Sustainability Transitions in Heterogeneous Contexts[1]

An integrated perspective on basic service innovation in informal settlements of developing cities

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Abstract

The need for transitioning towards more sustainable technologies, products and sector structures has received increasing attention in academia and policy circles over the past two decades. Despite representing a truly global challenge, the majority of extant conceptual frameworks drew on insights from a few OECD countries and sectors – energy, transport and water – that are highly centralized and materially and institutionally homogenous. The present paper examines whether these frameworks are also suitable for analysing transitions in more heterogeneous contexts. By investigating the relevance of key concepts in the transitions literature – 'socio-technical regimes', 'technological innovation systems' and 'practices' - we reconsider the analytical qualities and limitations of extant frameworks. We reflect on insights gained from a set of case studies in the provision and use of water and sanitation services in informal settlements of the city of Nairobi. High degrees of heterogeneity characterize this context due to widespread poverty, social inequality, fragmented public service provision, informal economies and unreliable formal institutions. This case therefore represents an antipode of sorts to the conventional application contexts of transition studies. We reflect the generic relevance of key transition concepts, and reconsider their interpretation for better addressing the challenges of transitions in heterogeneous settings. These reflections enable the formulation of an enlarged set of transition pathways, provide a fresh view on how actors can contribute to transitions, or not, how power relationships come to bear and highlight the role of interconnections among transition activities at different geographical scales. The proposed framework results in much more than just applying established transition concepts to a new geographical context. It calls for a renewed perspective on transition theorizing, at large.

[1] *This is a very first draft of a paper providing the synthesis on a set of several case studies dealing with transitions in water and sanitation services in informal settlements of Nairobi, Kenya.*

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1. Informal settlements as a new inspirational exemplar for transition theorizing

Transitions researchers have recently argued for developing more context sensitive understandings of environmental innovations and sustainability transitions (Bergek et al. 2015; Coenen et al. 2012). Among other things, this has sparked a vibrant set of studies on the geography of transitions (Hansen and Coenen, 2015; Truffer et al. 2015). These studies elaborate how transition processes are embedded in specific local contexts (Truffer and Coenen 2012; Dewald and Truffer 2012), how they interconnect across scales and build up global regime structures and innovation systems (Fünschilling and Binz, 2018; Binz and Truffer 2018) and how these interrelations are mediated by all sorts of power relationships (Lawhon and Murphy, 2012; Murphy 2015). The geography perspective is particularly insightful when analysing transitions in contexts that are considerably different from those that had inspired the transition literature originally. Most of these related to initiatives in specific OECD countries like Germany, the Netherlands, Denmark or Australia and were oriented at heavily infrastructure reliant sectors like energy, urban water or transport (Markard et al. 2012). In these original contexts, regime structures have proven to converge to rather homogenous and stable configurations that provide services to a large majority of users in a given territory. More recently, transition studies have been criticized as having focused too much on these rather simple substitution processes from one dominant regime structure to a new one and that actual transition processes can be much more messy and variegated (Genus and Cole 2008; Markard and Truffer 2008; Smith and Berkhout 2005; Geels and Schot 2007). It therefore remains a matter of debate how generally applicable the concepts are beyond the original, rather simple contexts of application.

In the present paper, we reflect on the applicability and usefulness of current sustainability transitions thinking in heterogeneous contexts. Like the majority of transition cases, we focus on an empirical case of basic service provision but in a geographical context - a rapidly growing city in Africa (Nairobi) – which departs from the standard quite fundamentally. We analyse potentially sustainable innovations and envisaged sectoral transformations in the provision of water and sanitation services in Nairobi's informal settlements. The relevance of sustainability transitions in this city is hard to deny given the social and environmental problems and highly uneven forms of economic development that have marked its evolution. A large number of basic service provisioning initiatives targeted at Nairobi's poor have failed so far, or at least did not scale up sufficiently, raising key questions about the prospects for sustainability transitions. As we argue below, such failures result from capability, coordination, and institutional limitations and because many actors pushing for new solutions to these problems still entertain rather linear and mechanistic understandings of how new service innovations should be introduced and diffused. Specifically, there is an insufficient understanding of, or accounting for, the heterogeneity of provisioning options and user practices such that new innovations only partially align with the needs, resources, and priorities of poor urbanites thus limiting their scalability and adequacy in helping to create stable, sustainable alternatives. Needed is a systemic perspective that is capable of capturing and interpreting this complexity, one that accounts for the interactions between the social, cultural, and technological characteristics of innovations, the institutional environment, the everyday practices and contexts of the poor, the role of multi-scalar factors (e.g., transnational trade and investment), and the role that power-relations playing in shaping the evolution and sustainability of basic service sectors.

Transition studies provide a potentially suitable systemic perspective on these challenges. Over the past decade, we have seen a rapidly expanding number of studies that addressed sustainability oriented initiatives in the Global South (Wieczorek, 2018). Many of the authors have applied established transition concepts, but have at the same time expressed discontent about their adequacy and/or have suggested specific extensions (among others Sixt et al, 2018; Blum et al. 2015; Tigabu et al. 2015a,b; Berkhout et al. 2009; Rock et al. 2009; Murphy 2001). However, to the best of

our knowledge, no encompassing reconsideration of transition concepts in Global South contexts has been formulated so far. In the present paper, we therefore want to examine core concepts of transition studies with regard to their suitability in those heterogeneous and complex contexts as those that are prevalent in many regions of the Global South – most dramatically in urban informal settlements. The proposed framework builds on and integrates conceptual extensions of extant transition thinking at three interconnected levels: i) how to understand *stability and obduracy*, which result in strong path dependencies for current systems of provision and use. ii) How to identify enabling conditions and critical resources for technical, institutional and organizational *innovation and change processes*. iii) How to identify possible *transitions pathways* towards more sustainable future regime structures and user practices. We elaborate these extensions by drawing on insights from a number of recent conceptual contributions relating transition concepts to insights from established literatures: neo-institutional sociology (Fünfschilling and Truffer, 2014), innovation systems approaches (Binz and Truffer, 2017) and practice theory (Schatzki, 2001; Shove and Walker 2007; Jones and Murphy, 2011).

First, we will elaborate what kinds of forces contribute to *stability and obduracy* in extant basic services systems in cities of the Global South. We approach this question through two complementary entry points: stabilizing forces in the provision of services (extending and specifying the concept of socio-technical regimes) and stabilizing forces related to domestic practices of citizens (extending on user related practice theory). Socio-technical regimes as identified in OECD countries typically presuppose rather mature, stable and homogenous institutional structures, which provide high quality and reliable services to a majority of consumers in a given territory. Cities in the Global South are typically deviating from this ideal type situation in several respects. Many overlapping offerings of varying quality exist, which serve population segments very unevenly and create manifold negative impacts on local communities and natural environments. To grasp these complexities, we build on recent proposals by van Welie et al. (forthcoming) and distinguish two levels of interrelated socio-technical regime structures: service regimes (e.g. the “automobile” regime) and sectoral regimes (e.g. the “individual transport” regime) based on identifying both user and provider practices. Instead of sectors being dominated by a single service regime, assemblages of competing and partly unreliable service regimes may co-exist. This leads to different types of sectoral regime constellations. In many OECD countries, we see rather monolithic sectoral regimes, whereas in most cities of the Global South they appear as fragmented or splintered. The heterogeneity and complexity of the situation calls for a specific epistemological approach to identify regimes. The prevalence of fragmented or splintered regimes implies that users cannot be considered as passive receivers of services anymore but as conscious, proactive and capable managers of their livelihoods under quickly changing and resource constrained context conditions, which are mediated by cultural, political, economic and socio-demographic resources and capabilities. We propose to analyse users through the way they shape and reproduce the different service regimes while managing what we call “oscillating domestic spaces” (Cherunya et al., submitted). Both the identification of more heterogeneous modes of provision and use, require a different epistemological approach compared to the host of transition studies (Jones and Murphy, 2011). We therefore propose to identify regime structures through the practices of providers and users in the reproduction of different regime splinters.

Second, besides explaining stability, transition theorizing has to specify how socio-technical systems can be changed through different forms of *innovation and change processes*. We assume that different actors possess diverse portfolios of capabilities to incite changes either in provision or use practices. Following a socio-technical systemic perspective, we use the concept of system failures (primarily capability, coordination or institutional failures) to understand why specific initiatives will

be successful or not (Klein-Wolthuis et al. 2005; Weber and Rohracher 2012). More specifically, we will present three illustrative cases where specific actors have been successful (or not) in changing fundamental characteristics of the prevalent service regimes. The first example relates to capability failures and elaborates on why incumbent utilities trained in managing the globally dominant service regime often fail to extend services into informal settlements. The established capabilities and organizational structures represent barriers to developing new capability portfolios for new offerings in informal settlements, where different kind of service regimes pre-exist. The second example illustrates the implications of coordination failures and asks why donor supported initiatives by NGOs and social enterprises aiming at innovative new service regimes often fail to scale. We propose a (technological) innovation system perspective to identify potential synergies among the different initiatives, which are not leveraged by the specific actors. The third example focuses on institutional failures. It explains the success of initiatives by community based organizations who have managed to provide reliable sanitation services, in contexts where other and more financially powerful actors have failed. Again, an innovation system perspective enables the identification of innovation capabilities that these organizations can mobilize. Their specific capabilities rely on the intimate understanding of the practice contexts, under which users have to take care for their livelihoods. This enables these organizations to innovate in social and institutional terms, an expertise that more technology savvy actors often lack.

Building on these extended conceptualizations of conditions for stability/obduracy and innovation/change, we are able to identify a broader set of *transition pathways* than those usually considered both by development agents and by transition scholars (Geels and Schot, 2007). Instead of depicting one monolithic sector regime as the ultimate aspirational endpoint, sustainability transitions should rather be oriented at managing various heterogeneous service regimes, the improvement of interfaces among these regimes, the proper consideration of user practices in the design and implementation of new services and rely on the broad range of resources of different types of actors. Regarding the overall transition process, this framework departs from a naïve conception of a one-leap transformation towards a tidy future and instead argues for the virtues of stepwise and parallel transformation processes, where different constellations of improved service provision options are developed over time. The perspective on heterogeneous pathways implies in particular that path-dependencies can rely on a wide variety of conditions, that geographical embedding and scale problems cannot be left unconsidered and last but not least that power considerations move centre stage in transition theorizing.

In order to formulate a coherent framework for analysing sustainability transitions in cities of the Global South we have to conceptualize stability, change and pathways in an integrative way. To elaborate such a framework, the paper is structured into five sections. The next section elaborates on how to reconsider core concepts of transition thinking that explain stability and obduracy for heterogeneous contexts such as those found in urban informal settlements in the Global South. Section three addresses the challenges of transforming these service regimes from the perspective of three illustrative cases which highlight three system failures: capabilities, coordination and institutional failures. Section four discusses the implications of these reconsiderations for an extended set of transition pathways for informal settlements and the roles different actors can play in implementing these. We conclude by proposing a research agenda building on the developed conceptual frameworks suggesting that a better understanding of path-dependencies, geographical embedded- and interconnectedness and impacts of power relationships are key for achieving this integration. Far from resulting in a simple application of well-established theories to a new geographical context, this framework promises to open up fresh perspectives on transition processes, at large.

2. The need for moving transition studies into more heterogeneous contexts

2.1 Rather homogenous cases inspired original transition studies: energy transitions

Transition studies have received considerable attention over the past twenty years, both by academic and by policy circles (Smith et al. 2010; Markard et al. 2010). Their specific vantage point is to analyse stability and change in socio-technical systems. These are constituted by the interplay of technologies, infrastructures, cultural meanings, organizational forms and regulations, which align into configurations that work (Rip and Kemp 1998; Geels 2004) in order to provide those reliable and stable products and services that made modern life possible. The early conceptual ideas were applied to a number of historical case studies like urban water management (Geels 2005, 2006), the transition from horse carriages to automobiles (Geels 2005) or from sailing ships to steam ships (Geels 2004). Due to the rapid rise of the climate change discourse, the energy sector became a very pressing application field for transition thinking both in historical reconstruction and for the support of future oriented transition processes (Markard et al. 2012). The specific challenge of the energy sector could easily be portrayed as requiring a transition from a definite, rather clearly circumscribed established socio-technical regime (the fossil fuel cum nuclear power based centralized way of providing, distributing and consuming electricity) towards a new, renewable energy based and potentially more decentralized sector structure. As a consequence, a lot of emphasis was put on analysing success conditions for renewable and decentralized energy technologies to emerge, mature and gain bigger market shares. Especially the Technological Innovation Systems and related literatures developed quite elaborate understandings on how to analyse the progressive maturation of newly emerging industries as socio-technical systems (Bergek et al. 2008; Hekkert et al. 2007; Garud and Karnoe, 2003). Paradoxically, the very convincing tale of an urgently needed, rather simple energy transition trajectory led to the impression that transition theorizing was essentially promoting a linear technology-push view. One that misses out on the subtleties and complexities of most other real world transformation processes in other realms of the economy and society (Shove and Walker, 2007; Genus and Cole 2008; Markard and Truffer, 2008; Geels and Schot 2007).

Beside the strong emblematic empirical focus on the prospective energy transition, the spatial variety of contexts was also very limited. Most of the studies focused on the national scale and a limited number of OECD countries such as Denmark, Sweden, the Netherland, Germany, the UK and Australia (Markard et al. 2012; Hansen and Coenen, 2015). Geographers started to argue that this narrow empirical focus was not without consequences for the way the concepts had been framed and the likely policy implications that could be derived from this literature (Coenen et al. 2012). A geographical perspective on transition processes has to move beyond giving privilege to the needs of national policy makers. It has to address how transition processes are embedded in regionally diverse social and institutional structures (Truffer and Coenen 2012), how the stability of existing regimes as well as the success conditions of transformation processes are posited in multi-scalar processes (Fünfschilling and Binz, 2018; Binz and Truffer, 2017), and who would win and who would lose in any specific transition (Truffer and Coenen, 2012; Lawhon and Murphy 2012). As a consequence, transition studies have been called to move into more heterogeneous geographical and sectoral contexts.

2.2 Transitions in heterogeneous contexts: The case of informal settlements

Transitions in informal settlements in the Global South represent perhaps one of the most challenging contexts for the extant transition concepts and frameworks. Conditions of widespread poverty, social inequality, heterogeneous and fragmented public service provision, informal economies and unreliable formal institutions require the questioning of many dimensions that had been taken for granted in original transition theorizing. Systemic approaches promise to provide

better insight into the challenges and opportunities that informal settlements represent for the development and diffusion of new and better products and services compared to the still dominant linear and mechanistic understandings of engineers and many national and international donor agencies. The past decades have shown that conventional theories of innovation and market expansion had limited success in improving the lot of the poorest population segments. Myriad novel service offerings, business models and regulatory reforms have shown limited success in scaling up. Systemic approaches are promising because they enable the identification of manifold stabilizing forces that limit the success of promising alternatives.

As a consequence of the pressing challenges of global sustainability, there has recently been a strong rise of transition studies applied to contexts of the Global South (Wieczorek 2018). While having proven useful in many respects, the concepts were however also found to be limited in grasping the complexities of such heterogeneous contexts. There are several reasons justifying this concern. First, most countries in the Global South experienced a colonial period, during which time highly unequal sociotechnical systems were put in place, systems that reflect the priorities, experiences, culture, and practices of colonizers rather than those of indigenous peoples. Such provisioning systems were, from the outset, bifurcated between those serving the colonizers and those available to indigenous populations, thus creating separate and unequal regimes that were never intended to converge. With independence, governments and municipal leaders were forced to contend with these discontinuous systems, highly limited resources, and continued dependence on aid money to fund infrastructure projects. The net result was the continued, deeply embedded evolution of sociotechnical regimes that were sharply divided between conventional (i.e., more centralized, formal, westernized) provisioning systems (e.g., water, sanitation, energy) that are accessible to the minority of most urban populations, and heterogeneous, informal, and ad hoc systems that the majority of residents (esp. the poor) rely on to access basic services. Heterogeneous or splintered regimes such as these belie the monolithic perspectives (i.e., a single regime) that marks much of the transitions literature and raise pressing concerns about how to understand, conceptualize, and rigorously analyse multiple, in situ, regimes and their co-evolution.[2]

Second, and related, there is the institutional transfer fallacy that seems to plague transitions research – the notion that externally (i.e., donor, NGO) driven initiatives, niche innovations, and/or investments can reconfigure, restructure, and align existing regimes into singular, modern, and deeply integrated entities (Engelbert and Tull, 2008). In other words, the focus of transition management in the Global South is often on convergence towards westernized, single regime structures given the existing literatures and concepts provide us with few insights into how multiple regimes might co-exist in a single context. This translates into policies and initiatives that presume that existing institutions and forms of embeddedness or lock-in (e.g., political, cultural, cognitive) can be eliminated or replaced simply through the right technologies and institutions, and that these innovations will facilitate a convergence to a single regime and the elimination of the regimes serving poorer, majority communities. This is a critical limitation given the interdependencies and complementarities that often exist between co-located, heterogeneous regime structures such as in, for example, the case where the state's lack of investment in provisioning systems in informal settlements helps to subsidize uneven investments in "modern" infrastructure in wealthy communities.

[2] We are not the only ones to raise concerns on this front. Members of the Sustainability Transitions Research Network (STRN) too have recently questioned the adequacy of the regime concept for developing regions/cities (the Global South), asking whether "the definition of a regime need to be expanded to encompass differing grades of uniformity, stretching from highly monolithic to highly hybrid configurations?" (Kohler et al., 2017, p. 36). This is a critical concern, one that this paper addresses directly.

Third, and finally, the lack of research into regime structures and practices in the Global South has meant that transitions concepts continue to reify users and user practices associated with Northern or Westernized contexts. The point being that given the material challenges, historical and cultural contingencies, and heterogeneity of sociotechnical systems in the Global South, there is a dire need to understand the diverse array of provisioning and use practices that are co-present, particularly in rapidly growing and poorly planned cities. In such contexts, there is no singular provider or user subject but instead a diverse range of practices and combinations of practices through which (multiple) provisioning regimes operate (van Welie et al. submitted). Needed is more inductive, on-the-ground research to document and understand heterogeneous practices in order to identify alternative pathways for sustainability transitions, those that may not entail an evolution to homogenous or centralized (one-size fits-all) regimes.

Such concerns are particularly pressing in the context of informal settlements where there is typically little investment in, or planning of, the basic infrastructures that are vital for households and livelihoods. Moreover, informal settlements are vulnerable politically as changes in political priorities of municipal leaders and other elites can threaten their existence and/or any support they may receive from the state. Changes in the political priorities and strategies and power-relations of actors can have detrimental effect on the settlements. Within such settlements, several regimes – energy, water, sanitation, housing, transportation – converge at the scale of the household where limited resources and poor infrastructure forces individuals and families to develop a diverse array of practices in order to meet basic needs. Moreover, given the costs and other challenges, trade-offs between competing services are often necessitated meaning that user practices and the demand for preferred provisioning options often vary throughout the year or day, depending on critical factors such as gender, age, and income. All told, informal settlements are settings that fundamentally challenge many of the assumptions about regime structures, and taken-for-granted user rationales, built into existing transitions concepts and thus demand far greater attention. Beyond helping to advance transitions concepts and theories they are also places in dire need of creative solutions to extreme material, socioeconomic, and environmental constraints, thus providing transitions researchers with the opportunity to contribute to pressing global issues such as poverty, inequality, and social/environmental justice.

We therefore claim that in order to better explain stability and obduracy of service provisions in such heterogeneous contexts as informal settlements in cities of the Global South, we need to revisit the core concept of transition studies that addresses stability and obduracy: the socio-technical regime. The specific challenges that informal settlements represent for sustainable transformation processes will be addressed in section three. As we will show, a focus on codified institutional structures will not suffice for this task. We have to complement it with a view on how practices of different actors stabilize prevailing structures. We therefore elaborate a more heterogeneous regime concept in the following, elaborate the practice perspective on users and finally argue for the mutual complementarity of these two perspectives. Using the case of water and sanitation systems in Nairobi, we then discuss the challenges that cities of the Global South, and particularly the heterogeneous contexts that are informal settlements, face for potential transitions, manifest in capability, coordination, and institutional failures that constrain or limit the prospects for just and sustainable transformations.

The case of Nairobi's sanitation sector is well suited to demonstrate the value of this approach. The city is facing significant infrastructure challenges as it rapidly grows and the gap between the rich and the poor has become increasingly extreme in recent years. Adequate provision of sanitation services is a fundamental challenge to the city`s inhabitants, and a major task for city officials, especially in the informal settlements where 36% of Nairobi`s population lives (Mansour et al., 2017). The highly

uneven spatial differentiation of sanitation configurations was initiated during the colonial period of residential segregation and it has become more pronounced and complicated during the era of neoliberalism (Nyanchaga and Ombongi, 2007). The sanitation sector today is characterized by a high variety of access options and conditions, multiple providers, different institutional arrangements, different spatial structures and user practices, and complex formal and informal governance structures. Complicating matters further is the fact that different sanitation configurations are operated within single geographical areas and residents typically use more than one configuration in the course of their day. Nariobi's informal settlements have furthermore been a testbed for many initiatives of alternative service provision, which led some commentators to label it a "the silicon valley of shit" (Kalan, 2011).

The data for the three cases discussed in this section was collected by two of the co-authors, between February and December 2016. A total of 152 semi-structured interviews were held with relevant people ranging from representatives of government agencies, the local government, Non-Governmental Organizations, international agencies to sanitation enterprises, formalized and non-formalized sanitation service providers. Additionally, five focus groups in informal settlements with women community groups were conducted. The insights from these focus group discussions were combined with visits to the homes of 32 residents in three informal settlements to discuss and observe their living conditions and their everyday domestic practices. The collected data was complemented with secondary resources such as policy documents, action plans, reports, newspaper articles and available literature on sanitation in Nairobi. All interviews were recorded, transcribed and coded using MAXQDA 12. The different case studies have been more extensively elaborated in a number of recent publications (van Welie et al. resubmitted, van Welie et al. submitted; van Welie and Truffer, submitted; Cherunya et al. submitted a; Cherunya et al. submitted b)

3. Understanding stability and obduracy in heterogeneous contexts

3.1 Stabilities in the provisioning of services: splintered regimes structuring the sectors

To account for the heterogeneity and complexities that typically characterize informal settlements in the Global South, we have to unbox the concept of the socio-technical regime. In the literature so far, the term has been used at variable levels, denoting as well specific technologies (e.g. the internal-combustion engine automobile regime), whole technological fields (e.g. the automobile regime), or even entire sectoral fields (the personal mobility regime). As long as specific sectors are largely dominated by specific technologies (as the case of the personal mobility regime aptly illustrates), a rather loos and encompassing use of the term may be defendable. Given the high complexity of alternative offerings in informal settlements, however we have to be more precise about what sort of socio-technical regime structures are actually addressed. In such a vein, van Welie et al. (forthcoming) propose the distinction of service regimes sector regimes.

Service regimes form around specific institutionalized combinations of technologies, user practices and organizational forms for providing the service. The reconstruction of service regimes requires a grounded approach, able to inductively identifying differentiations and their characteristics. Therefore, van Welie et al. (forthcoming) proposed a practice lens to reconstruct service regimes as configurations of user and provider practices organized around a specific technology or service option. A stabilized service regime is marked by routinized practices that may be difficult to change once established. This stability is caused by various processes and patterns such as shared understandings about how, when and where to provide and use a basic service/artefact. The processes and patterns associated with service regimes can be conceptualized along several basic

practice dimensions (infrastructures & artefacts; organizational modes; rationales & meanings, and time-space characteristics). When these dimensions are aligned with one another, a stabilized service regime comes into being.

Sectoral regimes refer to the provision of broad societal functions like transport, food, safe urban water, electricity and so forth. Sectoral regimes typically encompass several service regimes. For example the personal mobility regime (sectoral level) typically consists of more or less aligned service regimes related to i) the automobile, ii) busses and trams, iii) bicycling, iv) trains and v) pedestrian mobility forms. The different service regimes may be institutionalized to different degrees and my be more or less well aligned with each other. A sectoral regime will be very strong when the constituting service regimes are well established and strongly institutionalized. Strong sectoral regimes can however still exhibit major negative consequences for the social and natural environments they are operating in. In general, we would expect less negative impacts, depending on how well the complementarity between and inter-operability between the different service regimes is organized. Different degrees of alignment between the service regimes can be interpreted as different types of sectoral regimes. Many basic service sectors in OECD countries can be characterised as monolithic regimes, i.e. a sectoral regime which consists of one dominant service regime. This is the case that was most strongly represented in the original transition studies. In general however, sectors will consist of assemblages of co-existing service regimes without any clear relationship of dominance. We distinguish three forms here: A polycentric regime describes a sectoral regime that consists of several service regimes, which are each fully developed and well-aligned with each other. A fragmented regime consists of several fully developed and self-contained service regimes, however at the sectoral level the service regimes are misaligned. Lastly, splintered regimes consist of poorly developed service regimes which exhibit many internal misalignments, as well as misalignments with the other service regimes.

We observe that many basic service sectors in informal settlements in the Global South are splintered, because these specific heterogeneous contexts are characterized by partial public service provision, lack of resources for users, and unreliable formal institutions. Splintered regimes in informal settlements consist of several different service regimes that have different degrees of internal alignments, but still all show relatively strong degrees of institutionalization of certain elements. This strength may for example result from a good fit with contextual requirements (local or landscape factors) and low levels of contestation by different actors. The strength of the service regimes can therefore be rather high, and thus lead to a stable and persistent splintered sectoral regime. In such splintered regimes, the provision of services is typically inefficient (e.g. basic service providers in different service regimes are not complementing each other in order to improve their services) and users can only meet their daily basic needs through the users' own proactive efforts managing their livelihoods. This latter characteristic of a splintered regime asks for an elaboration how user practices in heterogeneous contexts contribute to the stabilization and obduracy of service offerings.

3.2 Stability in the use of services: managing oscillating domestic space

We posit that a major reason for a persistent use of unsafe and unhygienic service options in informal settlements, and insufficient adoption of seemingly superior service offerings, stems from an inappropriate understanding of the contexts in which users have to manage their daily lives. Conventional approaches for interventions in informal settlements (mostly proposed by economists, psychologists, or engineers) often waver between under-socialized accounts seeing users as isolated rational actors and over-socialized accounts, which expect highly routinized behaviour prescribed by cultural and economic structures. Cherunya et al. (submitted) provide a middle ground perspective

by conceptualizing users engagement with basice services offerings through a practice perspective (Schatzki, 2001; Shove and Walker 2007; Jones and Murphy, 2011). They claim that the key to a better understanding of user practices lies in the disentanglement of the space-time characteristics of domestic practices. Instead of representing rather neatly delimited “market segments” they portray users as being pro-active, actors constructing the conditions of their daily livelihoods under very complex conditions of external influences and personal capabilities. They have to cope with what Cherunya et al. (submitted) call “oscillating domestic spaces”, which highlights the tensions between individual rational preferences, everyday obligations, contextual factors and wider cultural and economic structural factors. This way, the active role users play in the stabilization of splintered regimes can be more adequately addressed.

The domestic space is a symbolic and material space in which people engage in daily tasks related to making a ‘home’. This space includes multiple highly dynamic local preconditions that enable or disable individuals and groups to perform certain tasks in their daily domestic engagements. The local preconditions are to a large degree unreliable because of the influence of external factors (including weather seasonality, external project-fundings, political tensions and social instabilities, and economic meltdowns among others), leading to oscillations of the domestic space. The three preconditions are: (i) material factors – importantly the functionality of service infrastructures and artefacts – that directly (as elements) and indirectly (as support infrastructure) enable practices, (ii) meanings – the individual and shared socio-cultural norms and values, social relations and local institutions, (iii) capabilities of individuals and groups – these are dynamic capacities to carry out domestic tasks by drawing on relations, institutions and material resources (importantly economic). These preconditions tend to influence many domestic tasks, as tasks bundle together, and combine to create highly complex situations that challenge both existing and novel service options. To perform practices under such unstable conditions, inhabitants need to develop response strategies and maintain multiple alternative options. The combination of local preconditions and specific response strategy defines how the domestic space oscillates over time. These oscillations can exhibit very individual patterns. domestic spaces may for instance change differently even within a specific household, where preconditions and response strategies may vary between husband, wife and children depending on how certain external conditions impact the capabilities of each of them.

Innovations promoted under an over- or under-socialized perspective typically only take a limited number of these complexities into account. As a consequence, the promoted alternatives often anchor onto only a very small part of the complex domestic space and are in disarray with the actual needs for most of the time. Embedding novel service options in oscillating domestic space is often rationalized by users as a useful “add-on”. Users tend to welcome these additional options as diversifying their portfolio of alternatives that includes both the superior and previously existing inferior service options. Radical substitution of service offerings is not perceived as a logical approach by users because instabilities in other practice preconditions (like individual income instabilities) may still persist. This may then also be the reason why people dismiss the novel options after a short while, because they do not provide sufficient benefit in the context of all the other options. Another consequence of the oscillations is that is almost impossible to categorize informal dwellers into binaries like individuals “with access” and those “without access``. Such “market segmenting” rests often on the assumption of stable practice preconditions and homogeneity of social groups. The daily uncertainties pushes people to make different choices as they reflect on a wide range of immediate constraints, opportunities and priorities in the entire domestic space.

Compared to the practices that stabilize the provision side of socio-technical regimes, we maintain that user practices in a context with unmet needs, and uncertainties in basically all aspects of daily life can also create a form of ‘lock-in’ that is hard to escape. Under these conditions, people are not

ready to let go of seemingly “inferior” service offerings and less desirable practices if they prove meaningful and useful during specific situations of oscillating domestic spaces.

3.3 A general approach to explain stability and obduracy in heterogeneous contexts

We may now propose an integrated view on how socio-technical systems get stabilized in heterogeneous contexts like those represented by informal settlements in cities of the Global South. We have to acknowledge the heterogeneity and partial overlap of systems of provision, which we have specified as a multitude of service regimes being in more or less strong disarray among each other while providing only partially satisfying services to the users and/or creating all sorts of adverse effects to the social or natural environments. Despite the low degree of formalization, the limited functionality, and often very high costs that users have to bear in order access the services, the regime splinters may still exhibit a high level of obduracy. This is due to the practice preconditions in terms of capabilities, resources, and institutional context conditions that prevail for the different actors, and which will condition their room for manoeuvre for changing these stable structures.

Of particular emphasis is the way users come into this picture. In many of the traditional transition studies, users are mainly considered as the logical end point in the value chain of a socio-technical system. They have decisive power as the ultimate arbiter on the success or not of a new service offering (constituting the “market” as the ultimate selection environment). The user perspective presented here requires however, a more fundamental reconsideration on how we think about transitions in socio-technical systems. It is not only about better understanding the kind of users that have to be considered, which will ultimately lead to sharper market segmentation. The perspective we have presented implies that the system boundary that delimits the relevant transition realm has to be redrawn. What is at stake is the reorganization of entire bundles of practices that users mobilize to manage the oscillating domestic spaces. And these bundles are connected to a multitude of provision structures. The technology perspective and the user perspective therefore do not fit seamlessly but have to be considered as complementary perspectives in their own right (Shove, Pantzar and Watson, 2012).

As a general proposition, we may expect that the more the sectoral regime is splintered, the more negative consequences in terms of individual effort and uncertainty, as well as in terms of impacts on social and natural environments have to be expected. Improvement of individual service regimes as well as better alignments between them will – as a tendency – increase the functionality and sustainability of the sectoral regime, by for instance reducing the efforts of access for a diverse range of users. Given the increased complexity we have to consider in the interpretations of socio-technical regimes, we also have to expect that there will be many roads to improvement. This assessment is at odds with the hope to ever find an all-encompassing integrated framework. So, transitions have to be able to bridge different system delimitations and transformation trajectories. In the next section, we will turn to the question how different actors commanding specific resources and capabilities may aim at transforming socio-technical systems into more sustainable directions.

4. Innovations and change processes: Resources and limitations of different actors

Given the high degrees of complexity and the variegated sources of stability in socio-technical systems of informal settlements, attempts to transform the prevailing socio-technical regimes will also be multiple and complex. Compared to the standard case portrayed in many transition studies of a gradual substitution of one dominant regime by an upcoming but still immature one, will clearly not provide an adequate understanding of the challenges that actors face when aiming at innovation and change in basic service regimes. We assume that actors have command over specific resources

and capabilities, which empower them to intervene in specific aspects of service regimes, sectoral regimes or user practices. Better, more sustainable service offerings will ultimately have to balance these three domains and construct new "configurations that work" (Rip and Kemp, 1998). We furthermore also assume that actors are typically embedded in specific regime structures, their capabilities are, as a consequence, often limited to activities that fit into this existing regime logic. Fundamental regime change, or the cross-over between existing regimes will be harder for them to implement. Given the high complexity and unpredictability of context conditions, and the variety of strategies to deal with oscillating domestic spaces, actors may need to command a diverse set of know-how and capabilities.

From a socio-technical system perspective, we would therefore expect that the challenges of transforming the existing regimes go far beyond conventional market or state failures. We would expect that manifold system failures have to be overcome in order to successfully innovate or change the existing structures. The original literature on innovation systems has proposed a set of four structural system failures related to the resources of actors (capability failures), missing interactions between different actors (coordination failures) and mismatches in terms of institutional contexts or infrastructures (institutional and infrastructure failures) (KleinWoolthuis et al. 200x). More recently and in a transition context, Weber and Rohracher (2012) have added four transformational system failures like demand articulation failures, directionality failures, policy integration failures and reflexivity failures. All of these failures may potentially also be present in more heterogeneous transition processes.

It is beyond the scope of this paper to provide a full mapping of the different resources and capabilities that actors could potentially mobilize in order to overcome the manifold system failures present in informal settlements of cities in the Global South (or any other region in the world). We can therefore not present a fully-fledged integrated theory of innovation and change processes in heterogeneous regime contexts. We can however provide some illustrative examples on how specific actor groups try to improve service provision schemes, elaborate what sort of resources they can mobilize in order to transform specific aspects of the service regimes, improve alignments within the sectoral regimes or how they mobilize knowledge to identify or transform user practices. We do this by drawing on three case studies from innovation and change processes for water and sanitation services in informal settlements of Nairobi city, Kenya: i) pro-poor initiatives by the urban water utility extending their services into informal settlements. This case emphasizes primarily the problems of capability failures of specific actors in a systemic context. ii) Lacking synergies among different donor driven innovation initiatives aiming at improved sanitation services. This case emphasizes in particular the problems of coordination failures. iii) Success conditions for community based organization in managing public toilets in a stable and affordable way. This case mostly illustrates the importance of providing services that fit with the preconditions of user practices.

4.1 Coping with capability failures: pro-poor strategies of water utilities

The first case is the city`s water and sewerage utility has recently started to expand its operations into the informal settlements (van Welie et al., submitted). Informal settlements presented a new context for the utility, because historically the utility only operated in high-income areas of the city, where it installed conventional sewer systems and domestic connections in the locally prevailing service regime. The utility`s conventional capabilities were therefore strongly aligned to the standards set by the world-wide "large-scale centralized infrastructure paradigm" (Fuenfschilling and Binz, 2018). Some exemplary capabilities were the promotion of household water taps and flushing toilets; hierarchical and formal relationships between the utility and its customers; formal, written

procedures for connection applications based on land titles; the installation of infrastructures in high-income planned neighbourhoods; and monthly payment systems.

These capabilities were insufficient for the utility to operate successfully in informal settlements, were other service regimes operate in a contexts characterized by much higher complexities associated with multiple informal institutional arrangements, poor infrastructure conditions, inefficient governance structures, very heterogeneous user needs and rampant poverty. The utility needed a radical innovation strategy to adapt its organizational mode and to develop new capabilities that could fit the service regimes prevailing in the informal settlements. By setting up a new and rather independent pro-poor business unit, the utility managed to develop new capabilities that enabled the set-up of several projects in informal settlements. Exemplarily capabilities that the utility developed were social skills to interact intensively with customers, capabilities to collaborate with community groups, skills to deal with cartels, new public service models, and flexible (non-monthly) payment systems. However, these changes in the capability portfolio of the utility led to tensions within the organization and even to mismanagement of some projects because most parts of the utility still relied on the traditional capabilities of the organization. To solve these internal tensions, the utility therefore re-integrated their pro-poor capabilities into their formal organizational structures. This led to the dismissal of some of the earlier service offerings and the promotion of new ones, which were better aligned to the centralized service regime. These latter innovation projects were in disarray with many characteristics of the informal settlements, and therefore did not perform well in terms of serving the urban poor. The case shows that innovators might have a hard time to develop the necessary capabilities to act in different service regimes. Such ccapability failures can form a barrier towards successful innovative service offerings in for example the informal settlements, where different kind of service regimes exist than in high-income neighborhoods.

4.2 Addressing coordination failures: innovations in on-site sanitation chains

The second case are the innovative initiatives by NGOs and social enterprises supported by international donors, which aim at developing new on-site sanitation service offerings (van Welie and Truffer, submitted). These innovators try to implement sanitation services that include the storage, collection, transportation, treatment and safe disposal or reuse of sanitation waste. In Nairobi, three different innovative approaches are piloted/rolled out in informal settlements. Bio-centres, which are centres with public toilets in which a biogas reactor is used to treat waste and produce biogas that is used for cooking and to heat showers in the centres. Secondly, personal single-use biodegradable bags, used in people`s homes or at schools for the storage of excreta, which are regularly collected and transported to a storage location for the composting process. Lastly, container based sanitation, which are stand-alone waterless toilets that capture waste in (portable) containers. The containers are regularly collected, transported and the waste is composted and treated. Each approach is set-up, operated and coordinated by one actor (NGO or social enterprise).

A Technological Innovation System perspective enables a systemic and integrated view across these different initiatives. Systemic analysis revealed that many innovations have been tested in isolation from each other – even though they target the same problems in the same city. Several key systemic formation processes lag behind. For example, the diffusion of knowledge has been very limited, because research and piloting is led by individual chain operators who are strongly coordinating their own initiatives, but do not interact much. Consequently, many different treatment technologies have been developed and tested by different actors in the city.

The lack of coordination between the different innovative initiatives in the city might thus have hampered innovation development of (aspects of) on-site sanitation systems. Improved synergies

between the innovative efforts could lead to more systemic change in the sanitation sector. Innovative on-site sanitation services can influence the dimensions of several service regimes and could potentially contribute to aligning different service regimes. For example the coordinated collection of waste from various on-site services in different service regimes. Additionally, establishing coordination with the actors that are taking care of the major share of on-site sanitation services in the city, such as manual pit emptiers and exhauster truck operators, can as well contribute to the creation of alignments in the splintered regime. All-in-all a lack of coordination hampers the scale-up and improvement of (innovative) on-site service offerings.

4.3 Dealing with institutional failures: the capacity of community based organizations

The absence of state-based service arrangements in informal settlements of Nairobi led to community groups establishing local arrangements to provide themselves with basic services (managing public toilets, public water kiosks, solid waste management services, security, and money saving and lending services among other activities) (Hailey, 1999; UN-Habitat, 2003). In the general environment of survival in the low-income areas, the grassroots groups evolved to also address basic family consumption and income requirements. Today, belonging to a grassroots group is common-practice in informal settlements in Nairobi and has become a fundamental livelihood strategy. Further, grassroots groups have become one of the key service providers in these settlements.

More recently, state-based agencies are taking the mandate to provide and to regulate services in informal settlements, thus exploring efficient actor-arrangements. The processes of policy-making and decision-taking seem to continually favour service co-production with private entrepreneurs – and less with grassroots groups. However, these private entrepreneurs and state-based utilities have not been successful in extending basic service infrastructures in informal settlement – a new social and technological context for them. Considering the potential contestations involving grassroots groups, in the processes of formulating new actor-arrangements, and the challenges faced by the entrepreneurs and the utility, it becomes critical to analyse the roles and agencies of grassroots groups in determining the future of service provision in urban areas. This can provide policy makers with insights on how such dynamics in actor-arrangements should be handled.

Taking a Technological Innovations Systems approach, the case by Cherunya et. al. (Submitted) analysed the resources, structures and functions built up by grassroots groups in the informal settlements to successfully provide sanitation. They show that these needs-driven grassroots groups in resource-deficient settings are innovative in several aspects that public utilities and private entrepreneurs continue to struggle with. Some examples include: (i) They have the ability to quickly embed their service offerings, as the grassroots groups have grounded understanding the daily user-needs (market formation), in this regard alsohaving flexibility and autonomy in how they manage their services enables them to make gradual and innovative improvements of the service offerings, (ii) By making collective group investments they overcome economic risks associated with informal settlements (such as fires) (entrepreneurial activities). Individual entrepreneurs often avoid making investments in informal settlements because of such risks, (iii) Grassroots groups build legitimacy of their service offerings because the benefits remain locally within the community - becoming a daily livelihood opportunity (legitimacy). State-based utilities have to make huge investments to legitimize themselves as they have for decades neglected informal settlements, thus lacking trust locally, (iv) while the state-based utility struggles to acquire fundings, grassroots groups are able to mobilize local resources through established savings groups, as well from NGOs that support other domains of the groups` activities (resource mobilization), (v) the prominent grassroots groups in Nairobi`s informal settlements are part of a national and international network of community groups (Slum Dwellers International) a platform where they exchange on challenges and approaches to improving

service provision in informal settlements (knowledge development, diffusion and guidance of search).

State-based utilities often overlook these institutional strengths of grassroots groups and maintain a perception that informal settlements require external help and advanced technologies. They continue to push for the rationale that community-based service provisioning is not efficient and stable service is the most important requirement for informal settlement dwellers. However, we see that informal settlement dwellers choose to rely on services they perceive beneficial to them beyond only providing a service, they choose a service of more trusted provider, and are not ready to let go of what has contributed to their livelihood needs.

In organizing new actor arrangements for providing sustainable services to informal settlement dwellers, these factors ought to be considered by state-based agencies. Particularly, reflecting on the influence of grassroots groups to the longer-term transitions of basic service provision in informal settlements, grassroots initiatives can be understood as an "incumbent regime" actor. They are strongly locally embedded and established and can potentially resist change in actors-arrangements as this disrupts their daily livelihoods.

5. Transition pathways and strategic implications

The three cases illustrate how different actors aim at transforming some of the stabilized structures in service regimes, sectoral regimes and user practices. The associated innovation processes are not limited to high-tech products. They encompass business models, organizational structures, capability portfolios, cooperation networks but also changes in user practices. As a consequence, we could potentially identify many more transformation processes by all sorts of actors. For instance, many actors are working on the improvement of existing service regimes, the establishment of new ones, the smoothening of interfaces between different service offerings, the general improvement of capabilities and resources of specific actors, the improvement of formal institutions and policies that support and enable change processes, the networking with other initiatives, cities and regions in order to find better solutions, and so on. The alluring simplicity of the original emblematic transition model is not very appropriate in the heterogeneous context of informal settlements. It is not one clearly delimited (monolithic) regime that is being challenged by an equally clearly identifiable niche. Transition pathways are potentially much broader, multifaceted and can lead to a broad range of potentially more sustainable end states.

Alongside the multiplicity of transition pathways, we can also not assume that there is a clear distinction between incumbents and niche actors. Utilities for instance are incumbent players, which are backed up by government money, have easier access to big investment funds and are actively participating in the global centralized regime of urban water management. However, when confronted with the challenge of providing services to the informal settlements, they find themselves in a position that rather resembles the one of a niche player: they do not command over the necessary capabilities, the lack the legitimacy and other resources to successfully operate in this unusual business context. Community based organizations on the other side would rather fit the profile of niche actors in a conventional interpretation, by trying to establish non-standard solutions to the poor. They largely do not possess academic frontier technical know-how and are not strong in terms of financial resources. Still, by possessing intimate knowledge about the local institutional context conditions, they are able to mobilize financial resources, trust and legitimacy and by this successfully innovate in contexts that are too difficult for other actors. By this, they become incumbent regime actors in their own right. And as one would expect from all regime actors, they will

often act rather defensively when it comes to the introduction of new alternative niche solutions, like for instance the ones provided by the pro-poor business units in the first phase of the utilities engagement.

Also with regard to the spatial delimitation of relevant transition processes, we have to let go of older seemingly simple understandings of transition processes. Both regimes and innovation activities cannot easily be delimited to specific territories, neither to a national nor to a regional or local scale. The urban utility is heavily influenced by initiatives and cognitive framings provided by global regime structures in the realm of urban water management. This is in turn providing them with legitimacy to access international resource flows like from the World Bank or international finance institutes. The case of alternative service offerings also shows a strong local to global connection in that all of the discussed initiatives are highly interconnected with similar initiatives in other parts of the world. At the same time they have only very little or superficial interconnections with other initiatives happening in the city of Nairobi. These global connections and local anchorings also provide them with legitimacy to access resource flows from international donors. And finally, even the most local of all actors, the CBOs who are constituted by inhabitants of specific neighbourhoods and very reluctant to accept new members, they are globally interconnected in global associations like Slum Dwellers International (McFarlane, C. (2012).

Transition pathways have therefore to be thought in broad and complex ways. This does however not imply that anything goes. Transition processes in heterogeneous contexts of informal settlements have to deal with improvements of existing and the development of radically new service regimes. But more than that, the emphasis on alignments between service regimes has to be taken into consideration. The end point of the development trajectory of sectoral regimes should therefore not be expected to be one monolithic structure. Rather moving from the current splintered regime structure towards a fragmented, or even better polycentric regime, constellation might be a more realistic and socially less disruptive vision to where the basic service sectors should converge. This would for instance suggest that the utility would have to invest in new capabilities and service models outside of the centralized regime in order to be able to serve larger shares of the population. Possible alignments could be reached by sanitation policies that address the needs of alternative service regimes more explicitly. The capabilities to manage and further develop the other service regimes are typically available with other actors non-state actors (i.e. NGOs, CBOs, private enterprises etc.). The public utility would therefore have to collaborate more closely with there non-state actors in order to provide reliable services. Such collaborative effort could result in improved alignments between, for example, the public sanitation regime and the shared on-site sanitation regime. In both service regimes, NGOs, CBOs and self-help groups are actively involving the residents in the informal settlements in service provisioning. Consequently, these non-state actors envision delegated service provision as the ideal future. The organizational modes of CBOs and NGOs could be improved by learning from each other's service approaches.

We conclude that a system perspective has a definite added value for better understanding the challenges of improving basic service sectors in informal settlements. We have shown in the three cases that the perspective on socio-technical systems enables to ask new questions that other more linear or mechanistic approaches would likely miss out. The alignment between capability portfolios and socio-technical regime structures as discussed in the case of the utility enables to analyse how powerful actors may still be constrained by their expertise in running a particular regime. The case on alternative services offerings showed that a systemic perspective could help to identify coordination failures, which lead to too costly and not very effective parallel innovation processes. A shared understanding of where competition could be profitable in the search of new, more sustainable solutions and where uniting forces would be important to mobilize a critical mass of resources, can

be very important. Finally, a broader perspective on splintered regime structures and user practices forces us to reconsider the sort of capabilities that are needed for the transformation of service regimes into a more sustainable direction. Hence, a broader set of actors has to be considered as resourceful partners in the transformation processes than what most of the official policy strategies are prepared to admit. All said, we maintain that a socio-technical systems perspective has definite advantages over rivalling more partial approaches. Transition concepts are potentially strong starting points for conducting a systemic analysis of ongoing or envisaged transformation processes. However, we have to enlarge the analytical concepts, we have to adapt some of the epistemic approaches, and we have to accept a broader range of potential transition pathways.

6. Conclusions and future directions

We started out with this paper to ask whether extant transition theorizing was able to address transition processes outside of the early rather simple contexts of a few sectors in a few western European countries. We portrayed informal settlements of cities in the Global South as a sort of antipode case, where many implicit, taken for granted societal context factors of the original writings had to be questioned. By focusing on a typical sectoral example, the provision of water and sanitation services in Nairobi, we were able to revisit some core concepts of established transition thinking: the operationalization of socio-technical regimes, the application range of technological innovation systems and the role of users. All three domains indicated a need for extending the interpretation of the core concepts. In particular, we also argued that in the contexts of informal settlements we also needed an epistemological shift away from more or less obvious and formalized institutional structures towards an identification of institutions through provision and consumption practices. The resulting conceptual approach cannot be portrayed as providing a neatly integrated framework. Rather we see a number of complementary entry points for grasping the challenge of transition processes. Besides specifying these entry points, we elaborated the need for a well-structured systemic perspective on these phenomena and therefore claim that an (enlarged) transition perspective has a strong original contribution to offer for better understanding sustainability transitions in the highly heterogeneous contexts of informal settlements in the Global South.

We want to stress however, that these extensions are not limited to application contexts in the Global South. Rather we claim that informal settlements provided the “discovery context” for identifying necessary extensions when aiming at applying transition thinking to more complex cases than the ones portrayed in the original literature. The distinction of service regimes and sectoral regimes could for instance be very useful in analysing transition processes in polycentric regimes such as the personal transport sector all over the world. In a recent contribution, Schippl et al. (IST conference paper) analyse difference in transport regimes in cities and rural areas in these terms in order to better understand different trajectories in the introduction of electric mobility in Germany. The improvement of alignments between different sector regimes is for instance the core goal of platform innovations (sharing economy). Therefore the frameworks presented here could also be of interest to apply transition thinking to a new kind of innovation activity that has been rather unhandy up until now. Another example is the translation of oscillating domestic spaces to contexts outside of informal settlements could still have a strong relevance. It could revivify some of the old ideas of time-geography in the analysis of how users may shape and integrate new service offerings into their daily life courses. So, we claim that there is a bigger agenda out there that will ultimately broaden the scope of phenomena addressed by transition research both in sectoral terms and in geographic terms.

In terms of the future research agenda that is generated by this broadened application field of transition research, we would like to shortly expand on three questions that deserve particular attention in the future. First, we need to further enlarge our understanding of path dependencies in socio-technical systems. Moving away from a rather simple substitution idea of transitions needs attention to a wide range of stabilizing forces that might interact to become a source of dynamics of socio-technical regimes on their own right (see e.g. Fünfschiling and Truffer, 2014 for a discussion of similar points building on concepts of institutional logics). By this, we can evade some of the institutional transfer fallacies that were mentioned earlier and the idea that existing institutions – and the embeddedness of practices in these – can simply be replaced or eliminated through the right technocratic solutions. Such concerns demand a far greater attentiveness to the particular forms of (multi-scalar) territorial, network, and societal embeddedness (see Hess, 2004) that sustain path dependencies such as those promulgating highly uneven basic service regimes in cities of the Global South. This calls for more inductive research into the everyday worlds of poor urbanites in order to facilitate research that is able to identify realistic alignments between these everyday worlds and socio-technical/institutional solutions to basic needs provisioning systems, particularly in the Global South.

Second, we claim that the geography of transitions requires special attention, with an emphasis on territorial, spatial, and scalar concerns. Territorial issues relate to the concerns highlighted above under path dependencies, that is that transitions scholars need to do a better job of the place-specific rationales and drivers of provisioner/user practices in order to better conceptualize and understand the prospects for transition pathways. Understanding territorial embeddedness demands that we call greater attention to place-making processes – the discursive, material, political, and socioeconomic dynamics through which individuals, communities, governments, and non-local entities (e.g., foreign investors, donors) strive to make places (i.e., cities) into singular kinds of entities, processes that ultimately exclude and marginalize groups and communities, such as those forced to live in the informal settlements that often exist in the shadows of modern skyscrapers/built environments. Scholars also need to pay careful attention to the spatial divisions (splinters) that mark all cities and to determine what these mean with respect to the dynamics of transitions and the prospects for convergence and fairer/more even distributions of services across a city. A key question here is how the socioeconomic spaces of extreme immiseration/accumulation that mark splintered cities can be reconciled and managed for effectively – politically and materially, and in ways that reduce inequality, legitimize and empower those traditionally on the margins (e.g., residents of informal settlements) and facilitate significant progress toward sustainability objectives. What kinds of experiments and niche innovations might facilitate such a dynamic? As for scale, this needs to be considered much more explicitly, particularly with respect to multi-scalar factors (e.g., investors, INGOS, donors, remittances, geopolitics, knowledge flows) and their influence on transition pathways such as transnational ties. Some researchers (e.g., Wieczorek *et al.,* 2015) have sought to account for transnational ties in transitions processes but there is a lack of depth with respect to how these ties actually influence systemic transformations. Needed is research into the socio-spatial processes through which extra-local "pipelines" (e.g., for knowledge, capital, or technologies) are, or are not, effectively articulated into or aligned regime structures such that sustainability transitions become possible (Bathelt *et al*., 2004). By socio-spatial processes we mean the dynamics and spaces through and within which new ideas or niche innovations become legitimated, trusted, shared, and diffused to planners, policy makers, community leaders, social movements, and households

Last but not least, the extended framework calls for a more serious and explicit consideration of power relationships as it plays a central role in questions related to stability and obduracy. Power

can be manifest along several key axes that should be key concerns to transitions researchers. Raw political or material power (e.g, money) is the most obvious as it has the ability to directly prevent or enable transitions related activities or innovations to be realized. Social power too is critical, manifest in an individual or organization's social capital, elite status, and/or its role as a gatekeeper or legitmator of new ideas or alternative transition pathways. Two key questions in this regard being: a) How do innovations and the actors promoting them achieve legitimacy such that their ideas/technologies gain traction? Where does legitimacy come from – what are its local/territorial, societal, or multi- bases? And finally, power is also constitutive within individuals – transitions are shaped by the power that individuals (particularly the poor in the case of informal settlements) feel that they possess with respect to being able to adopt new technologies, transform their practices, and manage the risks that accompany such changes. This is an area ripe for much greater research, particularly that of the grounded/ethnographic variety, asit can reveal forms of governmentality that obstruct, in highly significant ways, the emergence of alternative transition pathways.

All said, we conclude that transition thinking is ready to move into more heterogeneous contexts, in which transition processes are likely to happen. The basic systemic approach has a lot of purchase, but concepts have to be enlarged in order to be up to the task.

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