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# Infrastructure Transitions in Southern Cities: Organising Urban Service Delivery for Climate and Development

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## Abstract

Rapidly growing cities in the Global South are characterised by high levels of vulnerability and informality and are expected to bear a disproportionate share of the costs of a changing climate. The confluence of climate change impacts, inequitable urbanisation processes, and under-development emphasise the need for accelerated urban transitions in Southern cities, yet mainstream theories of urban sustainability transitions have been shown to be insufficient for such contexts. This is particularly relevant with regard to urban infrastructure: While mainstream urban theory tends to regard infrastructure as static, centralised, and heavily engineered, infrastructure configurations in cities of the Global South are often heterogeneous, comprising multiple dynamic social and material flows. Drawing on theory from Southern Urbanism and empirical data of unorthodox infrastructures from 14 cities, this article assesses the potential challenges posed by applying a key transitions framework—namely the Multi-Level Perspective—in Southern contexts. The article closes by suggesting a set of theoretical propositions for future conceptual and empirical research that could advance transitions literature more broadly, and highlights the need for all cities to pursue inclusive service delivery models that are responsive to the complex and shifting landscape of climate impacts.

## Keywords

climate change; Global South; multi-level perspective; poverty; Southern urbanism; urban infrastructure

## 1. Introduction

The confluence of urbanisation and climate change presents an unprecedented challenge to conventional theories of how to bring about sustainability transitions in the built environment and its associated institutional structures. Urban infrastructures are directly or indirectly responsible for a significant proportion of greenhouse gas emissions, yet their efficacy is also key in building the resilience of urban areas to climate change and enabling citizens to adapt and respond to environmental shocks. As a result, urban infrastructures and the services they deliver both configure, and increasingly are configured by, urban responses to climate change (Bulkeley et al., 2014).

Whether carbon-intensive or not, inadequate or outdated physical infrastructures and inefficient or inequitable access to the associated services provided by those infrastructures can have dramatic effects on human wellbeing, the economy, and the environment (Floater et al., 2014). This is most acutely felt in the cities of the so-called Global South, where 90 percent of all population growth until 2050 will take place (United Nations Department of Economic and Social Affairs, 2019) and where more than a billion people already live in informal settlements. Informal settlements are especially ill-prepared for the risks of climate change, many of them being located in high-risk areas. Access to basic public services that help to build citizens' adaptive capacity to shocks is often inadequate or non-existent.

Cities in high-income countries face different yet related infrastructure challenges in the context of environmental change. Nowadays, many cities in the North are dealing with carbon lock-in arising from having constructed long-lived, energy-intensive infrastructures that generate emissions either directly (for example, buildings and factories which burn fossil fuels for energy) or indirectly (for example, urban sprawl and cultural preferences that encourage a dependence on private cars; Erickson & Tempest, 2015). Developed cities also face the capital-, labour-, and time-intensive challenge of updating and maintaining vast, centralised systems, as well as uncertainties around future demand, which is likely to grow.

Accordingly, urban actors worldwide are seeking alternatives to the “modern infrastructure ideal” (Graham & Marvin, 2001) of large-scale, centralised, and top-down networks. The majority of residents in Southern cities access or augment their access to urban infrastructure and the services it provides via decentralised and often informal channels, where a host of initiatives of varying degrees of formality and with varying levels of state support have evolved to fill service delivery gaps (Hodson et al., 2012). These infrastructures are often provided either for or by (or both for *and* by) the very citizens who are otherwise excluded from formal service delivery models, offering lessons for urban inclusion. They are often inherently flexible and adapted to local circumstances, offering lessons for resilience-building in the face of climate uncertainty.

This article argues that reframing this “unorthodox” infrastructure development in the context of climate uncertainty may lead to new insights for alternative pathways towards more inclusive and resilient cities. Central to this reframing is an understanding of the dynamics and characteristics particular to urban infrastructure development in the Global South. Drawing on 13 case studies of unorthodox infrastructure provision from the Global South, the article extracts principles for alternative imaginaries of urban service delivery that may be both more inclusive and better positioned to respond to a future defined by climate uncertainty. It explores how the nexus of climate change and development challenges in Southern cities necessitates a re-evaluation of the way in which sustainability transitions more broadly are conceptualised, challenging the hegemony of Northern urban theory and praxis.

The rest of the article is structured as follows. The remainder of this section resolves some definitional matters. The following section briefly reviews two key areas of literature—namely sustainability transitions and Southern Urbanism—upon which the analytical framework used for this article is built. The methods section follows, briefly outlining the empirical data collection approach for the case studies and explaining the application of the analytical framework to conduct a meta-analysis of these cases. Headline results from the meta-analysis, illustrated by vignettes of the case studies, are presented in Section 4. Section 5 discusses the implications of these findings for the theory and praxis of sustainability transitions. The article concludes with a reflection on the need—and the opportunity—to envision a more inclusive urban future that will be defined by continuous adaptation of the built environment in the face of climate uncertainty.

In framing this work, three terms are used that require further elaboration, though it is outside the scope of this article to engage in the detailed discussion they deserve. Firstly, the term “Global South,” though contested, is used. It is understood not as a geographical construct but rather as a way to conceptualize a de-territorialised political economy of the uneven processes of economic development generated by capitalism and colonialism (Mahler, 2018). Secondly, the term “unorthodox” is used to describe service delivery models that may only be categorised this way when assessed by Western standards, and may be conventional within urban contexts in the Global South. It is thus employed to reflect the divergence of these models from mainstream theoretical perspectives rather than to suggest that they deviate from the norm in the contexts within which they exist. Third, the term “climate uncertainty” is used to reference the inherent unpredictability in the extent, timing, and impacts of climate change resulting from complex interactions between natural processes and human activities. More broadly, efforts to respond to that uncertainty can themselves have unpredictable results, which in turn poses significant challenges for planning and implementing effective adaptation and mitigation strategies. This is particularly the case in urban environments where both the variability and intensity of climate-related events, and the implementation of projects in the name of climate action, can have profound social, economic, and environmental consequences.

## 2. The Analytical Framework

Initial attempts to better connect transitions studies to Southern contexts emphasise the need to engage with local dynamics, where context and specificity plays a key role, calling for more knowledge-intensive urbanist approaches that draw on understandings of how people organise locally (Swilling & Anneck, 2012). This is particularly relevant for—and at the same time offers opportunity to learn from—service delivery in Southern cities, which is variously described as unorthodox, alternative, informal, non-conformist, or unconventional. Conceptualising everyday infrastructure practices as such reinforces the centrality of hegemonic Northern planning customs in both theory and practice (Lawhon et al., 2023)—a shortcoming to which Southern Urbanism seeks to respond.

### 2.1. Sustainability Transitions in Urban Service Delivery

Environmentally sustainable and socially inclusive alternatives to prevailing forms of urban service delivery are urgently required in the face of the climate emergency and related global crises. It is widely agreed that standalone interventions will not be sufficient to address these challenges at the scale which is needed. Accordingly, theory and practice are increasingly focused on sustainability transitions—that is, the evolution of both social and technological institutions towards sustainability (Köhler et al., 2019).

Sociotechnical systems—including for example energy supply, water supply, transportation networks, and telecommunications networks—can be understood as networks of actors, institutions, material artefacts and knowledge which interact to deliver specific services to society (Markard et al., 2012). A transition is a fundamental shift in the way sociotechnical systems are organised, which necessarily involves substantial technical, institutional, organisational, political, economic, and cultural changes (Geels & Schot, 2010). A sustainability transition, therefore, is the transformation process through which established sociotechnical systems attain more sustainable configurations.

### 2.1.1. A Multi-Level Perspective on Urban Service Delivery

The Multi-Level Perspective (MLP) is the key analytical framework upon which transitions theory is based, and was developed to assess the role of multi-actor processes in transitions (Geels, 2012). It posits that various dynamics influencing a sociotechnical transition occur simultaneously across three different, interacting levels (see Table 1): The landscape level involves macro-level exogenous factors such as economic, political, and environmental trends; a regime is an established set of rules, norms, and technologies embedded in entrenched institutions and infrastructures; and niches are sites of radical innovation that, if successfully diffused, might destabilise, alter, or even replace incumbent regimes. The analytical constructs, concepts, and principles of the MLP that are most relevant for this research are expanded upon in the Supplementary Material.

Though nowadays a well-established evolutionary perspective, the (use of the) MLP has also been subject to criticism. Notably, transitions research in general has keenly favoured Northern European case studies, perhaps reflecting the provenance of the most cited authors (Markard et al., 2012). In contrast, studies on the transition processes of countries in the Global South, though growing in number, are relatively rare (Köhler et al., 2019; Wieczorek, 2018). The theoretical and conceptual foundations of transitions studies have therefore neither been adequately applied in such contexts, nor developed with those contexts in mind. These geographical limitations are not restricted to transitions theory but are prevalent in urban theory more generally. Partly as a result of its origins in contexts where ecological modernisation has been a common response to sustainability challenges in the built environment, the MLP tends towards the suggestion of applying technical solutions to environmental and societal problems (Savaget et al., 2019). This narrow view on sustainability emphasises technical fixes at the expense of more participatory processes (Lawrence &

**Table 1.** Analytical constructs of the MLP (Geels, 2002, 2012).

Construct	Definition
Niche	<ul style="list-style-type: none"> <li>Protected spaces that support emerging innovations;</li> <li>Novel innovations are intended to be used in or even replace the dominant regime.</li> </ul>
Regime	<ul style="list-style-type: none"> <li>A semi-coherent set of deep-structural rules that coordinate and guide an actor's perceptions and actions;</li> <li>Stabilised by many lock-in mechanisms.</li> </ul>
Landscape	<ul style="list-style-type: none"> <li>A set of deep structural trends;</li> <li>The external structure and context within which niche and regime interactions take place;</li> <li>Commonly includes factors such as economic growth, wars, broad political trends, major environmental challenges, <i>and</i> cultural and normative values.</li> </ul>

Haasnoot, 2017; Lin et al., 2017) and in place of social or political reorganisation (Hegger et al., 2007). Studies using the MLP have typically centred around discrete technologies and innovations, while conceptual blind spots remain with regard to the role that power imbalances and politics play in defining and enabling (or hindering) transitions processes (van Welie & Romijn, 2018). The MLP is considered especially insufficient for isolating the significance of geopolitical dynamics in shaping transitions pathways (Meadowcroft, 2011; Swilling & Annecke, 2012). It thus provides relatively little insight into how the developments of certain infrastructures are a product of a global process resulting from the interplay of decisions made across the political, socio-technical, and technological realms (Derwort et al., 2022).

Despite the aforementioned limitations—and in an effort to address these—a growing number of scholars are recognising the value of using sociotechnical theory to study sustainability transitions in the Global South (Ghosh et al., 2021; Hansen et al., 2018; Jayaweera et al., 2023; van Welie & Romijn, 2018; Wieczorek, 2018). In addition to noting the potential utility of the MLP as an analytical lens in this setting, most authors also observe that the MLP would benefit from input that serves to make it more sensitive to contexts outside of its origins (Murphy, 2015), helps it move beyond technological determinism (Savaget et al., 2019), contributes to broadening its geographical basis (Wieczorek, 2018), and offers further insight into integrating issues related to power and politics (Gillard et al., 2016; Köhler et al., 2019).

## 2.2. Southern Urbanism

Existing research finds that examining Southern contexts through a *modified* transitions lens can constructively highlight the interplay between niche service delivery models and wider landscape pressures such as poverty and inequality (Oates, 2021; Ramos-Mejía et al., 2018). Indeed, for transitions theory—as for theory and practice more generally—it is of vital importance to engage with empirical work that comes from contexts where conventional urban theories hold little relevance (Parnell & Pieterse, 2016; Robinson, 2006) but where the overwhelming majority of urban growth between now and 2050 will occur.

A rich and growing body of work that broadly falls under the heading “Southern Urbanism” responds to the shortcomings highlighted by critiques of modern urban theory, many of which are consistent with the shortcomings identified in sustainability transitions theory. Southern Urbanism is unambiguously based on empirical and conceptual contributions from the Global South. This is in contrast both with dominant urban theory—which is biased towards the urban condition in the Global North—and with attempts to describe a universal form of the “global condition” of urbanisation (Brenner & Schmid, 2014, p. 747)—which implies that the majority of cities experience largely the same problems and thus can employ the same solutions (Roy & Ong, 2011; Schindler, 2017).

That said, a set of broad, common characteristics that are in general applicable for Southern cities can be identified in the Southern Urbanism literature (Table 2; these characteristics are also elaborated upon in the Supplementary Material). Amongst other things, this set of features places issues of politics and power (imbalances) centre-stage, critically questioning development interventions by exploring for and by whom the development and greening of urban infrastructure takes place (Hodson et al., 2012; Holgersen, 2020). It directly addresses the fact that institutions, especially state institutions, often have limited human, financial, and technical capacity. It therefore emphasises the significance of the actions and responsibilities of a wider range of actors, including small and medium local enterprises, NGOs, community-based

**Table 2.** Key characteristics of Southern Urbanism identified through a systematic literature review by Parida and Agrawal (2023).

Characteristic	Description
Persistence of long expansion and continuous transitions have colonial roots and are dominated by post-colonial elite politics	Urban spaces are often characterized by a hybrid spatial culture, mostly driven by discourses on social identity traceable to a longstanding legacy of colonialism and elite politics
Territorial change is a governance priority	Governance regimes are inclined more towards the transformation of land (through infrastructure and real estate development) compared to industrial production
Informality is a dominant process as well as the context in which everyday urban processes manifest	Urban processes are evolving within a wider context where both state and non-state actors and institutions practice different forms of informality. At the same time, in the various urban processes, the formal and informal actors/institutions constantly shape each other
City spaces and resident groups are characterized by high vulnerability	Cities that are characterized by a large part of the population being vulnerable to socio-economic, cultural, as well as emerging environmental (and climate) risks
Everyday urban processes are driven by uncertainty, surprises, and creative livelihood techniques	Waves of change can have their origins anywhere—through middle-class activism as well as through subaltern assertiveness on land through legal or “rogue” means; livelihood techniques of residents of informal settlements are highly unique and adaptive based on the degree of vulnerability as well as closeness to political circles
Conflicting rationalities persist between and within groups	There is a persistent clash of rationalities between techno-managerial planning and governance systems and marginalized urban populations in the city (predominantly seen in informal settlements)
A disconnect between capital and labour	Southern cities have been accumulating a huge workforce, yet the formal economy is unable to absorb most of the labour force

organisations, and individuals. It stresses that many of the often creative livelihood and survival strategies undertaken by such actors are undertaken either in the context of and/or as a direct response to chronic vulnerability, which can be understood as the persistent and long-term susceptibility of certain populations or areas to adverse conditions and shocks. This arises from a combination of systemic factors, such as inadequate infrastructure, limited access to essential services, socio-economic inequalities, and (disproportionate) exposure to environmental risks, and is often deeply rooted in historical, political, and economic structures.

### 3. Methodology

#### 3.1. Case Selection and Data Collection

This article is based on case studies of 13 service delivery initiatives from across 14 Southern cities, carried out during the course of a multiyear, multistakeholder international research project funded by a global knowledge coalition. Cases were selected in collaboration with the coalition members based upon the following criteria.

They must: (a) be an initiative closely related to the provision of a basic urban service; (b) intend to deliver some form of climate action, whether mitigation or adaptation; (c) intend to deliver some form of human development benefit; and (d) demonstrate organisational arrangements that might be considered “unorthodox” according to mainstream urban theory. The justification for case selection on a case-by-case basis can be found in the Supplementary Material.

The empirical data was collected during multiple phases of fieldwork in 14 cities across six countries between May 2018 and July 2023 (see Table 3). Methods included semi-structured interviews, site visits, multistakeholder workshops, focus groups, and the extensive consultation of policy documentation and other literature (see the Supplementary Material for a full overview and breakdown of methods per case study).

### 3.2. Data Analysis

The initial analysis of each case involved the inductive coding of case-specific data to produce an extensive account of each initiative including the policy context, its organisational arrangements, its climate and development impacts, key successes and challenges, and recommendations for scaling up the benefits. For the purposes of this article, a secondary meta-analysis was then conducted, which involved using an analytical framework combining the MLP with Southern Urbanism (developed in Section 2 and clarified in the Supplementary Material) to interpret the (analysed) results of each case study. This abstraction allowed for a comparative meta-analysis across cases in order to extract broader implications for both sustainability transitions theory and for the governance of urban service delivery more generally. The cross-case nature of

**Table 3.** Overview of case studies <sup>(i)</sup>.

Case study	Country	City	Sector <sup>(ii)</sup>
1 Dockless bicycle-sharing scheme	China	Shanghai	Transport
2 Sponge cities programme		Wuhan	Water
3 Waste picker cooperative	India	Ahmedabad	Waste
4 Community-led participatory housing		Kochi and Trivandrum	Housing
5 Residential rooftop solar		Delhi	Energy
6 Participatory slum upgrading	Kenya	Nairobi	Housing
7 Energy efficient affordable housing	Mexico	Hermosillo	Housing
8 Bicycle-sharing scheme		Mexico City and Guadalajara	Transport
9 Locally-led adaptation plan		Xalapa	Water
10 Land registration programme	Tanzania	Dar Es Salaam	Housing
11 Community-led participatory housing		Dar Es Salaam	Housing
12 Solar-powered streetlights	Uganda	Jinja	Energy
13 Local waste-to-briquettes enterprise		Kampala	Waste

Notes: (i) Previously published policy-focused work on these cases is available at <https://urbantransitions.global/publications/?select-publication-series%5b%5d=frontrunners>; (ii) Each case is assigned to the sector to which it primarily relates, though in many cases there is direct or indirect overlap with other sectors.



this evaluation ensures that the conclusions drawn, though inherently subjective, are as verifiable, transferable, reliable, rigorous, and robust as possible.

#### 4. Headline Results From Meta-Analysis of Case Studies

This section briefly highlights some of the most salient findings from the meta-analysis in relation to the shortcomings of transitions theory, and in the context of inequitable access to urban infrastructure services that is compounded by the impacts of climate change. It presents vignettes from specific cases to illustrate these results.

The cases demonstrate the diverse ways in which non-state actors are asserting their influence on urban service delivery through self-organising initiatives, in response to conventional state-led mechanisms that are struggling to meet the demands of growing urban populations in an environmentally sustainable manner. In doing so, many of the infrastructure projects studied are contributing to building urban resilience to climate change through a combination of improving ecological and social security. In the cities of Kochi and Trivandrum, in the Southern Indian state of Kerala, community-based organisation Kudumbashree was mandated to oversee the implementation of a nationwide slum upgrading programme (Basic Services for the Urban Poor; case 4). In partnership with the municipal government and a local architecture firm, they developed cost-effective low-carbon neighbourhoods that have the highest occupancy rates among the settlements involved in the Basic Services for the Urban Poor programme. In Jinja, Uganda, efforts undertaken by an organisation of slum dwellers resulted in a joint project with the municipality to erect 20 solar-powered streetlights in an informal settlement (case 12). Initially a one-off infrastructure investment, the project has led to continued collaboration on urban planning priorities. In Ahmedabad, India, a group of women waste pickers formed a cooperative under the Self Employed Women's Association and entered into a contract with a district authority to collect and segregate waste from around 45,000 households between 2004 and 2009 (case 3). This resulted in an increase in the amount and security of the women's earnings as well as the collection and recycling of an estimated 70 percent of household waste. In the Bosco neighbourhood of Hermosillo, Mexico (case 8), a local architect designed a sustainable living community using green building techniques without increasing the upfront cost of investment compared to "business as usual" development. This cost-effectiveness was partly achieved by gaining authorisation to build at higher than usual density, resulting in the use of less land without having to compromise on housing quality. A similar approach was taken by the Chamazi housing cooperative in Dar Es Salaam, Tanzania, which applied for and was granted permission to develop incremental housing on plots of half the legally ordained minimum plot size (case 11). Though their application was submitted in response to the forced resettlement of the low-income community who were looking for a way to develop housing that suited their own needs and resources, it has wider implications for resilience too in terms of flexible building standards and increasing liveable density.

At the same time, however, a contradictory narrative emerges. Despite isolated successes, there are often barriers to the wider scaling up or out of these initiatives, which are rarely integrated into wider spatial planning processes. For example, the land purchased by the Chamazi housing cooperative has since been surrounded by informal settlements, preventing the expansion of trunk infrastructure and effectively cutting off the community from the city centre and its abundance of income-generating opportunities. In Wuhan, China, 389 sponge projects covering almost 40 square kilometres have been developed to showcase the

protective qualities of nature by expanding parkland, vegetation, green buildings, and permeable pavements (case 2). Yet the sponge cities programme has been critiqued as a series of technical interventions—most of which are located outside of the built-up urban areas where they are most needed, since land is cheaper and construction is more straightforward—that promote land-based urban growth and property speculation. Similarly, Tanzania's 20,000 Plots Project was widely praised for being the country's largest national land delivery scheme in decades but has since been shown to have increased urban sprawl and land speculation (case 10).

These (in)coherences can be in part attributed to the extent to which initiatives are integrated into wider institutional arrangements. In Nairobi's Special Planning Areas, participatory slum upgrading has been legally mandated, giving greater voice to communities (case 5), while Shanghai's bicycle sharing scheme is being rolled out alongside complementary efforts designed to offer comprehensive non-motorised transport options for its residents, including an expanded public mass transport system, restrictions on vehicle ownership, and investments in pedestrian and cyclist safety (case 1). In contrast, in Ahmedabad, the contract between the district council and the women waste pickers was terminated after the district was absorbed into the wider city's jurisdiction, meaning the waste pickers were suddenly obliged to meet the requirements of a tender process that demanded the use of high-tech machinery—a condition they were unable to satisfy. In Hermosillo, while the Bosco neighbourhood inspires the imagination of a greener housing sector, it is seen as a one-off example rather than a replicable model. These examples indicate that the perceived benefits from technocentric interventions—such as those designed around the construction of trunk infrastructure, land registration and titling, or waste incineration—are not automatic, and can even have an adverse effect on climate and development goals when contextual conditions and equity concerns are not explicitly addressed in the project design and the accompanying policy strategies.

## 5. Situating Southern Urban Service Delivery in Transitions Studies

Section 2 highlighted a set of established limitations of transitions theory for understanding service delivery in Southern cities. The case studies show how these limitations are particularly salient when climate and development goals are taken as key contextual elements shaping the purpose, structure, and governance of infrastructure services. Climate change is well established as a factor exacerbating the social, economic, and environmental challenges of infrastructure provision, both in the Global North (Corvellec et al., 2013) and South (Dodman et al., 2023). Similarly, development challenges are regularly coupled to discussions around access to basic services (Lawhon et al., 2023). However, juxtaposing climate risk with development needs in the context of urban service delivery systems calls into question dominant understandings of infrastructure resilience. Beyond the capacity of the physical engineered networks to withstand or recover from climate-related shocks, the cases highlight the importance of embedding adaptive capacities into governance structures as well as building the resilience of all populations by ensuring their basic needs are met. Several of the cases highlight how failing to integrate successful service delivery mechanisms into wider multi-level governance structures and decision-making strategies can minimise or even reverse climate and development gains. This may lead to the further exclusion of vulnerable groups who participate in or benefit from the provision of a service, as in the case of the women waste pickers in Ahmedabad who lost their job security due to stringent regulations, for example. Inflexible planning rules could also be blamed for the underperformance of sponge city projects, which are implemented based on the same set of technical guidelines in each pilot city despite vastly differing meteorological and hydrological conditions

across China. Conversely, the examples from Jinja, Kerala, and (to an extent) Nairobi show how changing the rules and structures of infrastructure governance to account for heterogeneity—in these examples by institutionalising meaningful participation in equitable low-carbon infrastructure provision—can generate ongoing co-benefits. Though the institutional settings differ greatly across cases, a common need to encompass the socio-political dimensions of sustainability in urban service provision—for example through fostering institutional flexibility, community empowerment, and equitable access to resources—is clearly identifiable, and is supported in existing literature (Lawhon et al., 2023; Wamuchiru, 2017).

The importance of attending to power imbalances in transitions processes is especially essential since the global response to climate change has ushered in new forms of intervention in the built environment of Southern cities by actors from the Global North (for example, through development finance or private sector investment), often reproducing patterns of imposition that mirror colonial infrastructural and governance practices. The evidence from the case studies underscores the need for transitions theory to critically examine these patterns—for example, in India, the replacement of the effective recycling activities of the Self Employed Women's Association with technically-versed private operators, set against the backdrop of a national preference for “smart” solutions such as waste incineration plants; similarly, the ongoing privatisation of Uganda's waste sector that diverts scarce resources away from local enterprises and towards externally financed mega-projects; and the formalisation of land under Tanzania's 20,000 Plots Project without adequate regard for local ownership structures and livelihood strategies. In practice, this manifests in spatial policy designed primarily around wealth-generating (or wealth-extracting) infrastructure projects and real estate investments. Where a techno-managerial lens might lead to the conclusion that factors preventing niche activities from generating meaningful and lasting regime change are related to internal shortcomings (such as their failure to become commercially viable at scale) or external factors (such as restrictive spatial policy and a stringent regulatory environment), interrogating the underlying governance and power relations paints a more nuanced picture in which climate and development goals are superseded by—or are even used as rhetoric to justify—the pursuit of deeply embedded financial and geopolitical interests through infrastructure investment. Transitions theory, if it is to realise its transformative ambitions, must account for and resist neo-imperial tendencies that overlook local contexts and knowledge systems. Instead, it should advocate for participatory approaches that prioritize voices from and the needs of the Global South, recognizing the diversity of experiences and expertise that these communities bring to the table in addressing climate change.

In this context, incremental infrastructures need to be considered as the norm, and not the exception, in post-colonial cities (Silver, 2014), affecting both the way that niches can be conceptualised and, accordingly, the strategies that are put in place to protect and manage innovations. From a conventional transitions perspective, many of the cases studied here would likely be conceptualised as niches, because they operate (at least partially) outside of formal institutions, have frequently emerged at the local level in response to place-specific needs, or are not considered commercially viable when measured in conventional economic terms. Ultimately, they rarely fit the Western neoliberal model of urban service delivery upon which transitions theory has been generated. However, in most cities of the Global South, such activities are arguably in fact an integral part of the regime: For example, an estimated 1 percent of the urban population in developing countries—equal to almost 20 million people worldwide—is engaged in informal waste picking activities (International Labour Organization & Women in Informal Employment: Globalizing and Organizing, 2017), while the urban poor are most often responsible for the upgrading of their own homes (Bredenoord &

van Lindert, 2010). This is in line with previous research that has indicated the distinction between niche and regime is increasingly difficult to ascertain in Southern contexts (Ghosh & Schot, 2019; van Welie, 2019).

A key tenet of Southern Urbanism is that empirical differences between cities should be studied not independently but rather alongside a critique of existing knowledge production and processes (Lawhon et al., 2020). Uncritically applying the MLP framework in settings of informality, with its emphasis on niche innovations and grassroots initiatives, may both overlook context-specific aspects of existing regimes and neglect the systemic barriers and power imbalances that commonly hinder sustainable development efforts in the Global South. Similarly, its focus on niche development may not fully accommodate the urgent need for transformative change, the environmental case for which is amplified by the presence of persistent poverty and inequity.

Problematising the service delivery models commonly seen in transitions studies creates space to interrogate a far broader range of options in urban service delivery (Lawhon et al., 2018), and for this the MLP serves as a valuable analytical entry point. At the same time, its applicability in Southern contexts requires critical examination and adaptation to ensure its relevance in fostering socially inclusive as well as ecologically sustainable development. While the imperative for sustainability transitions in urban service delivery has never been more urgent, the case studies illustrate that an evolving climate crisis necessitates a re-evaluation of what is meant by “transition”: Who defines the future state towards which a transition is needed in the context of unprecedented uncertainty, and who can participate in the process of getting there? Traditionally, transitions theory has focused on these pathways and end-states, often conceptualized as shifts from one stable regime to another. However, the dynamic and unpredictable nature of climate change compels us to reconsider this. Rather than a linear or teleological process, transitions in the context of climate change must be viewed as iterative, adaptive, and continuous. This reorientation recognizes that the “end-state” of the transition is in fact a moving target, where adaptation and transformation are constant requirements in response to the changing climate landscape. This calls for a conceptual shift away from orthodox considerations of infrastructure as top-down, stable, replicable, and wealth-generating (Lawhon et al., 2023), towards understanding both infrastructure and the associated services it provides as a set of evolving and dynamic interconnected systems with multiple and overlapping social, economic, and environmental objectives.

## 6. Propositions for Sustainability Transitions Theory

The analysis and discussion presented above can be synthesised into a set of theoretical propositions for the further development of the MLP framework and transitions studies more generally. Though tailored to the research presented in this article, the propositions are generally aligned with existing and acknowledged critiques of the MLP (Geels, 2011) and the research agenda for the field of sustainability transitions studies (Köhler et al., 2019).

*Further develop understandings of niche organisational arrangements:* Managerial, fiscal, and legislative interventions related to making discrete technologies competitive remain dominant in transitions literatures (Oates et al., 2023; Smith & Raven, 2012; van Welie & Romijn, 2018). The findings presented here, however, demonstrate that niches are not just spaces for technical innovation but are also critical for fostering more socially and environmentally sustainable organisational forms (Fransen et al., 2023; Patnaik & Bhowmick,

2020; Wolfram, 2018). Allowing these organisational forms to develop will depend on innovations in governance structures rather than technologies (Bosomworth et al., 2017) and necessitates new metrics for evaluation that go beyond traditional financial and economic metrics.

*Recognise the existence of multiple, overlapping, and in some cases unorthodox, systems within regimes:* While unorthodox infrastructure initiatives may not address all drivers of social injustice or climate change (and nor should they necessarily be responsible for doing so), they do provide a valuable complement to conventional, centralised, or formal systems. Many of the unorthodox delivery models studied in this research—and the vast array of similar and emerging initiatives through which the majority of urban residents, not least the urban poor, access services in Southern cities—are thus arguably integral components of existing infrastructure regimes (Ghosh & Schot, 2019). They may exist alongside more conventional state-provided service delivery systems or there may be no alternative, yet still their degree of informality has so far largely prevented such models from being taken seriously in infrastructure planning. On the contrary, conditions such as informality, and communal organisation should be foregrounded as majority conditions to which development agendas must meaningfully respond. This is increasingly crucial in light of the enormity of the sustainability challenges society faces today, and the sustained and joint contribution of all actors that will be necessary in making the huge changes required to achieve transitions.

*Interrogate the distinction between the concepts of niche and regime:* Connected to the previous proposition, this research highlights how unclear the division between niche and regime can be in the context of urban infrastructure in Southern cities, where the boundaries between niches and regimes can be more fluid. Unorthodox service providers such as community-based enterprises often operate in a grey area, simultaneously challenging and integrating with existing regimes. This is particularly salient where urban service delivery mechanisms operate across a spectrum of formal and informal, top-down and bottom-up, and centralised and communal approaches. This hybridity suggests that what mainstream transitions theory might classify as niches are not always isolated pockets of innovation but can be deeply embedded within and continuously interact with the regimes in which transformation is sought. Similarly, it is not easy to delimit the regime in such contexts because the technological, regulatory, and infrastructural frameworks as defined by certain (Northern) standards may not adequately capture the complexity of more hybrid systems. It might therefore be valuable to reconsider the prevailing duality through which niche and regime are currently viewed and instead move towards a more mutable classification of the concepts.

*Embed climate in all conceptualisations of niche, regime, landscape, and transition:* Climate change is commonly understood as a landscape factor within the MLP framework, a backdrop in which environmental change is exerting pressure on infrastructure systems to adapt and evolve over time. The case studies here, however, demonstrate this conventional perspective to be inadequate. Climate change is not just an external pressure; it continuously interacts with and shapes the socio-technical nature of niches, regimes, and transitions. It is a multifaceted phenomenon that both influences and is influenced by the very fabric of socio-economic structures, calling for a more prominent integration into the MLP. The immediacy and pervasive nature of the climate crisis necessitates that niches prioritise resilience and sustainability. The scale of the climate challenge forces regimes to restructure and shift resources to climate-related priorities. Moreover, the uncertainty associated with both the impacts of and responses to climate change demands a continuously evolving and iterative conceptualisation of transitions. This requires the holistic mainstreaming of climate change into understandings of sustainability transitions, ensuring that niche

innovations, regime transformations, and landscape dynamics are all aligned with overarching climate resilience and sustainability goals.

## 7. Conclusions

Drawing on critiques from Southern Urbanism and extensive empirical data from 14 Southern cities across three continents, this article highlights potential shortcomings in current transitions theory. It stresses the need for a paradigm shift away from hegemonic theory and practice that currently imposes a predominantly Northern perspective on infrastructural change. Situating climate change and development as ongoing challenges that are central to understanding service delivery in Southern cities, the research suggests that some of these limitations can be overcome by embracing the diversity and dynamism of infrastructural landscapes that might be considered “unorthodox” when viewed through certain theoretical lenses.

The findings from diverse case studies illustrate how non-state actors are catalysing innovative, self-organising service delivery initiatives to address gaps left by more conventionally endorsed centralised infrastructure. These initiatives are pivotal in enhancing urban resilience to climate change, especially but not exclusively for vulnerable populations, and often do so while improving ecological and social security. However, alongside these successes, the findings show that systemic barriers can hinder the scaling and integration of such initiatives into broader urban planning frameworks. Common challenges include regulatory constraints, a lack of institutional support, and spatial inequities that are in turn exacerbated by climate impacts.

For practice, these insights underscore the critical role of adaptive governance structures and inclusive decision-making processes in fostering resilient and equitable urban development. A more theoretically motivated synthesis of the results suggests several key directions for advancing understandings of transitions studies, centred around a critical engagement with the key analytical constructs of niche, regime, and landscape. Applying these concepts to infrastructure service delivery in Southern cities highlights the need for greater flexibility in the way in which they are commonly delimited, which until now has been largely according to Northern standards. Further, embedding climate considerations into all facets of niche, regime, landscape, and transition analyses more broadly—rather than treating climate change simply as a contextual factor—is crucial. The propositions introduced above thus collectively advocate for a more inclusive, adaptive, and context-sensitive approach to transitions theory, which is particularly urgent for addressing global sustainability challenges in diverse Southern urban contexts and is relevant globally too. Although research presented in this article has focused on the Global South, the limitations of large-scale, centralised systems in addressing the diverse and dynamic realities of infrastructural change in the context of climate uncertainty also deserve greater consideration in the Global North. These findings emphasise the defining role that so-called unorthodox infrastructures could play in building inclusive and resilient cities in any city concerned with more socially just and ecologically sustainable futures.

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### Conflict of Interests

The authors declare no conflict of interests.

### Data Availability

Metadata and background information relevant to this article, including the case study coding and analysis, is available at the following DOI: <https://doi.org/10.4121/c8a2a8aa-6a1a-4ba4-9d9d-c264fd1894f3>.

### Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

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