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ECONOMIC GEOGRAPHY

The Geography of Technology Legitimation: How Multiscalar Institutional Dynamics Matter for Path Creation in Emerging Industries

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abstract

Research in economic geography has recently been challenged to adopt more institutional and multiscalar perspectives on industrial path development. This article contributes to this debate by integrating insights from (evolutionary) economic geography as well as transition and innovation studies into a conceptual framework of how path creation in emerging industries depends on the availability of both knowledge and legitimacy. Unlike the extant literature, we argue here that not only the former but also the latter may substantially depend on nonlocal sources. Conceptually, we distinguish between multiscalar export, attraction, and absorption of legitimacy. Coupled with conventional knowledge indicators, this approach enables us to reconstruct how not only external knowledge sourcing but also multiscalar institutional dynamics contribute to a region or country's ability to leverage its potential for path creation in an emerging industry. Methodologically, we develop legitimation indicators from a global media database, which was built around the case of modular water technologies. Cross-comparing the evidence from six key countries (India, Israel, Singapore, South Africa, the UK, the US) with differing path creation constellations for this emerging industry, allows us to hypothesize how multiscalar legitimation influences a country's prospects for creating a radically new industrial path.

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Supplemental data for this article can be accessed here.

Researchers in economic geography (EG) have recently started developing more institutional and multiscalar perspectives on industrial path creation and diversification processes (Boschma et al. 2017; MacKinnon et al. 2018; Hassink, Isaksen, and Trippl 2019). Among other efforts, work on institutional agency (Dawley 2014; Isaksen et al. 2018; Sotarauta and Suvinen 2018; Grillitsch and Sotarauta 2019) has conceptualized path creation as a process of mindful deviation not only from technological and knowledge artifacts but also from the relevant institutional structures (Garud and Karnøe 2001). This line of theorizing has convincingly shown that distributed system-building processes, drawing on policy interventions, institutional entrepreneurship, and strategic resource mobilization, play a key role for path creation, largely on par with related knowledge and skill sets (Garud and Karnøe 2003; Garud, Kumaraswamy, and Karnøe 2010; Dawley 2014; Binz, Truffer, and Coenen 2016; Carvalho and Vale 2018).

At the same time, the literature on industrial path creation still has a rather coarse and undifferentiated view on the relevant institutional structures and dynamics that influence why a new path emerges in one region while it fails in another. In particular, the legitimation of radically new industrial paths that diverge from the status quo is not yet well understood. Moreover, the multiscalar contexts in which the relevant institutional structures develop and change has remained underresearched. This article addresses these two gaps by asking how path creation potentials in regions are influenced by and dependent upon multiscalar legitimation dynamics.

To answer this question, we propose combining recent EG perspectives with transition studies, which have conceptualized in depth how the coevolution of institutional dynamics and technological innovation influence the development potentials of new industrial paths. These studies elaborate how institution-oriented agency can provide breeding grounds for newly emerging sociotechnical configurations (Hoogma et al. 2002; Schot and Geels 2008) and detail what kind of institutional and technological alignment processes have to happen for emerging industries to scale and mainstream (for instance as depicted in the literature on technological innovation systems, see Hekkert et al. 2007; Bergek et al. 2008; Markard forthcoming). Such processes are closely related to the coevolution of new technologies and their markets (Dewald and Truffer 2011, 2012; Quitzow et al. 2014) or how technology legitimation influences development trajectories

of new industries (Bork et al. 2015; Binz et al. 2016; Markard, Wirth, and Truffer 2016).

One of the hallmarks of the transitions literature is the distinction between innovation processes in well-established sectors (sociotechnical regimes) and emerging industries that are new to the world (sociotechnical niches) (Geels 2002; Markard, Raven, and Truffer 2012). Boschma et al. (2017) use this distinction to further conceptualize the institutional dynamics that enable path creation processes in *new-to-the-region* and *new-to-the-world* industries. Particularly in new-to-the-world industries (emerging industries in the remainder), where technological development, product profiling, and user preferences have to be aligned for the first time, the ability to institutionally embed and thus legitimize an emerging industry becomes a crucial determinant of successful path creation. Related industries are often, but not exclusively, found in the context of infrastructure sectors (e.g., transportation or information and communication technology), linked with innovations addressing grand challenges (e.g., renewable energies), or in emerging platform-based industries (e.g., Uber or Airbnb) (Coenen, Hansen, and Rekers 2015; Pelzer, Frenken, and Boon 2019; Trippl et al. 2020).

In innovation and transition studies, legitimation has been conceptualized as the process by which proponents of a technology attempt to align norms, values, and beliefs in favor of their proposed solutions (Hekkert et al. 2007; Bergek et al. 2008; Binz et al. 2016; Markard, Wirth, and Truffer 2016). Our framework draws on this interpretation but contests the often-implicit assumption that the relevant institutional processes are limited to regional or national boundaries. Recent contributions hint at the multiscalar nature of legitimation processes for emerging industries, for example, through the adoption of nonlocal narratives and policies or the attraction of external investors and industry advocates (Crevoisier and Jeannerat 2009; Späth and Rohracher 2012; Quitzow 2015; Sengers and Raven 2015; Binz, Truffer, and Coenen 2016).

Building on these insights, we propose a set of generic, multiscalar mechanisms through which industry legitimacy may be generated by drawing on local and/or nonlocal structures and supportive narratives enacted by actors on different spatial scales. More specifically, we look at (1) genuine *endogenous legitimation* within a region or country, (2) the mobilization of legitimacy from external sources (*absorption*), (3) the *attraction* of external actors contributing to local legitimation, and (4) the *export* of legitimacy by local industry proponents.

The institutional capability of a region or country to leverage these processes may be crucial for its path creation prospects (Malmberg and Maskell 1997). We will elaborate this argument by developing a typology of different path creation constellations that depend on preexisting knowledge and capabilities, on the one hand, and active legitimation processes around an emerging industrial path, on the other hand. With the help of our empirical analysis, we show how actors in various countries mobilize legitimacy in the face of different structural preconditions, allowing us to create hypotheses on what sort of multiscalar legitimation processes may contribute most effectively to path creation in different contexts.

Empirically, we focus on the case of a new industrial path that is currently evolving around modular water technologies (henceforth referred to as modular technologies). The modular water industry is still in an emerging development phase globally, challenging the widely established regime around conventional, centralized wastewater treatment (referred to as conventional technologies from now on) (Fuenfschilling and Binz 2018). To empirically assess the relevant legitimation dynamics, we propose a mixed-method approach that builds on a database of newspaper articles (Nexis Uni). Over 180 English-language newspapers and industry magazines were selected

in order to identify articles dealing with water and sanitation problems for an eight-year period (2011–18). The articles selected were coded by means of a sociotechnical network analysis heuristic (Heiberg, Truffer, and Binz 2020) and then analyzed with novel indicators for the relevance of multiscalar technology legitimation processes. By coupling these legitimation measures with patent data, as well as information on path dependencies in built infrastructures, we arrive at a typology of generic path creation constellations. Eventually, we assess to what extent multiscalar legitimation processes are used in leveraging the potentials of path creation constellations in different countries.

Our results show considerable variation in these constellations. The US, for example, can be characterized as a *lead-market constellation*, which combines well-developed local knowledge and capabilities with rather weak institutional path dependencies. With similar knowledge capabilities but facing a locked-in sociotechnical regime, Israel and Singapore signify *export-oriented constellations*. India and South Africa, in turn, represent cases with rather weak knowledge and capability stocks but also weak path dependencies and strong environmental problem pressures, thus exemplifying *challenge-driven path creation constellations*. The UK, eventually, faces a *regime lock-in constellation* associated with a strong regime and only modestly established knowledge and capabilities. In these different constellations and spatial contexts, we find that actors engage in the multiscalar mobilization of legitimacy to varying degrees, enabling the formulation of hypotheses on how these processes support or hinder industrial path creation more generally.

The argument of the article will be elaborated in the following steps. The next section will review the industrial path creation literature and draw on recent insights from transition and innovation studies regarding the multiscalar nature of industry legitimation. Based on this, we propose an integrated framework of different types of path creation constellations for which multiscalar legitimation processes may matter. In the section that follows, we apply this framework to the case of path creation around modular water technologies and introduce our methods. The results are presented in the penultimate section, comparing six country cases. The final section discusses our insights into different path creation constellations as well as the conceptual implications and limitations of our research before concluding with an outlook on avenues for future research on the multiscalar institutional foundations of path creation.

Multiscalar Legitimation in Industrial Path Creation

The literature on industrial path creation in evolutionary EG and regional studies has paid comparatively little attention to institutional factors such as social, cultural, and normative contextual conditions for emerging economic activities (MacKinnon et al. 2009; Hassink, Klaerding, and Marques 2014; Hassink, Isaksen, and Trippl 2019). Furthermore, attempts to investigate the institutional preconditions to path creation have rather favored macrolevel and static approaches, such as that of Boschma and Capone (2015), who apply a varieties of capitalism lens to study how macroeconomic structures in coordinated and liberal market economies lead to different industrial diversification patterns. Critics of this approach have called for a more explicit consideration of process-based and microinstitutional approaches associated with path development trajectories (see, e.g., Dawley 2014; Zukauskaite, Trippl, and Plechero 2017; Isaksen et al. 2018; Sotarauta and Suvinen 2018).

The role of distributed and embedded agency in emerging industries is introduced most prominently by Garud and Karnøe (2003). They propose conceptualizing it as the

continuous recombination of regionally available codified and tacit knowledge stocks by a heterogeneous set of actors, leading to different national innovation trajectories, labeled as science-technology-innovation–based *breakthrough* or doing-using-interaction–based *bricolage*.

Carvalho and Vale (2018) show how the latter process led to unrelated diversification in the biotechnology sector in a peripheral Portuguese region with comparatively weak initial knowledge and skill endowments. They conclude that path creation was not facilitated by technological or knowledge relatedness, but rather by *institutional relatedness* (see also Content and Frenken 2016). Also Binz, Truffer, and Coenen (2016) show how a new water recycling industry emerged in Beijing through a process of *anchoring and system building*, which allowed local actors to outcompete rival initiatives in other regions that were initially endowed with stronger related variety (Xi'an and Shanghai).

A similar agency-based approach was suggested by Grillitsch and Sotarauta (2019), who argue that change agency for path creation is not limited to technology entrepreneurship but also includes *institutional entrepreneurship* and *place leadership*. While institutional entrepreneurship relates to active processes of institutionalizing new or transforming existing institutions (Battilana, Leca, and Boxenbaum 2009), place leadership is more concerned with the alignment of various actors to jointly mobilize resources in favor of a certain path creation trajectory (Gibney, Copeland, and Murie 2009).

Despite this increased acknowledgment of the role of institutional dynamics in industrial path creation, the related conceptualizations (around broad notions like institutional thickness, system-level agency, or institutional entrepreneurship) have remained somewhat vague as to the relevant factors and mechanisms that condition the emergence of radically novel industries as well as about the multiscalarity of the relevant institutional change processes. This is why we propose a closer connection to transition studies, which have recently used sociotechnical regimes and technology legitimation as heuristics for assessing the institutional dynamics that make an emerging industry comply with existing institutions or cause it to adapt the institutional environment in a region to such a degree that it becomes more supportive of the emerging industrial path (Aldrich and Fiol 1994; Bergek, Jacobsson, and Sandén 2008; Geels and Verhees 2011; Binz et al. 2016; Markard, Wirth, and Truffer 2016).

Legitimation as a Focal Lens to Understand Institutional Dynamics Around Path Creation

An important conceptual aspect in EG is that emerging industries are embedded in two relevant institutional contexts: a regional and a sectorial one (Boschma et al. 2017). While EG is predominantly concerned with the regulative, normative, and cultural-cognitive structures in a region that supports or hinders innovation, transition research focuses on understanding how inherently multiscalar sociotechnical systems in sectors that fulfill societal functions (energy, water, transport, agro-food) are built, maintained, and potentially replaced (Rip and Kemp 1998). A core of this literature deals with explaining how path dependencies can be assessed through the concept of sociotechnical regimes. These are defined as highly institutionalized configurations of knowledge, practices, technologies, products, user needs, regulation, institutions, and infrastructures, which coevolve and get aligned over time, thus locking sectors into path-dependent development trajectories over expanded time spans (Rip and Kemp 1998). At the same time, transitions scholars have elaborated in great detail how such path dependencies may vary between different regions and be broken up through

distributed and system-level agency—as in the technological innovation systems framework (Bergek et al. 2008; Hansen and Coenen 2015; Markard, Wirth, and Truffer 2016) or in sociotechnical alignment and scaling processes happening in protective spaces, so-called sociotechnical niches (Rip and Kemp 1998; Geels and Raven 2006).

Similar to the notions of agency in the path creation literature, transition studies emphasize the importance of collective, more or less coordinated, strategies, mobilizing various emerging system resources for successful innovation. Binz, Truffer, and Coenen (2016) argue that four key system resources have to be mobilized in a region to enable path creation processes: knowledge, markets, financial investment, and legitimacy. The mobilization of legitimacy is arguably of key importance, especially for emerging industries that have no predecessor in the social order (Aldrich and Fiol 1994; Rao 2004). Legitimacy is commonly defined as "a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman 1995, 574). It thus denotes a societal assessment of how well an emerging industry is aligned with the relevant regional and sectorial institutional contexts (Markard, Wirth, and Truffer 2016). If an industry is well aligned, the relevant audiences will take it for granted and confer resources to its further development, be it in the form of policy support, the installation of test markets, the provision of educational services, venture capital, or even through the absence of organized opposition from citizen's movements.

If it is in conflict, the industry's proponents will have to engage in active institutional work to change the relevant structures in favor of the new organizational form (Lawrence and Suddaby 2006). The actor strategies that aim at changing the relevant institutional contexts often comprise rather subtle and discursive interventions in the social order, for example, through the construction of new identities and norms, changing normative associations, or educating relevant audiences about the benefits of a new solution (Lawrence and Suddaby 2006; Fuenfschilling and Truffer 2016). Such interventions are *embedded* in the sense that they are both enabled and constrained by the institutional structures that they attempt to influence (Garud and Karnøe 2003; Battilana, Leca, and Boxenbaum 2009). Over time, system resource mobilization and institutional work will adapt the relevant institutional structures to such a degree that legitimacy for the emerging industry is created and/or the legitimacy of the preexisting path is eroded (Rao 2004; Battilana, Leca, and Boxenbaum 2009; Binz et al. 2016; Fuenfschilling and Truffer 2016; Markard, Wirth, and Truffer 2016).

Linking such observations back to the path creation and diversification literature, Boschma et al. (2017), on the one hand, argue that institutional work and technology legitimation are particularly important in cases of unrelated diversification. To make *large jumps* in the product space (Hidalgo et al. 2007), actors have to engage in a distributed, bricolage-type of agency to overcome place dependencies stemming from the preexisting (or missing) resources in a region. On the other hand, institutional work and legitimation are crucial, especially for newly emerging industries that have to overcome the path dependency emanating from a deeply institutionalized sociotechnical regime in a sector. From a geographic point of view, both overcoming place dependencies and sectorial path dependency may involve active institutional work at the local level. Yet, in the case of sectorial path dependencies, agency in local contexts will have to be complemented with challenging the dominant regime (which often develops in international networks) through multiscalar forms of institutional work (Fuenfschilling and Binz 2018). Following this reasoning, technology legitimation becomes an umbrella term for the variegated types of institutional work that are

relevant for industrial path creation and that may be enacted by local or nonlocal actors on different spatial scales and in different places. We will now turn to elaborating the multiscalarity of these processes in more detail.

Nonlocal Sources of Path Creation

The importance of nonlocal knowledge as a source of path creation and diversification has long been acknowledge in EG, but a focal research agenda around this theme has only formed more recently in the path creation literature (Boschma et al. 2017; Trippl, Grillitsch, and Isaksen 2017, Neffke et al. 2018; Klement and Strambach 2019). In their seminal article, Martin and Sunley (2006) highlight that new paths may emerge from the importation of organizational forms, technologies, firms, or institutional arrangements from other places. However, it remained unclear how exactly the importation of institutional arrangements would play out, and whether and how it resembles the sourcing of nonlocal knowledge.

In order to tackle this challenge, we build on a more recent framework proposed by
 Trippl, Grillitsch, and Isaksen (2017) on how external sources of knowledge can contribute to regional industrial path creation. Their heuristic separates the anchoring of nonlocal knowledge for path creation into the *attraction* of new actors from outside a region and the *absorption* of nonlocal knowledge through more intangible linkages. Attraction relates to the inflow of new organizations or individuals, for example, through labor migration, the resettlement of firms, takeovers, mergers, or foreign direct investments (FDIs). Absorption does not require actors to relocate, but rather relates to formal or informal linkages between organizations or individuals based on different types of nonspatial proximities that facilitate knowledge diffusion (Bathelt, Malmberg, and Maskell 2004; Agrawal, Cockburn, and McHale 2006).

Building on this differentiation, Trippl, Grillitsch, and Isaksen (2017, 692) argue that "the need and attractiveness for exogenous actors/resources as well as the absorptive capacity to turn those into new growth paths" are the most crucial determinants of the importance and role of nonlocal resources in path creation processes. Attractiveness reflects the capacity of a region to draw in knowledge carriers, such as individuals or organizations, for example, through local assets such as a relevant skills base, education, security, more competitive salaries, or other regional amenities. Absorptive capacity, in contrast, reflects the ability of *anchoring* (Crevoisier and Jeannerat 2009) nonlocal, mobile knowledge into a locally embedded path.

We propose conceptualizing the nonlocal relationships that impact legitimacy for an emerging industrial path in a region along similar lines, drawing on recent insights from transition studies. Transition scholars argue that legitimacy in a region may be fueled by trade or collaboration networks, when entrepreneurs absorb success stories from abroad, or when they invite external actors to contribute to solving local problems. The Chinese photovoltaic (PV) industry, for example, initially almost completely legitimized itself through overseas export successes and listings on international stock exchanges (Zhang and White 2016; Binz and Anadon 2018). A study on the global diffusion of bus rapid transport (BRT) systems (Sengers and Raven 2015) similarly finds that *places* can be mobilized by a global community of actors who use success stories of certain cities to push infrastructure projects in regions far away. Späth and Rohracher (2010, 2012) refer to discourse coalitions in emerging renewable energy paths to show how Austrian actors absorbed national and international narratives purposefully by translating and using them in specific regional contexts. By absorbing nonlocal narratives, they managed to align other actors'

technological choices across various governance levels. These insights suggest that attraction and absorption processes are relevant not only for knowledge but also for legitimation dynamics. Of course, emerging industries may also predominantly draw on legitimacy that has built up endogenously within a regional context, as in the case of the Danish wind turbine industry (Garud and Karnøe 2003). Yet, as recent literature shows, the wind power case is arguably also quite special in that its innovation and institutional embedding processes depended particularly strongly on spatial proximity (Huenteler et al. 2016; Binz and Truffer 2017). In other industries, multiscalar linkages may be much more relevant for the buildup of industry legitimacy. We can therefore conceptualize multiscalar legitimation interactions in three generic ways (Figure 1).

Absorption relates to a situation in which regional actors internalize legitimacy from other places. This mostly happens through reference to cases of success or failure in other parts of the world. For instance, the early legitimation of BRT systems in several South East Asian cities was strongly driven by the absorption of the emblematic *success case* of Bogota, Colombia (Sengers and Raven 2015). In this process, supportive narratives were transported between places not only through mobile actors but by other forms of communication such as the media, expert journals, or informal communications at industry events, etc.

Attraction refers to legitimacy that is built up by drawing external actors that create favorable market environments for novel products into a region. Attraction can happen rather passively, for example, when a region presents itself as a promising market for new technologies or, more proactively, when local actors try to actively construct favorable institutional framework conditions for external firms to operate in the region. An example of a rather passive strategy is Norway, which strategically developed into the current global lead market in electric vehicles by leveraging strong deployment policies and by mobilizing its energy mix, which is based on almost 100 percent hydropower (Ryghaug and Skjølsvold 2019). Both factors helped lay the foundation for the development of a novel industry around battery development, produced in the

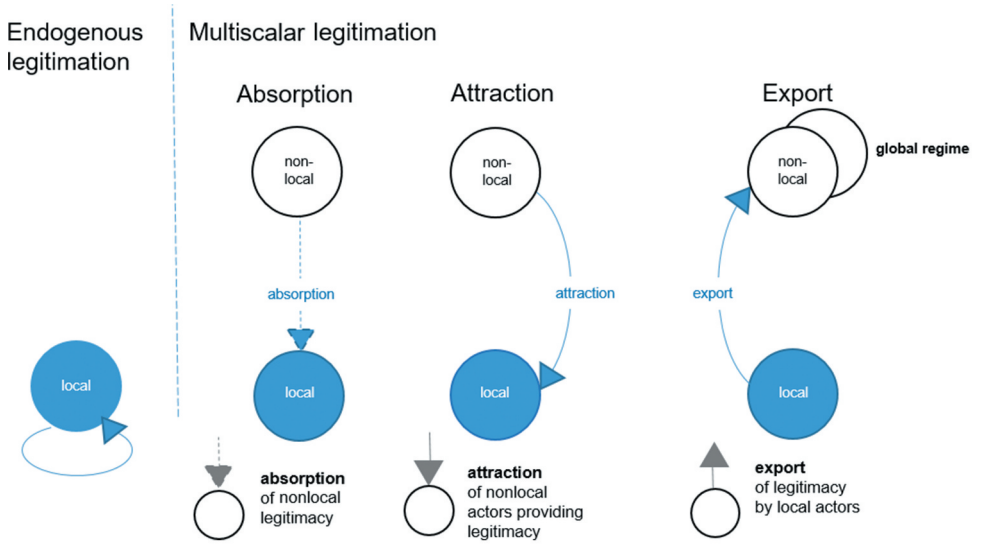

Figure 1. Multiscalar legitimation processes.

Agder region (Barbiroglio 2020). Examples of more proactive attraction strategies abound in the catch-up literature, for instance, when latecomer regions proactively attract FDIs or participate in technology transfer programs supported by international organizations (Gosens, Lu, and Coenen 2015; Yeung 2016).

As the mirror image of attraction, we can expect to see legitimation activities that draw on a pronounced export strategy. Export refers to a strategy in which legitimacy is not primarily achieved by endogenous institutional embedding, but rather by serving markets and influencing institutional environments outside the home region. The platform-economy company Uber, which actively attempted to legitimize its service Uber pop in various world cities while simultaneously delegitimizing the existing regulations around taxi laws, constitutes an illustrative example (Pelzer, Frenken, and Boon 2019). Export to other regions may at the same time coincide with absorption, that is, when narratives about export success help to mobilize indigenous resources such as export risk insurance, industrial support policies, or local venture capital.

Based on these specifications, we propose conceptualizing the transregional flows of legitimacy in similar terms as the transregional knowledge flows identified by Trippl, Grillitsch, and Isaksen (2017), yet with some important qualifications. Most importantly, we have to account for institutional contexts established on different *scales*, such as on the regional, national, and global scale, while acknowledging that these levels are socially constructed and intrinsically intertwined and imbricated (Brenner 2001; MacKinnon 2011). For the case of legitimation, it is particularly important to understand that sociotechnical regime structures relate to the dominant institutional structures in sectors, which often reach beyond single regions or countries, up to a global scale (Fuenfschilling and Binz 2018). Regime structures are predominantly developed, maintained, and changed by (international) expert networks in a sector, and may shape the way national or regional industrial strategies can be carried out, particularly when it comes to radically new approaches. At the same time, the sociopolitical and cultural legacies in regions and countries lead to strong spatial variation in regimes since global regime structures are only partially or *creatively* translated back into regional and national settings (Fuenfschilling and Binz 2018). The challenge of legitimizing emerging industries is thus a dual one in that it requires tackling both the place dependency in regional/national institutional structures as well as path dependencies in international sectorial structures (Boschma et al. 2017). We have to acknowledge the multilayered structure of legitimation strategies beyond the simpler *local vs. nonlocal* exchanges that were identified for the knowledge dimension. Moreover, the export of legitimacy can be further differentiated into those activities targeting other national/regional–scale institutional contexts and those activities targeting the *global* regime.

Analytical Framework

On this basis, we propose a typology of path creation constellations that is based on two analytical dimensions (see Table 1). The first dimension describes the strength of related knowledge and capabilities in a region. The second dimension depicts the resistance of the established regime against a newly emerging industry. The strengths of this resistance can be measured on the basis of two conditions: (1) the number of alternative regimes currently prevailing in a sector and (2) the degree to which the current regime is challenged by emerging alternative industries and/or external conditions. The dominance of the current regime can be measured as a gradient between monolithic and polycentric constellations (van Welie et al. 2018). A highly monolithic,

Table 1

Path Creation Constellations in Emerging Industries

		Institutionalization/Coherence of Sociotechnical Regime	
		weak	strong
Availability of knowledge and capabilities	high	lead market	export driven
	low	challenge driven	regime lock-in

hard to change, regime structure can be found in the electricity sector, which in many places is still dominated by fossil fuel–based technologies, centralized generation, long-distance transport, large utility companies, and decentralized consumption (Verbong and Loorbach 2012). A polycentric, and thus more easily adaptable, regime structure can in turn be found in the transport sector, where several service regimes for alternative mobility solutions coexist (i.e., around cars, public transport, bicycles, etc.) (Geels et al. 2011). The contestation of a regime can in turn be measured by how strongly its core logic is challenged by social movements, competing technologies, and related institutional logics or exogenous *landscape pressures*.

Based on these conceptualizations, we may now distinguish four ideal-type path creation constellations, which depend on the knowledge base and strength of regime structures in a region (Table 1). In general, we would expect that the more related knowledge a region provides, the higher is its ability to create a new path in a given emerging industry. In terms of institutional contexts, we expect that the stronger and the more unchallenged the incumbent regime in the respective sector is, the more difficult it will be to establish a new path in the region (Boschma et al. 2017). These two structural conditions result in the following path creation constellations.

First, regions hosting high levels of related knowledge and relatively weak regime structures can be characterized as providing a *lead-market constellation*. With easy access to relevant knowledge and a favorable institutional environment, local firms may find it easy to develop new products and services; lobby for supportive policies, to install local niche markets; and find competent partners for raising financial resources. The ensuing path creation dynamics would likely start with local niche formation for a new sociotechnical configuration, followed by endogenous build-up of supportive innovation systems, and the gradual establishment of alternative local regime structures. Once the industry is established locally, the export of ready-made solutions may be undertaken, and local actors may seek to alter the global regime through targeted institutional work in other regions and on other spatial scales.

A second constellation depicts regions that possess related knowledge capabilities but face strong path dependencies from the incumbent regime. In this situation, the proponents of the emerging industry will often be forced to gain legitimacy in foreign markets. Successful penetration of foreign markets may subsequently be used to mobilize resources domestically. The related path creation dynamics will typically depend on transnational companies building up markets for technologies far away, without relying on short-distance exchange between market formation and technology development. We would thus label this constellation as *export driven*.

A third constellation relates to regions that lack related knowledge, while facing rather weak path dependencies from existing regimes. The latter may be due to the existence of varying competing service solutions in a place (i.e., in the highly dynamic context of booming megacities) or strong landscape pressures for which the novel

technology would provide a better solution (e.g., arid areas having to fight with severe water shortages). These regions will depend on external actors providing and promoting alternative solutions, building up corresponding markets, or helping to develop a stronger knowledge base through cooperation with external companies, FDI, and/or inward labor mobility. We call this a *challenge-driven constellation*.

Finally, regions that lack knowledge and capabilities and face strong path dependencies from incumbent regime structures may be characterized as a *regime lock-in constellation*. This is arguably the most challenging constellation for path creation, since regional actors would have to attract or absorb both legitimacy and knowledge from elsewhere. Although instances of successful path creation have been described for such situations (i.e., the example of on-site water reuse in Beijing or of PV panel manufacturing in China), any strategy in this situation will likely face strong barriers and thus need an elaborate, long-term support strategy.

While the typology in Table 1 depicts ideal-type path creation constellations, the actual strategies of regional policy makers or local companies in real-world cases will likely cover the full portfolio of endogenous and external knowledge and legitimacy mobilization patterns, as identified in "Indicators for Discursive Regime Strength and Multiscalar Legitimation Processes." We would, in other words, expect actors in a lead-market and export-driven constellation also to be able to engage in the export of legitimacy to other regions and on the global scale. Attraction and absorption of legitimacy may further occur, to some extent, in all types of configurations, either creating novel (export-driven, regime lock-in) or maintaining existing (challenge-driven, lead-market) institutional environments. Whether or not the potentials of a given constellation will be leveraged, or even what kind of strategies the individual actors will mobilize to overcome resource deficits, remains an empirical question. We will operationalize this generic framework and map the diversity of resource mobilization strategies for an illustrative empirical case in what follows.

Mapping Global Legitimation Activities for Modular Water Technologies

To illustrate and validate our framework empirically, we will apply it to the case of modular water technologies, which represent a currently emerging, radically novel industrial path in the water sector. The global water sector had an estimated investment volume of over $US500 billion in 2014, which is only a fourth of the yearly investments needed to fulfill the sustainable development goals by 2030 (World Water Council and OECD 2015; Hutton and Varughese 2016; OECD 2018). It is dominated by publicly or privately managed water utilities, which often collaborate with large multinational equipment suppliers, engineering consultants, and service providers like Dow, Veolia, Suez, or Thames Water (Lieberherr and Fuenfschilling 2016). Next to public funding, investment in large-scale water infrastructures and technologies increasingly comes from private investors but also from multi- and bilateral development banks and philanthropic donors (OECD 2019).

The sector is confronted with grand challenges like climate change and rapid urbanization, which render the operation and maintenance of large-scale infrastructures increasingly difficult (Sadoff et al. 2015; UN-WWAP 2015; Eggimann et al. 2018; OECD 2019). Small, flexible, modular water technologies are hence increasingly regarded as a promising means of flexibly alleviating water scarcity, supporting cities in becoming more resilient, and helping them to implement more sustainable urban water management practices (Wong and Brown 2009; Larsen et al. 2016). Often

applied in small-scale, off-grid contexts, modular water technologies can benefit from so-called economies of unit numbers, bringing them management and cost advantages compared to conventional large-scale water infrastructures (Dahlgren et al. 2013; Wilson et al. 2020).

Given these characteristics, they fundamentally challenge the dominant regime logic in the water sector, which is predisposed to technologies designed for large unit-scale and custom-built water infrastructures (Fuenfschilling and Binz 2018). In contrast to this highly institutionalized regime, the actor network pushing for modular technologies is still in a rather nascent stage, with limited commercial applications and an actor structure that is dominated by small- and medium-sized enterprises (OECD 2019). Funding still mostly originates from grants provided by private foundations and venture philanthropy, like through the Bill and Melinda Gates Foundation (BMGF), but also via nongovernmental organizations (NGOs), development agencies, and some social impact investors (OECD 2019).

In light of these specifications, we expect strong legitimation challenges among actors pioneering innovative modular approaches and regime actors defending the centralized paradigm. We further expect a broad range of multiscalar legitimation activities as the centralized sociotechnical regime is globally rather standardized with relatively few regional variations (Fuenfschilling and Binz 2018).

Measuring Legitimation and Discursive Path Dependency

To operationalize our framework, we constructed a data set by means of a semiqualitative methodology—which we call sociotechnical network analysis (STNA)—that rests on a discourse and social network analysis tool (Discourse Network Analyzer [DNA]) developed in the political sciences (Leifeld 2013, 2017; Heiberg, Truffer, and Binz 2020). Given the global ambition of this study, we do not aim to analyze legitimation through a full-fledged discourse analysis (e.g., Geels and Verhees 2011), but rather focus on organizations' (positive or negative) evaluations of technologies or related infrastructural and institutional elements in media coverage. For example, newspaper articles are coded for individual statements through which organizations contribute to a specific favorable or obstructive narrative (narrative events in the remainder) around certain technologies or institutions. STNA conceptualizes these narrative events—statements around institutional or technological elements—as an interaction between *actors* that make normative claims about certain *concepts*. The time-referenced and coded data that are retrieved based on qualitative content analysis are subsequently transformed into network matrixes that enable the quantification of various relationships between actors and concepts across time, allowing for the analysis of the alignment and reconfiguration processes associated with changing sociotechnical regimes (Heiberg, Truffer, and Binz 2020).

In the present article, we aim to investigate the geographic patterns behind the narrative events. We thus capture contributions to legitimizing and de-legitimizing narratives made by actors around technologies as well as institutional elements in the media. For this, we use a binary qualifier variable, which classifies each coded excerpt as either legitimizing or de-legitimizing a concept. This distinction, of course, constitutes a strong simplification of reality. Yet, in light of the fundamentally opposing infrastructural logics associated with conventional and modular water technologies, it was usually easy to identify whether an actor framed a concept in a favorable or obstructive way.

Further, a valid operationalization of our framework requires the identification of the spatiality and scalarity of the coded narrative events. To this end, we coded three types of spatial variables associated with each code. First, actors—mostly organizations in our case—are assigned to a specific location where they carry out most of their activities (*actor location*). Here, we distinguished roughly between national and global actors, which refers to the scale where most of their activities take place. Global-scale organizations (such as transnational corporations, NGOs, industry associations, etc.) are defined by being active in various locations around the world. If necessary, and not encompassed by our textual sources, the assignment to scales is based on supplementary desk research.[1]

Second, we identify whether the narrative an organization contributed to includes a spatial reference to a specific case or activity somewhere abroad (*narrative location*). Typical examples involve reference to companies or global NGOs that promote specific technologies abroad, or reporting on the success or failure of specific projects from other geographic contexts. For instance, in Israeli newspapers, a recurrent narrative promoting the local modular industry hinted at a huge market for these technologies emerging in China and made reference to Israeli companies' successful involvement in experimental projects in several Chinese regions. For such narratives, we would code China as the *narrative location*.

The third locational variable denotes the geographic places and scales of the audience that articles are targeting (*audience location*). This assumes that a media article always wants to inform some geographic-specified readership. The audiences addressed are either predominantly (sub-)national-scale public audiences, for example, for nationally or regionally distributed newspapers like the *Times of India, The Guardian*, or the *Washington Post*, or global-scale expert audiences, as in sector-based global magazines like *Chemical Week* or *Business Monitor Online*. In national legitimation processes, media articles capture the interplay of different value perspectives in policy contexts within clearly delimited territorial boundaries. Global-scale outlets, by contrast, capture the (dis-)agreements on certain infrastructure solutions among global experts with academic, business, or financial backgrounds.

Data Sources

To characterize different countries' generic path creation constellations, we select indicators for both the availability of place-based knowledge related to water technologies and for the strength of the incumbent sociotechnical regime. To identify existing national knowledge and capabilities, we access innovation performance indicators from the OECD.stat database, which are based on PATSTAT data on patent family filings that were filtered for water technologies[2]. To assess regime strength, we collect centralized sewerage connection rates from the WHO/UNICEF Joint Monitoring Project on water supply, sanitation, and hygiene, and we combine them with the degree of discursive path dependency evident in the media, based on our own data set (see "Multiscalar Legitimation Processes"). To identify legitimation activities globally, over 180 English-speaking newspapers covering most OECD countries plus India, South Africa, China, and Singapore, as well as selected global expert magazines, were accessed through the online newspaper repository LexisNexis. The outlets were filtered for articles dealing with solutions to solve

[1] For example, on sources like Bloomberg.com.

[2] See Appendix 1 in the online material. We use patent data as an indicator to compare the creation of knowledge and capabilities across countries due to their availability over long time spans and

water problems during 2011–18.[3] The source base was built around a source collection that contained a selection of the world's major English-speaking newspapers, industry magazines, and trade publications, which are held in high esteem for their content reliability.[4] The base was further manually extended for media coverage in world regions that were only sparsely or not at all represented by the initial assemblage (i.e., India, African countries). We only included outlets that were covered over the whole time period and that were considered of national or international importance by LexisNexis.[5]

A search query was then formulated[6] to filter articles published between 2011 and 2018 from the source base. Of initially about 800 articles, 563 where deemed relevant and subsequently coded by a single coder with the help of DNA software.[7] The first author developed and tested a coding scheme (for details on the coding scheme, see Heiberg, Truffer, and Binz 2020) before a second coder was educated in consistently applying it through several coding runs with test data involving feedback rounds and intercoder reliability checks.

Due to the structure of our databases, we will focus our remaining analysis mostly on national and global scales. An expansion of the analysis to subnational scales would in principle be easily possible by applying the same method to media and patent databases that contain more fine-grained information on regional and local newspaper coverage and inventor data.

Indicators for Discursive Regime Strength and Multiscalar Legitimation Processes

The narrative events captured from our database enable us to disentangle the endogenous and multiscalar dimensions of legitimation as concepualized in "Mapping Global Legitimation Activities for Modular Water Technologies." In a first step, we identify geographic hot spots of legitimation activities. This is achieved by mapping the frequencies of narrative events at the level of national audiences.

For each country case, the absolute numbers of legitimizing and de-legitimizing narrative events per year are subsequently taken to construct a **favorable narrative share** (Figure 2, I). It is defined by the sum of narrative events that legitimize modular technologies or de-legitimize conventional technologies divided by the sum of all narrative events in a specific country. The higher the measure, the more challenged the regime is. Together with the connection rate to centralized water infrastructures, this indicator measures the degree of institutionalization of the conventional sociotechnical regime in a given country.

We then ask how prevalent processes of endogenous legitimation, absorption, attraction, and export of legitimacy are in select hotspot countries. This enables us to

comparability, especially at the country level (Archibugi and Planta 1996). While we are aware that not all innovations in the water sector may be patented, previous investigations of innovation activities in the water sector have shown their general applicability for the sector (e.g., Moro et al. 2018; OECD 2019).

[3] See Appendix 2 in the online material for the technological specification of modular versus centralized systems.

[4] The LexisNexis Academic database was updated in spring 2019. Its successor NexisUni does not provide the exact same source collections anymore. URL: https://www.lexisnexis.com.

[5] See Appendix 3 in the online material for a full list.

[6] See Appendix 4 in the online material.

[7] See Leifeld, Gruber, and Bossner 2019. *Discourse Network Analyzer Manual*. https://github.com/leifeld/dna/releases/download/v2.0-beta.24/dna-manual.pdf.

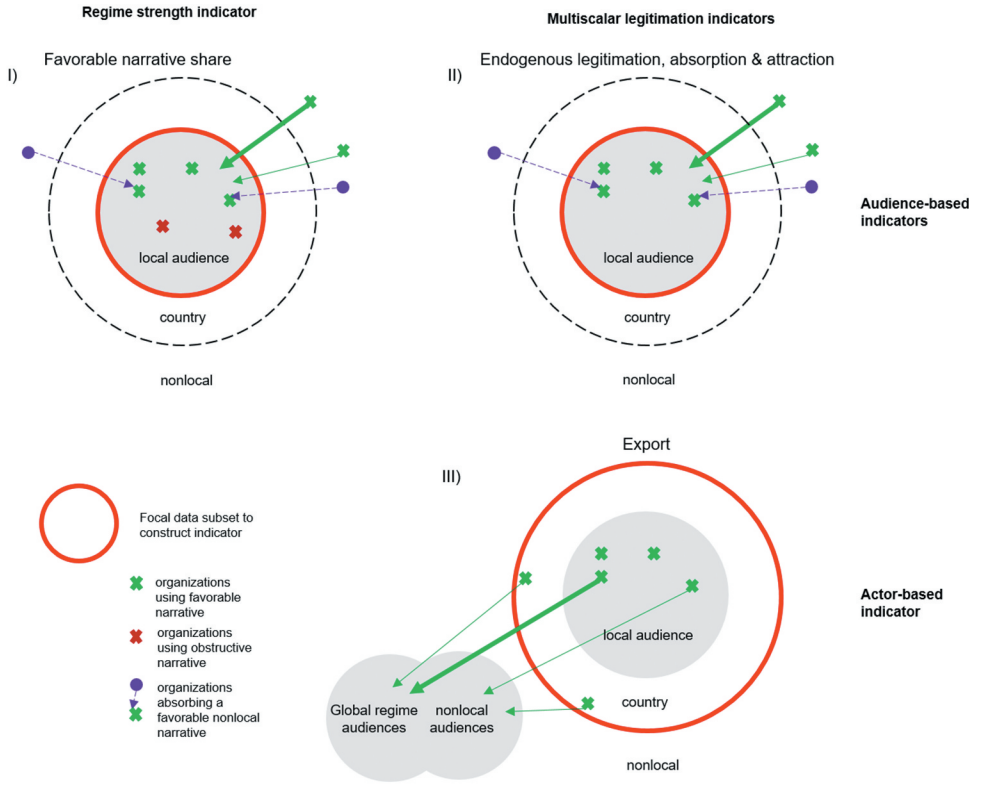

Figure 2. Data subsets to calculate indicators for regime strength and multiscalar legitimation processes.

assess the importance of multiscalar legitimation processes in countries with differing path creation constellations.

To assess the prevalence of multiscalar legitimation processes, we develop four indicators.[8] The relative importance of endogenous legitimation inside a country is given by the **endogenous legitimation** indicator (Figure 2, II). It measures the share of favorable narrative events by local actors among all favorable narrative events in a country. The importance of attraction processes is captured by the **attraction** indicator (Figure 2, II). It is given by the share of favorable narrative events by nonlocal organizations among all favorable narrative events in a country. Finally, the **absorption** indicator (Figure 2, II) represents the share of narrative events that absorb success stories from elsewhere among all favorable narrative events in a country. Unlike attraction, absorption is operationalized as an inherently transnational process because success or failure cases that can be absorbed are necessarily associated with stories from distinct other countries or regions.

While endogenous legitimation, import, and absorption can be calculated based on narrative events addressing an audience in a specific country (*audience based*), the **export** indicator follows a slightly different logic, since it is calculated using the share of favorable narrative events by local actors addressing the global scale or another

[8] For a detailed description of each indicator and its calculation, see Appendix 5 in the online material.

countries' audience (Figure 2, III). The export indicator is hence *actor based*. Figure 2 illustrates the logic behind the different indicators and their respective data subsets.

Results

The main descriptive statistics of our analysis can be obtained from Table 2. Roughly two-thirds of all the narrative events captured legitimize the existing regime and conventional industry. The remaining third of events are favorable to the emerging modular industry. We capture data from six countries (the rest of the world being clustered in larger world regions) plus the global-scale regime audiences (adding up to sixteen audience locations). Most narrative events can be identified in India, the US, Singapore, South Africa, the UK, and Israel, as well as on the global scale. Narrative events addressing these major national and global-scale audiences account for over 78 percent of all legitimation activities in the data set (Table 2).

The analysis of path creation constellations (visualized in Figure 3 and Table 3) shows that in India, a higher favorable narrative share for modular technologies coincides with a weak regime in centralized infrastructures. Combined with low

Table 2

Data Set		
Years observed:	8	
Documents:	576	
Narrative events after duplicates/document cleared:	1435	
Narrative events favorable to conventional technologies	911	
Narrative events favorable to modular technologies	524	
DNA Variables:		
Organizations:	566	
Organization types:	8	
Concept codes (referred to in narratives):	51	
Actor locations:	20	
Narrative locations:	19	
Audience locations:	16	
Overall narrative events per country (or clustered in supranational regions):	Count	% of subtotal
India	280	21.93
US	199	15.58
Singapore	150	11.75
South Africa	138	10.81
UK	104	8.14
Israel	96	7.52
East Africa	66	5.17
East Asia	53	4.15
Southern Africa	50	3.92
Oceania	45	3.52
Canada	41	3.21
Europe	30	2.35
Central and West Africa	14	1.1
Other Africa	6	0.47
China	5	0.39
Subtotal	1277	100
% of subtotal (top-6 countries)	967	75.72
Overall narrative events in global-scale expert discourse:	Count	% of total
Global-scale	158	11.01
% of Global-scale and top-5 countries		78.4
Total	1435	100

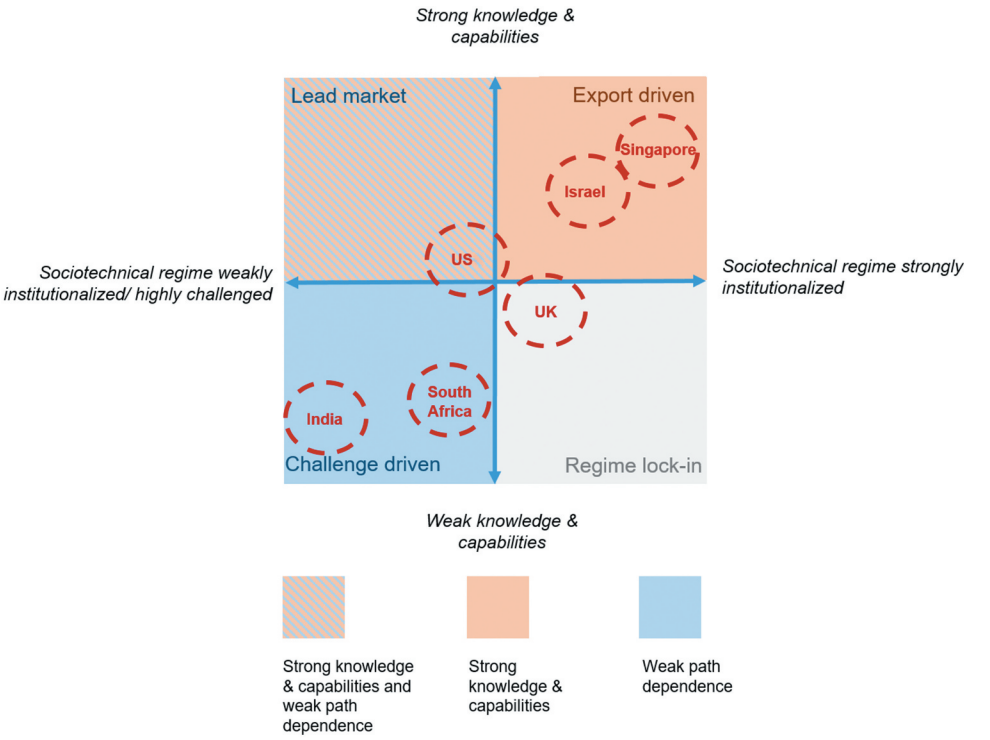

Figure 3. Path creation constellations across countries.

knowledge and capabilities, this reflects a challenge-driven path creation constellation. In Singapore, in contrast, high patenting in water technologies and a 100 percent connection rate to centralized infrastructures go hand in hand with a strong regime orientation, thus indicating an export-driven constellation. Israel, a leading innovator in the water field, combines strong patenting with a moderately strong favorable narrative share and a complete lock-in to centralized infrastructures, thus resulting in an export-driven constellation. South Africa, in turn, has a very weakly established centralized infrastructure regime, resulting in a more challenge-driven constellation. The US constitutes an intermediate case, thus representing a potential lead-market constellation. Finally, the UK constitutes a case with weak to moderate patenting activities, a strongly dominant centralized infrastructure regime, which is, however, highly challenged by multiple narratives promoted in public media. Taken together, this results in a regime lock-in constellation.

In what follows, we will review the indicators for multiscalar legitimation processes to assess their importance in each of the four quadrants of our typology. This enables an assessment of whether certain multiscalar legitimation processes may be more relevant in certain quadrants than in others. The values of the audience-based attraction, absorption, and endogenous legitimation indicators can be obtained from Figure 4a. The different scores will be contextualized with additional qualitative information drawn from the text analysis.

Table 3

Country-Level Indicators for Path Creation Constellations

Availability of knowledge and capabilities

Knowledge indicators

	Average Annual Water Technology Patent Family Filings 2011–16, per 1 Million Inhabitants*	Share of Water-Related Patents Among All Patents
India	0.08	1.3
US	7.93	1.44
Singapore	11.1	2.45
South Africa	0.3	3.31
UK	4.02	1.85
Israel	9.54	1.5
OECD	7.22	1.7

* PATSTAT data from OECD.stat

Regime strength

Infrastructural indicators
Sanitation service levels 2017, % of households*

	Sewered	Non-sewered
India	11	89
US	82	18
Singapore	100	0
South Africa	58	41
UK	97	3
Israel	99	1

* WHO and UNICEF data from Joint Monitoring Project on water supply, sanitation and hygiene

Discursive indicators
Narrative events concerning modular water technologies 2011–18*

	All Narrative Events	Favorable Narrative Events	Favorable Narrative Share %
India	280	138	49
US	199	68	34
Singapore	150	20	13
South Africa	138	41	30
UK	104	49	47
Israel	96	40	42

*Own database

Lead-Market Constellation (US)

The US constitutes the only country in our data set that can be associated with a lead-market constellation. For countries in this quadrant, we would not only expect the creation of a favorable environment locally but also strong potential for exporting legitimacy both to other countries and to the global regime. As Figure 4 clearly indicates, US actors indeed engage more strongly in the export of favorable narratives than actors from most other countries featured in our data set. The respective US actors involve tech firms in the modular technology field, such as Cambrian Innovation or RWL Water, as well as NGOs, industry associations, and several public authorities

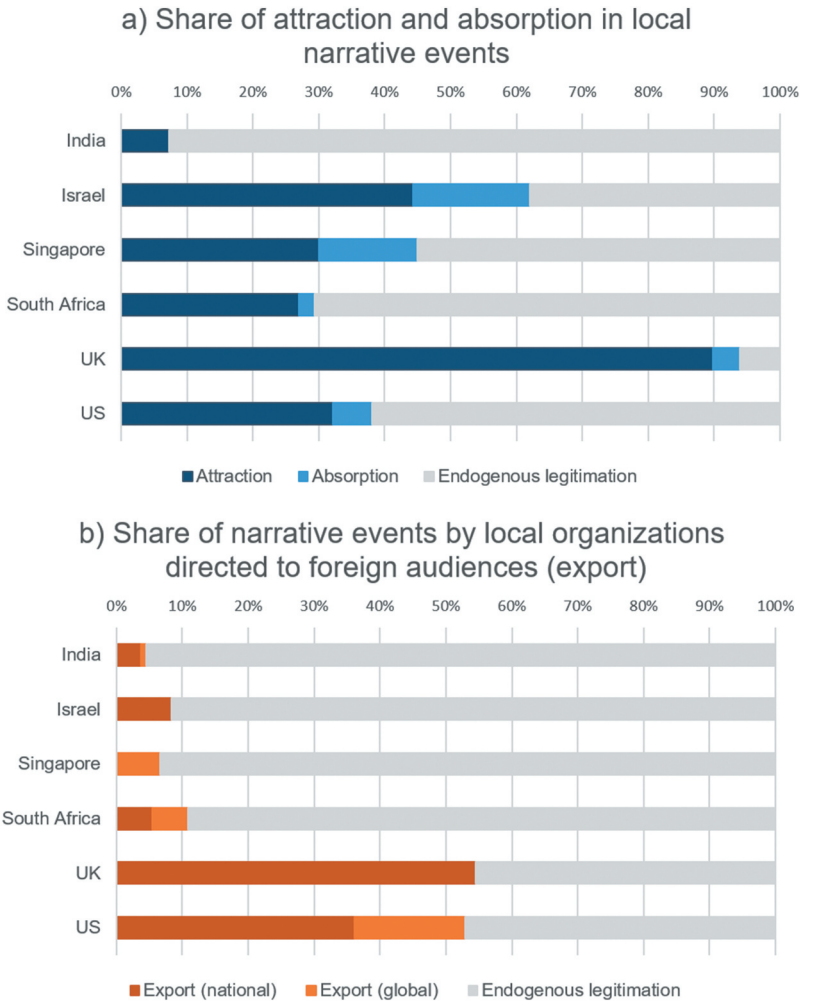

Figure 4. Multiscalar legitimation processes across countries.

(especially in arid Western states like California or Arizona). Most strikingly, over 16 percent of all favorable narratives by US actors are associated with statements addressing global-scale audiences. Most of these export activities are associated with statements by big universities such as MIT, Caltech, and Harvard, as well as individual venture capital firms directed toward international industry and policy audiences. Hence, diverse US actors seem to be able to contribute to dominant narratives among professionals in the global water sector. Directly shaping the prevalent global regime narratives may be a powerful method for big countries, like the US, to position themselves as global lead markets, since the professional community will disseminate and reproduce these narratives in other parts of the world and hence legitimize the US solutions there. At the same time, professional global networks may also feed legitimacy back into the US and hence strengthen the emerging niche in the long run.

Further, US media coverage is also strongly influenced by attraction and absorption processes, which make up about 40 percent of all favorable narrative events in the country. Actors legitimizing modular technologies in the US consist of international

organizations (like the World Health Organization [WHO]) as well as tech firms from Israel (like IDE) and Australia (Aquacell), which see a potential market for modular technologies in the US. The latter has indeed become a key provider of on-site water reuse technologies in Northern California recently. Further, international universities (e.g., from Germany, Israel, and the UK) are frequently given a voice in the US media. Absorption, in fact, relates to the reporting of successful deployment cases from all other countries investigated in this article, including the BMGF activities in Durban (South Africa). Additionally, deployment cases from Israel, Singapore, India, or Australia are often used by universities and NGOs advocating modular technologies.

In addition, the text analysis revealed that the US faced particular regional environmental pressures, for example, through droughts that hit California and the Western states peaking between 2014 and 2016.[9] These events pushed water issues into the public media, which additionally attracted global and transnational experts to legitimize modular solutions locally. Overall, the US context can thus be characterized by a strong export of legitimizing narratives to the global regime as well as by a balanced mix of attraction, absorption, and endogenous legitimation activities, which, taken together, create a supportive institutional environment for industrial path creation, potentially making US actors the forerunners of a wider sectoral transition.

Export-Driven Constellations (Israel, Singapore)

For countries with strong local knowledge capabilities, as well as strong regime structures, we expect analytically distinct legitimation strategies, which depend more on export activities with the subsequent absorption of success stories into the local context. As discussed above, Israel and Singapore can be positioned in this quadrant. Israeli actors conducted about 10 percent of their narrative events in other countries (Figure 4b). Unlike in the US case, they do not target the global regime, but rather attempt to directly support export markets in other countries, most prominently in the US. At the same time, absorption processes also play a comparatively strong role in that case. Most of the absorbed narratives are built around Israeli companies' (such as Emefcy) successful engagement with modular water technologies in foreign markets, for example, in China or the Americas. Additionally, Israel manages to attract European, US, and global-scale organizations to colegitimize the emerging industrial path around modular water technologies in Israeli media outlets. Overall, multiscalar legitimation processes make up the largest part of all legitimation activities in that case. Fulfilling its potential in an export-driven constellation (e.g., targeting markets like the US), path creation in Israel heavily benefits from multiscalar legitimation, partly compensating for the lack of an existing domestic market.

Singapore is characterized by a similarly strong deployment of attraction and absorption processes among all favorable narrative events. Unlike Israel, however, the discourse in Singapore remains strongly dominated by narratives around conventional large-scale water technologies (Figure 4a). Moreover, unlike Israel, Singaporean promoters of modular technologies rather target the global regime and not specific countries. An explanation for this pattern may be found in Singapore's strong export orientation in centralized wastewater reuse and desalination, which builds on its Four National Taps water strategy (Public Utility Board of Singapore 2018). Since the national water technology export activities are already strongly focused on this trajectory, modular technology proponents face strong opposition by export-oriented competitors and rather follow a long-term strategy in changing the global sociotechnical regime. While Israel follows a rather classic export-driven legitimation strategy, including export and

[9] National Integrated Drought Information System, https://www.drought.gov/drought/states/california.

subsequent absorption processes, in Singapore regime resistance cannot be overcome yet; hence actors focus on legitimizing niches on the global scale. Overall, the data from Israel and Singapore suggest that the success of an export-driven path creation constellation depends on actor strategies that effectively mobilize nonlocal legitimacy.

Challenge-Driven Constellation (India, South Africa)

Countries that largely lack knowledge and capabilities, but at the same time represent potentially favorable institutional environments due to strong challenges to the regime, may in turn provide an attractive environment for foreign actors and hence depend more heavily on attraction processes than the other cases. In our data set, India and South Africa exemplify this path creation constellation. Legitimation patterns within both countries are strongly dominated by a combination of endogenous legitimation and attraction processes. Export to other countries and the global regime remain low, and absorption from other countries is virtually nonexistent.

South African actors appear to influence the global regime in a few instances, yet much less strongly than US or Singaporean actors. Where it occurs, it is driven by the University of KwaZulu Natal and Durban municipality, which are also the most prominent proponents domestically, having a long-standing record of experimenting with and implementing modular technologies in informal settlements (Sutherland, Scott, and Hordijk 2015). Apart from these, we also find the government promoting modular solutions in response to severe droughts in 2015/16 (Baudoin et al. 2017). These pressures also attracted international organizations like the International Water Association and the UN to legitimize modular solutions in South Africa. Further, the qualitative data suggest that modular water technologies are already an institutionalized part of many Indian and South African cities, since decentralized and modular sanitation is a widely diffused practice in both countries (Ulrich et al. 2018; Schellenberg et al. forthcoming).

India, in particular, has a long history in the application of modular water infrastructures. Narratives by Indian actors thus often revolve around these preexisting modular water infrastructures, which are promoted by a large variety of actors ranging from public authorities to NGOs and companies. Regional discursive hubs can be identified, in particular, in the southern states of Tamil Nadu, Karnataka, and Maharashtra, as well as in some northern states such as Uttar Pradesh and Himachal Pradesh. Local environmental problems, like overly polluted rivers and sewerage overflow, often lead regional organizations to suggest an increased use of modular technologies for greywater reuse, rainwater harvesting, or on-site wastewater treatment. Overall, we may expect challenge-driven countries to create legitimacy endogenously building on existing institutional templates and in reaction to landscape pressures. While these cases often provide institutional windows of opportunity for path creation, the lack of knowledge capabilities may require the absorption and attraction of knowledge from beyond the region. A feasible strategy in this constellation would thus involve attracting capable foreign firms and experts based on the strategic promotion of local markets and legitimation trajectories.

Regime Lock-In Constellation (UK)

Regime lock-in constellations, finally, are the hardest to tackle, even with multiscalar legitimation strategies, due to the lack of local knowledge capabilities and strong regime structures. To create a domestic path, local actors may thus have to engage in a diversity of legitimation strategies in parallel, such as developing an export-driven trajectory (similar to the Israeli case), while also attracting foreign firms to both

transplant external knowledge and discursively challenge the domestic regime. The UK constitutes an illustrative case in this regard, since almost all legitimation activities in domestic media coverage are based on attraction processes. There are two reasons for this. On the one hand, there have been frequent reports about the Californian drought between 2014 and 2016, especially in *The Guardian*, giving a voice to US entrepreneurs in the UK's small, modular technology field. On the other hand, the BMGF, which funds various British research partners in the context of their *reinvent the toilet challenge*, frequently pushes their ideas in British media.

Thus, while British infrastructures and endogenous legitimation is strongly focused on the centralized regime, British media also provide a platform for external industry proponents to promote their ideas about modular water technologies, effectively challenging the sociotechnical regime. International actors, like BMGF, may find the UK an attractive location to legitimize modular technologies in order to gain attention from investors or powerful British companies. At the same time, British industry proponents themselves mostly target foreign markets in the rest of the English-speaking world. Hence, for the UK, we may observe a combined strategy of attracting foreign legitimizers to the otherwise strongly path-dependent institutional environment, with British industry proponents seeking their luck in export markets. The British case thus illustrates how an internationally well-connected country, despite facing a regime lock-in constellation, may become a hub for transnational legitimation flows and even generate opportunities for path creation thanks to the attraction of foreign legitimizers.

Discussion and Conclusions

The goal of the present article was to address the question of how path creation potentials in regions are influenced by and dependent upon multiscalar legitimation dynamics by developing a conceptual and empirical means of disentangling multiscalar legitimation processes in new industrial path creation. We have demonstrated how regional path creation constellations differ according to their existing knowledge and capabilities and with respect to the institutionalization of the sociotechnical regime relative to the emerging industry. We have then shown how, within these varying structural constellations, multiscalar legitimation processes can be empirically identified through the analysis of narrative events in public media. In light of the findings presented, our research brings to the fore several aspects that may enrich future work on nonlocal sources of industrial path creation within the discipline of EG and beyond.

While recent research on path creation has focused mostly on regional and national institutional dynamics (Gong and Hassink 2019; Miörner and Trippl 2019), our work is innovative in proposing a more global and multiscalar perspective on institutional dynamics. Our results show how multiscalar legitimation processes may shape a region's ability to create industrial paths in emerging industries. In particular, we illustrated the importance of nonlocal sources of legitimacy for regional path creation in conjunction with nonlocal sources of knowledge (Trippl, Grillitsch, and Isaksen 2017). Our results indicate that an explicit consideration of multiscalar flows of legitimacy is crucial for identifying potential strategies of regional actors. Integrating these insights with recent understandings of multiscalar knowledge flows, it is possible to formulate a number of original hypotheses that shed light on success conditions of path creation processes (see Table 4).

In a lead-market constellation, knowledge and legitimacy can be developed endogenously. In this case, actors will likely engage in the export of both knowledge and legitimacy in order to shape supportive institutional environments, both in the sector's

Table 4

Relevance of Multiscalar Resource Formation Strategies in Different Path Creation Constellations

		Lead Market	Export Driven	Challenge Driven	Regime Lock-In
Knowledge	Endogenous		++	-	
	Attraction and absorption		+	++	
	Export		++	-	
Legitimacy	Endogenous	++	-	++	-
	Attraction	+	+	+	++
	Absorption	+	++	-	++
	Export	++	++	-	-

Note: ++ high relevance; + intermediate relevance; - lower relevance

global regime as well as in other regions. Lead-market countries like the US, may additionally benefit from nonlocal sources of legitimacy in a similar manner as organizationally thick and diversified regions benefit from absorptive capacity and attractiveness in the anchoring of extraregional knowledge resources (Trippl, Grillitsch, and Isaksen 2017). In an export-driven constellation, the lack of a favorable institutional environment needs to be compensated by active export activity, absorption, as well as attraction of legitimacy, which can be facilitated through (experimental) commercial activities abroad. Put differently, in an export-driven constellation, multiscalar legitimation processes serve to mobilize a path potential that could not be created or maintained in the local context alone (see also Kwak and Yoon forthcoming).

A challenge-driven constellation, in turn, has ample opportunities to build up legitimacy endogenously, while depending on knowledge and other missing system resources that must be attracted from abroad. This situation may be best compared to an organizationally thin or peripheral region in which actors face the greatest difficulties, yet can nonetheless reap the largest benefits from absorbing extraregional knowledge and other resources (Trippl, Grillitsch, and Isaksen 2017). Finally, in a regime lock-in constellation, resources need to be almost entirely drawn in from nonlocal sources or be developed from scratch domestically. Since the latter often proves difficult, actors in a regime lock-in constellation may chose a legitimation strategy that builds strongly on extraregional legitimacy. A regime lock-in constellation may for example, relate to old industrial regions, for which empirical studies have suggested that multiscalar institutional interventions may matter just as much as the absorption of nonlocal knowledge (Dawley 2014; Dawley et al. 2015; Trippl, Grillitsch, and Isaksen 2017; Hassink, Isaksen, and Trippl 2019).

As apparent from these hypotheses, our results point to the importance of interactions between regional entities and global sociotechnical regime structures (Fuenfschilling and Binz 2018) that may substantially affect the path creation prospects of a region. Beyond only looking at institutional environments *on* different spatial scales, mostly referring to regulation and policy processes (Martin 2010; MacKinnon et al. 2019), we have shown that these institutional environments may be affected by processes that run *across* different spatial scales. The transnational absorption of legitimacy through narratives around foreign success cases, or the attraction and export of legitimacy from and to a global-scale community of experts that reproduces the global sociotechnical regime, reveal that new windows of opportunity for paths in emerging industries may develop in contexts that existing theorizing would not have suggested (as the cases of Israel and the UK illustrate). Hence, merely looking at endogenous institutional work for an emerging industry or at static layers of institutions that affect path creation regionally blind

researchers to the diverse ways through which industry proponents may influence relevant institutional environments in and across spatial scales.

We began this article with the ambition to analyze the importance of multiscalar institutional dynamics for regional industrial path creation. However, our actual framework has focused on legitimation processes. A more encompassing perspective would additionally have to consider other relevant system resource formation processes such as market formation and the mobilization of financial investment (Binz, Truffer, and Coenen 2016). Furthermore, the method proposed could be further improved. Since we only capture legitimacy generated through articles in selected media outlets, we cannot make any claims about legitimacy conveyed through more tangible actions such as investment decisions or presentations at trade fairs or conferences (Bork et al. 2015). Future research should thus venture to identify broader valuation concerns, which may require the triangulation of data generated by means of a variety of databases/methods. As discussed above, our method could be applied to more detailed analyses at the regional level to gain more in-depth insights into the subnational validity and specificity of the processes studied in this article. Eventually, an analysis of the role of multiscalar legitimation processes in more traditional and established sectors could provide important insights beyond the case of an emerging (cleantech) industry as analyzed herein.

In summary, we maintain that the conceptual framework, method, and databases presented open an important new inroad to understanding the systemic interplay between novel technologies, institutions, and knowledge in a globalizing innovation and industry formation race. Contextualizing the contribution of this article in a wider conceptual perspective will enable economic geographers and transition scholars to combine the exploration of productive trading zones with theorizing in other disciplines, such as neoinstitutional sociology or the literatures on institutional work and entrepreneurship. Embracing and expanding on these theoretical insights constitute the topical horizon for geographers and transition scholars alike, particularly in light of increased efforts to understand path creation in emerging or green industries (Trippl et al. 2020).

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