focus of transition studies is by nature on the procedural dimension, early studies of socio-technical system transitions were predominantly oriented towards historical perspectives on transition patterns and drivers of change (cf. for instance Geels 2002; Solomon/Krishna 2011). Due to its normative stance, sustainability transitions has a more pronounced future-orientation (Turnheim/Sovacool 2020). The question as to which knowledge, solutions or governance approaches are most effective in achieving socio-technical system change is at the heart of sustainability transitions (Kemp/Rip/Schot 2001; Markard/Geels/Raven 2020). Consideration of the influence on transitions of socio-technical imaginaries and dominant ideas about a certain kind of future has added a more political note to the debate (cf. Jasanoff/Kim 2009; Feola/Goodman/Suzunaga et al. 2023). Reflecting on current trends and expected change, scenario thinking, designing visions and initiating concrete developments to facilitate deliberate change

towards an intended future is part and parcel of the everyday doings of the institutional activity of spatial planning (Healey/Shaw 1993; Moroni 2020). The interface between planning, sustainability and resilience is therefore evident and has been addressed by planning and transition scholars alike (cf. for instance Wilson/Piper 2010; Elmqvist/Andersson/Frantzeskaki et al. 2019), pointing to the unique expertise of planners when it comes to sustainable future-making.

In the following section, we further elaborate on these aspects as three planning literacies that we consider important for operationalising transitions. It is important to note that these literacies build on a critical realist notion of space that acknowledges both the relevance of an objective material, biophysical reality for sustainable transformations, and the existence and influence of diverse individual and collective perceptions of space and deliberative (and potentially competing) constructions of this material reality. We can then juxtapose seemingly disparate philosophical understandings of space as specific qualities of how planning interprets and interacts with society, space and their respective transformations. Such diversity in the readings (and theories) of space is also characteristic of the (urban) sustainability transitions discourse, where realist and social-constructivist perspectives have made equally valuable contributions to explaining patterns and variability in transitions (Egermann/Ehnert/Wolfram et al. 2024). To us, this diversity in readings of space constitutes one of the key anchoring points of the two fields, as the following elaborations show.

3 Operationalising transition knowledge with three planning literacies⁵

3.1 Spatial literacy: Materiality and meaning

There has been much debate about sustainability transitions lacking a context-sensitive perspective that highlights regional differences in transition patterns (Coenen/Benneworth/Truffer 2012; Levin-Keitel/Mölders/Othengrafen et al. 2018). We describe above how the discourses of

⁵ This assessment comes with one caveat: it is based on our experience as planning researchers and years of observation of the scientific and praxis landscape in spatial planning in the Germanic planning context with its historical, cultural, institutional and judicial specifics. We are well aware that these literacies may hence look different in other planning cultures and planning systems. However, we consider our perspective to be a good starting point for further advancing the contextual differentiation of key planning literacies at the interface with sustainability transitions.

geographies of transitions and urban sustainability transitions have successfully aimed to resolve this issue. Ensuing work has provided lots of relevant insights into the specific challenges of transitions in different institutional contexts, innovation systems and (national) economies, as well as an important perspective on transitions in different types of places, most prominently, cities. They have thus certainly contributed to a better contextualised understanding of sustainable system change.

Material space: Built structures, nature and land We agree with the criticisms stemming from this strand of discourse that transition studies often “implicitly suppose that transition processes play out (and can be analysed) within the boundaries of pre-given, and often formal, geographical categories such as ‘cities’, ‘regions’, ‘nations’ or ‘the global South’” (Binz/Coenen/Murphy et al. 2020: 2). Furthermore, other authors have also complained that the sustainability transitions discourse lacks sufficient consideration of material dependencies in the governance of transitions (van Assche/Duineveld/Beunen et al. 2022). Such materialities include physical spatial structures such as high density building in urban centres with very specific physical infrastructures like urban energy networks or transport systems. The facilities, streets and pipes that ultimately constitute these materialities are often immediately linked to formal geographies such as “the municipality”.

Hence, we argue that a differentiated spatial lens – while in dire need of the multi-scalar and institutional perspective that the geographies of transitions discourse calls for – needs at the same time to go beyond this perspective and address material spatial realities such as biophysical conditions, topography, distance and the availability of land as further determinants (cf. for instance Wamsler/Brink/Rivera 2013). From a spatial planning perspective, these factors become decisive once we shift our focus away from innovation perspectives on, say, renewable energy technologies such as wind turbines to their concrete materialisation in the form of a wind park in search of the “best” (or rather, most cost-efficient or socially accepted) location.

This perspective is important. The materialisation of sustainability objectives “on the ground” ultimately boils down to questions of location (e.g., for wind turbines) and distance (e.g., for active transport infrastructure). It hence requires knowledge of materialities like building stock and land availability, and their suitability for different kinds of development as the “real” context of sustainable transformations. This kind of knowledge can be provided by spatial planning.

In addition, a perspective on biophysical materialities also puts natural resources centre stage – not just as potential resources for more sustainable modes of production

(e.g., in a regional bioeconomy). It highlights the necessity of supplementing the rather ecomodernist, technology-driven sustainability transitions discourse with an ecosocial perspective that particularly engages with the maximum ecological limits of transformation. Thinking beyond the commodification of renewable natural resources as facilitators of sustainable system change immediately entails questions of nature conservation and protection – an aspect that is inseparably linked with land-use planning and hence deserves to be addressed in the local operationalisation of sustainable transformations. We expand on this in Section 3.2.

Socio-cultural space: Sense of place and place-dependencies Another important perspective is the socio-cultural dimension of space. With its focus on rational change mechanisms, such as technological innovation, market formation or household behaviour, transition studies has long been blind to aspects such as imagination, aspirations or emotions associated with radical change (cf. Feola/Goodman/Suzunaga et al. 2023; Bogner/Kump/Beekman et al. 2024). In spatial planning, this dimension of space – from local traditions, self-understandings and framings to attitudes and images of place – has been included as an influential factor of spatial development at least since the political turn in planning (Othengrafen 2012). This “sense of place” constitutes the sometimes hard-to-grasp cognitive representations of a specific locale that turn into dominant drivers of social action after numerous iterations of discursive meaning-making (Sum/Jessop 2013). In simple terms, it can be described as those “imagined path-dependencies” that explain why certain transition endeavours or sustainable technologies fail to find a footing in some cities or regions while thriving in others. It is – at least in part – because they fail to fit into a local self-image, identity or problem framing of place (Feola/Goodman/Suzunaga et al. 2023; Suitner/Haider/Krisch et al. 2025). A socio-culturally sensitive lens can also enhance perspectives on key issues of sustainability transitions such as scaling (Bögel/Augenstein/Levin-Keitel et al. 2022).

Research addressing the ensuing multi-layered place dependency of transitions is still rare though. Loeber and Kok (2024), for instance, point out how intermediaries in sustainability transitions are deeply linked with local identity, place-based networks and place-based learning. Von Wirth and Levin-Keitel (2020) explain how sustainability experiments interact with their respective socio-spatial contexts. And Suitner and Krisch (2024) demonstrate how key actors’ knowledge and reflexivity of local material, institutional and socio-cultural spatial specifics influence the success of local sustainability initiatives.

If we agree that place-sensitivity is a factor in transitions, spatial planning – with its nuanced understanding of

how materiality and sense of place, territoriality and multi-scalar institutional contexts combine into a full-fledged picture of the spatiality of a specific locale – can be of great value for putting sustainability transitions on the ground. A concrete example (among many) is multi-criteria locational analysis, which is a prerequisite when it comes to implementing concrete sustainable infrastructure projects in space. A further example is provided by the analysis of identity and image, frames and imaginaries, the mapping of socio-cultural space and the design of an ensuing place-based development perspective or vision.

3.2 Instrumental literacy: Rules, regulations and state-led action

Sustainability transitions has long lacked debate on the role of the public sector and the local state as actors in and resources for acceleration (cf. Johnstone/Newell 2018 for one of the few exceptions). We argue that planning as an institutional activity (Moroni 2020) falls exactly into this representation of the public sector and the local state and should hence be discussed in the context of transitions and the state with more emphasis. Previous studies have already addressed the role of planning as a specific governance mechanism for strategically preparing and institutionally embedding transitions (cf. Hrelja/Hjerpe/Storbjörk 2015; Nieminen/Salomaa/Juhola 2021). However, these studies have not gone into more detail concerning the actual instruments and ensuing questions of decision-making and the challenges of putting transitions on the ground.

We contend that the local level presents not merely a challenge in terms of implementation, but also a set of unresolved questions pertaining to the role of the local state, the nature of democratic decision-making in a multi-level governance system, and the relative efficacy of top-down and bottom-up approaches to the diffusion of innovation. There is a clear opportunity to transfer and translate questions of rules and regulations, operationalisation and control approaches, as well as state guidelines from planning research into transition studies. As Mölders and Levin-Keitel (2022) showcased, the contributions of spatial planning go far beyond the deepening of (already well-studied) system knowledge. They further involve engagement with (contested) target knowledge, transformative knowledge and the frequently asked question of implementation and society-driven transformations. These different forms of knowledge apply to legal norms and regulations, as well as formal and informal planning instruments, which can be used as communication and cooperation tools. The mobility transition is an illustrative example that demonstrates how this can be achieved.

Legal norms and regulations The implementation of innovation is significantly influenced by legal norms and formal avenues of decision-making. In particular, concrete legal norms and planning instruments address and define the use of physical space. For example, laws and norms at the national level determine the conditions under which planners can implement a 30 km/h zone for cars, establish a street that prioritises bicycles or define the legal basis for infrastructure investments over the next 30 years. Soininen, Romppanen, Huhta et al. (2021) provide an illustrative example of the multifaceted roles that law and concrete legal forces play in facilitating or impeding sustainability transitions. The institutional activity of planning has the potential to make a significant contribution to the integration of diverse demands and legal claims from sectors such as transport planning and building acts, as well as constitutional law through the establishment of legally binding plans and programmes, and the pursuit of planning research with an integrative focus.

Formally binding planning instruments In a similar manner to the way in which legal norms provide a framework for local interactions, binding planning instruments and their inherent logic also exert a significant influence on spatial development. The implementation of zoning concepts has resulted in the segregation of residential, commercial and recreational areas, accompanied by a proliferation of vehicular traffic and a transport system that is heavily reliant on cars. As part of mobility transitions, the “15-minute city” concept and its implementation in urban neighbourhoods represents a significant departure from the decades-long tradition of urban development (Mouratidis 2024). It necessitates not only the management and implementation of car-free zones but also an adaptation of the logic of land-use and development plans, or the designation of new zoning categories such as “urban areas” in the German system (Baumgart 2019).

From our perspective, an even more fundamental consideration is the inherent logic of planning to protect and preserve certain land uses, such as nature and countryside. While transition studies tend to focus on change, particularly in terms of phasing in and out, as well as the implementation of innovation, there is a paucity of research exploring the role of land use that not only stays unchanged but must also be actively protected. Nature conservation has thus been living in the shadows in a field that has traditionally been keener on technology as a means of system optimisation and growth, rather than on sufficiency and restraints (Isenhour 2016; Grunwald 2018). This is an area that warrants greater attention in the context of transition processes. Spatial planning with its competencies can play a significant role in this regard, as it inherently involves

weighing up land-use permissions and prohibitions for the greater good. With such an approach, spatial planning could also contribute to freeing sustainability transitions from the accusation of ecomodernism and integrating sustainable infrastructure expansion with calls for respecting planetary boundaries.

Informal planning instruments Informal planning instruments could be used in a similar way to formal ones. Their implementation is often validated by political decision-making procedures such as local council resolutions. Even though informal plans like urban development plans or mobility master plans seem to be common practice, they are still hardly reflected upon or analysed in terms of their suitability as governance instruments in transition research (Scholl/Kemp 2016). In addition to binding instruments, which are inherently committing, process and decision-making are particularly important here. Incorporating the content of various transformations into informal plans and programmes guarantees the voluntary and democratically determined adoption of an administration’s fundamental maxims for action. The political nature of decision-making processes in democratic systems is evident, as even the administration cannot base decisions on how a city should develop in the future solely on its own discretion. Political parties and their elected representatives as well as the institutional structures within local councils or committees validate spatial strategies and visions for the future, which are crucial for the implementation of transformations. This represents a significant democratic legitimisation of transformative change.

With its instrumental legacy, it seems that there are a number of main areas in which planning research could contribute to the transition discussion: integrating sectoral norms and laws at the local level, utilising and modifying legally binding plans and programmes, and employing the well-established decision-making rules of informal instruments are illustrative examples of how planning knowledge can be used to enrich the debate. The instruments that can be employed to effect transformations seldom even require innovation. Such instruments have existed for a considerable period of time, during which planning has accrued a substantial corpus of experience and knowledge about how to employ them to direct spatial change. However, in order to gain an accurate understanding of their capabilities and limitations and to deploy them in a sustainable manner, it is essential to include planning knowledge, the underlying planning and legal system, and the local planning culture with this intricate set of tools.

3.3 Future literacy: Directionality and democratisation

The temporal dimension is an intrinsic aspect of transition studies, as evidenced by the multi-level perspective or the x-curve model. These models illustrate the optimal temporal trajectory of innovations or exnovations that are expected to contribute to a sustainable way of life. Governance approaches such as transition management further elucidate the conditions under which such processes can succeed, emphasising joint knowledge production and a sequence of different participation formats (Loorbach 2007). However, these accounts lack a clear perspective on democratic legitimisation in the process of carving out pathways towards a certain future. We contend that spatial planning, with its expertise in aligning structures, actors and resources in democratic legitimisation processes about future developments, can substantially contribute to this.

The theoretical considerations from planning theories regarding decisions about the future can represent an important contribution to future-making debates in sustainability transitions. Examples range from rationalist approaches that generate images of the future and introduce them as inspiration for transformation processes (Amer/Daim/Jetter 2013), to the experiences and pitfalls of collaborative approaches and their criticism by antagonistic planning theories (Healey 2003; Gualini 2015), or approaches that understand planning as a political process and consider the implications this has for less consensual decisions (Low 1991). Furthermore, contemporary theories are also sought, including ones that espouse circular planning, transformative planning and pragmatic planning.

The potential value of implementing planning theories and especially procedural theories as part of a comprehensive future literacy is indispensable. We introduce three examples to illustrate some relevant approaches: first, imaginations and climate futures as rationalist inputs to debates about the future; second, participation and co-creation as well-established but ambivalent approaches to collaborative future-making; and third, labs and policy recommendations as a shift from “is” to “ought” in urban transformation.

Imaginations and climate futures in local and regional context Visions, future scenarios and images of a region’s or city’s development can help to illustrate abstract discussions around transformation, providing concrete examples of change and making the future more tangible (Smith/Stirling/Berkhout 2005). Broad concepts like mobility or energy transition are translated and visualised within a specific context, highlighting how these shifts could manifest in local lifeworlds based on local conditions. For instance,

what would energy transition look like in a region with vast forests, or under which circumstances could mobility transition succeed in sparsely populated rural areas? A key element in this process is making the future and potential developments understandable and thus open for debate. Different futures can be negotiated through scenarios, while also emphasising that spaces will evolve even without intervention, and that maintaining the status quo will require significant effort (Smith/Stirling/Berkhout 2005). The extensive experience of urban and regional planning with scenario development and its role in democratic discourse is hence ideally suited for integration into sustainability transitions.

Participation, co-creation and the communicative turn The rationalist approach to planning, exemplified by the “Godfather” model, (at least partly) had to adapt to changing democratic and societal ideals in the late 20th century (Healey 2003). The communicative turn and the shift in understandings of planning from a synoptic to a more comprehensive and collaborative practice have led to discussions on participation, co-creation and joint decision-making since the 1990s (Healey 2003). In contrast to sectoral planning approaches, where the planner is perceived as an expert in a specific field of knowledge (e.g., water management or transport planning), integrative spatial planning is regarded as a moderating role, balancing diverse demands in space. We contend that it is crucial that this be translated into sustainability transitions, as it necessitates a discrete examination of disparate demands, their underlying causes and logical structures, and an appreciation of their spatial ramifications and distinctions, in addition to social and communicative processes. It is frequently the case that an acceleration of sustainable transformations is at odds with democratic principles, resulting in the exclusion of marginalised interests and needs and the exacerbation of existing inequalities (cf. Skjølsvold/Coenen 2021 for energy transitions). It is our contention that spatial planning’s future literacy can assist in overcoming this dilemma by co-creating concepts of a liveable future based on agreed-upon practical problematisations associated with the lifeworldly local challenges of transformation. This is crucial for a democratically legitimate and well-accepted idea of a sustainable future that can guide everyday practice, policy decisions and long-term strategies for systemic change.

Testing future and policy business In contrast to the majority of academic disciplines, transdisciplinary research is designed to be directly implemented in real-world contexts, typically adopting a transdisciplinary approach that is manifested in various formats. This encompasses the utilisation of actual laboratories as experimental platforms to assess

novel methodologies, in addition to less conspicuous instances such as the formulation of policies and the transdisciplinary interchange of knowledge in general. Furthermore, in addition to a scientific analysis of the status quo, the development of future-oriented theories is required to facilitate the transition from analyses of “what is” to examinations of “what should be”. In this context, planning employs a range of models and concepts that align with the principles of sustainable spatial development, while acknowledging the inherent complexity of wicked problems. Some of these concepts are already well established in sustainability transitions, such as the 15-minute city, the principles of which have been implemented in real-world laboratories and the like (Mouratidis 2024). To date, other concepts such as Transport-Oriented Development at the regional level, point-axial distributions of infrastructure and so forth have received less attention. Ultimately, the very nature of planning involves direct implementation or, at the very least, addressee-oriented research leading to recommendations for action.

The questions of how multiple simultaneous transitions influence territorial development is an emerging area of research where spatial planning has the potential to make significant contributions to knowledge, while also undergoing a process of evolution and development – particularly in terms of strengthening its own theoretical foundations. In socio-technical contexts, policies frequently seek to regulate the sustainability of complex systems, encourage the development and dissemination of sustainable innovations or shift individual behaviour towards more sustainable practices. However, the planning discipline is inherently concerned with future knowledge, stressing another perspective characterised by sensitivity to diverse demands, logics and the acknowledgement of multiple realities, each with its own potential futures. This multiplicity could provide sustainability transitions with a valuable pathway from understanding “what is” to envisioning “what ought to be”, thereby offering substantial opportunities for advancing the theoretical foundations of transition studies.

4 Conclusions

In this paper, we have supported criticisms of the failure to put sustainability transitions sufficiently on the ground. We argue that one reason for this is a veritable gap between the system knowledge of transition studies and the local lifeworlds where transformative change ultimately happens. Diving into the vast array of sustainability transitions literature, we found that a number of debates had already contributed to a more polymorphic and spatially variegated understanding of transitions. However, a closer look at how

spatial planning discourse engages with sustainability transitions revealed its added value beyond existing transition studies debates. We highlighted this by considering three key literacies of spatial planning that can aid the tailored operationalisation of transition knowledge in concrete places. First, a spatial literacy that combines the (bio-)physical realities of socio-technical systems “in space”, the institutional layer of land use and dedicated urban functions, and the diverse and potentially competing socio-cultural representations of and aspirations towards space. Second, an instrumental literacy that focuses on the cultures and mechanisms of state-led action in specific places and consequently utilises the locally specific, formal and informal instruments of spatial planning to translate abstract transition endeavours into concrete spatial regulations and projects. And third, a future literacy that introduces scenario-inspired, co-creative and experimental future-making techniques from planning into sustainability transitions as tools for developing democratically legitimate directionality. In combination, the spatial reflexivity, formal agency and interventionist nature of spatial planning with its emphasis on creating target knowledge and transformative knowledge for “doing” sustainable spatial development in concrete places blends well with the systems-oriented, yet prescriptive theories of sustainability transitions.

With that, we are by no means claiming that spatial planning has “better skills” or “more important knowledge” than sustainability transitions research. We have rather aimed to outline three fields for fruitful exchange and mutual learning between sustainability transitions scholars and planning researchers, fields that should be explored further to promote local transformations towards sustainability. We hence particularly call for spatial planning scholars to engage more with sustainability transitions to add their unique perspective on local change to an important scientific debate. It is evident that the principles of planning sciences, particularly as they relate to transformative planning, are subject to constant development. This evolution is further compounded by the dynamic evolution of the role and self-image of planners within the context of planning practice (cf. Schmitt/Magnusson 2024; Wagner/Knieling/Weiland 2024). To us, three qualities of spatial planning stand out that can be read between the lines of the above elaborations:

First, spatial planners naturally take an integrated perspective that is indispensable for overcoming the silos and sectoral approaches that constitute often-cited barriers to transitions (Healey 2003). By incorporating the different logics and voices, path- and place-dependencies, and change dynamics of different sectors and systems, spatial planning may sometimes seem overly complex and ponderous. However, such comprehensive perspectives reveal where sectoral transition pathways or interests might

clash – particularly regarding land-use aspirations and future imaginaries.

Second, as transitions always start from pre-existing sociotechnical and sociospatial structures, institutions, power dynamics and local (political) cultures, they must be well-embedded in these contexts (Suitner/Krisch 2024). The failure of local sustainable transformations is rarely ever a question of a lack of technological solutions, but rather of an inadequate fit with local regulations, interests, future visions and political rationalities (Hodson/Geels/McMeekin 2017). Spatial planning operates at just this junction and is hence experienced in navigating it. This skill becomes even more important in light of the conflicts that local sustainability transformations entail, such as land-intensive energy transition vs. net-zero land-take objectives.

And third, it is precisely at the interface of spatial planning and sustainability transitions that a critically reflective perspective on the role of planning as an instrument of power is needed. Some authors in sustainability transitions assume that in any case “planning promotes spatial and infrastructural sustainability” (Carroli 2018: 82). There is ample evidence that this is not automatically the case and that planning can be instrumentalised to act contrary to general definitions of sustainability. We therefore call all-the-more urgently on spatial planning scholars to get involved in sustainability transitions debates and to engage in a productive but critically reflective debate on spatial planning for local sustainable transformations.

Lastly, there are some critical limitations to our paper that need to be addressed. We state above that our perspective on the three key planning literacies stems from our own research context and planning-cultural experience in the Germanic planning system. Therefore, the concrete manifestation and relevance of literacies is biased by this specific view on planning and might look vastly differently in other planning systems and planning cultures – yet another testament to the relevance of context. Hence, there might of course be other literacies to explore beyond the ones briefly introduced here – something we hope planning scholars will be motivated to engage with (think of, for instance, skills related to engagement in experimental settings, pilot programmes, international exhibitions or similar). Finally, we have not discussed the limitations within the key literacies of planners that we propagate. For example, it would be easy to critically note that future literacy alone cannot guarantee transformation, as most “futures” are merely extensions of the status quo and not transformative at all.⁶ It could also be rightfully argued that knowledge of material and

⁶ We thank one of our anonymous reviewers for pointing to this argument.

institutional structures will be insufficient if planners lack the decision-making power to implement structural change. However, these critical considerations should not detract from the closer integration of two fields that are committed to the same goal, they should rather reinforce the idea that more intensive cooperation is useful to better understand and solve these issues.

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