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ORIGINAL ARTICLE

Many pathways toward sustainability: not conflict but co-learning between transition narratives

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Abstract Sustainability transitions aim to comprehensively address key challenges of today's societies through harmonizing ecological integrity and social viability. During the last decades, increasing attention has focused on the conceptual development and identification of trajectories that navigate societies toward sustainability. While a broad agreement exists with regard to the need for mainstreaming sustainability into the core of decision-making and everyday practices, different transition pathway narratives are advocated to foster urgently needed structural and societal changes. In this article, we describe four archetypes of present transition narratives, examining the system properties (from underpinning intent to mechanistic parameters) that each narrative seeks to transform. We review the articulated critiques of, and provide exemplary case studies for, each narrative. The four transition narratives are (1) the green economy, (2) low-carbon transformation, (3) ecotopian solutions and (4) transition movements. Based on our analysis, we argue that despite the assumption that these narratives represent competing pathways, there is considerable complementarity between them regarding where in a given system they seek to intervene. An integrative approach could potentially help bridge these intervention types and connect fragmented actors at multiple levels and across multiple phases of transition processes. Effectively mainstreaming sustainability will ultimately require sustainability scientists to navigate between, and learn from, multiple transition narratives.

Keywords Sustainability transformation · Narrative analysis · Meta-narratives · Leverage points · Sustainability science · Sustainability mainstreaming

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Introduction

Sustainability transitions aim to comprehensively address the key challenges of today's societies, harmonizing ecological integrity and social viability (Kates and Parris 2003; Markard et al. 2012). Originating from the urgent need to curb environmental degradation and address the widening gulf between the rich and the poor, sustainability has become a comprehensive guiding concept in science and practice (Gibson et al. 2005). During the last decades, efforts have increasingly focused on identifying trajectories that move societies toward sustainability (Geels 2005; Meadows 2008; Loorbach and Rotmans 2010). This has created room for various interpretations and definitions of sustainability making this normative concept "essentially contested" (Gallie 1955, p. 196; Connelly 2007).

Proponents of sustainability transitions have developed multiple (potentially) contested pathways for guiding societies toward sustainability. In particular, controversies have emerged between weak and strong sustainability (Dietz and Neumayer 2007; Pelenc and Ballet 2015), between technocentrism and ecocentrism (Bailey and Wilson 2009; Audet 2014), between adaptation and transformation (Kates et al. 2012; Dow et al. 2013; Aall et al. 2015) and between reformist and revolutionary positions (Geels et al. 2015). The diverging conceptual foundations have given rise to distinct transition narratives that advocate very different pathways for navigating societies toward sustainability.

Transition pathway narratives can be conceptualized as comprehensive solution approaches to sustainability challenges. Narratives can be understood as stories that address a specific problem (beginning), detail core objectives and a sequence of key actions (middle) and propose a solution (end) (Roe 1994). As such, narratives represent system framings, which differ according to the actor that articulates system boundaries, elements, dynamics and goals as well as the ways in which the system should be transformed to generate desired outcomes (Leach et al. 2010). Thus, narratives are not merely stories, but they function as justification for particular interventions, essentially creating pathways of change (Leach et al. 2010; Scoones et al. 2015). Transition pathways and their underlying narratives can operate and are reinforced at various system scales, describe developing system properties such as incentives, responsiveness, rules and underpinning beliefs, as well as create system behavior such as inertia, dependencies and cascading effects (Burch et al. 2014). For example, a transition pathway narrative may focus on a sustainability problem such as climate change describing its setting, the source of the problem (e.g., carbon dioxide emissions) and its consequences (e.g., impacts on the economy); it identifies the key actors including those that will fix the problem (e.g., legislators), the ones that are causing it (e.g., countries) and the ones that are affected (e.g., national economies). It delineates the premise of the story as the need to transition toward a specific goal (e.g., low-carbon economy) and clarifies how this should be done through outlining key objectives (e.g., reduction of carbon dioxide emissions) and required actions (e.g., international climate treaty).

Inherent to different sustainability transition pathway narratives is the notion that they represent idealized approaches for navigating societies toward sustainability. In fact, they advocate alternative sustainability solutions and due to their controversies competing for superiority (Beland Lindahl et al. 2015). This is often based on the differing underpinning assumptions in terms of both problem setting and proposed solutions. For example, two prominent pathways for dealing with waste mainly advocate either a reduction in material flows (cradle to grave strategy) or the elimination of waste (cradle to cradle strategy) (Wiel et al. 2012). Here, we would argue that the advocacy of a particular transition pathway is not based solely on its efficacy, but also on the worldviews of the particular advocate. The cradle to grave approach may be particularly compatible with convention approaches such as increasing efficiency of waste plants, whereas the cradle to cradle strategy promotes a pathway that aims to transform prevailing beliefs and practices, turning waste products into resources (e.g., Short et al. 2014).

Transition pathway narratives aim at contributing to mainstream sustainability, ultimately replacing conventional practices and ideas with new belief systems (McAlpine et al. 2015). More specifically, mainstreaming sustainability requires integration of sustainability principles into all societal realms as well as up-scaling change of physical and societal structures (Wamsler et al. 2014; Luederitz et al. 2016). Therefore, sustainability transitions need to go beyond mere system modification. Such transitions must rupture conventional practices and revolutionize structures and dynamics related to the institutional, technological, economic, and cultural dimension of societies (Schneidewind 2013; Bouvrie et al. 2015). Given their transformational nature, the varied worldviews and perspectives from which they arise and their potential incompatibility, there is a need for further scrutiny of the underpinning assumptions of different transition pathways.

In this article, we examine the characteristics of different transition pathway narratives and organize them according to the respective interventions that they target. We examine four archetypes—frequently found narratives that exhibit distinct characteristics—expanding on the critique that these approaches have attracted and exemplify their implementation through illustrative case studies that help root our analysis in practice ("Sustainability transition pathway narratives: from shallow to deep levels of transformation"). In "Discussion", we revisit the criticism that narrative advocates are confronted with, discuss the transformational potential of integrating narratives for sustainability mainstreaming and reflect upon the role of sustainability scientists in sustainability transitions. In conclusion, we argue for a move beyond the notion of purely competing pathways of transformational change and to consider how different transition narratives provide opportunities of co-learning to foster sustainability transitions ("Conclusion").

Sustainability transition pathway narratives: from shallow to deep levels of transformation

During the last decade, distinct transition pathway narratives have emerged that focus on different aspects of change and suggest contrasting trajectories to guide

societies toward sustainability. The ordering function of narratives (i.e., detailing settings, actors, objectives, actions and solution) reflects how advocates perceive their realities while simultaneously influencing how recipients of such narratives make sense of the issues being addressed (Jones et al. 2014; Hermwille 2016). Previous research has identified transition narratives according to the actors or the technology involved (Lo 2014; Scoones et al. 2015). Others have emphasized the geographical embeddedness or analyzed sustainability framings in different transition narratives (Swilling et al. 2015; Beland Lindahl et al. 2015; Hermwille 2016; Frantzeskaki et al. 2016). In this study, we expand on this research systematically investigating the interventions that archetypical transition narratives target.

Sustainability transitions are characterized as (1) multi-actor, (2) multi-level and (3) multi-phase processes (Loorbach et al. 2008): (1) proponents of narratives may range from civil society to governments, and private companies and academic researchers (Avelino and Wittmayer 2015). (2) Transitions emerge from dynamics at various scales including the macro-level (landscape), meso-level (regime) and micro-level (niche level) (Geels 2002). For the purpose of this analysis, we simplified this relational perspective, operationalizing levels as global, regional and local (e.g., Raven et al. 2012; Hansen and Coenen 2015). Finally, (3) phases of transition have been conceptualized as an s-curve in which pre-development processes take off and accelerate and eventually stabilize as a new system configuration (Rotmans et al. 2001; Vandevyvere and Nevens 2015).

Our analysis focuses on archetypical narratives to conceptualize sustainability mainstreaming in transition studies. Thus, it aims at depicting the broad (collective) patterns and the core foci of the narratives, rather than providing in-depth scrutiny of the individual transition pathways. Following the analytical framework for describing narratives developed by Jones et al. (2014), we examine the setting, involved actors, core objectives and key actions, and the premises of transition pathway narratives. In addition, we consider the narratives' level of operation and discuss their significance for different phases in sustainability transitions. Such analyses are susceptible to individual biases; therefore, we rely, where possible, on peer-reviewed articles as the source of information to ensure some degree of rigor. Moreover, we employ the seminal work of Donella Meadows (1999) on leverage points as places to intervene in a system to conceptualize how, and at what points in the system, the interventions target to achieve transformational change.

Leverage points are places where small interventions enable large, transformational shifts in society (Meadows 1999, 2008). Different leverage points focus on different places to lever change, and as a consequence their ability to shift a society from one state to another varies in strength (Meadows 1999). Meadows identified 12 leverage points that are particularly powerful for changing a system that can be aggregated to four general types of interventions; see Table 1. The four broad types of interventions—*parameters*, *flows*, *design* and *intent* (Abson et al. 2016)—range from relatively shallow interventions (*parameters*, *flows*) that are rather easy to implement, but with limited ability to lead to transformational change, to deep leverage points (design, intent) which are harder to achieve, but lead to potentially greater systemic transformation. *Parameter interventions* focus on modification of 'mechanical' system properties, such as taxes and incentives. *Flow interventions* seek to increase the responsiveness of the system to change, allowing existing processes and structures to adapt more quickly to changes in the system, such as the implementation of participatory elements in the decision-making processes. *Design interventions* seek to change the rules of the system, how and by whom the system is managed and organized, such as the change from consumers to prosumers. Finally, *intent interventions* attempt to shift the underpinning beliefs, mindsets and goals that shape system *design*, *flows* and *parameters,* such as focusing primarily on sufficiency instead of efficiency and efficacy (Abson et al. 2016).

The intervention types indicate places where narrative advocates can potentially intervene, but also exemplify key characteristics of the analyzed narratives. Thus, this framework allows a twofold analysis examining what intervention types are central to a narrative (e.g., what changes their advocates try to implement) as well as investigating the system properties that define it. For example, a narrative that addresses climate change may aim to implement a new legislation, such as a carbon tax (*parameters*) or propose the revision of societal norms, such as changing accepted practices around the use of fossil fuel-based transport (*intent*) for reducing carbon dioxide emissions. In both cases, specific system properties are targeted by the suggested actions. While in the first case the prevailing *intent* of the system is taken for granted suggesting rather mechanistic changes, in the second case the goals of the system are questioned. Accordingly, our analysis depicts the overall system properties that underlay a transition pathway narrative as well as scrutinize the places that are suggested for interventions.

The four transition narratives examined in this article are: (1) the green economy (Jänicke 2012; e.g., Bowen and Hepburn 2015); (2) low-carbon transformation (e.g., Lo 2014); (3) ecotopian solutions (e.g., de Geus 2002; Anderson 2007) and (4) transition movements (e.g., Kurland et al. 2012; Shawki 2013). In the following sections, we provide a brief description of each transition narrative, examine the intervention types that shape them, and

Table 1 Intervention types and leverage points for intervening in a system (adopted from Abson et al. 2016; Meadows 1999)

Types of interventions	Description (adopted from Abson et al. 2016)	12 Leverage points (adopted from Meadows 1999)
Parameters	Modifiable, mechanistic system characteristics such as taxes, incentives and standards, or physical elements of a system, such as sizes of stocks or rates of material flows	Parameters: constants and numbers such as subsidies, taxes and standards
		Buffers: the sizes of stabilizing stocks relative to their flows
		Stock-and-flow: physical systems and their nodes of intersection
Flows	Interactions between elements within a system that drive internal system dynamics (e.g., dampening or reinforcing feedback loops) or provide information regarding desired system outcomes (e.g., the effectiveness of a given incentive scheme)	Delays: the lengths of time relative to the rates of system changes
		Balancing feedback: the strength of the feedbacks relative to the impacts they are trying to correct
		Reinforcing feedback: the strength of the gain of driving loops
Design	Characteristics of a system relate to the structure of information flows, rules of the system, power and self-organization	Information flows: the structure of who does and does not have access to information
		Rules: incentives, punishments and constraints
		Self-organization: the power to add, change or evolve system structure
Intent	Characteristics relate to the norms, values and goals embodied by the system and the underpinning paradigms out of which the system arises	Goals: the purpose or function of the system
		Paradigm: the mindset out of which the system—its goals, structure, rules, delays and parameters—arises
		Transcend paradigms

elaborate on the leverage points that are targeted. In addition, we review articulated criticism and visit illustrative case studies to link the conceptual framing to real-world practices.

Green economy

In a nutshell, the green economy addresses the risks of environmental degradation and resource scarcity as well as navigating their impacts on national economies. International elites, intergovernmental organizations and legislators promote this narrative. Businesses and industries that deplete natural resources are framed as economically inefficient and ultimately harmful to human well-being. The goal is to transition toward an environmental benign economy, archiving economic green growth through policy instruments that incentivize and regulate specific economic activities.

The goals and mindset that inform the *intent* of the green economy narrative arise from the belief that green growth will curb the systemic environmental, social and financial problems that societies are facing (Jänicke 2012). The green economy is intertwined with the long-standing objective of gross domestic product growth, which is the "greatest interest to policy-makers at the present time" (Bowen and Hepburn 2015, p. 410). This transition narrative has been prominently advocated by international elites framing the green economy as an environmental benign production mode of the whole economy (Hamdouch and Depret 2010; Jänicke 2012; Bowen and Hepburn 2015).

The *design* of this narrative is largely premised on the currently dominant economic system, power structures and rules. At its core, the green economy can be characterized as seeking to improve the 'environmental efficiency' of our current economic systems, rather than challenge the underpinning logic, goals and structured associated with such systems (Bina 2013; Borel-Saladin and Turok 2013). It is argued that 'green' or 'clean' technologies provide the means for entering a post-carbon era, decoupling economic growth and carbon dioxide emissions (Hamdouch and Depret 2010). Thus, the narrative's focus goes beyond individual industrial sectors, for example, the growth of green technology or segments such as low-carbon development. In so doing, it may have the potential to be used to harmonize the diverse institutions that govern individual sectors of the economy and to facilitate coordinated action at the global level.

This narrative is primarily framed in terms of national strategies targeting *parameter interventions* such as economic incentives, stabilizing stocks and infrastructure; see Table 2 (Vazquez-Brust and Sarkis 2012a; Bowen and Hepburn 2015). In particular, three prominent interventions are associated with this narrative: price policy tools, non-price policy tools and voluntary approaches (Vazquez-

Brust and Sarkis 2012b). Price policies are the most popular tools, focusing on subsidies, taxes, and standards to reduce the risk of environmental scarcity, natural hazards or climate change (Hallegatte et al. 2012). The objective of these tools is to 'get the price right' through taxation, subsidies and control mechanisms. Taxation is employed to account for the damage caused by certain activities, for example, as intended by a carbon tax. Subsidies are commonly used to encourage the reduction of environmental damage, for example, by incentivizing electric vehicles. Other tools control the amount of environmental damage through tradable permits (e.g., cap and trade), or determine who has the right to cause what kind of damage through the assignment of property rights (Hallegatte et al. 2012; Vazquez-Brust and Sarkis 2012b). Non-price policy tools regulate activities by setting standards (e.g., energy efficiency) or supporting specific practices and innovation, including network formation (Vazquez-Brust and Sarkis 2012b). The third branch of advocated policies comprises voluntary approaches to address specific sustainability challenges intending to shift business operation toward greener operations. Voluntary standards such as 'green labels' are an illustrative example of this type of instruments.

Besides prominent support from various intergovernmental organizations and national agencies (such as the Organization for Economic Co-operation and Development—OECD, the International Chamber of Commerce, the United Nations Environment Programme—UNEP), the green economy narrative has attracted substantial criticism. It is accused of focusing solely on globalized, market-based solutions in the hope that economy benefits will lead to environmentalism (ecological modernization) (Jänicke 2012). The emphasis on win–win solutions as well as the belief that existing political and economic arrangements will bring about the required changes neglects issues of justice and underlying social dynamics (Brand 2012; Cook and Smith 2012). It is also criticized for its focus on national and global economic dynamics counteracting local efforts and differences (Jackson 2009). As such, the focus on free trade, global competitiveness, exploitation of natural resources and the strengthening of dominant power relation is claimed to contradict any serious attempt toward sustainability (Barbier 2011; Brand 2012). Thus, the green economy is critiqued for re-enforcing current practices and that its objectives tend to support business-as-usual procedures.

Case study: green economy

In the province of Quebec, Canada, a broad coalition of environmental non-governmental and business sector organizations has been formed in recent years to promote and lobby for "the green economy we want" (SWITCH Alliance 2013). While the alliance puts the problem of curbing greenhouse gas emission on top of its priorities, it also advocates the transition to a green economy as an 'opportunity' to launch a new era of growth in the manufacturing sector, which has suffered a decline in the last decade. The SWITCH narrative thus puts forward the key role of clean tech enterprises as drivers of the green economy and calls for the Quebec government to help in setting the right institutional context. The Alliance has produced reports on the advantages of eco-taxes as a means to facilitate the commercialization of locally developed green techs, on the role of public procurement to send 'signals' to markets, and other economic incentives that would help to position Quebec enterprises at the forefront of the race for growth opportunities. It has steadily supported the Quebec–California carbon market, which constitutes the backbone of the Quebec strategy to fight against climate change. Over recent years, successive governments have reacted positively to these arguments, to the point that SWITCH leaders were invited to take part in governmental consultative committees. Nevertheless, the development of the fossil fuel industry in the St.Lawrence River, Valley and Gulf (shale gas exploitation, pipelines, deepwater drilling) continues, despite considerable civil society protests. Hence, while price incentive policies are being mainstreamed as a green economy strategy, unsustainable business-as-usual practices continue unabated in certain sectors of the economy.

Low-carbon transformation

In a nutshell, the low-carbon transformation addresses climate change and related impacts on municipality and city life. City administrations and local governments advocate this narrative as they target the activities of local enterprises and citizens that cause carbon emissions. The goal is to transition toward resilient cities that are capable of mitigating climate change and adapting to unavoidable impacts through spatial planning and controling appropriate behavior.

This transition pathway follows a similar *intent* to the green economy while placing a strong emphasis on cities and local governments as the most effective actors in addressing climate change (Rosenzweig et al. 2010; Bulkeley 2010; Lo 2014). The narrative is rooted in climate change mitigation initiatives and fostered through the Rio Earth Summit in 1992. Cities and local governments have exercised their sovereignty, changing the *design* and *flows* of local structures through spatial planning, transport, energy and waste management (Bulkeley et al. 2012). In addition, local governments have expanded their influence beyond the regulatory and service provisioning role to

foster low-carbon transformations (Bulkeley and Betsill 2005; Burch 2010). Low-carbon transformation considers local realities explicitly through addressing the impacts of climate change related extreme events. The underlying narrative frames addressing environmental issues as essential for promoting development (Roberts 2008). During the last two decades, the low-carbon transformation narrative has gained increased attention from local and regional actors involved in the area of low-carbon urbanism and low-carbon governance (Lo 2014). Around the world, city administrations and local governments as well as transnational networks and public–private collaborations are prominently advocating the low-carbon transformation (Rosenzweig et al. 2010; Lo 2014; Fünfgeld 2015).

The low-carbon narrative mainly targets *flow interventions* including changes to key infrastructure, attempting to decrease delays in feedbacks within the systems, increasing responsiveness, as well as reshaping, balancing and reinforcing feedbacks; see Table 2 (Bulkeley and Kern 2006; Rice 2013; Lo 2014). Local governments address city dynamics through their mandate for spatial planning (Bulkeley et al. 2014; Wamsler et al. 2014). For example, in response to natural hazards and threads in relation to climate change, local governments have the ability to revise spatial planning regulations to ensure that settlements are built above the expected sea level rise (Wamsler et al. 2014). In addition, modification of existing, or creation of new, control mechanisms can balance or reinforce certain practices and dampen undesired behavior (Moloney and Horne 2015). Voluntary programs create synergies between residents, businesses and the local government changing existing governance arrangements and nurturing increased momentum to create support for decentralization beyond solely replacing political leaders (Rice 2013; Bulkeley et al. 2014). The involvement of residents into ambitious agenda setting and information dissemination about municipal transition targets is another way of ensuring high support and buy-in (Hoppe et al. 2015).

In recent years, major criticism has been articulated also with regard to this narrative. Essentially, it is argued that low-carbon initiatives are not contributing to the urgently needed radical change but "are tinkering around the edges" (Lo 2014; Moloney and Horne 2015, p. 2249). In fact, activities that relate to this narrative are often motivated by economic costs and potential benefits while operating on short-term funding to address long-term objectives (Hodson and Marvin 2012). As such, the narrative codifies "outcomes that would have been achieved in any case" (Millard-Ball 2012, p. 301). In addition, related governance arrangements might primarily reinforce the current state promoting economic growth with environmental interests remaining peripheral (Hodson and Marvin 2012). It is also claimed that the low-carbon transformation narrative only addresses tangible problems which are compatible with existing goals and policies and thus prolonging the conventional practices and ideas (Moloney and Horne 2015).

Case study: low-carbon transformation

In response to climate change and finite fossil fuel resource, the City of Växjö, Sweden, excelled in the application of Agenda 21, setting ambitious goals and fostering a low-carbon transformation (Johanson 2010). In 1996, the Växjö City Council unanimously adopted a low-carbon transformation strategy with the objective of becoming fossil fuel free by 2030 (Emelianoff 2013). The initial focus on climate change, energy use, transport and water has been expanded through the municipality's 2014 environmental program, including 30 targets within several areas of activity. Among others, targets aim at increasing the share of organic or locally produced food in municipal kitchens, or having 90% of household and business recycle their food waste by 2020 (Växjö Kommun 2014). Växjö's low-carbon agenda is supported by a network of dedicated politicians and ambitious officials as well as their collaborations with non-governmental organizations, municipality owned and private business, the university and citizens (Johanson 2010). Through regular meetings and working groups, this alliance has identified feasible measures to foster the low-carbon transformation (SusCom 2004). While municipality-owned companies have been effectively regulated through environmental programs, other businesses have taken voluntary measures to join forces with the local government. Moreover, municipal subsidies have financed energy efficiency refurbishment of private homes and helped support fossil-free vehicles (Azevedo et al. 2013). Despite the actions of the municipality, many strategic decisions remain at odds with the long-term goal of a fossil-free city (SusCom 2004; Khan 2013). Overall, the daily life for the citizens of Växjö has not changed, economic growth remains a key objective of the municipality and carbon emission reduction has only been achieved for low-hanging fruits (Pool 2010).

Ecotopian solutions

In a nutshell, ecotopian solutions address societies' unsustainable development trends and their impacts on the natural environment. Advocates of this narrative include committed individuals and communities that rebel against traditional legislative powers, which dominate ordinary citizens. Its goal is to transition toward greater social–ecological integrity through creating living spaces outside of conventional, state-led governance and support of narrative aligned belief systems and practices.

Ecotopian solutions present an autonomous ecological living narrative that challenges the *intent* of the status quo through translating idealized alternatives into reality (de Geus 2002; Anderson 2007; Pepper 2007). This narrative is largely influenced by visionary imaginaries of an ecological-oriented system framing which emphasizes environmental ethics, natural conservation and technology use to facilitate simple living (Naess 1973). Narrative advocates seek to *design* systems in ways that provide ordinary citizens with greater influence in determining how and by whom the system can be changed as well as defining constraints for such changes (Anderson 2007). Ecotopian solutions differ from other social movements due to the explicit aim of creating individual, experimental and disconnected solution approaches for sustainable lifestyles. Recently, the narrative has gained increased attention in the implementation of ecological villages and sustainable neighborhoods, as well as through sustainable entrepreneurship providing practical examples for sustainability solutions (Joss 2011; Beatley 2012; Parhankangas et al. 2015). Pivotal actors range from individuals to small businesses and communities (e.g., Ecotopia Österlen 2012; Fraker 2013). In addition, local governments are sometimes involved in enacting spatial planning regulations that support citizen (Coates 2013a) and business-led solutions (Joss 2011). This system framing emphasizes experimentation with alternative worldviews as an effective means of learning. For example, advocates may test new living arrangements or technologies that support their values and ideas. Ultimately, these experiments may influence conventional practices as they showcase the feasibility of implementing alternative approaches (Anderson 2007). The narrative's core emphasis is on defining rules, powers and self-organization, and less on the more mechanistic changes that may accompany shifts in system's *intent* and *design*.

Ecotopian narratives at local to regional levels commonly promote interventions that target the overall *design* of societies; see Table 2. For example, interventions change the process that organizes communities through bottom-up governance of residents themselves (Smith 2007; Coates 2013b). Such planning and building processes require changes in formal procedures fostering legal recognition and reducing hierarchies in decision-making (Anderson 2007). Changes in the governance arrangements also create a sense of ownership in advocates of this narrative and increase their access to information (Smith 2007; Walker 2008). More specifically, the ownership of ecotopian solutions provides sustainability enthusiasts with opportunities for influencing and determining policies for regulating activities and practices (Chance 2009). Finally, ecotopian solutions actively support self-organization in 'placemaking' creating new, unconventional arrangements, opening the urban anonymity and strengthening social connections (Milbourne 2012; Coates 2013b).

The notion of providing a comprehensive solution to the current, unsustainable development pathway has attracted various criticisms (e.g., Pepper 2007). In particular, ecotopian solutions are critiqued for their claim of social inclusiveness while representing particular interests, and for the lack of support for consensus as well as capacity building in communities. As such, the narrative is criticized to provide solutions only for similarly minded individuals that engage in pro-environmental behavior, because they already have a strong moral motivation to live sustainably (Deakin and Allwinkle 2007; Eriksson 2008). The long-term viability of these efforts is questioned as demographic change might soften policies and moral obligations. In fact, the personal freedom and the lack of coordinated enforcement of rules and obligations incentivizes individuals to choose alternatives that may contradict the 'intended' changes broadly promoted by this narrative, and return to conventional practices whenever preferred (Anderson 2007). Finally, ecotopian solutions are critiqued for creating sustainability enclaves for the rich, embedded in an environment of unsustainable behavior and practices and remaining parasitic on mainstream approaches (Anderson 2007; Coates 2013b).

Case study: ecotopian solutions

The Vauban neighborhood in Freiburg, Germany, emerged from an ecotopian vision of alternative sustainable housing (Schroepfer et al. 2007). While the City of Freiburg purchased the vacant French army site after the withdrawal of the allied forces in 1992, different citizen groups expressed their visionary goals of developing the area into an ecologically advanced and socially integrated urban community (Coates 2013b). After various negotiations, between the city of Freiburg and community initiatives, the planning process was formalized through recognizing a citizen association as a legal participatory planning body (Fraker 2013). Over 40 community groups of future homeowners were established to guide and instruct their own building projects in line with new policies for energy efficiency. Among others, ambitious regulations enabled the implementation of a 'car-free' vision, realized a mixed-use design and ensured green spaces throughout the neighborhood (Fraker 2013; Coates 2013b). While Vauban is considered to have successfully implemented its visionary goals, it has also been criticized for being largely detached from the rest of the city—not only in its urban form, but also with regard to the community structure (Schroepfer et al. 2007). For example, the neighborhood's population might be more progressive and susceptible to the vision of 'car-free' living than people in other areas of the city.

Others have reported on the dissatisfaction of car owners and an increasing problem of illegal parking in Vauban (Field 2011).

Transition movements

In a nutshell, transition movements focus on counteracting the growth-based economy and globalization trends that impact social and environmental well-being. This narrative is driven by citizen initiatives that identify neo-liberal politics and multinational corporations as harmful to the integrity of local communities. The aim is to transition toward a society that promotes local governance, culture and economy through fundamentally changing personal behavior and interactions between citizens.

Transition movements aim to transform the *intent* that underpins conventional practices and ideas, challenging the increased dependence on globalized structures and the growth-based, neo-liberal mindset (North 2010; Hopkins 2012). In response to environmental issues, this narrative advocates novel solutions that account for local situations and represent the interests of those involved (*design*) (Gibbons et al. 2006; Seyfang 2009). While related environmental movements have a long history, this narrative describes a rather recent phenomenon with many related network initiatives being founded in the mid-2000s (Kurland et al. 2012; Shawki 2013). Contrary to advocates of ecotopian solutions, which create their own spaces, initiatives that promote this narrative operate within given structures of the mainstream (e.g., marked-based economy, public housing, municipal spatial planning) with the aim of ultimately transforming the *intent* of the system. Individuals or community groups that initiate and operate transition movements prominently advocate localism, promoting local production and consumption of goods and services. They construct a locally embedded narrative that seeks radical change in personal behavior to replace current decision-making and everyday practices (Aiken 2012; Shawki 2013; Lo 2014). The narrative of transition movements is considered to be particularly effective in changing individual behavior because of its emphasis on local ownership, empowerment and inclusiveness (Warren and McFadyen 2010; Lo 2014).

The transition movements' narrative focuses on interventions that target changes in societal norms, values and goals; see Table 2. An example, among others, is community currencies that create a complementary exchange medium to counteract globalization trends, support the local economy and create values beyond the monetization of goods and services (Michel and Hudon 2015). The advocated interventions are largely approaches for implementing radical solutions side by side to existing structures in which businesses or governments operate (Hegger et al. 2007). This includes proposals for de-growth that contradict globalization trends, opposition to privatization efforts or rejection of market-based instruments. Essential to this bottom-up movement are motivations to replicate and scale advocated solutions elsewhere, mobilizing actors in different contexts or at higher hierarchical levels (Lo 2014). For example, a citizen initiative in Portland (USA) tripled the rate of a residence-owed solar energy system by organizing campaigns, workshops, and question and answer sessions to empower homeowners to become energy producers and successfully moved this approach to a city-wide application (Aylett 2013).

Transition movements are critiqued for their reluctance to engage in broader political issues beyond localism-oriented approaches and for lacking the capacity to generate consensus over specific targets of what needs to be changed (Connors and McDonald 2010). While an open, "welcome all-comers" approach is often emphasized, its local focus necessitates explicit or implicit exclusion (Aiken 2012). Due to its openness to multiple interests, and lack of a clear, multi-level sustainability vision or goal, this narrative runs the risk of being co-opted by other purposes and losing momentum over ideological debates, weakening its active role in sustainability transitions (Connors and McDonald 2010). Finally, due to the often segmented focus on particular topical issues (e.g., food, economy, transport) and small-scale interventions, advocated by small social groups, transition movements fail to translate solutions beyond the local level and to address societal realms comprehensively (Taylor 2012). In fact, they are criticized to fail to conceptualize integrated economies, or upscale the approach to the city level or a metropolitan area. Thus, the transition movement narrative is critiqued for generating hypothetical solutions that lack compatibility with conventional practices and ideas, which prevents incremental implementation.

Case study: transition movements

The Ithaca HOURS local currency is a transition movement in Ithaca (USA). Introduced in the early 1990s, Ithaca HOURS is a paper-based currency with one HOUR representing 1 hour of basic labor which is valued equivalent to 10 USD. The currency was created in support of the local economy lifting "the lowest paid up without knocking down higher wages" (Glover n.d.). During its height in popularity, the Ithaca Hours was used for purchasing and selling goods and services by approximately 7 % of the 30,000 inhabitants of Ithaca, with over 300 local businesses participating (Jacob et al. 2004). In addition, the local currency also had a small loan and grant program (Mascornick 2007). In line with experience with other local

Table 2 Overview of the four transition pathway narratives and the advocated intervention types

Intervention types	Green economy	Low-carbon transformation	Ecotopian solutions	Transition movements
Parameters	Regulate price policies and non-price policies Develop voluntary standards	Regulate spatial planning, transport, energy and waste management	Construct self-sufficient living spaces	
Flows	Increase green growth and slow down non-related economic development	Create synergies between residents, businesses and the local government Use control mechanisms to dampen undesirable behavior		
Design	Build on and reinforce the current economic system, power structures, and rules Improve 'environmental efficiency'	Build on the current economic system Build capacities in cities and local governments to trigger change	Provide ordinary citizens with greater influence to undertake and constrain system change	Account for local ownership and the interests of those involved Promote radical change in personal behavior
Intent	Transition toward an environmentally benign 'status quo' economy	Transition toward resilient cities that mitigate and adapt to climate change	Transition toward integrated social–ecological living spaces outside of the 'status quo'	Transition toward local communities including their governance, culture and economy

currencies (Michel and Hudon 2015), people participating in Ithaca HOURS reported about an increase in self-esteem and confidence, and improved personal relationships (Jacob et al. 2004). However, the popularity declined substantially in the mid-2000s with fewer businesses accepting the local currency (Khromov 2011). Besides a general shift toward electronic payment, the founder of Ithaca Hours left the town thereby losing its most prominent advocate. In 2015, a new local currency was established with ithacash (Meckley 2015).

Discussion

The analysis of the four archetypical transition narratives comprises a diverse set of pathways toward sustainability. In the following sections, we discuss the four narratives in relation to each other. In "Learning from critique: Transition narratives and their criticism", we revisit the criticism related to the narratives and identify the strengths and weaknesses of these, presumably comprehensive, approaches. Next, we discuss the transformational potential and the collective ability of the four narratives to mainstream sustainability ("Transformational potential of transition narratives: leverage points for mainstreaming sustainability"). Finally, through reflecting on the four case studies, we call attention to the role of research in mainstreaming sustainability ("Transcending paradigms: potential roles for researchers in sustainability transitions").

Learning from critique: transition narratives and their criticism

The four narratives that we explored are each subject to major criticism. The green economy is attacked for reenforcing current practices and supporting business as usual. Efforts that relate to low-carbon transformation are criticized for addressing only tangible problems while falling short to question conventional practices and ideas. The ecotopian solutions narrative is condemned for creating scattered sustainability enclaves that are incompatible with system-wide applications. Finally, critics of transition movements question their scalability as the solutions often conflict with the *intent* and *design* of the larger systems in which they are unavoidably embedded.

This criticism can be linked to the type of system properties (*intent*, *design*, *flows* and *parameters*) that transition narratives target (see Table 2). Narratives that advocate 'shallow' interventions that are straightforwardly implemented (green economy; low-carbon transformation) tend to be criticized for failing to achieve the required systemic change. The criticism that focuses on interventions that target deep-rooted change tend to emphasize the lack of effective processes (ecotopian solution; transition movements). Moreover, low-carbon transformation and the green economy pathways (unlike the ecotopian and transitions pathways) have relatively clearly defined and fixed sustainability goals. The extent to which relatively fixed or flexible visions and goals are considered preferable varies. Sustainability transitions can be conceptualized as being about steering toward a well-defined goal, or adaptively

navigating through complex, dynamic societal change (Ison and Schlindwein 2015).

Our analysis reveals a more nuanced view on the different transition narratives depicting their strengths and weaknesses. The ability of the green economy narrative to harmonize institutionally fragmented settings and move ideas into the large-scale application is crucial for the success of sustainability transitions (Olsson and Galaz 2012; Borel-Saladin and Turok 2013). In addition, changes that seem negligible at first may provide entry points for larger shifts. For example, carbon emission taxation has successfully reduced negative environmental impacts in British Columbia (Canada) while influencing public preferences in favor of such interventions (Murray and Rivers 2015). The innovation potential of narratives that focus on local, small-scale settings may be overlooked in a similar way (Westley et al. 2011). For example, social groups employing the transition movements narrative have succeeded in transforming regional energy markets through embedding technological change in the societal context (e.g., Aylett 2013). This more nuanced perspective is in line with Donella Meadows' (1999) conceptualization of leverage, which emphasizes the strong interconnectedness of deep and shallow leverage points.

The criticism provides learning opportunities about the relation between incremental and abrupt transformational change as well as the problems targeted through transition narratives. Proponents whose worldviews, power relationships and access to resources align with conventional practices and ideas may tend to favor incremental change [e.g., international elites (green economy); local governments (low-carbon transformation)]. In contrast, those with diverging worldviews, lack of power and limited resources may tend to favor abrupt transformation [e.g., social groups (ecotopian solution, transition movements)]. But as proponents of narratives differ, so do the problems that they target. This does not suggest that addressing certain problems is more correct than addressing others. Rather, it implies that narrative advocates' understanding of what is feasible varies and they perform best when diagnoses and action are naturally linked (Weick 1984). For example, the low-carbon transformation narrative deals effectively with the problem of carbon dioxide emissions through the common local government approach of self-governing, provisioning of services and controlling of spatial planning (Lo 2014). Similarly, proponents of the ecotopian solution narrative are able to encourage ordinary citizens to engage in experiments that fundamentally change decision-making and everyday practices (Anderson 2007). This depicts the ability of narratives to reformulate sustainability issues as "*mere problems* [allowing] for a strategy of *small wins* wherein a series of concrete, complete outcomes of moderate importance build a pattern that attracts allies and deters opponents" (Weick 1984, p. 40, emphasis added).

Transformational potential of transition narratives: leverage points for mainstreaming sustainability

Our analysis exemplifies which narrative targets what type of interventions (i.e., *parameters, flows, design, and intent)* in support of creating pathways for mainstreaming sustainability. The narratives of transition movements and ecotopian solutions focus primarily on deep intervention types (*intent* and *design*). The low-carbon transformation and green economy narratives concentrate on more shallow interventions (*flows* and *parameters*). While transition narratives compete for superiority, they may serve different purposes and thus different functions in sustainability transitions. One can observe this complementarity through linking the four archetypical transition narratives as a meta-narrative to the different phases that are used to conceptualize societal transformations (e.g., Rotmans et al. 2001; Nevens et al. 2013). In the pre-development phase of sustainability, mainstreaming the transition movements narrative may play a crucial role by creating the setting in which radically new ideas can flourish. For example, the idea of transforming an existing unsustainable energy system into one that is ecologically integrated, socially equitable and community controlled may emerge from bottom-up processes (e.g., Blanchet 2014). The concerns about local dynamics provide the breeding ground for rethinking the prevailing energy system and developing innovative solutions. In the take-off phase of sustainability mainstreaming where changes get underway, the ecotopian solution narrative can move radical ideas into experimentation. For example, sustainable urban neighborhoods can function as a test bed to experiment with renewable energy production, self-sufficiency and ownership (e.g., Coates 2013b). This can create examples for the implementation of radical change and provide best practices for guiding the replication in similar settings or the application at larger scales. In the acceleration phase of sustainability mainstreaming, where change becomes visible, the low-carbon narrative or alike may be critical to implement change at the regional level. For example, a city government's commitment to reduce their carbon dioxide emissions in energy production and become fossil fuel free can move innovative ideas into system-wide application (e.g., Emelianoff 2013). This could provide the needed momentum for mainstreaming change beyond single small-case application and spur confidence in the success of, and commitment to, the greater transformation. Finally, in the stabilization phase, the approaches employed by the green economy type narratives may have the ability to promote nationwide uptake of sustainability-related change, adjusting and modifying the context in which sustainability change can prosper. For example, national parliaments and agencies can promote the diffusion of renewable energy

technologies through policy instruments (Jacobsson and Lauber 2006). This completes the sustainability mainstreaming process of innovation related to a single sustainability issue. While this description seems to be a straightforward procedure, it ultimately necessitates an ongoing battle, creating "winners and losers, challeng[ing] vested interests and trigger[ing] changes in alliances" (Picciotto 2002, p. 323). In addition, relating narratives to specific phases suggests a false linearity, because change is more complex and may be bottom-up, top-down or internally induced (e.g., de Haan and Rotmans 2011; Kofler et al. 2014). As indicated above, acting on more shallow leverage points can also pave the ground for interventions at deeper leverage points.

The benefits of creating nested meta-narratives that detail how different intervention types can be aligned to support sustainability transitions are twofold. First, Roe (1994, p. 4) sees the potential of meta-narratives to create a new transition narrative that supports and instructs decision taking where present approaches have failed to solve a problem and "are so conflicted as to paralyze decision-making". Accordingly, creating meta-narratives provides opportunities to "confront power" as it suggests that present narratives are outdated and their focus on "uncertainty, complexity, and polarization" is not of interest anymore. "Instead of looking into the past to understand power relations today, [meta-narratives look] … to the future … recast[ing] the givens and status quo in a different light" (Roe 1994, p. 15). Second, nested meta-narratives create explicit learning opportunities for understanding how framings of sustainability transitions emerge and how they relate to seemingly contradictory pathways (Audet 2014; Frantzeskaki et al. 2016). Moreover, developing future-oriented meta-narratives allows for outlining pathways to archive sustainability visions identifying concrete actions across all intervention types (e.g., Wiek and Iwaniec 2013).

None of the four examined transition pathway narratives represents blueprints for, or panaceas to, the complex dynamics of mainstreaming transformational change toward sustainability. In fact, up-scaling transformational change demands contextualization with regard to actors, resources and contexts (e.g., Farla et al. 2012; Wamsler et al. 2014; Hansen and Coenen 2015). Reviewing the narratives individually, they seem mutually exclusive with varying strength and emphasis on technocratic and operational pathways (green economy, low-carbon transformation) versus *intent*-shifting pathways (ecotopian solutions, transition movements). However, all narratives have transformational capacity and integrating these seemingly divergent stories provides multiple places to intervene in a system to trigger transitions toward sustainability. Thus, 'shallow' intervention types (*parameters*, *flows*) that may primarily result in system modification are as important as 'deep' intervention types (*design*, *intent*) that have the potential to lead to transformational change throughout the system (Meadows 1999). While, ideally, changes in the *intent* of a system will result in changes in its *design*, *flows* and *parameters (*Abson et al. 2016*)*, mechanistic *parameters* also have the ability to stimulate changes in deeper system properties. However, any isolated focus on a single intervention is likely to remain 'mere tinkering' on single system properties rather than effectively pursuing transformational change throughout the system. Learning from diverging narratives may be quite useful for enriching pathways, mitigating their weaknesses and aligning their strengths. The integration of narratives that target different interventions suggests itself as more effective than following the false dichotomy of conflicting transition pathways.

Sustainability mainstreaming requires the integration of narratives' most useful interventions leaving behind the battleground of potentially contested pathways and their controversies. Instead of reinforcing the idea of competing pathways, our analysis emphasizes the fundamental limits of single narratives and depicts the potential benefits of combining the useful aspects of different narratives. Broad-scale, mechanistic (*parameters*) interventions may facilitate mainstreaming, but lack the power of new ideas, which can significantly change, or at least challenge, the *intent* of the system. Implementation of such interventions may be more feasible on small scales where impacts of potential failure are limited and unintended consequences are less harmful. The search for interventions that have the potential to change the *intent* of a system may thus be most fruitful on a local level. However, no matter how powerful interventions may seem that target the *intent* of the system, without the needed up-scaling their impact will remain limited.

Transcending paradigms: potential roles for researchers in sustainability transitions

Transition narratives have implications beyond their practical employment, as they provide learning opportunities for sustainability scientists to integrate different intervention types into nested meta-narratives. Scholars working on sustainability transitions tend to focus their research on particular transition pathways, but sustainability mainstreaming requires them to leave their doorsteps. In fact, our analysis suggests opportunities for sustainability scientists to facilitate mutual learning among narrative advocates, but also bridge the divide between narratives (Loorbach et al. 2011). With regard to the solution-oriented agenda of sustainability science (Miller et al. 2014), the question is not which narrative is superior in accomplishing sustainability outcomes, but how sustainability

mainstreaming can be facilitated across different narratives and intervention types. Thus, researchers could pursue an active role in mainstreaming sustainability into everyday practices and the core of decision-making (Wittmayer and Schäpke 2014). In light of the presented case studies, we would argue that sustainability mainstreaming requires researchers to navigate between narratives. A narrow focus on a single narrative may impede ambitions to capture the significance of specific insights for broader transitions. Ultimately, this requires sustainability scientists to transcend the *intent* of individual narratives, as no transition pathway is true or false but the idea of narratives itself constitutes a narrative (cf. Meadows 1999).

Sustainability scientists have the unique opportunity to facilitate unconventional alliances for integrating narratives. While alliances within a given narrative may be essential for nurturing sustainability transitions, unconventional alliances that transgress narrative boundaries are crucial for mainstreaming (Brown et al. 2013). Pursuing this task would require researchers to facilitate such alliances by reaching out to actors that have no or only nascent track records in sustainability, but aspire to contribute to sustainable transformation (Loorbach et al. 2011). Effective collaborative research needs to connect advocates of different intervention types and explicitly move away from single narratives toward integrated nested meta-narratives. Connecting actors across narratives may provide unique opportunities for integrating narratives and mainstreaming transformational change.

Conclusion

In this article, we analyzed four archetypical transition pathway narratives examining their underpinning mindset, essential qualities, internal dynamics and feedbacks, and mechanistic parameters. In addition, we reviewed commonly articulated critiques and provided exemplary case studies rooting this analysis in practice. The four narratives that we analyzed included (1) the green economy, (2) low-carbon transformation, (3) ecotopian solutions and (4) transition movement. The articulated criticism asserted, respectively, that the narrative (1) re-enforces conventional practices and supports business as usual, (2) addresses only tangible problems while failing to challenge conventional practices and ideas, (3) results in scattered sustainability enclaves that are incompatible with system-wide applications, and (4) remains hypothetical as implementation fundamentally contradicts the current system. These criticisms are linked to the intervention type that respective transition narratives address (or fail to address).

Instead of reinforcing the conflict between pathways, our analysis exemplifies which narrative most effectively addresses which intervention type in support of mainstreaming sustainability. The narratives of transition movements and ecotopian solutions focus primarily on deep intervention types (the *intent* and *design* of a system) which are harder to achieve, but potentially lead to greater systemic transformation. The low-carbon transformation and green economy focus on shallow interventions types (the *flows* and *parameters* of a system) that are relatively easy to implement, but with limited ability to lead to transformational change. Thus, narratives may play different roles in sustainability transitions given that societal transformations undergo different phases and take place on different levels. However, none of the four examined transition narratives represents blueprints for, or panaceas to, the complex dynamics of mainstreaming sustainability, in part because none seeks systemic change across all four intervention types. Accordingly, sustainability mainstreaming requires the learning from different narratives' most useful interventions, leaving behind the battleground of potentially contested pathways and their controversies.

Transition pathway narratives have implications beyond their practical employment, requiring sustainability scientists to actively foster the integration of different intervention types. Our analysis indicates the need for sustainability scientists to actively link different narratives generating insights for broader transitions and utilize opportunities for mainstreaming sustainability. For this, critical reflection is needed on the underlying worldviews of proponents that engage in particular sustainability transitions, and the potential danger of narratives being co-opted for purposes other than transformations toward sustainability. Finally, sustainability scientists should facilitate unconventional alliances to link transition pathway narratives. Connecting actors across narratives may provide unique opportunities for learning from narratives and mainstreaming transformational change. Research on sustainability transitions needs to move from intensifying conflicts to co-learning between transition pathway narratives.

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