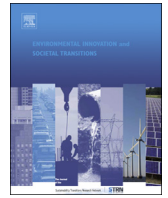




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Transformative innovation and translocal diffusion

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ABSTRACT

This paper develops a conceptual understanding of transformative innovations as shared activities, ideas and objects across locally rooted sustainability initiatives that explore and develop alternatives to incumbent and (perceived) unsustainable regimes that they seek to challenge, alter or replace. We synthesize empirical work from two European research projects (TRANSIT and ARTS), in which initiatives and networks were empirically studied, to develop a broader conceptual understanding of the emergence of transformative innovation. The development of initiatives can occur through growing, replicating, partnering, instrumentalising and embedding. This is supported through translocal networks that connect initiatives by sharing ideas, objects and activities across local contexts. This translocal characteristic of transformative innovations harnesses an enormous potential for sustainability transitions, but requires further understanding as well as governance support. The perspective we present provides a conceptual starting point to further explore the development and diffusion of transformative innovation as well as transition governance strategies.

1. Introduction

The call for new governance approaches and innovations to accelerate and guide sustainability transitions has entered mainstream discourses. The United Nations Convention on Biodiversity, the European Environmental Agency, the OECD, the German Advisory Council on Global Change, the European Union and national governments have over the past years launched reports and policy programs in support of sustainability transitions (EEA, 2015, 2019; OECD, 2015; WBGU, 2013) and call for ‘transformative change (Diaz et al., 2019). The core argument in these policy documents is in line with the core premise of sustainability transitions research (Grin et al., 2010; Markard et al., 2012; Loorbach et al., 2017): systemic change is necessary to achieve just and sustainable futures within ecological boundaries before 2050. The need for sustainability transitions is caused by increasing concerns over persistent societal problems such as climate change, loss of biodiversity, resource depletion and inequality. These complex, global challenges have been identified decades ago but have so far not been addressed successfully. Our economies continue to develop along unsustainable pathways and push ecological boundaries, despite of ambitious policy commitments, large scale investments in innovation and voluntary actions.

This inability to change direction especially through controlled, managed or incremental strategies has been the focus of the socio-institutional perspective in sustainability transitions research (Grin et al., 2010; Markard et al., 2012; Loorbach et al., 2017). One of the central problems addressed is that policy and innovation are primarily geared towards optimising existing regimes, leading to path-dependencies and lock-in (Kemp and Loorbach, 2003). In this paper we take this socio-institutional perspective and build

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upon the literature on transition governance and transition management (Loorbach, 2010). This argues that a key problem of policy-driven innovation is that it often presumes rational, planned innovation journeys of technologies that at a certain point will scale and diffuse through market mechanisms. This policy focus arguably ignores other types of innovations that emerge more organically within society in which technology is a less dominant element such as novel lifestyles, business models or organisational forms.

In this paper, we seek to develop a better conceptual understanding of the potential of such innovations to contribute to sustainability transitions and how they develop and diffuse. These innovations often take the shape of local sustainability initiatives that seek to advance a social or just local economy, low consumption lifestyles, democratic and renewable energy systems, regional sustainable food systems or living and building in harmony with nature. Such sustainability initiatives are inherently rooted in geographical contexts, political cultures, and driven by engaged citizens or entrepreneurs that often respond to opportunities or persistent problems in their specific environment. However, such local initiatives are also connected to other local initiatives across the globe: they form translocal networks that exchange, translate and diffuse ideas, objects and activities. In this way they collectively develop a shared ‘transformative innovation’ that includes a shared discourse, objects as well as practices. They are thus considered as socio-material, emergent, multi-actor phenomena (Avelino and Wittmayer, 2016).

As transdisciplinary action researchers, we want to explore the potential of such transformative innovations as they are a phenomenon that could help identify sources and mechanisms of sustainability transitions. But they also do represent experimental efforts to develop radical alternatives to current and unsustainable economic models. By exploring the dynamics of transformative innovations in and with practice we also might contribute to increasing their visibility and impact. Through critical engagement with multiple translocal networks and sustainability initiatives, we became aware of their strength in empowering local citizens and finding ways to adapt and learn, to inspire and mobilize and to translate global concerns and ambitions into very practical, tangible and effective small scale action. But rather than to see the translocal networks and local initiatives as solutions, we want to explore the extent to which they have the potential to contribute to wider systemic changes in society. This means we want to explore both how to better understand their development as well as their diffusion as a basis for possible transition governance support.

This paper is of a conceptual and explorative nature and builds upon insights from transitions research on social innovations as a potential source for transformative change (Avelino et al., 2019a,b; Dro and Therace, 2011) and on extensive empirical work in two European-funded research projects. First and foremost the TRANSIT project (Avelino et al., 2019a; Haxeltine et al., 2017a; Wittmayer et al., 2019). TRANSIT developed a theoretical framework to understand if and how social innovations contribute to transformative change (Wittmayer et al., 2017b). It did so through an iterative research design (Haxeltine et al., 2017b). A total of 20 embedded in-depth case studies were conducted covering 20 translocal networks and 40 local manifestations of these networks using document review, semi-structured interviews, and participant observation (Wittmayer et al., 2015a,b; Jørgensen et al., 2014). In addition, a database was developed covering more than 450 critical turning points in the development of some 80 initiatives, mainly relying on semi-structured interviews (Pel et al., 2017). Examples of translocal networks and initiatives studied were ecovillages, renewable energy cooperatives, transition towns and science shops – both at the level of local initiatives as well as their networking activities and organisations (www.transitsocialinnovation.eu). In this paper we mainly draw upon the concept of transformative social innovation developed in TRANSIT as well as the empirical data on how (some of) the translocal networks under study worked with social innovation and how they were diffused¹.

We also build upon the ARTS project that studied initiatives in their geographical context, i.e. five European city-regions (Ehnert et al., 2018; Frantzeskaki and Rok, 2018; Gorissen et al., 2016). It did so using mapping exercises identifying regional initiatives, in depth interviews and participatory envisioning with these initiatives. Examples are initiatives in urban agriculture, sustainable food, cargo-biking, sharing economy, ethical banking, composting and recycling and organizing sustainability festivals as well as food banks and swapping stores. ARTS identified the mechanisms of growth and diffusion through which sustainability initiatives develop (www.acceleratingtransitions.eu) on which we rely in this paper. It also showed that in very different urban-regions quite similar initiatives develop and that there is exchange and learning between initiatives in different regions.

We seek to broaden the current focus on (socio-)technical innovations in transitions studies towards ‘transformative innovations’ as emergent networks of locally specific implementation of shared ideas, objects and activities. These may include technological innovation but are more broadly about new ways to provide basic needs (energy, food, mobility, housing, finance). Including ‘non-technological’ innovations increases our understanding of changes in the broader social fabric, i.e. the socio-institutional context. The deep empirical engagement with so many of these initiatives working on different kinds of transformative innovation, also triggered a new conceptual reflection upon the role, mechanisms and patterns of the development and diffusion of such alternative practices and activities that challenge incumbent societal regimes. Hence, the two guiding questions for this paper can be summarized as: How can we understand transformative innovations from a socio-institutional transitions perspective? What are the patterns and mechanisms behind their emergence and diffusion?

The paper is structured as follows: in Section 2 we discuss the limitations of dominant innovation and sustainability policies that rely primarily on planning, markets and incremental novelties. In Section 3, we conceptualize transformative innovation and its potential for sustainability transitions. Section 4 then explores how transformative innovation develops and highlights its translocal

¹ We refer to the published case study reports that have been produced for each of the embedded network studies. Each embedded network case was studied at the level of the network and two local manifestations – for each network level analysis, researchers were advised to perform document analysis (social media, websites, archival analysis, secondary documents, and scientific literature), 3-5 interviews, and 2-12 hours of participant observations; for each local manifestation analysis, document review, 6-10 semi-structured interviews and 10-80 hours of participant observation.

character: the interplay between inherently local embedding of new practices, values and norms, and their facilitation through global networks, platforms and structures. In Section 5, we formulate reflections and implications of the offered perspective with regard to sustainability transitions research and governance.

2. Sustainability transitions and the role of innovation (policy)

Processes of non-linear systemic change in complex societal systems have become the object of research especially since the late 1990's under the headers of 'transition' (Elzen et al., 2004; Grin et al., 2010; Rotmans et al., 2001) and 'transformation' (Folke, 2006; Gunderson and Holling, 2002; Olsson et al., 2006). We use the term 'transformative change' to denote such non-linear systemic change that leads to fundamental, qualitative changes in societies' cultures, structures and practices (Loorbach et al., 2017). The field of sustainability transitions research has since its emergence branched out across disciplinary fields and produced a large number of new perspectives and interdisciplinary concepts and models (Köhler et al., 2019; Loorbach et al., 2017b). Transition management in this context developed as a new mode of governance focused on facilitating radical long-term change through empowerment of transformative agency by building up capacities and developing new network coalitions with shared transition agendas (Loorbach, 2010). The approach, both the theoretical basis as well as the methods and tools developed over time, takes a fundamentally critical stance against incumbent policies and institutions as inherently incremental and path-dependent. It thereby also takes a critical approach to regular innovation policies and its emphasis on technological and managed innovation.

There has been a critical debate around the politics of transitions and possible misalignment between innovation and transition policies (Alkemade et al., 2011). A key problem here is the extent to which policy-support for innovation makes it more or less likely that such innovations are captured and lose their radical edge (Avelino et al., 2016; Pel, 2016). The diffusion of innovation is typically understood in terms of up-scaling through learning effects and cost-reductions visualized through s-shaped curves (Rogers, 2003). However, these transition approaches do not fundamentally question existing regimes, nor provide an understanding of the extent to which the studied alternative can or cannot be transformative. Approaches like strategic niche management (Kemp et al., 1998; Raven et al., 2007; Schot and Geels, 2008), technological innovation systems (Bergek et al., 2008; Suurs, 2009) and transformative innovation policy (Schot and Steinmueller, 2016; Diercks et al., 2019) therefore argue for more attention to socio-institutional and market contexts that co-shape technological innovation journeys. These explore how institutional, governance or market mechanisms can enable diffusion and upscaling of identified solutions (Alkemade et al., 2011; Bergek et al., 2008; Kivimaa and Kern, 2016; Schot and Geels, 2008; Schot and Kanger, 2018; Steward, 2012).

When considering for example the innovation dynamics in current mobility systems (e.g. Birtchnell et al., 2018; Kanger et al., 2019) by now a 'socio-technical' transition from internal combustion engines (ICE) to electric vehicles (EV) seems to be accelerating. However, it is by no means clear that this adds up to a sustainability transition. While electric vehicles do have the potential to challenge some aspects of the fossil fuel based transport system (provided that the energy used for the cars has been obtained from renewable sources), they do not challenge the socio-spatial car regime in spatial, social and cultural terms – in fact electric vehicle can further reproduce that social spatial car regime (Zijlstra and Avelino, 2012). Especially in urban contexts, other possible pathways could be based on walking, cycling, public transport and shared mobility. While such a pathway has social, economic and environmental benefits, it also implies a radical reduction of individual mobility, the number of vehicles and the amount of revenue streams from parking and taxes. From a socio-institutional perspective, governmental agencies as well as incumbent market actors will likely (and finally) support a shift to electric but not necessarily have the interest or capacities to support alternative and potentially more sustainable transition pathways. Such alternative and sustainable transition based on low levels of consumption, emission and resource use often lack a 'business case' and thereby structural support from both policy and market actors.

(Technological) innovation may thus also impede most desired transformative change towards sustainability, and even accelerate developments towards unsustainability. It has been argued that in order for innovations to help tackle persistent societal problems, they have to address and transform the systemic root causes of these problems (e.g. Grin et al., 2010; Moore and Westley, 2011), and that innovations can (only) be transformative to the extent that they challenge, alter and/or replace existing structures in the social context (Avelino et al., 2019a,b; Haxeltine et al., 2017a). For innovations to have such transformative impact, they must – by definition – become applied in and accessible to society, and thus undergo some form of mainstreaming, diffusion, scaling, institutionalisation and/or translation (Smith, 2007a; Pel, 2016). In this process, innovations lose (some of) their novelty and will reproduce the existing structures that they meant to challenge in the first place, thereby possibly aggravating societal problems and contradicting (some of) their original intentions (Blok and Lemmens, 2015).

Various theoretical developments have taken a more systemic, historical, institutional and political perspective on how social innovation relates to transformative change, including empirical studies of numerous 'social innovation' initiatives and networks with explicit transformative ambitions (e.g. Westley and McGowan, 2017; Avelino et al., 2019a; Moolaert et al., 2017; Haxeltine et al., 2017a). These more political and critical perspectives on social innovation, overlap with developments in research on sustainability transitions and transformations (Markard et al., 2012; Stirling, Loorbach et al., 2017; Köhler et al., 2019). While all these fields are characterized by considerable theoretical diversity and conceptual disagreement, with some building on evolutionary and structuralist perspectives, while others take a more relational or narrative perspective (Garud and Gehman, 2012), they still share an explicit and critical attention for the distinction between 'innovation' on the one hand and 'transformative systems change' on the other hand and underline that the process by which innovations gain transformative impact is inherently paradoxical, dialectical and highly political (Avelino et al., 2016; Smith and Stirling, 2018; Pel et al., 2020).

Transition governance literature (Loorbach, 2010; Grin et al., 2010) argues that the dominant logic of incumbent policies and markets is by definition at odds with the nature and dynamics of transformative innovation and therefore new forms of governance

for transformative change need to be explored. Policy processes are inherently incremental and focused on gradual improvement through planning and implementation. Innovation policies most often identify societal goals and then desired (technological) solutions to support through R&D subsidies and pilot projects assuming that market mechanisms will take care of the wider diffusion. However, from a sustainability transitions perspective both pattern of optimisation through incremental improvement and the incumbency of markets and institutionalized socio-economic regimes create or even enhance path-dependencies. Also, (innovation) policy tends to emphasize developing new solutions, rather than to identify existing solutions, reward prevention, or not doing anything. In relation to transformative change, current innovation policy does neglect issues such as facilitating exnovation, phase-out and degrowth (e.g. Davidson 2019, David and Gross, 2019).

3. Transformative innovation and its potential

The starting point for transition governance research (Loorbach et al., 2017) is the basic insight that actors embedded in a societal regime are constrained by entrenched institutions and path-dependencies to shift structurally to a changing and dynamic external context or respond to opportunities arising from experimental initiatives. Path-dependencies, sunk costs and lock-in mechanisms lead to continuing optimisation that in turn then reinforces path-dependency. Change within a regime-context is by definition incremental and geared towards increased efficiency and improvement. But there are always other contexts that are more flexible and can be utilised by individuals, business, policy entrepreneurs, researchers to explore and develop completely different practices and solutions. Transitions research suggests that unsustainable, path-dependent regimes over time inevitably enter a phase of destabilization as a result of path-dependencies and increasing pressures (Turnheim and Geels, 2012; Bosman et al., 2014; Kungl and Geels, 2018; Rotmans and Loorbach, 2009) and the phase out of specific regime elements creates space for alternatives to emerge. Empirical research into transition initiatives and networks shows that many are able to grow, spread and gain momentum for their innovation over the past decades.

Such destabilization and unlocking of incumbent, unsustainable regimes may create the space for breakthroughs and institutionalization of alternatives (Tàbara et al., 2018) such as sustainable lifestyles (low meat diets, reducing flying, producing own energy, cycling) or economic models (natural capital based, true cost, circular, solidarity economies). Such (potentially) transformative alternatives are abstract as well as specific: they become visible in local contexts in specific ways (initiatives) and in more generic ways through translocal networks or more generic ideas, objects or ideas. An energy cooperative is an example: there is a wide diversity of legal forms, business models, cultural values or professionalization. Yet at the same time there are global networks, manuals, conferences, lobby and discourse. Taking this perspective we define transformative innovations as *shared activities, ideas and objects across locally rooted sustainability initiatives that explore and develop alternatives to incumbent and (perceived) unsustainable regimes that they seek to challenge, alter or replace* (Avelino et al., 2019a,b; Haxeltine et al., 2017b).

To accommodate for both the ambiguity of innovation (whether it contributes to optimisation or transformation can only be retrospectively assessed) as well as the importance of agency related to those innovations, we do not see such innovations as ‘the solution’ or ‘means to an end’ but rather as emerging experimental processes that generate insights into desired transition pathways and the barriers to these transitions. The extent to which such emergent innovation is transformative, can only be assessed in hindsight as they are interacting with institutional contexts in ‘transformations in the making’. Transformative innovations are driven by actors across market, state and community logics and connect to others in networks and strategic alliances through which they diffuse (Backhaus et al., 2017; Pesch et al., 2018; Wittmayer et al., 2015a,b, Avelino et al., 2019a,b; Loorbach et al., 2016). For example, communal food-growing initiatives in the UK formed intermediary actors that aggregated lessons learned and influenced policy-making (Hargreaves et al., 2013; White and Stirling, 2013). In Sweden, local groups lobbied for new policies and governance organisations to promote ecosystem-based management and environmental education for healthy food, water management and urban farming practices (Frantzeskaki et al., 2017). Initiatives experimenting with solar collectors in Austria, wind technologies in Denmark and car-sharing in Switzerland, managed to create new markets (Späth and Rohrer, 2012, 2010). In the Transition Town network (Longhurst and Pataki, 2015) local experiences are shared and synthesized in handbooks that inspire others to adopt similar practices. Through such ‘translocal networks’, initiatives thus share identity, experience, lessons and create a context of empowerment and diffusion (Avelino et al., 2019b). Table 1 below summarizes selected examples of such translocal networks and the transformative innovations they support (see also <http://www.transitsocialinnovation.eu/resource-hub/> for extensive background material).

Transformative innovations are a *multi-actor phenomenon* that can originate in any institutional context or societal sphere (Avelino et al., 2015; Wittmayer et al., 2017a). It is also *socio-material innovation* (building on e.g. (Chilvers and Longhurst, 2016; Haxeltine et al., 2017a)), that can include both technological and social novelties. We consider innovation to be something ‘new’, including renewal and reinvention, as well as new combinations of existing elements, ultimately providing an alternative to the current context. Transformative innovations are also *emergent*: their emergence from co-evolving local, ‘bottom-up’ or grassroots initiatives has been relatively well studied, for example transition initiatives, grassroots innovation, and social movements (Feola and Nunes, 2014; Connelly et al., 2011; Moore and Westley, 2011; Rossi, 2017; Seyfang and Smith, 2007). This literature addresses the drive for systemic change and the agency behind it, yet less explicitly focuses on development and diffusion of initiatives driving transformative innovation and their emergent potential for the advancement of sustainability transitions.

One obvious characteristic of many of such local sustainability initiatives is that they seek to transform ‘consumption society’ or ‘capitalist systems’ (Loorbach et al., 2016; Longhurst et al., 2016). In doing so, they put their vision of a desirable society into practice (Wittmayer et al., 2019): they experiment with local production and consumption systems, social economic models, sharing benefits and profits, direct democracy, radical transparency and sustainable materials and revitalising old sustainable practices. On a small

Table 1
Examples of Transformative Innovations (building upon Jørgensen et al., 2016).

| Name (website) | Emergent network | Transformative innovation |
|---|--|--|
| Impact Hub (www.impacthub.net) (Wittmayer et al., 2015a,b, Avelino and Wittmayer, 2019) | 100+ Impact Hubs host co-working spaces for communities of social entrepreneurs and provides access to networks enabling knowledge and idea exchange. | This includes new (working) spaces and practices, new (working) relations and new forms of (network) governance. Also, (the enterprises of) individual Impact Hub members develop new services and products; and the Impact Hub network explicitly relates to discourses on social innovation and seeks to create ecosystems for societal change. |
| Rescoop (www.rescoop.eu) (Huybrechts and Haugh, 2018) | 1500 European renewable energy cooperatives adhering to a cooperative code | Renewable energy cooperatives are a business model that allows citizens to actively participate in and/or own renewable energy or energy efficiency projects – as such it re-evaluates the relations between consumers and producers as well as between citizens and local governments in energy systems. |
| Global ecovillage Network (www.ecovillage.org) (Kunze and Avelino, 2015) | about 10,000 communities and related projects that explore alternative ways of building and living in an ecological, resilient and regenerative manner | Ecovillages provide places to reinvent a new culture of cooperation, emotional openness and trust (“a new WE”) including new forms of communal organisation and, structures. Through living in intentional communities, social relations between people and between humans and nature are recreated. |
| Transition Network (www.transitionnetwork.org) (Longhurst and Pataki, 2015) | 1100+ local initiatives aiming to empower communities and develop locally resilient and sustainable economies | Transition movement combines an innovative (place based) narrative of change with a novel set of organisational processes to support activists in creating localised experimental space for new kinds of grassroots project to emerge. The local initiatives can be considered as bottom-up social experiments that trigger changes in people's everyday actions, behaviour, and routines. |
| La Via Campesina (https://viacampesina.org/) (Juarez et al., 2015) | Movement of 182 local and national organisations across 81 countries worldwide representing 200 million farmers | La Via Campesina develops a new narrative opposing neoliberalism, works towards changing the governance of and access to natural resources and demands social justice. It empowers farmers to counter global food-industry and defend inclusive rural development. |

scale, sustainability initiatives like ecovillages, sustainable food cooperatives, and local economic systems are feasible and create benefits for people and nature. Such benefits do not produce the kind of economic profits and benefits of current (and unsustainable) regimes of production and consumption, but, by growing in size and impact and diffusing globally, they challenge these incumbent regimes. In our empirical work across the two EU funded projects (TRANSIT, ARTS), we could identify different strategies and ways in which transformative innovation initiatives pursue transformative change. These relate to social processes of diffusion that can be facilitated with a broad range of strategies and instruments. In the next section, we explore this development and diffusion of transformative innovation.

4. Transformative innovation and translocal diffusion

Having established a broader understanding of transformative innovation, we need to better understand how it develops and diffuses, and how it impacts its incumbent contexts (or not). Sustainability transitions research scholars have developed different typologies to describe the development of innovation in the context of transformative change. This includes for example ‘deepening, broadening or scaling-up’ (Van den Bosch, 2010), ‘replicating, scaling-up or translating’ (Raven, 2007; Seyfang and Haxeltine, 2012; Smith, 2007b), ‘replicating, scaling and embedding’ (von Wirth et al., 2019), ‘shielding, nurturing or empowering’ (Smith and Raven, 2012), and ‘scaling out, scaling up or scaling deep’ (Moore et al., 2015). To some extent, these typologies draw upon insights from (socio-) technical innovation theory on how technological innovations emerge, develop and, following an initial phase of exploration and experimentation, manage to scale their impacts to contribute to systemic change (Metcalf, 1997; Rogers, 2003; Weber, 1997; Wejnert, 2002). In our conceptualisation we build on these understandings and emphasize transformative innovation as socio-material, emergent, multi-actor phenomena.

Within the EU-funded ARTS² project transition initiatives across six European regions were studied. ARTS identified the different ways through which initiatives develop (see Table 2). While ARTS studied individual initiatives in the regional context, it became clear that in different regions quite similar initiatives emerged that from a distance could be seen as different expressions of a similar ‘transformative innovation’. Examples of this are food and energy cooperatives, sharing platforms or urban greening initiatives.

The mechanisms presented in Table 2 describe how potentially transformative initiatives develop locally. TRANSIT on the other side focused on (translocal) networks that represent such local initiatives and identified their role in supporting their development

² <http://acceleratingtransitions.eu/>; <https://cordis.europa.eu/project/rcn/110573/reporting/en>

Table 2

Typology of development mechanisms of transformative innovation (based on Ehnert et al., 2018; Frantzeskaki et al., 2017; Gorissen et al., 2016).

| Development mechanism | Definition | Explanation |
|--------------------------|--|--|
| Growing | <i>The quantitative growth of a transformative innovation by attracting more participants or funding</i> | When a transformative innovation is developed locally, it is often in the form of an initiative, project or organization. These can stay small but also attract growing numbers of contributors or participants. From a transformative innovation perspective, growth is often achieved by increased social visibility, professionalization and communication capacities from initiators as well as their ability to generate resources. |
| Replicating | <i>The translation of the ideas, models and practices of a transformative innovation into another context</i> | Replication of innovative practices might ultimately be a process that contributes to systemic change, and is often 'replication through inspiration': individuals pick up ideas from media and get stimulated to start a similar initiative. |
| Partnering | <i>The pooling of resources, competences, and capacities between different transformative innovations</i> | This mechanism is resulting from the advantages of pooling synergies and resources but also from identified opportunities for collaboration to increase transformative impacts. |
| Instrumentalising | <i>The strengthening and embedding of a transformative innovation by exploiting opportunities in the governance context</i> | Depending on the actors ability to present the transformative innovation in an attractive way and being able to navigate bureaucracy, they might tap into government resources or support to become more sustainable |
| Embedding | <i>The institutionalization of a transformative innovation through mainstreaming and structural anchoring in for example regulation, physical space or funding schemes</i> | When a transformative innovation becomes mainstream, norm, routine or rule. Ultimately the embedding of transformative innovations also implies having achieved their transformative potential at a local level. |

and diffusion. By necessity, transformative innovations are expressed differently in different contexts and how they develop depends on (for example) the socio-political or cultural factors, incumbent routines and perceptions or available resources. The identified mechanisms are generic to how initiatives develop locally as well as how they connect across different contexts. The development of such initiatives beyond local and small scale does not necessarily have to be the (initial) ambition of the actors involved, but could be an emergent result of what they do. As we highlighted in Section 3, a key factor in the development of transformative innovation is the agency driving it and actors' abilities to translate, adapt, empower, inspire, connect and strategize. More often than not, their skills and capacities seem to be critical for the extent to which an initiative develops and realizes its transformative potential.

A key mechanism in developing translocally into a transformative innovation is through creating a shared discourse and identity – notwithstanding whether a network grows more organically through facilitating initiatives (e.g. Transitions Network) and their diffusion or more proactively steers expansion and growth (e.g. Impact Hub Network). Local initiatives and network organisations strategically relate to existing, create new or contribute to emerging ideas and discourses to position themselves vis-à-vis other actors to shape and express their collective identity implicitly and explicitly (cf. Polletta and Jasper, 2001). Transformative innovation initiatives explicitly position themselves opposite to incumbent, unsustainable or vested systems through their 'narratives of change' (Wittmayer et al., 2019). To this end they engage in the development of manuals, websites, newsletters, trainings, courses and conferences to empower initiatives and individuals. The second dimension relates to the fact that these initiatives are locally active and engaged while being globally connected, which creates a fascinating mix of spatially anchored with a globally visible transformative identity. Because of this blend between local specificity and global connectivity, we understand transformative innovations to be *translocal*.

Local embedding along with shared global identities appears to be a key feature of transformative innovation: while allowing for local adaptations and fit-to-context operationalization, they share similar values, practices and models globally through networking. Transformative innovations thus are global in the sense that they share certain principles, narratives of change and practices, yet they are local in the sense that they manifest themselves very differently having adopted and translated the principles and ideas into specific local contexts. This diversity and local embedding is simultaneously what makes them sustainable (context specific, human-scale, renewable) but also vulnerable (small-scale, non-commercial or not institutionalized). Analysing the networking constellations within which social innovations are embedded (Pel et al., 2020) distinguish different types of empowerment that these networking constellations afford. They differentiate, between 1) local embedding, which supports to become sustainably embedded in a local context; 2) translocal connectivity, the formation of translocal networks and shared identities; 3) discursive resonance, the codification of knowledge, concept and practices to create social cohesion and resilience. Moreover, the combination of local embeddedness and transnational connectedness enables actors to persist in challenging, altering and replacing incumbent, unsustainable regimes, which also helps to explain how transformative agency can develop despite of the unfavourable power dynamics that social innovators face in relation to dominant institutions in current economic and socio-technical systems (Avelino et al., 2019b). Fig. 1 below visualizes the complex mechanisms through which local initiatives develop and merge into globally connected transformative innovations.

Taking such a *translocal perspective on transformative innovation* opens up the debate around spatialities of sustainability transitions across territorial boundaries going beyond traditional concepts of localized clustering, densities and proximities of practices, cultures and structures. In general, a translocal perspective aims to capture socio-spatial dynamics and processes of simultaneity and identity formation that transcend boundaries. It may address the flow and circulations of ideas, symbols, and knowledge across localities

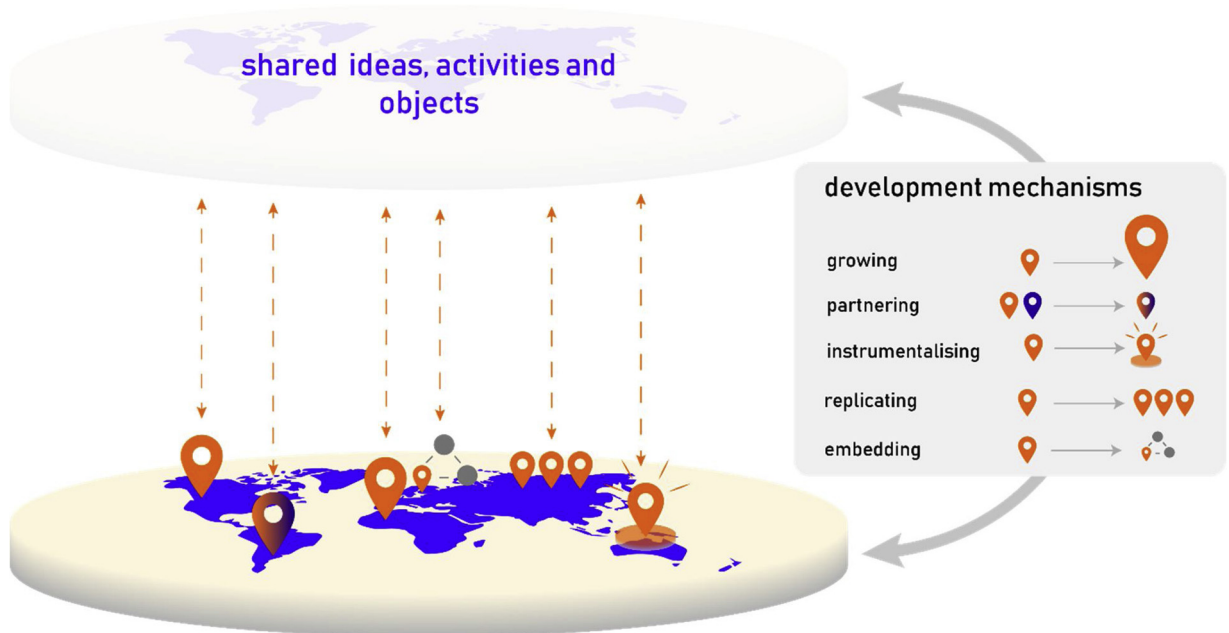


Fig. 1. Translocal diffusion of transformative innovation.

(Greiner and Sakdapolrak, 2013; Feola and Him, 2016). By emphasizing local practices and context conditions, it draws attention to local transformative change and engagement spaces for local action. Simultaneously, the concept acknowledges the connectivity of people, knowledge and resources within global networks. Among transition scholars, (Coenen and Truffer, 2012) pointed to the need to consider the translocal character of sustainability transitions more seriously. In presenting experimental interventions that consider themselves as driven by local concerns and actions, yet, at the same time being part of transnationally informed initiative. (Sengers et al., 2019) point to the fact that these transnational linkages between actors, knowledge, and other resources, “contribute to the enhancement of local capabilities and are ways of complementing for (locally) missing resources” (p.7). However, being linked within translocal (or: transnational) networks cannot only benefit the particular initiative or experiment, but could likewise open up additional diffusion pathways beyond the localized maturing of transformative innovation.

The emergence and development of transformative innovations from a local context of experimenting but linked to global transformative networks and discourses has also been an element of the ‘local – global model’ as described in the context of (global) niche development (Smith and Raven, 2012). This model maps the interrelatedness between local experimentation, the formation of (global) niches, and their interactions within emerging transitions. It describes how a diversity of experiments across various localities influence the emergence of ‘global niches’ (i.e. non-situated, sector niches) that can lead to niche-regime interactions and trajectories in socio-technical systems (e.g. the mobility, food or energy system). However, the model does not account for local place-specificity and the potential misalignment between global niche communities versus local multi-actor interests and place politics (Torrens et al., 2019). But it also doesn’t capture the distributed and socio-institutional character of transformative innovations and the different ways they can emerge translocally.

Networking translocally or being part of a translocal network (that is globally connected but locally rooted) empowers local initiatives to better engage with institutional change in their respective socio-material contexts and thereby increases the transformative impact of initiatives (Avelino et al., 2019b). But it also helps to build advocacy coalitions beyond the local to be able to jointly engage with national or transnational actors, such as the EU: to develop critical mass and political voice to directly lobby (trans-) national governments to change rules and regulations, build alliances with other societal actors, and by securing (or creating) new resources for the network and its members. The various ways in which initiatives and networks establish their transformative identity and subsequently diffuse underlines the need for a more inclusive and differentiated understanding of the role of innovation in sustainability transitions. In focusing on the broader diversity of transformative innovations, we also argue for a definition of innovation that includes the explicit transformative ambitions as well as the actual impacts upon an established regime that are generated through the process of innovating. While every alternative is unique in terms of content and context, there are general mechanisms in how they develop and deliberately pursue diffusion. The perspective we presented provides an analytical starting point to further analyse and explore these mechanisms and the related strategies empirically. One of the most striking characteristics is how it is both local, context-based and specific as well as global, generic and shared.

5. Reflections and conclusions

In this paper, we developed a conceptual framework of transformative innovations. Transformative innovations are defined as

socio-material, emergent, multi-actor phenomena: shared ideas, objects and activities across locally rooted sustainability initiatives. Transformative innovations are emergent: initiatives are locally rooted and find ways to exchange and translate shared ideas, objects and activities across different context. This is facilitated by translocal networks that enable their development and diffusion to form transformative innovations. Our key argument for focusing on transformative innovation is their potential contribution to broader sustainability transitions. Local initiatives are often struggling to make substantial and transformative impact in and on their local context, but collectively they can potentially empower and inspire much broader engagement as well as develop strategic advocacy and lobby. The other way around are general or abstract ideas and solutions often hard to implement into specific contexts. For sustainability transitions research, we argue that the emergent and hybrid global-local and abstract-concrete character of transformative innovations can provide a source for furthering our understanding of the dynamics of sustainability transitions as well as inspire new transition governance strategies.

Furthering our understanding of transformative innovation would include more attention to the socio-material aspects and how these diffuse. For example alternative lifestyles or business models develop and diffuse more organically through social processes of experiencing, learning, experimenting and entrepreneurship. We suggest more attention should be paid to how these processes of socio-material innovation contribute to emerging broader transformative innovations. To this end we identified the *translocal* character of this diffusion and presented examples of initiatives in networks that have global reach and appeal and consist of in many cases hundreds of local initiatives. They develop by growing, replicating, partnering, instrumentalising, and embedding: different ways in which individual initiatives engage with incumbent structures in their context and eventually build collective momentum. The implications of this translocal character however are also that individual initiatives often struggle in their own contexts, and are hardly recognized as serious options for innovation and sustainability policy. As their very nature is to transform existing systems, this means becoming the system by becoming institutionalized is not necessarily their ambition.

This raises important questions regarding transition governance. How to mobilize and strengthen the impacts of transformative innovations implies both strategies to support development in local contexts as well as diffusion into other contexts. Transformative innovations at the local scale are partly intangible, undervalued and often difficult to support effectively through (innovation) policy. At the same time they not necessarily engage translocally with specific policy regimes as these are often national or transnational. While we see some examples of how for example translocal networks lobby at the EU level, it is a challenge and opportunity for translocal networks to engage more strategically (and collectively) to influence actual policy change. The potential of transformative innovations is that they might complement more incremental policy-led processes towards sustainability by offering radical alternatives and a broad support base of real-life examples and engaged citizens. They might also offer a more positive outlook into what is possible and what can be realized by entrepreneurs, communities or local networks against the often complicated, incremental and politicized national or transnational sustainability policies.

Transformative innovations offer future oriented contexts of learning-by-doing for sustainability transitions. In a context of increasing social polarisation and pessimism about achieving transformative change through institutionalized policy processes, transformative innovations offer a much needed antidote. And as crises accelerate and incumbent regimes destabilise, transformative innovation also demands more dedicated and tailored governance support. Governance to support transformative innovation could focus on the development mechanisms as well as on the translocal networks and diffusion to effectuate their transformative potential. This would imply to strategically empower transformative innovations to engage with incumbent regimes as well as to strategize across different transformative innovations to build transformative movements. Operationalising such a transition governance approach implies a need to structure the analytical perspective offered in this paper as well as further research to explore ways in which transformative innovation can be facilitated to engage with a destabilizing regime (actor).

It would imply systematic action research that brings together actors from different types of transformative innovations with proactive actors from the regime to develop shared language, discourses, align resources, structural elements and experimentally develop new practices. There is a lot of experience with this in practice, it is what makes transformative innovations. But it is hardly translated in more strategic, formal and science-policy supported structures. Existing governance approaches often do not address the translocal character of transformative innovations nor the political implications of government engagement with these. But given the potential of transformative innovations to support local sustainability as well as contribute to global sustainability challenges, it would make sense to invest much more in translocal transition governance. This would require transition governance approaches that embrace the diversity and values of transformative innovation and mobilises its potential to help transform incumbent societal regimes.

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References

- Alkemade, F., Hekkert, M.P., Negro, S.O., 2011. Transition policy and innovation policy: friends or foes? *Environ. Innov. Soc. Transit.* 1, 125–129.
- Avelino, F., Wittmayer, J.M., 2016. Shifting power relations in sustainability transitions: a multi-actor perspective. *J. Environ. Policy Plan.* 18 (5), 628–649. <https://doi.org/10.1080/1523908X.2015.1112259>.

- Avelino, F., Wittmayer, J., 2019. The Transformative Potential of Plural Social Enterprise: A Multi-Actor Perspective, Chapter in Eynaud et al. *Theory of Social Enterprise and Pluralism: Solidarity Economy, Social Movements, and Global South*. Routledge.
- Avelino, F., Dumitru, A., Longhurst, N., Wittmayer, J., Hielscher, S., Weaver, P., Cipolla, C., Afonso, R., Kunze, I., Dorland, J., Elle, M., Pel, B., Strasser, T., Kemp, R., Haxeltine, A., 2015. Transitions towards new economies? A transformative social innovation perspective. *TRANSIT Working Paper*; 3.
- Avelino, F., Grin, J., Pel, B., Jhagroe, S., 2016. The politics of sustainability transitions. *J. Environ. Policy Plan.* 18 (5), 557–567.
- Avelino, F., Wittmayer, J.M., Pel, B., Weaver, P., Dumitru, A., Haxeltine, A., Kemp, R., Jørgensen, M.S., Bauler, T., Ruijsink, S., O’Riordan, T., 2019a. Transformative social innovation and (Dis)Empowerment. *Technol. Forecast. Soc. Change* 145, 195–206.
- Avelino, F., Dumitru, A., Cipolla, C., Kunze, I., Wittmayer, J., 2019b. Translocal empowerment in transformative social innovation networks. *Eur. Plan. Stud* doi: 10.1080/09654313.2019.1578333. Available online: <https://doi.org/10.1080/09654313.2019.1578333>.
- Backhaus, J., Genus, A., Lorek, S., Vadovics, E., Wittmayer, J.M., 2017. *Social Innovation and Sustainable Consumption: Research and Action for Societal Transformation*. Routledge.
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Res. Policy* 3, 407–429.
- Birtchnell, T., Harada, T., Waitt, G., 2018. On the verge of change: maverick innovation with mobility scooters. *Environ. Innov. Soc. Transit.* 27, 118–128.
- Blok, V., Lemmens, P., 2015. The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. *Responsible Innovation 2*. Springer, pp. 19–35.
- Bosman, R., Loorbach, D., Frantzeskaki, N., Pistorius, T., 2014. Discursive regime dynamics in the Dutch energy transition. *Environ. Innov. Soc. Transit.* 13, 45–59.
- Chilvers, J., Longhurst, N., 2016. Participation in transition (s): reconceiving public engagements in energy transitions as co-produced, emergent and diverse. *J. Environ. Policy Plan.* 5, 585–607.
- Coenen, L., Truffer, B., 2012. Places and spaces of sustainability transitions: geographical contributions to an emerging research and policy field. *Eur. Plan. Stud.* 3, 367–374.
- Connelly, S., Markey, S., Roseland, M., 2011. Bridging sustainability and the social economy: achieving community transformation through local food initiatives. *Crit. Soc. Policy* 2, 308–324.
- David, M., Gross, M., 2019. Futurizing politics and the sustainability of real-world experiments: what role for innovation and exnovation in the German energy transition? *Sustainability Sci.* 14 (4), 991–1000.
- Diaz, S., Settele, J., Brondizio, E., Ngo, H., Guèze, M., Agard, J., Chan, K., 2019. Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- Diercks, G., Larsen, H., Steward, F., 2019. Transformative innovation policy: addressing variety in an emerging policy paradigm. *Res. Policy* 48 (4), 880–894.
- Dro, I., Therace, A., 2011. *Empowering People, Driving Change: Social Innovation in the European Union*. Publications Office.
- EEA, 2019. *Sustainability transitions: policy and practice*. EEA Report No 09/2019. European Environment Agency.
- Ehnert, F., Frantzeskaki, N., Barnes, J., Borgström, S., Gorissen, L., Kern, F., Strenchock, L., Egermann, M., 2018. The acceleration of urban sustainability transitions: a comparison of Brighton, Budapest, Dresden, Genk, and Stockholm. *Sustainability* 3, 612.
- Elzen, B., Geels, F.W., Green, K., 2004. *System Innovation and the Transition to Sustainability*.
- European Environment Agency, 2015. *SOER 2015 — The European Environment — State and Outlook 2015, A Comprehensive Assessment of the European Environment’s State, Trends and Prospects, in a Global Context*. January, 5.
- Feola, G., Him, M.R., 2016. The diffusion of the Transition Network in four European countries. *Environ. Plann. A: Econ. Space* 48 (11), 2112–2115.
- Feola, G., Nunes, R., 2014. Success and failure of grassroots innovations for addressing climate change: the case of the transition movement. *Glob. Environ. Change* 24, 232–250.
- Folke, C., 2006. Resilience: the emergence of a perspective for social-ecological systems analysis. *Glob. Environ. Change* 253–267.
- Frantzeskaki, N., Rok, A., 2018. Co-producing urban sustainability transitions knowledge with community, policy and science. *Environ. Innov. Soc. Transit.* 47–51.
- Frantzeskaki, N., Borgström, S., Gorissen, L., Egermann, M., Ehnert, F., 2017. Nature-based solutions accelerating urban sustainability transitions in cities: lessons from Dresden, Genk and Stockholm cities. *Nature-Based Solutions to Climate Change Adaptation in Urban Areas*. Springer, pp. 65–88.
- Garud, R., Gehman, J., 2012. Metatheoretical perspectives on sustainability journeys: evolutionary, relational and durational. *Res. Policy* 41 (6), 980–995. <https://doi.org/10.1016/J.RESPOL.2011.07.009>.
- Gorissen, L., Spira, F., Meynaerts, E., Valkering, P., Frantzeskaki, N., 2016. Moving towards systemic change? Investigating acceleration dynamics of urban sustainability transitions in the Belgian City of Genk. *J. Clean. Prod.* 173, 171–185.
- Greiner, C., Sakdapolrak, P., 2013. Translocality: concepts, applications and emerging research perspectives. *Geogr. Compass* 5, 373–384.
- Grin, J., Rotmans, J., Schot, J., with, ic., Loorbach, D., Geels, F.W., 2010. *Transitions to Sustainable Development; New Directions in the Study of Long Term Transformative Change*. Routledge, New York.
- Gunderson, L.H., Holling, C.S., 2002. *Understanding Transformations in Human and Natural Systems*.
- Hargreaves, T., Hielscher, S., Seyfang, G., Smith, A., 2013. Grassroots innovations in community energy: the role of intermediaries in niche development. *Glob. Environ. Change* 5, 868–880.
- Haxeltine, A., Pel, B., Dumitru, A., Avelino, F., Kemp, R.F., Bauler, T., Kunze, I., Dorland, J., Wittmayer, J., Jørgensen, M.S., 2017a. Towards a TSI theory: a relational framework and 12 propositions. *TRANSIT Working Paper #16*, December 2017.
- Haxeltine, A., Pel, B., Wittmayer, J.M., Dumitru, A., Kemp, R., Avelino, F., 2017b. Building a middle-range theory of Transformative Social Innovation; theoretical pitfalls and methodological responses. *Eur. Public Social Innov. Rev.* 2 (1), 59–77.
- Huybrechts, B., Haugh, H., 2018. The roles of networks in institutionalizing new hybrid organizational forms: insights from the European Renewable Energy Cooperative Network. *Organ. Stud.* 39 (8), 1085–1108. <https://doi.org/10.1177/0170840617717097>.
- Jørgensen, M.S., Wittmayer, J., Avelino, F., Elle, M., Pel, B., Bauler, T., Kunze, I., Longhurst, N., 2014. Methodological guidelines for case studies Batch I. Deliverable 4.1. *TRANSIT: EU SSH.2013.3.2-1 Grant Agreement n. 613169*.
- Jørgensen, M.S., Avelino, F., Dorland, J., Rach, S., Wittmayer, J., 2016. Synthesis across social innovation case studies. Deliverable 4.4. *TRANSIT: EU SSH.2013.3.2-1 grant agreement n. 613169*.
- Juarez, P., Balázs, B., Trentini, F., Korzenszky, A., Becerra, L., 2015. WP 4: Case Study Report: La Via Campesina. *TRANSIT: EU SHH.2013.3.2-1 Grant agreement no: 613169*.
- Kanger, L., Geels, F.W., Sovacool, B., Schot, J., 2019. Technological diffusion as a process of societal embedding: lessons from historical automobile transitions for future electric mobility. *Transp. Res. D Transp. Environ.* 71, 47–66.
- Kemp, R., Loorbach, D., 2003. Governance for sustainability through transition management. *Open Meeting of Human Dimensions of Global Environmental Change Research Community, Montreal, Canada Vol. 20*.
- Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technol. Anal. Strateg. Manag.* 175–196.
- Kivimaa, P., Kern, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Res. Policy* 1, 205–217.
- Köhler, J., Geels, F.W., Kern, F., Markard, J., Wiecek, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., 2019. An agenda for sustainability transitions research: state of the art and future directions. *Environ. Innov. Soc. Transit.* 31, 1–32.
- Kungl, G., Geels, F.W., 2018. Sequence and alignment of external pressures in industry destabilisation: understanding the downfall of incumbent utilities in the German energy transition (1998–2015). *Environ. Innov. Soc. Transit.* 78–100.
- Kunze, I., Avelino, F., Flor, 2015. WP4 Case Study Report: Social Innovation and the Global Ecovillage Network. *TRANSIT*. <http://www.transitsocialinnovation.eu/resource-hub/transit-research-report-social-innovation-and-the-global-ecovillage-network>.
- Longhurst, N., Pataki, G., 2015. WP4: Case Study Report: The Transition Movement. *TRANSIT: EU SSH.2013.3.2-1 Grant Agreement No: 613169*.
- Longhurst, N., Avelino, F., Wittmayer, J., Weaver, P., Dumitru, A., Hielscher, S., Cipolla, C., Afonso, R., Kunze, I., Elle, M., 2016. Experimenting with alternative economies: four emergent counter-narratives of urban economic development. *Curr. Opin. Environ. Sustain.* 22, 69–74. <http://www.sciencedirect.com/science/article/pii/S1877343517300635>.
- Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance* 1, 161–183.
- Loorbach, D., Avelino, F., Wittmayer, J.M., Haxeltine, A., Kemp, R., O’Riordan, T., Weaver, P., 2016. The economic crisis as a game-changer? Exploring the role of

- social construction in sustainability transitions. *Ecol. Soc.* 21 (4), 15. <http://www.ecologyandsociety.org/vol21/iss4/art15/>.
- Loorbach, D., Frantzeskaki, N., Avelino, F., 2017. Sustainability transitions research: transforming science and practice for societal change. *Annu. Rev. Environ. Resour.* 1.
- Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. *Res. Policy* 6, 955–967.
- Metcalfe, J.S., 1997. On diffusion and the process of technological change. In: Antonelli, G., De Liso, N. (Eds.), *Economics of Structural and Technological Change*. Routledge, London.
- Moore, M., Westley, F., 2011. Surmountable chasms: networks and social innovation for resilient systems. *Ecol. Soc.* 1, 5.
- Moore, M., Riddell, D., Vocisano, D., 2015. Scaling out, scaling up, scaling deep: strategies of non-profits in advancing systemic social innovation. *J. Corp. Citizsh.* 58, 67–85.
- Moulaert, F., Mehmood, A., MacCallum, D., Leubolt, B., 2017. *Social Innovation as a Trigger for Transformations-The Role of Research*. Publications Office of the European Union.
- OECD, 2015. *Synthesis Report System Innovation*.
- Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C., Holling, C.S., 2006. Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecol. Soc.* 1.
- Pel, B., 2016. Trojan horses in transitions: a dialectical perspective on innovation 'capture'. *J. Environ. Policy Plan.* 18 (5), 673–691.
- Pel, B., Bauler, T., Avelino, F., Backhaus, J., Ruijsink, S., Rach, S., Jørgensen, M.S., Kunze, I., Voss, G., Dumitru, A., Lema Blanco, I., Afonso, R., Cipolla, C., Longhurst, N., Dorland, J., Elle, M., Balázs, B., Horváth, J., Matolay, R., Wittmayer, J., Valderrama Pineda, A., Serpa, B., Rösing Agostini, M., Lajarthe, F., Garrido, S., Picabea, F., Moreira, J., Trentini, F., Bidinost, A., Weaver, P., Heimann, R., Skropke, C., Hoffmeister, K.L., Tawakol, D., Olivotto, V., Tsatsou, A., Zahed, Y., Moet, R., Zuiderdijk, L., Renema, J., Kemp, R., 2017. The Critical Turning Points database; concept, methodology and dataset of an international Transformative Social Innovation comparison. TRANSIT Working Paper #10.
- Pel, B., Wittmayer, J.M., Dorland, J., Jørgensen, M.S., 2020. Unpacking the social innovation ecosystem: an empirically grounded typology of empowering network constellations. *Innov. Eur. J. Soc. Sci. Res.* 1–26. <https://doi.org/10.1080/13511610.2019.1705147>.
- Pesch, U., Spekkink, W., Quist, J., 2018. Local sustainability initiatives: innovation and civic engagement in societal experiments. *Eur. Plan. Stud.* 1–18.
- Polletta, F., Jasper, J.M., 2001. Collective identity and social movements. *Annu. Rev. Sociol.* 1, 283–305.
- Raven, R., 2007. Niche accumulation and hybridisation strategies in transition processes towards a sustainable energy system: an assessment of differences and pitfalls. *Energy Policy* 4, 2390–2400.
- Raven, R.P.J.M., Bosch, S.J.M., Weterings, R., 2007. *Strategic Niche Management and Transition Experiments: From Analytical Tool to a Competence Kit for Practitioners*.
- Rogers, E.M., 2003. *Diffusion of Innovations*, 5th ed. Free Press, New York.
- Rossi, A., 2017. Beyond food provisioning: the transformative potential of grassroots innovation around food. *Agriculture* 1.
- Rotmans, J., Loorbach, D., 2009. Complexity and transition management. *J. Ind. Ecol.* 2, 184–196.
- Rotmans, J., Kemp, R., van Asselt, M., 2001. More evolution than revolution: transition management in public policy. *Foresight* 1, 15–31.
- Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technol. Anal. Strateg. Manag.* 5, 537–554.
- Schot, J., Kanger, L., 2018. Deep transitions: emergence, acceleration, stabilization and directionality. *Res. Policy* 6, 1045–1059.
- Schot, J., Steinmueller, E., 2016. *Framing Innovation Policy for Transformative Change: Innovation Policy 3.0*. SPRU Science Policy Research Unit, University of Sussex, Brighton, UK.
- Sengers, F., Wiczorek, A.J., Raven, R., 2019. Experimenting for sustainability transitions: a systematic literature review. *Technol. Forecast. Soc. Change* 145, 153–164.
- Seyfang, G., Haxeltine, A., 2012. Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environ. Plann.-Part C* 3, 381–400.
- Seyfang, G., Smith, A., 2007. Grassroots innovations for sustainable development: towards a new research and policy agenda. *Environ. Polit.* 4, 584–603.
- Smith, A., 2007a. Translating sustainabilities between green niches and socio-technical regimes. *Technol. Anal. Strateg. Manag.* 4, 427–450.
- Smith, A., 2007b. Translating sustainabilities between green niches and socio-technical regimes. *Technol. Anal. Strateg. Manag.* 4, 427–450.
- Smith, A., Raven, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. *Res. Policy* 6, 1025–1036.
- Späth, P., Rohracher, H., 2010. 'Energy regions': the transformative power of regional discourses on socio-technical futures. *Res. Policy* 4, 449–458.
- Späth, P., Rohracher, H., 2012. Local demonstrations for global transitions—dynamics across governance levels fostering socio-technical regime change towards sustainability. *Eur. Plan. Stud.* 3, 461–479.
- Steward, F., 2012. Transformative innovation policy to meet the challenge of climate change: sociotechnical networks aligned with consumption and end-use as new transition arenas for a low-carbon society or green economy. *Technol. Anal. Strateg. Manag.* 4, 331–343.
- Suurs, R.A., 2009. *Motors of Sustainable Innovation: Towards a Theory on the Dynamics of Technological Innovation Systems*.
- Tàbara, J.D., Frantzeskaki, N., Hölscher, K., Pedde, S., Kok, K., Lamperti, F., Christensen, J.H., Jäger, J., Berry, P., 2018. Positive tipping points in a rapidly warming world. *Curr. Opin. Environ. Sustain.* 120–129.
- Torrens, J., Schot, J., Raven, R., Johnstone, P., 2019. Seedbeds, harbours, and battlegrounds: on the origins of favourable environments for urban experimentation with sustainability. *Environ. Innov. Soc. Transit.* 31, 211–232.
- Turnheim, B., Geels, F.W., 2012. Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913–1997). *Energy Policy* 50, 35–49.
- Van den Bosch, S., 2010. *Transition Experiments: Exploring Societal Changes towards Sustainability*.
- von Wirth, T., Fuenschilling, L., Frantzeskaki, N., Coenen, L., 2019. Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. *Eur. Plan. Stud.* 2, 229–257.
- WBGU, 2013. *Welt im Wandel - Gesellschaftsvertrag für eine Große Transformation*.
- Weber, K.M., 1997. *Innovation Diffusion and Political Control of Energy Technologies: A Comparison of Combined Heat and Power Generation in the UK and Germany*.
- Wejnert, B., 2002. Integrating models of diffusion of innovations: a conceptual framework. *Annu. Rev. Sociol.* 1, 297–326.
- Westley, F., McGowan, K., 2017. *The Evolution of Social Innovation: Building Resilience through Transitions*. Edward Elgar Publishing.
- White, R., Stirling, A., 2013. Sustaining trajectories towards sustainability: dynamics and diversity in UK communal growing activities. *Glob. Environ. Change* 5, 838–846.
- Wittmayer, J.M., Avelino, F., Afonso, R. (Eds.), 2015. *WP4 Case Study Report: Impact Hub TRANSIT: EU SSH.2013.3.2-1 Grant agreement no: 613169*. <http://www.transitsocialinnovation.eu/resource-hub/wp-4-case-study-report-impact-hub>.
- Wittmayer, J.M., Avelino, F., Dorland, J., Pel, B., Jørgensen, M.S., 2015b. *Methodological Guidelines Batch 2. TRANSIT Deliverable 4.3. TRANSIT: EU SSH.2013.3.2-1 Grant Agreement No: 613169*.
- Wittmayer, J.M., Avelino, F., van Steenbergen, F., Loorbach, D., 2017a. Actor roles in transition: insights from sociological perspectives. *Environ. Innov. Soc. Transit.* 24, 45–56.
- Wittmayer, J.M., Kemp, R., Haxeltine, A., Avelino, F., Pel, B., Ruijsink, S., Jørgensen, M.S., Rach, S., 2017b. *Transformative Social Innovation – What Have We Learned in Four Years of Research? (TRANSIT Brief; 6)*.
- Wittmayer, J.M., Backhaus, J., Avelino, F., Pel, B., Strasser, T., Zuiderdijk, L., 2019. Narratives of change: how social innovation initiatives construct societal transformation. *Futures* 112, 102433. <https://doi.org/10.1016/j.futures.2019.06.005>.
- Zijlstra, T., Avelino, F., 2012. A socio-spatial perspective on the car regime. In: Geels, F., Kemp, R., Dudley, G., Lyons, G. (Eds.), *Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport*. Routledge, New York.