Sustainability transitions in urban basic infrastructure services

Organising principles from Southern cities

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Sustainability transitions in urban basic infrastructure services

Organising principles from Southern cities

Dissertation

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by

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Summary

Background and problem statement

Urban basic infrastructure services (UBIS) form the foundation upon which human settlements are built. The sustainable and inclusive provision of UBIS is critical for both improving the quality of life for urban populations and managing the ecological footprint of cities. UBIS include essential services such as energy, transport, water and sanitation, and waste collection, as well as housing (though itself not a service per se, housing is the primary means through which most citizens access – and as such is inseparable from – the aforementioned components of urban infrastructure (Satterthwaite, 2020)).

Infrastructural development in cities of the Global South, where the majority of population and urban growth between now and 2050 is expected to occur (UNDESA, 2019), remains underrepresented in broader studies on urban sustainability, despite its central position at the intersection of poverty, inequality, and climate change. While mainstream theory views infrastructure primarily as large-scale, static and centralised, Southern cities often have more heterogeneous, dynamic infrastructure configurations (Lawhon et al., 2018). This reality calls for a more nuanced and diversified approach to both conceptually understanding and practically delivering UBIS – an approach that can address global environmental challenges while incorporating place-based needs, particularly those of communities facing structural disadvantages due to historical or ongoing inequities. To this end, it is widely accepted that studies of urban sustainability, including those on sustainable UBIS, must move beyond technological determinism (Savaget et al., 2019), expand their geographic focus to include the Global South (Wieczorek, 2018), and integrate considerations of power and politics into the analysis (Gillard et al., 2016; Köhler et al., 2019).

This thesis explores sustainability transitions in UBIS in cities of the Global South with a focus on the ways in which service delivery can be organised to deliver co-benefits for society and the environment. Specifically, it examines whether and how organisational arrangements that might be considered “alternative”, “non-conventional”, or “unorthodox” when viewed through the lens of mainstream urban theory contribute to both ecological sustainability and social inclusion.

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By addressing this gap, the thesis seeks to provide theoretical and practical insights for the organisation of urban service delivery – not only in the Global South, but for all cities worldwide seeking to address contemporary social and environmental challenges.

Research questions and chapter summary

The central research question guiding this study is: **How can theoretical and empirical contributions from the Global South inform the transition to sustainable urban basic infrastructure services?** The thesis unpacks the central research question through three sub-questions, each of which is answered in a corresponding chapter or chapters.

Following the introduction, the empirical section of the thesis begins by outlining the scientific context within which this research is situated, addressing the first sub-question: **How are sustainability transitions in urban basic infrastructure services currently conceptualised?** While there is broad consensus on the need for sustainability transitions in urban service delivery, the concepts of "sustainability" and "sustainability transitions" remain inconsistently defined and are often interpreted through a narrow, technocentric lens. As these concepts gain traction among governments, social movements, and practitioners, their inconsistent and uncritical application requires attention. **Chapter 2** tackles this issue through a corpus-assisted discourse analysis of the sustainability transitions literature on UBIS. The findings reveal that sustainable urban service delivery is predominantly framed as an institutional and economic challenge, with a focus on top-down, techno-managerial approaches. These approaches prioritise technical solutions to environmental problems while downplaying the social dimensions of sustainability. This chapter also confirms the geographical bias currently prevalent in transitions studies, with the majority of work originating in and using case studies from cities of the Global North.

In a step towards redressing this imbalance, the thesis then asks the second sub-question: **What are the gaps and opportunities of applying transitions frameworks to urban basic infrastructure services in the Global South?** To explore this, **Chapter 3** applies a key transitions framework – the Multi-Level Perspective (MLP) – to case studies of UBIS in Southern cities, using grounded theory principles to critically examine the applicability and relevance of the MLP in contexts outside of those in which it originated. Empirical case studies from Ahmedabad, India, and Jinja, Uganda, show how niche innovations in waste management and solar energy respectively can increase service access, reduce ecological footprints, and empower

marginalised groups. These innovations emerge not only from technological advances but also from novel organisational forms that bring together citizens, service providers, community-based organisations, local businesses, and state actors. Lessons from these and other Southern urban sociotechnical configurations could inform cities worldwide seeking more socially and environmentally sustainable service delivery models, though the MLP requires further refinement in order to accurately respond to circumstances that are contextually distinct to those of its Northern origins.

This need in part gives rise to the third sub-question: **How can alternative organisational arrangements in Southern cities contribute to the delivery of sustainable urban basic infrastructure services?** The focus here is on the underexplored organisational dimensions of these models and how they align with different interpretations of sustainability and transition, based on a set of in-depth case studies of UBIS delivery models. **Chapter 4** explores the contributions of community-based organisations to urban solid waste management. The chapter draws on case studies from Luchacos, a waste-to-briquettes enterprise in Kampala, Uganda, and the Self-Employed Women's Association (SEWA), a cooperative of waste pickers in Ahmedabad, India. In **Chapter 5**, the sectoral focus shifts to housing. Two national land and housing delivery programmes – the 20,000 Plots Project in Tanzania and Basic Services for the Urban Poor (BSUP) in India – are studied alongside city-level community-led housing initiatives in both countries – Chamazi Housing Cooperative in Dar Es Salaam, Tanzania, and Kudumbashree in Kochi and Trivandrum, Kerala, India. In both chapters, analysis shows that, with sufficient state support, community-based organisations can contribute significantly to both ecological sustainability and human development goals, offering innovative solutions that complement broader municipal strategies. This may necessitate rethinking dominant transition strategies in both theory and practice, ensuring they are based on increasing human wellbeing rather than solely on economic profit.

Finally, **Chapter 6** seeks to unify the findings of all preceding chapters with a view to answering the central research question. Drawing on Southern Urbanism theory and empirical data from 14 cities from across Africa, Asia, and Latin America, this chapter both shows how mainstream urban sustainability transition theories often inadequately account for the unique infrastructural challenges in Southern cities, and offers a set of theoretical propositions to guide future research, particularly as pertains to the MLP.

Main findings and research contribution

This research highlights that the pursuit of sustainability in urban basic infrastructure services has predominantly been framed as a technical and economic challenge. It shows how academic and policy discourses on sustainable service delivery tend to give precedence to technical solutions to environmental issues while often overlooking the socio-political dimensions of infrastructure development. In practice, this means that issues related to the equity of access to and participation in the delivery of services are frequently sidelined in favour of economic efficiency and technological innovation – a challenge that is especially (though not only) significant in cities of the Global South, where poverty and inequality is prevalent. Uncritically applying techno-managerial fixes, however, may fail to address or even exacerbate the very challenges for which they are designed.

Yet this research also highlights, and builds upon, a growing focus on social justice and equality within sustainability transitions, reflected by increasing attention for community-led, bottom-up, and participatory approaches to urban service delivery in Southern cities.

The main theoretical contribution of this thesis is the proposal of a set of propositions for the further development of the MLP and wider transitions studies. Firstly, it calls for an expanded understanding of niche organisational arrangements, arguing that niches are not just spaces for technical innovation but also crucial for fostering socially and environmentally sustainable organisational forms. This shift may require innovations in governance instead of (or at least as well as) technology, and the adoption of new metrics for assessing "success" that extend beyond traditional financial and economic measures. Secondly, the research recognises the existence of multiple, overlapping, and sometimes unorthodox systems within regimes, in particular emphasising the importance of informal and communal organisation as integral components of infrastructure systems in Southern cities. These models, while often overlooked by mainstream theory and practice, could provide valuable alternatives to conventional systems and as such should be included in both development agendas and decentralised approaches to urban planning globally. Thirdly, the thesis interrogates the rigid distinction between niche and regime, proposing a more fluid understanding of these concepts. It highlights how unorthodox service providers in Southern cities frequently operate in hybrid spaces, interacting with and sometimes integrating into existing regimes, blurring the boundaries between the two. Finally, the thesis argues for the embedding of climate and equity considerations across all transitions frameworks, asserting that these issues are not simply landscape factors but aspects that continuously interact with all transitions approaches.

The practical contribution of this thesis is a set of policy- and practice-oriented principles that focus on improving the coordination of urban development policies by integrating across sectors, levels of government, and stakeholders. The research advocates for the creation of legal and practical opportunities for unorthodox or non-conventional service providers to participate in municipal service delivery systems, and calls for national policy reforms that reduce the current bias towards technical solutions, promoting instead the inclusion of community-based organisations and small enterprises, for example through enhanced access to both financial and non-financial support. Finally, it highlights the importance of ensuring that environmental and equity concerns are consistently integrated into the design and delivery of service provision frameworks in cities worldwide.

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Samenvatting

Achtergrond en probleemstelling

Fundamentele stedelijke infrastructuurdiensten vormen de basis waarop menselijke nederzettingen zijn gebouwd. De duurzame en inclusieve levering van zulke infrastructuurdiensten is cruciaal voor het verbeteren van de levenskwaliteit van stedelijke bevolkingen en het beheersen van de ecologische voetafdruk van steden. Fundamentale stedelijke infrastructuurdiensten omvatten essentiële diensten zoals energie, transport, water en sanitatie, en afvalinzameling, evenals huisvesting (hoewel huisvesting op zichzelf geen dienst is, vormt het de primaire toegangspoort voor de meeste burgers tot bovengenoemde elementen van stedelijke infrastructuur en is het daarom onlosmakelijk verbonden met deze diensten (Satterthwaite, 2020)).

Infrastructuurontwikkeling in steden in het mondiale Zuiden, waar het merendeel van de bevolkingstoename en stedelijke groei tussen nu en 2050 zal plaatsvinden (UNDESA, 2019), wordt vaak onderbelicht in bredere studies over stedelijke duurzaamheid, ondanks de centrale rol van deze steden op het snijvlak van armoede, ongelijkheid en klimaatverandering. Waar gangbare theorie infrastructuur vooral beschouwt als grootschalig, statisch, en gecentraliseerd, hebben steden in het Zuiden vaak meer heterogene, dynamische infrastructuurconfiguraties (Lawhon et al., 2018). Deze realiteit vraagt om een meer genuanceerde en gediversifieerde benadering van zowel het begrijpen als het leveren van fundamentele stedelijke infrastructuurdiensten, die in staat is om mondiale milieuproblemen aan te pakken en tegelijkertijd lokale behoeften te integreren, vooral die van gemeenschappen die structurele nadelen ervaren door historische of voortdurende ongelijkheid. Daarom wordt het algemeen erkend dat studies over stedelijke duurzaamheid verder moeten gaan dan technologisch determinisme (Savaget et al., 2019), hun geografische focus moeten verbreden naar het mondiale Zuiden (Wieczorek, 2018), en macht- en politieke overwegingen in de analyse moeten worden opgenomen (Gillard et al., 2016; Köhler et al., 2019).

Dit proefschrift verkent duurzaamheidstransities in fundamentele stedelijke infrastructuurdiensten in steden in het mondiale Zuiden, met een focus op hoe dienstverlening kan worden georganiseerd om zowel milieu- als maatschappelijke voordelen te realiseren. Het onderzoekt specifiek of en hoe organisatorische

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structuren die vanuit het perspectief van gangbare stedelijke theorie als “alternatief”, “niet-conventioneel” of “onorthodox” worden beschouwd, kunnen bijdragen aan zowel ecologische duurzaamheid als sociale inclusie. Door deze lacune aan te pakken, streeft het proefschrift ernaar theoretische en praktische inzichten te bieden voor de organisatie van stedelijke dienstverlening, niet alleen in het mondiale Zuiden maar ook voor alle steden wereldwijd die hedendaagse maatschappelijke en milieuproblemen willen aanpakken.

Onderzoeksvragen en hoofdstuksamenvatting

De centrale onderzoeksvraag van dit onderzoek luidt: **Hoe kunnen theoretische en empirische inzichten uit het mondiale Zuiden bijdragen aan de transitie naar duurzame fundamentele stedelijke infrastructuurdiensten?** Deze centrale vraag wordt verder uitgewerkt in drie deelvragen, die elk in een of meerdere hoofdstukken worden behandeld.

Na de introductie begint het empirische deel van het proefschrift met het schetsen van de wetenschappelijke context waarbinnen dit onderzoek zich bevindt, door de eerste deelvraag te adresseren: **Hoe worden duurzaamheidstransities in fundamentele stedelijke infrastructuurdiensten momenteel geconceptualiseerd?** Hoewel er brede consensus bestaat over de noodzaak van duurzaamheidstransities in stedelijke dienstverlening, blijven de concepten “duurzaamheid” en “duurzaamheidstransities” inconsistent gedefinieerd en worden ze vaak door een beperkte, technocentrische lens geïnterpreteerd. Nu deze concepten steeds meer aandacht krijgen van overheden, sociale bewegingen, en praktijkorganisaties, is het belangrijk om hen inconsistent en onkritisch gebruik te onderzoeken. Hoofdstuk 2 pakt dit probleem aan door middel van een corpus-ondersteunde discoursanalyse van de literatuur over duurzaamheidstransities in fundamentele stedelijke infrastructuurdiensten. De bevindingen laten zien dat duurzame stedelijke dienstverlening overwegend als een institutionele en economische uitdaging wordt gezien, met een focus op top-down, techno-manageriële benaderingen. Deze benaderingen geven prioriteit aan technische oplossingen voor milieuproblemen, terwijl de sociale dimensies van duurzaamheid vaak worden genegeerd. Dit hoofdstuk bevestigt ook de geografische bias die momenteel heerst in transitiestudies, waarbij het merendeel van de studies afkomstig is uit en gebruikmaakt van casestudies uit steden in het mondiale Noorden.

Om deze ongelijkheid deels te herstellen, stelt het proefschrift de tweede deelvraag: **Welke hiaten en kansen bestaan er bij het toepassen van transitie frameworks op fundamentele stedelijke infrastructuurdiensten in het mondiale Zuiden?** Om dit te onderzoeken, past Hoofdstuk 3 een belangrijk transitie framework – het Multi-Level Perspective (MLP) – toe op casestudies van fundamentele stedelijke infrastructuurdiensten in steden in het Zuiden, waarbij grondslagen van de gefundeerde theorie worden gebruikt om de toepasbaarheid en relevantie van het MLP kritisch te analyseren. Empirische casestudies uit Ahmedabad (India) en Jinja (Oeganda), laten zien hoe niche-innovaties in respectievelijk afvalbeheer en zonne-energie de toegang tot diensten kunnen vergroten, de ecologische voetafdruk kunnen verkleinen, en gemarginaliseerde groepen kunnen versterken. Deze innovaties ontstaan niet alleen uit technologische vooruitgang, maar ook uit nieuwe organisatorische vormen die burgers, dienstverleners, gemeenschapsorganisaties, lokale bedrijven en overheidsactoren samenbrengen. De lessen uit deze en andere stedelijke sociotechnische configuraties in het Zuiden kunnen steden wereldwijd informeren bij het zoeken naar sociaal en ecologisch duurzame modellen voor dienstverlening. Wel vereist het MLP verdere verfijning om accuraat te kunnen reageren op omstandigheden die contextueel verschillen van die van Noordelijke oorsprong.

Deze behoefte leidt tot de derde deelvraag: **Hoe kunnen alternatieve organisatorische structuren in steden in het mondiale Zuiden bijdragen aan de levering van duurzame fundamentele stedelijke infrastructuurdiensten?** De focus ligt hier op de onderbelichte organisatorische dimensies van deze modellen en hoe ze in lijn zijn met verschillende interpretaties van duurzaamheid en transitie, gebaseerd op een reeks diepgaande casestudies van modellen van fundamentele stedelijke infrastructuurleveringsdiensten. Hoofdstuk 4 onderzoekt de bijdragen van gemeenschapsorganisaties aan stedelijk afvalbeheer. Dit hoofdstuk put uit casestudies van Luchacos, een afval-tot-briketten onderneming in Kampala, Oeganda, en de Self-Employed Women's Association (SEWA), een coöperatie van afvalverzamelaars in Ahmedabad, India. In Hoofdstuk 5 verschuift de sectorale focus naar huisvesting. Twee nationale grond- en huisvestingsprogramma's – het 20.000 Plots Project in Tanzania en Basic Services for the Urban Poor (BSUP) in India – worden onderzocht, naast gemeentelijke, door de gemeenschap geleide huisvestingsinitiatieven in beide landen: de Chamazi Housing Cooperative in Dar es Salaam, Tanzania, en Kudumbashree in Kochi en Trivandrum, Kerala, India. Beide hoofdstukken tonen aan dat, met voldoende overheidssteun, gemeenschapsorganisaties aanzienlijk kunnen bijdragen aan duurzaamheids- en ontwikkelingsdoelen door innovatieve oplossingen te bieden die bredere gemeentelijke strategieën aanvullen. Dit kan vereisen dat dominante transitiebenaderingen in zowel theorie als praktijk worden heroverwogen, met als uitgangspunt het verbeteren van menselijk welzijn in plaats van economische winst.

Ten slotte poogt Hoofdstuk 6 de bevindingen van alle voorgaande hoofdstukken te verenigen om de centrale onderzoeksvraag te beantwoorden. Gebruikmakend van theorie over Southern Urbanism en empirische gegevens uit 14 steden in Afrika, Azië, en Latijns-Amerika, toont dit hoofdstuk aan hoe gangbare theorieën over stedelijke duurzaamheidstransities vaak onvoldoende rekening houden met de unieke infrastructurele uitdagingen in steden van het Zuiden, en biedt een reeks theoretische proposities om toekomstig onderzoek te sturen, vooral met betrekking tot het MLP.

Hoofdbevindingen en onderzoeksbijdrage

Dit onderzoek benadrukt dat het streven naar duurzaamheid in fundamentele stedelijke infrastructuurdiensten grotendeels wordt benaderd als een technische en economische uitdaging. Het toont aan hoe academische en beleidsmatige discoursen over duurzame dienstverlening de voorkeur geven aan technische oplossingen voor milieuproblemen, terwijl de sociaal-politieke dimensies van infrastructuurontwikkeling vaak worden genegeerd. In de praktijk betekent dit dat kwesties met betrekking tot rechtvaardigheid in toegang tot en participatie in dienstverlening vaak worden overschaduwd door economische efficiëntie en technologische innovatie. Dit probleem is vooral, maar niet uitsluitend, significant in steden in het mondiale Zuiden, waar armoede en ongelijkheid wijdverbreid zijn. Het onkritisch toepassen van techno-managerïële oplossingen in dergelijke contexten kan ertoe leiden dat de uitdagingen waarvoor ze bedoeld zijn om op te lossen, niet worden aangepakt of zelfs worden verergerd.

Tegelijkertijd benadrukt en bouwt dit onderzoek voort op een groeiende focus op sociale rechtvaardigheid en gelijkheid binnen duurzaamheidstransities. Dit wordt weerspiegeld in de toenemende aandacht voor gemeenschapsgerichte, bottom-up en participatieve benaderingen van stedelijke dienstverlening in steden in het Zuiden.

De belangrijkste theoretische bijdrage van dit proefschrift is het voorstel van een reeks proposities voor verdere ontwikkeling van het Multi-Level Perspective (MLP) en bredere transitiekunde. Ten eerste pleit het voor een bredere interpretatie van niche-organisatorische structuren, waarbij niches niet alleen worden gezien als ruimten voor technologische innovatie, maar ook als cruciaal voor het bevorderen van sociaal en ecologisch duurzame organisatorische vormen. Dit kan vereisen dat er meer aandacht komt voor governance-innovaties, in plaats van (of naast) technologische innovatie, en de introductie van nieuwe maatstaven voor succes die verder gaan dan traditionele financiële en economische criteria.

Ten tweede erkent het onderzoek het bestaan van meerdere, overlappende en soms onorthodoxe systemen binnen regimes. Het benadrukt het belang van informele en gemeenschappelijke organisatievormen als integrale onderdelen van infrastructuursystemen in steden in het Zuiden. Deze modellen, die vaak over het hoofd worden gezien, kunnen waardevolle alternatieven bieden voor conventionele systemen en zouden daarom moeten worden opgenomen in zowel ontwikkelingsagenda's als gedecentraliseerde benaderingen van stedelijke planning wereldwijd.

Ten derde stelt het proefschrift de strikte scheiding tussen niches en regimes ter discussie door een meer flexibele interpretatie van deze concepten voor te stellen. Het toont aan hoe onorthodoxe dienstverleners in steden in het Zuiden vaak opereren in hybride ruimtes, waarbij ze interactie hebben met en soms integreren in bestaande regimes, waardoor de grenzen tussen niche en regime vervagen.

Tot slot pleit het proefschrift voor de integratie van klimaat- en rechtvaardigheidskwesties in alle transitie frameworks. Het stelt dat deze kwesties niet simpelweg landschapsfactoren zijn, maar aspecten die voortdurend in interactie staan met alle transitiebenaderingen.

De praktische bijdrage van dit proefschrift omvat een reeks principes voor beleid en praktijk, gericht op het verbeteren van de coördinatie van stedelijke ontwikkelingsbeleid door integratie over sectoren, overheidsniveaus en belanghebbenden heen. Het onderzoek pleit voor het creëren van juridische en praktische mogelijkheden voor niet-conventionele dienstverleners om deel te nemen aan gemeentelijke dienstverlening en roept op tot nationale beleidswijzigingen om de bias richting technische oplossingen te verminderen. In plaats daarvan wordt gepleit voor de inclusie van gemeenschapsorganisaties en kleine ondernemingen, bijvoorbeeld door betere toegang tot financiële en niet-financiële ondersteuning. Ten slotte benadrukt het belang van het consistent integreren van milieu- en rechtvaardigheidskwesties in de ontwerp- en uitvoeringskaders voor dienstverlening in steden wereldwijd.

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1 Introduction

1.1 Research background

1.1.1 Urbanisation and urban basic infrastructure services

Today, more than half of the global population live in cities (UN Habitat, 2022) – more than ever before in human history. By 2050, it is projected that close to 70 percent of people will reside in urban areas (UNDESA, 2019).

Urbanisation offers numerous benefits that can drive economic, social, and cultural development. Economically, urban areas typically provide more diverse job opportunities, which can lead to higher incomes and improved standards of living (Abay et al., 2020). The concentration of businesses, industries, and services in cities fosters innovation and economic growth through increased productivity and the efficient exchange of goods and ideas (Boex et al., 2016). Socially, urbanisation can improve access to essential services such as healthcare, education, and public transportation, enhancing the overall quality of life for residents (Coalition for Urban Transitions, 2019; Pieterse & Parnell, 2014). Culturally, cities are often melting pots of diversity, bringing together people from different backgrounds and fostering cultural exchange and creativity (Maré & Poot, 2019). The dense population and built environment of urban areas can support more sustainable living practices, such as expansive public transportation systems, which reduce the environmental impact per capita compared to rural areas (Rode et al., 2019).

Yet rapid urbanisation can also lead to overcrowding, resulting in inadequate housing, increased traffic congestion, and strained public services (Ezeh et al., 2017). Environmental degradation is a major concern, as urban areas often contribute to higher levels of pollution, waste generation, and the destruction of natural habitats (Liang et al., 2019). The increased demand for resources such as

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water and energy can lead to shortages and exacerbate the pressure on already limited reserves (Rashid et al., 2018). Urbanisation can intensify social inequalities, with marginalised communities often facing poor living conditions and inadequate access to essential services (Zhang, 2016). Where the pace of urban growth outstrips the capacity of urban planning and governance, chaotic and unsustainable development patterns may emerge (*ibid*).

1.1.2 Urban basic infrastructure services

Cities are complex configurations comprising different and interconnected systems of physical, social, cultural, financial, natural and technological structures (Pandit et al., 2017) and urban infrastructure is the "connective tissue that knits people, places, social institutions and natural environment into coherent urban relations" (Graham & Marvin, 2001, p. 43). The quality and availability of services such as those provided by infrastructure in cities is perhaps the main reason that many urban areas are able to generate such positive environmental and socioeconomic impacts (Boex et al., 2016). Critical urban infrastructures – so-called because their failure "would trigger a detrimental shortage of supplies, a substantial disruption of public security, or similar dramatic consequences" (Monstadt & Schramm, 2017, p. 2,354) – deliver vital and often life-sustaining services to urban populations. These infrastructures and the totality of interactions, rules, norms and values that govern them is hereafter referred to as urban service delivery.

Urban infrastructure forms the foundation upon which cities are built and function. Particularly notable for their life-sustaining qualities are the infrastructures related to energy, transport, waste collection and management, and water and sanitation (Satterthwaite, 2014, p. 3). Housing can be considered equally essential, since it is the primary means by which citizens access the other infrastructures (Satterthwaite, 2020). These five infrastructural groups can be classified as urban basic infrastructure services (UBIS), as they fulfill the most fundamental needs for maintaining dignified human lives. It is largely thanks to the availability and quality of UBIS that cities are considered engines of economic growth, sites of innovation, and spaces for social transformation and political inclusion (Boex et al., 2016; UN Habitat, 2024).

BOX 1.1. DEFINING URBAN BASIC INFRASTRUCTURE SERVICES

Urban basic infrastructure refers to the fundamental physical and engineered structures, facilities, and systems that are essential for the functioning and well-being of urban communities. It encompasses a wide range of elements, including transportation networks, water supply and sanitation systems, energy grids, waste management facilities, and communication networks. Most commonly, the term "infrastructure" is typically employed to describe tangible, constructed elements such as roads, bridges, buildings, and public transit systems.

These physical components are designed to support and facilitate various services that benefit urban residents, such as transportation, energy distribution, water supply, and waste disposal. The concept of services pertains to the amenities, benefits, and functionalities derived from these physical infrastructures. For example, a bus is an infrastructure component that provides the service of transportation, enabling people to move efficiently from one location to another. Similarly, a water treatment plant can be seen as a physical infrastructure that supplies clean and safe drinking water to the community, which is a service.

The relation and distinction between infrastructure and services is crucial for understanding how urban systems operate and how they can be optimised to meet the needs of the population. Bringing these ideas together leads to the concept of urban basic infrastructure services. While the (mostly) physical engineering systems are relevant for the context of this research, and are referred to where applicable, it is perhaps more concerned with the services provided by those infrastructures, such as clean water, shelter, and energy access.

In the context of major environmental change, in particular climate change, the importance of the concept of urban basic infrastructure services is magnified. Infrastructure itself has embodied emissions, which are the greenhouse gases emitted during the construction, manufacturing, and maintenance of physical structures. For instance, building a bus involves emissions associated with producing materials and assembly processes. Additionally, there are service-related emissions that occur during the operation and use of these infrastructures, such as the emissions from fuel combustion when the bus is in transit. Both types of emissions are critical to consider when planning and developing urban infrastructure, as they contribute to the overall carbon footprint of a city.

Emissions are primarily connected to the *environmental* sustainability of services. The sustainability of services also has *social* dimensions, such as the ability of citizens to benefit from and participate equitably in the delivery of those services. This dual focus on environmental and social sustainability is increasingly considered essential for creating both systems and citizens that are resilient to shocks in the face of climate change and other global pressures. This research thus pays particular attention to lessons about the sustainability of infrastructure services that can be drawn from multiple sustainability-related dimensions and perspectives.

Despite the many positive effects of urbanisation, the pace at which it has taken place in recent years as well as its associated demographic trends have put a substantial strain on urban infrastructures (Resnick, 2014), and will continue to do so if cities do not create infrastructural configurations that better serve contemporary environmental and societal needs. Inadequate, poorly maintained, and/or carbon-intensive UBIS can contribute to a variety of global environmental challenges, perhaps most notably climate change (see Section 1.1.2), while the wellbeing of residents is severely impacted if UBIS are absent or difficult to access (Ezeh et al., 2017).

Conversely, improved and inclusive access to resilient infrastructure can yield cascading benefits for the entire city and even beyond (Mahendra et al., 2021; UN Habitat, 2024). For example, the costs associated with healthcare and lost economic productivity as a result of inadequate sanitation are estimated to be around US$223 billion per year (Wee, 2018); conversely, for every US$1 invested in water and sanitation, estimated benefits of up to US$34 are yielded in time savings, better health, and increased economic productivity (Hutton, 2013). Traffic congestion costs cities up to 10 percent of GDP, while a combination of shorter commutes and improved access to green public transit systems could reduce both commuters' expenditure and air pollution (Sudmant et al., 2020).

BOX 1.2. HOUSING AS AN UBIS – AND THE HUMAN RIGHT TO UBIS

Though housing and infrastructure are often treated as separate domains, this thesis aligns itself with work that argues housing is a critical component of infrastructure. Housing plays a central role in ensuring access to essential services, building the resilience of both citizens and the built environment, and driving transformative change in the context of climate action and urban development. It is often the primary means by which citizens access other UBIS (Satterthwaite, 2020). This is further emphasised in the "housing at the centre" approach of SDG 11, which recognises adequate housing as a cornerstone of development priorities (UN Habitat, 2023).

Including housing as an "infrastructure service" in this thesis is not intended to diminish the crucial role it plays in maintaining quality of life. Instead, it serves to reinforce the message that, as with the other UBIS that are the focus of this work, the benefits of housing extend far beyond the physical infrastructure (the building) itself. Connecting housing to the other UBIS is further intended to imply that they too should be recognised as equally fundamental in terms of human rights and development priorities, notwithstanding the differing legal basis for doing so.

Article 25 of the Universal Declaration of Human Rights (UDHR) adopted by the UN General Assembly in 1948 states that "[e]veryone has the right to a standard of living adequate for the health and well-being of himself and of his *[sic]* family" (UN, 1948) and goes on to explicitly mention housing as key in fulfilling this obligation. The UDHR has served as the basis upon which a host of further legislation has been developed, such as the human right to safe drinking water, which was first recognised by the UN General Assembly and the Human Rights Council as part of binding international law in 2010 (UN, 2010), and to sanitation, explicitly recognised in 2015 (UN, 2016). Access to the other UBIS is not enshrined in international law but is widely cited in soft law mechanisms such as the SDGs, and plenty of scientific work and advocacy groups are calling for these too to be recognised as basic human rights. Energy, for example, is widely considered necessary for citizens to be able to exercise economic, social, civil, and political rights (Owoeye, 2016). A growing number of (mostly national or subnational) cases advance the legal grounding for these claims on the basis that the right to energy can be derived from other rights, such as the right to adequate housing (Löfquist, 2020). Recent commentary from the Human Rights Council states that pollution – such as that caused by improper waste management – can impair the right to life and to a life with dignity (UN, 2019), while others call for a rights-based approach to (public) transport and urban mobility (Coggin & Pieterse, 2015; Sá et al., 2019).

1.1.3 Urban infrastructure and climate change

The process of urbanisation plays a critical role in shaping the ways in which human activities drive global unsustainability, and the ways in which the challenges thereof affect humans. In particular, urban infrastructures and the services they deliver both configure, and increasingly are configured by, cities' responses to climate change (Bulkeley et al., 2014).

Infrastructure and its associated services are directly or indirectly responsible for a significant proportion of greenhouse gas emissions (IPCC, 2023; Müller et al., 2013; Williams, 2013): buildings are responsible for 17.5 percent, transport for 16.2 percent, and waste for 3.2 percent (Ritchie & Roser, 2024). The way in which infrastructure is developed in these (and other) sectors therefore significantly influences the extent to which they contribute to global warming. Energy efficient building design, for instance, can greatly reduce the energy demand for heating and cooling, thereby lowering greenhouse gas emissions when compared to poorly insulated buildings that require excessive energy for temperature control (Yu et al., 2021). In the transport sector, investing in robust public transit systems powered by clean energy can decrease reliance on fossil fuels and reduce emissions, while

expanding road networks without investing in public transit can lead to higher carbon outputs (Alexandrakis, 2021; Held & Gerrits, 2019). Waste management practices like recycling and composting can help to minimise resource use, while amassing untreated waste in growing landfills can exacerbate methane emissions (Hoornweg & Bhada-Tata, 2012). These impacts are also influenced by wider urban planning practices and behavioural aspects. Urban sprawl, characterised by low-density development, often leads to increased reliance on private cars, contributing to higher transport emissions. Conversely, compact, connected, and coordinated urban planning can promote the use of non-motorised and public transit, thereby reducing emissions (Rode et al., 2019). Similarly, societal behaviours such as overconsumption result in more waste generation, while promoting a culture of sufficiency and conscious consumption can significantly reduce waste and its associated emissions.

At the same time, urban infrastructure networks are already being severely affected by the physical impacts of climate change (IPCC, 2023), with implications for economic productivity, human wellbeing and health, and loss of lives. Infrastructure is adversely affected by disasters and climate change: the Intergovernmental Panel on Climate Change (IPCC) estimates that annual infrastructure losses are already costing around US$14.6 billion (Dodman et al., 2022). Other assessments suggest this number may be even higher, finding that power generation and transport infrastructure incur losses of US$30 billion a year on average from natural hazards (about $15 billion each), with low- and middle-income countries bearing the brunt of this (about $18 billion of the total amount) (World Bank, 2019). These losses are expected to increase significantly as a result of worsening climate change. Extreme weather events such as floods, hurricanes, and heatwaves are only becoming more frequent and intense, damaging roads, bridges, water supply systems, and power grids. Flooding can overwhelm drainage systems and contaminate water supplies, leading to waterborne diseases and sanitation issues (Romero-Lankao & Norton, 2018). Heatwaves strain energy systems as the demand for cooling increases, often resulting in blackouts and stressing healthcare facilities (Pincetl et al., 2016). The economic productivity of cities is hindered as transportation disruptions delay goods and services, and damaged infrastructure requires costly repairs and upgrades. The increased frequency of natural disasters poses a direct threat to human lives and exacerbates social inequalities, as vulnerable communities often lack the resources to swiftly respond to or recover from inclement events.

The efficacy of urban infrastructure and the ability of people to access infrastructure services is key in building the resilience of urban areas and citizens to environmental shocks (Monstadt & Schmidt, 2019; Tzioutziou & Xenidis, 2021). Robust and well-maintained infrastructure can help people respond or adapt to the effects of climate

change by ensuring continuous access to essential services during and after extreme weather events. For example, resilient transportation networks can facilitate efficient evacuations during emergencies and ensure that supplies and services reach affected areas swiftly; reliable energy systems are crucial for maintaining critical functions in hospitals, communication networks, and other vital services during power outages; and effective water management systems can prevent flooding and protect water quality, safeguarding public health (Doberstein & Stager, 2013; Field et al., 2012; Ko et al., 2019; Rose, 2011; World Bank, 2012). The integration of green infrastructure, such as parks and green roofs, can further enhance urban resilience by reducing urban heat islands and managing stormwater runoff (Diep et al., 2019; Ramyar et al., 2021). These infrastructures are vital when responding to climate-induced and other natural disasters but are equally necessary for building the long-term adaptive capacity of citizens learning to live in a changing climate. Meeting future infrastructure needs will thus be paramount both in shaping future global emissions trajectories and in building human and ecosystem resilience to climate change.

1.1.4 Infrastructure challenges in Southern cities

Inadequate or outdated physical infrastructures and inefficient or inequitable service delivery mechanisms can have dramatic effects on human wellbeing, the economy, and the environment (Floater et al., 2014), with particularly deleterious effects for issues of equity and sustainability (UN Habitat, 2024). This is most acutely felt in the cities of Africa, Asia, and (to a somewhat lesser extent) Latin America, where 90 percent of all population growth to 2050 will take place (UNDESA, 2019).

With a significant global infrastructure deficit, millions of people in rapidly expanding cities, particularly in low- and middle-income countries, live with inadequate and unreliable access to basic infrastructure services such as energy, water and sanitation, waste management, and transportation. Governments worldwide already invest around US$1 trillion annually in infrastructure (Fay & Rozenberg, 2019), yet this falls short of the estimated US$94 trillion required by 2040 (Thacker et al., 2019). Furthermore, infrastructure is distributed highly unevenly around the world. The top three countries with the largest amount of urban built-up infrastructure – China, the United States, and Japan – together account for approximately 50 percent of the global total (Zhou et al., 2022). The gaps between high- and low-income countries are stark – the built-up infrastructure in 45 countries in the Global North which are home to 16 percent of the global population is roughly equivalent to that of 114 countries in the Global South that are home to 74 percent of the global population (Zhou et al., 2022).

In the Global South, almost one billion people live in slums (UN Habitat, 2016b), though in reality this number is likely to be even higher due to data deficiencies and the thresholds for the assessment of certain criteria being set too low (Satterthwaite, 2016). These settlements have been described as "perhaps the most striking representation of a global infrastructure crisis that has beset an increasingly resource-constrained world" (Schäffler & Swilling, 2013, p. 256). In informal settlements, as well as in many planned neighbourhoods in low-income countries, (access to) basic public services can be inadequate or non-existent. Even where the infrastructure exists, different factors can preclude certain groups from benefitting from the services it provides. "Access" is itself a multidimensional term that can understood as having both proximate and processual dimensions (Beard et al., 2016; Ranganathan & Balazs, 2015): in many cases, it is not (only) the physical absence of infrastructure that precludes citizens from accessing basic services (proximate dimensions of access), but also institutional factors that serve to exclude populations based on socioeconomic features such as income-level, ethnicity, legal status and gender (processual dimensions of access). Simply put, the physical presence of an infrastructure is not the same as being able to benefit from (the services provided by) said infrastructure.

Residents are severely disadvantaged by the inadequacy or absence of – or by their inability to access – these services in a myriad of different ways (Ezeh et al., 2017). For example, water supplies are frequently contaminated by solid and human waste, leading to serious public health issues that are particularly dangerous for children (Oates et al., 2018; Bain et al., 2014). Disadvantaged groups are unable to access urban opportunities and services due to prohibitively high travel times and transport costs (UN Habitat, 2016b). Many informal settlements are situated in areas that are exposed to natural and geographic hazards such as flooding, landslides, subsidence and local air pollution, for example from nearby industries (Landrigan et al., 2015). Climate change brings about an increased incidence of natural disasters (Field et al., 2012), and the associated risks to residents of informal settlements are exacerbated by overcrowded living conditions, unsafe housing, poor health, and inadequate infrastructure such as medical facilities and roads that are accessible to emergency services vehicles (Baker, 2012).

1.1.5 Alternative arrangements for sustainable and inclusive urban infrastructure

Theory and practice explore different ways of organizing the sustainable delivery of UBIS. Until relatively recently, the focus has been on what has come to be known as the "modern infrastructure ideal", which is a normative assumption that infrastructure services should be centrally organised. This is a common model in Europe and North America. In the Netherlands, for example, the Ministry of Infrastructure and Water Management is a central authority that provides a centralised water management policy. Water and sewage are transported to households through vast underground networks that have been specifically engineered and rationally planned to the framework of the urban grid.

The unprecedented scale and complexity of the afore-mentioned sustainability challenges is leading to the increasing recognition that achieving the "modern infrastructure ideal" (Graham & Marvin, 2001) of large-scale, centralised, universal and uniform infrastructure networks is neither feasible nor, in some cases, desirable. This is particularly the case in the Global South (Lawhon et al., 2018), where urban service delivery "has long involved multiple systems in varying degrees of coexistence" (Furlong, 2014: 139), and is increasingly true of the Global North too, where cities are searching for service delivery models that better serve environmental and societal needs. Despite this, efforts to respond to the contemporary challenges of delivering urban services have focused largely on the technological and economic efficiency of large-scale, top-down, publicly and/or privately provided systems. Indeed, "the reality of infrastructure design and development is still dominated by stable regimes favouring centralised solutions that have become locked into our urban systems" (Ersoy et al, 2020: 134).

There is nowadays consensus on the necessity of delivering UBIS in ways that reduce environmental impact (Ferrer et al., 2018), conserve resources (UNEP, 2019), and promote long-term ecological balance (Gaffin et al., 2012; Ramyar et al., 2021). Despite this, and despite the availability of a broad range of technical solutions, there remains a vast implementation gap and neither social nor environmental change at the scale required has been forthcoming thus far. Accordingly, cities worldwide are seeking alternatives to the "modern infrastructure ideal" in the form of more hybrid, disaggregated urban infrastructure configurations that may better serve contemporary environmental and societal needs (Furlong, 2014). In cities of the Global South, a multitude of activities and networked infrastructures alongside a variety of non-uniform modes of service delivery have long existed (Lawhon et al., 2018: 1), having developed over time in response to pressing service shortages. Formal, centrally planned infrastructures tend to coexist alongside a range of

alternative options, arising especially where piecemeal, informal development has shaped vast areas of, or indeed entire, (mostly) low-income cities that have come into being without formal planning processes and regulations (Satterthwaite et al., 2018). For example, piped water supply may be augmented by rainwater collection, communal systems and water kiosks, which in turn may be organised by various non-state providers and intermediaries, including local entrepreneurs, international NGOs, community-based organisations, informal operators, grassroots social movements, and/or individuals (Furlong & Kooy, 2017; Lawhon et al., 2018). The majority of residents in Southern cities access or augment their access to urban services and infrastructure via decentralised and often informal channels.

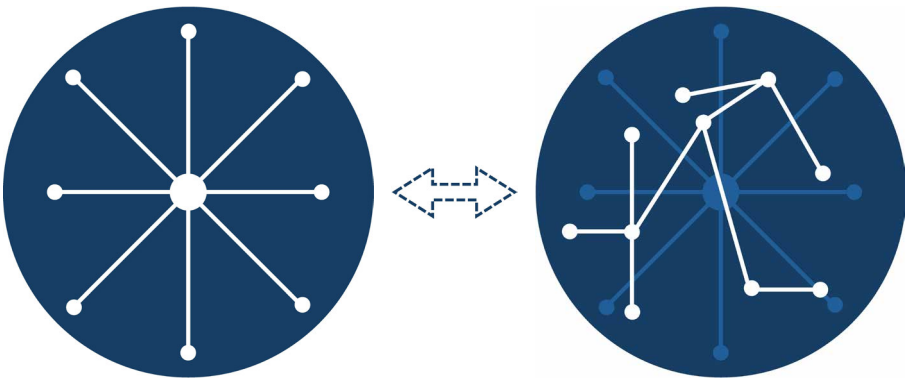

FIG. 1.1 Visualisation of centralised (left) and heterogeneous (right) infrastructure provision. Source: Author.

A growing body of work is reframing infrastructure and service delivery as heterogeneous (Lawhon et al., 2018), hybrid (Furlong, 2014), incremental (Silver, 2014) and post-networked (Monstadt & Schramm, 2017), particularly drawing on evidence from the Global South and depicted in Figure 1.1. Researchers have explored not only the implications of absent or failing large technical systems of urban service delivery, or the complications of transplanting these models to very different (often postcolonial) urban contexts, but also long-standing alternatives to these (Coutard & Rutherford, 2015). “Such literatures usefully describe and analyse what is there and how it works – or how and for whom it fails to work” (Lawhon et al., 2018, p. 3). A growing grassroots innovation scholarship contends that more local and community-based activities may create the necessary space for alternative forms of organisation, production and consumption (Boyer, 2015; Seyfang & Smith, 2007).

These include localised, decentralised and/or needs-driven service configurations, where various non-state providers and intermediaries, including local entrepreneurs, international NGOs, community-based organisations, informal operators, grassroots social movements, and/or individuals play a substantial role in developing UBIS delivery models (Monstadt & Schramm, 2017; Moretto et al., 2018), possible examples of which are given in Figure 1.2. The host of initiatives of varying degrees of formality and with varying levels of state support that have evolved to fill the gaps left by governments are increasingly considered to be generating new governance capacities for urban service delivery (Gillard et al., 2019; Oates et al., 2019; Oates et al., 2018; Hodson et al., 2012).

BOX 1.3. DELINEATING "NON-CONVENTIONAL" INFRASTRUCTURE

In describing forms of urban service delivery such as those described throughout section 1.1.5, the rest of this thesis uses the term "non-conventional." However, this obscures a critical tension: while these forms may be labelled non-conventional according to Western convention and within dominant theoretical frameworks, they are in fact often quite conventional within the specific urban contexts in which they exist. The term "alternative" is similarly problematic, as many of these organisational forms are not alternatives in the sense of being secondary options; rather, they are often the only viable solutions available, or are the most widely used even where other options are offered. Thus "non-conventional" and "alternative" are employed to reflect their divergence from mainstream theoretical perspectives rather than any deviation from the norm or the lived realities of the Southern cities studied here. This linguistic challenge underscores the bias in current theory and practice that will be further elaborated throughout this work, emphasising the need to critically reassess common framings and understandings of urban service delivery models in the Global South.

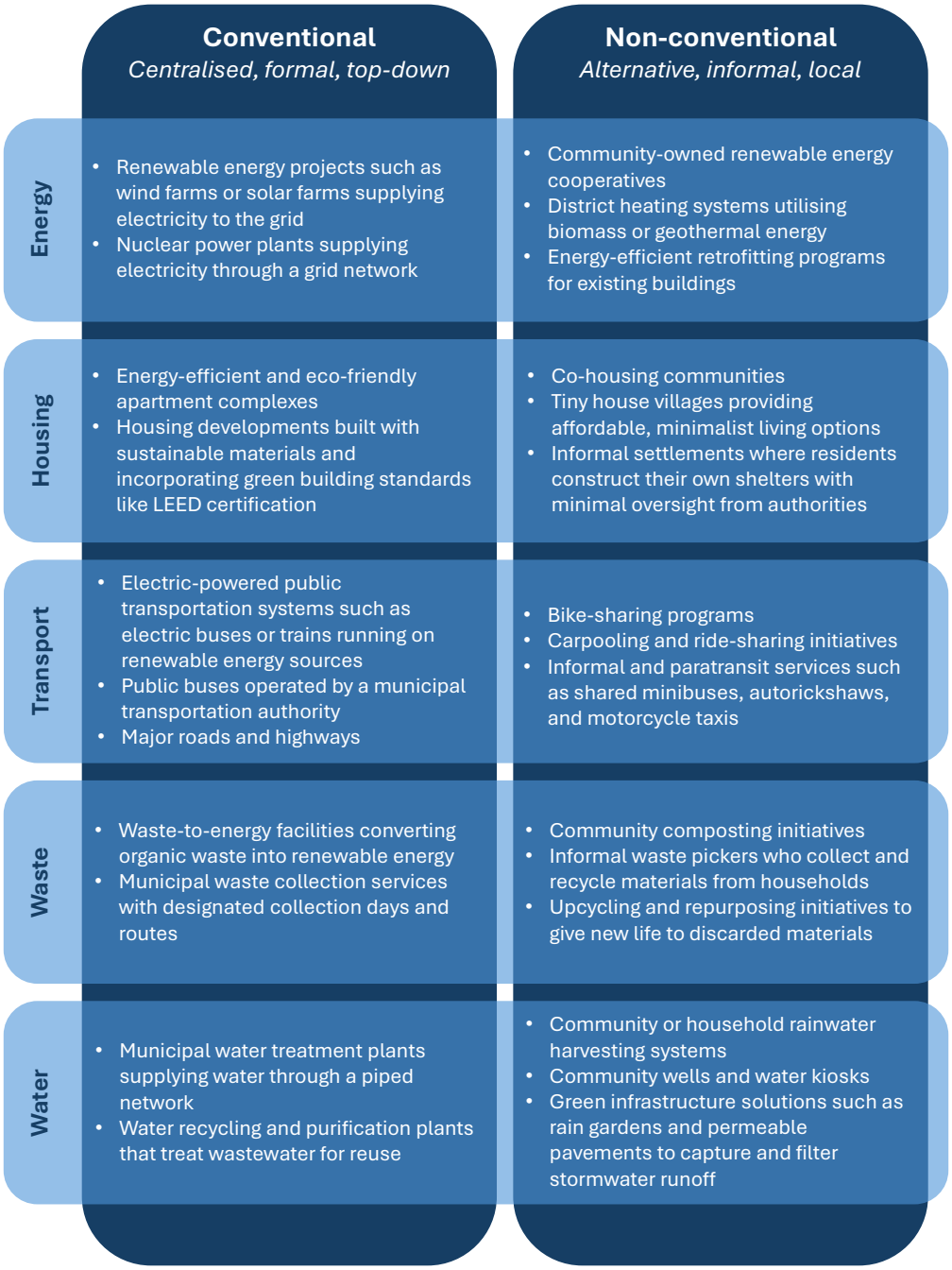

FIG. 1.2 Non-exhaustive list of examples of conventional and non-conventional urban basic infrastructure services as defined in this thesis (noting that the services listed in the righthand column are often not considered "non-conventional" by their users or in the contexts in which they operate). Source: Author.

Such arrangements are commonly found in Southern cities but are gaining attention in the Global North too. Cities in high-income countries face a different yet related set of challenges related to urban service delivery that has been organised according to the modern infrastructure ideal. Nowadays, many cities in the Global North are dealing with carbon lock-in arising from having constructed long-lived, energy-intensive infrastructures and institutions that generate greenhouse gas 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 and Tempest, 2015). These can be costly for the economy, the environment, and society. For example, the European Union (EU) estimates that traffic congestion costs the region 100 billion Euros annually, equivalent to approximately 1 percent of the EU's GDP (EU, 2011). Lock-in can be both technological and institutional, and can prevent the uptake of more sustainable substitutes; continuing down the "business-as-usual" trajectory for urban growth means that cities will "entrench less-efficient technologies, as well as the social and political institutions that support them, instead of low-carbon alternatives and their respective institutions" (Erickson and Tempest, 2015: 3). 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. It is not clear whether infrastructure systems in their current form will be able to keep pace with these future needs. With overstretched utilities, public budget cuts, climate change, and environmental degradation putting ever-increasing pressure on the ability of city authorities to deliver services, citizens and other non-conventional actors are increasingly initiating bottom-up urban development practices (Mens et al., 2021), partly driven by their dissatisfaction with the status-quo, and supported by (digital) technology and social media (Bryson et al., 2023; Nik-Bakht & El-Diraby, 2020)

Organisational arrangements including non-state actors are often associated with specific societal outcomes such as the improved accessibility and equity of urban service delivery (Jaglin, 2014; McGranahan, 2013), and are increasingly thought to have positive implications for environmental sustainability too (Ranzato & Moretto, 2018). Accordingly, the potential of non-state actors to be involved in the sustainable delivery of UBIS is touted as a potential opportunity to jointly address different dimensions of sustainability.

1.1.6 Sustainability transitions in UBIS

In response to the afore-mentioned sustainability challenges, research and practice have paid increasing attention to the conditions that bring about *sustainability transitions* in sociotechnical systems. The field of sustainability transitions is commonly used to understand the processes and pathways through which society can move from unsustainable infrastructural practices to more sustainable ones. Sociotechnical systems include, for example, energy supply, water supply, transportation networks, and telecommunications networks, and 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 such sociotechnical systems are organised, which necessarily involves substantial technical, institutional, organisational, political, economic and cultural changes (Geels & Schot, 2010). A sustainability transition therefore refers to a "long-term, multi-dimensional and fundamental transformation process through which established sociotechnical systems shift to more sustainable modes of production and consumption" (Markard et al., 2012, p. 956).

Within sustainability transitions studies, it is generally accepted that a transition may occur as the result of the interaction between three different levels which together comprise a key analytical framework, the Multi-Level Perspective (MLP) (Geels, 2002, 2011):

"a landscape (macro) level that encompasses the dynamics of deep cultural, economic and political patterns; a regime (meso) level that refers to the current practices, routines and dominant rules that prevail in a socio-technical system; and a niche (micro) level which represents the space where actors experiment with radical innovations that may challenge and break through into the prevailing regime" (Twomey & Gaziulusoy, 2014, p. 1).

The MLP and transitions theory are related but distinct concepts. The MLP is one of the most widely recognised and applied frameworks within transitions theory. Its broad acceptance and use in academic and policy contexts make its analytical constructs a convenient shorthand for discussing sustainability transitions, while its application in numerous case studies has helped to build a substantial body of empirical evidence, enhancing both its credibility and utility. Furthermore, its focus on multi-level interactions offers practical guidance on how to align policies and actions across different scales to facilitate transitions. Its focus on how niche innovation can disrupt existing regimes under certain landscape pressures suits the exploration of how non-conventional urban service delivery mechanisms (niches) can contribute to more sustainable urban infrastructural

models (regimes) in the context of climate change and social inequity (landscape pressures). The MLP will thus be the investigative focus of this research.

Sustainability transitions theory presents the opportunity to make a connection between good governance, quality of life, and technological advancement (Köhler et al., 2019; Markard et al., 2012). It is also gaining prominence in both research and practice, demonstrated by the increasing appropriation of transitions language by governments (e.g. "innovation policies"), research and policy organisations (e.g. "Coalition for Urban Transitions") and social movements seeking to challenge the current system (e.g. "Transition Network"). The increasing prevalence of transitions language in policy and practice has been highlighted by some scholars as indicative of its growing influence (Feola, 2020; Swilling & Annecke, 2012), suggesting it is not only theoretically but also societally relevant.

1.1.7 Southern Urbanism and transitions in the Global South

Despite the potential usefulness of transitions thinking for cities worldwide, it has until recently been predominantly applied in – and developed based on – high-income, largely Northern European contexts. This may in part reflect the provenance of the most cited authors, many of whom come from or are based in the Netherlands, Scandinavia and the United Kingdom (Markard et al., 2012), but aligns with the development of urban theory more generally, which has been sharply Euro- and American-centric (Brenner & Schmid, 2015).

A growing community of researchers and a burgeoning set of literature is responding to calls for exploring the applicability of transitions theory in low-income contexts (Furlong, 2014; Hansen et al., 2018; Markard et al., 2012; Swilling & Annecke, 2012; Wieczorek, 2018). The geographical diversification of transitions theory and its analytical frameworks is particularly relevant for UBIS since, until now, most attention has been concentrated on case studies from high-income countries, where infrastructure regimes are typically characterised by large-scale, standardised and centralised systems and stable institutions.

Development scholars and institutions have long promoted the potential of improved infrastructure for reducing poverty (Pieterse & Parnell, 2014). Development studies too is more and more dominated by debates on the failure of donor-led interventions in the South, the impacts of globalisation on vulnerable and marginalised groups, and postmodern critiques of the prevailing development paradigm (Desai & Potter, 2008). It is facing an internal reorientation towards *global* rather than *international*

challenges (Horner & Hulme, 2019), with transboundary challenges such as climate change and the COVID-19 crisis prompting development scholars to pay greater attention to inequity in the North, to more explicitly acknowledge the interconnected nature of global challenges, and to consider the opportunities for learning that can be generated in the South (Oldekop et al., 2020). Indeed, issues such as the restructuring of the state, social and economic inequality, citizen agency and participation, and environmental degradation are not, as is sometimes assumed, challenges only for the growing cities of the 'developing' world, but are universal (Maxwell, 1998).

Working across sectors and disciplines, development scholars have shown that sustainability policies and practices in the South must include poverty eradication if they are to be successful (Ramos-Mejía et al., 2018). The extent to which the process of infrastructure improvement can be executed in a way that is truly transformative from both an environmental and societal perspective presents clear synergies with sustainability transitions (Wieczorek, 2018). Though development studies has also shown the dangers of transplanting models of sustainable development from the Global North to the South without due consideration of the contextual factors at play (Castán Broto et al., 2018; Mamadouh et al., 2002), most scholars argue against dismissing out of hand the potential usefulness of theory from the South in the North, and vice versa. Theories travel, and can be used as a tool to explore all “cities and their elsewheres” (Mabin, 2014, p. 7).

Connected to development studies and in response to the shortcomings of modern urban theory is a rich and growing body of literature that broadly falls under the heading “Southern Urbanism” (Oldfield & Parnell, 2014). Southern urbanism directly and necessarily engages with some of the key areas that are currently underdeveloped in mainstream transitions literature. It is unambiguously based on empirical and conceptual contributions from the Global South, in contrast both with dominant urban theory, which is biased towards the Northern urban condition, and with attempts to describe a universal form of the “global condition” of urbanisation (Brenner & Schmid, 2014, p. 747), which directly or otherwise implies that the majority of cities experience largely the same problems and thus can employ the same solutions (Roy & Ong, 2011). Southern Urbanism also addresses the fact that institutions, especially state institutions, are often limited in terms of human, financial, and technical capacity and therefore places more emphasis on the actions and responsibilities of a wider range of actors, including not only international private firms but also small and medium local enterprises, NGOs, community-based organisations, and individuals. In doing this it places issues of politics and power (imbalances) centre-stage, critically questioning development interventions, reminding the researcher to always ask for whom and by whom urban development is taking place (Hodson et al., 2012; Holgersen, 2020).

1.2 Problem formulation

1.2.1 Research gap

As established previously, the most basic infrastructure services "form the foundation on which human settlements are built and function" and include water and sanitation, waste collection and management, transport, energy, and housing. The sustainable and inclusive provision of urban services is fundamental for maintaining and improving the living standards of citizens and managing a city's ecological footprint. Yet the provision of UBIS in low-income countries has thus far been largely neglected by sustainability transitions literature (Van Welie, 2019), and is under-represented in studies of urban sustainability more broadly, despite its position at the nexus of poverty, inequality, and climate change.

Where UBIS delivery in Southern cities is addressed, and given that many studies have been undertaken in the Northern context, research and practice frequently presupposes a set of underlying assumptions, including: (i) the need for all cities to transition from an unsustainable, carbon intensive system of service delivery to a carbon neutral system through the adoption of low-carbon technologies and practices; (ii) the dominance of top-down, centrally provided, universal, and uniform service delivery models; and (iii) the capacity and will of the state to provide, or at the very least to regulate the provision of, urban services and infrastructure for all (Dodman, 2009). However, the applicability of these assumptions varies significantly between and within urban areas due to wide-ranging spatial, social, cultural, economic and political factors, such as current urban form (dense or sprawling), levels of inequality, income levels, the city's economic base (industry- or service-oriented), governance structures, and the influence of those with vested interests (Dodman, 2009).

These variations raise important questions about how uninterrogated assumptions might influence urban sustainability transitions and the extent to which they adequately capture the diverse realities of Southern cities. Failing to understand specific national, regional, or local contexts and needs risks the adoption of a homogenous transition pathway that produces a pre-determined set of interventions in practice. Despite this, it is most often technologies and innovation thereof, rather than guiding principles, that are taken as the starting point for transitioning to more sustainable UBIS, whilst any social or cultural (re-)organisation is at best

treated as a by-product (Hegger et al., 2007). Particularly in the Global South, this is exacerbated by increasing foreign and private investment in, as well as donor financing of, urban infrastructures (Anand et al., 2018; Kurtiç & Nucho, 2022). Such investments are typically directed towards building and operating physical infrastructure, sometimes at the expense of understanding and integrating local social structures, and have been critiqued on the basis that they emphasise quick, visible results that demonstrate immediate impact, neglecting essential processes such as stakeholder consultations, capacity building, and adaptive management (Banks et al., 2015; Banks & Hulme, 2014). This perspective on what constitutes sustainable infrastructure risks overlooking the role of more participatory processes (Lawrence & Haasnoot, 2017; Lin et al., 2017), could be blind to power imbalances that ensure large parts of society remain vulnerable, marginalised and discriminated against (Bosomworth et al., 2017; Singh, 2018), and may fail to account for local needs and context (Balkaran, 2019). Indeed, the "ideologically informed trajectory of development towards the urban infrastructural ideal" (Kooy, 2014, p. 48) may itself exacerbate existing inequalities, or create new ones. These models can also directly or indirectly promote institutional transplantation, where recipient countries are coerced into adopting the prescribed economic and political institutions deemed most efficient by international agencies (Mamadouh et al., 2002).

This is not to discount the role of (improved) centralised infrastructure systems in building sustainable and inclusive cities. For example, decarbonising the existing electricity grid accounts for up to half of all urban mitigation potential to 2050 (Coalition for Urban Transitions, 2019) and transport is responsible for 14 percent of global greenhouse gas emissions (IPCC, 2014) – yet even when carbon-intensive and polluting, such infrastructures provide vital services for millions of urban citizens. Similarly, it is important not "to valorise any particular social or technological intervention" at the expense of another (Lawhon et al., 2018, p. 3). Rather, it is necessary to recognise and incorporate a broader range of approaches to urban service delivery, which can ultimately inform possibilities for a more ecologically sustainable and socially inclusive response to global environmental challenges. Accordingly, there is the need for studies on sustainable urban infrastructure to move beyond technological determinism (Savaget et al., 2019), broaden the geographical basis (Wieczorek, 2018), and further integrate issues related to power and politics (Gillard et al., 2016; Köhler et al., 2019).

1.2.2 Research aims and questions

The aim of this thesis is to explore sustainability transitions in UBIS in cities of the Global South. More specifically, it will analyse under what circumstances alternative organisational arrangements in UBIS in Southern cities might be considered sustainable, with the intention of extracting lessons and recommendations for theory, policy, and practice. With this and the research gap as identified above in mind, the overarching question this thesis will answer is:

— **How can theoretical and empirical contributions from the Global South inform the transition to sustainable urban basic infrastructure services?**

It is widely acknowledged that there is a need for sustainability transitions in the way urban services are delivered. However, even as the language of the sustainability transitions literature is being appropriated by governments, social movements and practitioners, the concepts of "sustainability" and "sustainability transitions" remain ill-defined and often narrowly applied. The departure point for this study is therefore to first identify the type of "sustainability transitions" currently being pursued as pertains to urban infrastructure. Accordingly, the first sub-question is:

— **How are sustainability transitions in urban basic infrastructure services currently conceptualised?**

From there, the next step in the research is to illustratively apply a key theoretical framework that is frequently used to understand sustainability transitions to case studies of UBIS in cities of the Global South. It is important to identify the extent to which the framework is, or is not, applicable for Southern cities. Accordingly, the second sub-question is:

— **What are the gaps and opportunities of applying transitions frameworks to urban basic infrastructure services in the Global South?**

It is then useful to empirically explore alternatives to conventional UBIS delivery models based on empirical evidence from cities of the Global South. In particular it is important to explore the under-studied organisational dimensions of these arrangements and how they connect with different understandings of sustainability. Accordingly, the third sub-question is:

— **How can alternative organisational arrangements in Southern cities contribute to the delivery of sustainable urban basic infrastructure services?**

BOX 1.4: RESEARCH QUESTIONS

Main question

How can theoretical and empirical contributions from the Global South inform the transition to sustainable urban basic infrastructure services?

Sub-questions

1. How are sustainability transitions in urban basic infrastructure services currently conceptualised?
2. What are the gaps and opportunities of applying transitions frameworks to urban basic infrastructure services in the Global South?
3. How can alternative organisational arrangements in Southern cities contribute to the delivery of sustainable urban basic infrastructure services?

1.3 Research approach

1.3.1 Case study selection

The scope of this thesis is, broadly speaking, non-conventional organisational arrangements for delivering UBIS in Southern cities. The selection of the urban South as a site of study was motivated by several key considerations. Firstly, the majority of the world's population and (future projected) urban growth are concentrated in Africa, Asia, and Latin America, making the South a focal point for tackling sustainability challenges. Secondly, much of the existing theory and knowledge on urban infrastructure and development is derived from models built in and based on case studies from the Global North, which may not be directly applicable to or effective in Southern contexts. Furthermore, it is these very models that are (at least in part) to blame for the carbon-intensive development trajectory that has brought about major environmental instability. Third, there is an ethical imperative to work towards improving the quality of life for all global citizens, especially in regions where poverty and inequality are most pronounced. Addressing these disparities is not only a matter of moral significance but also critical for achieving global sustainability goals.

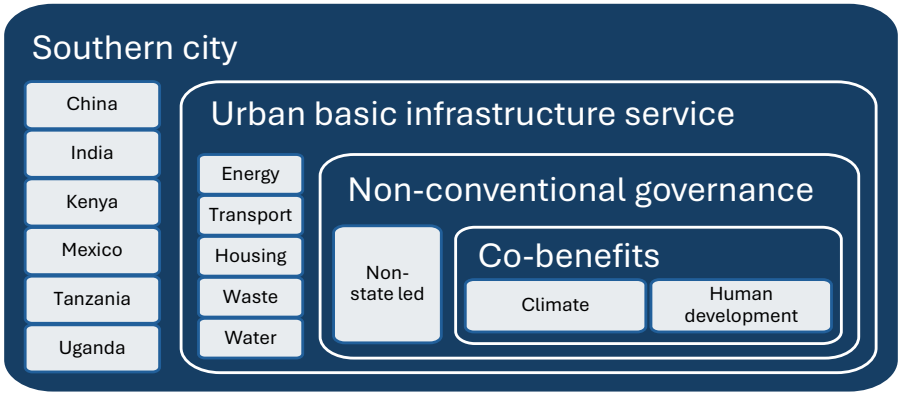

FIG. 1.3 Criteria for case study selection. Source: Author.

In terms of narrowing this scope, it is essential to select case studies from different regions and countries across the Global South so as to capture the diversity and complexity of urban transitions in this region, rather than contributing to the further homogenisation of urban theory. While Southern cities may share common sociopolitical conditions, there are also significant differences in cultural, institutional, political, environmental, and socioeconomic contexts that influence urban development. By examining a variety of cases from different contexts, this research aims to identify both shared and unique strategies and conditions, with the intention of gaining insights that can be broadly applicable but are also sensitive to the nuances of different urban settings within the Global South and indeed globally.

Cases were identified and selected together with international partners from the Coalition for Urban Transitions (CUT), a major international initiative to support decision makers to meet the objective of unlocking the power of cities for enhanced national economic, social, and environmental performance, including reducing the risk of climate change. CUT works across five focus countries – China, India, Mexico, Tanzania and Uganda – which helped narrow the focus. A case study from Kenya is also included. Cases also cover the five identified UBIS sectors. In line with the previously identified research gaps, UBIS case studies were selected based on the following criteria. Firstly, they must be considered organisational niche arrangements – that is, they must involve an element of self-organisation or co-production. Secondly, they must implicitly or explicitly offer an opportunity to contribute to ecological goals, for example by reducing emissions compared to conventional UBIS delivery models. Finally, they must implicitly or explicitly generate (or be intended to generate) social benefits.

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FIG. 1.4 Locations of the 13 case studies featuring in this thesis (two case studies were conducted in Dar Es Salaam.). Notes: Cases in blue were primary case studies that are analysed across multiple empirical chapters; case studies denoted in grey were part of the same overarching project and were used to support broader conceptual work, primarily featuring in chapter 6. See also Table 1.1 below and Appendix 1. Source: Author.

13 case studies are featured in this thesis (for an overview, see Figure 1.4 and Table 1.1). All case studies, with the exception of the Kenyan case, featured in the same research project, carried out together with the Coalition for Urban Transitions. All cases were selected according to the criteria outlined above (see Figure 1.3). Case studies are used in different ways that can largely be considered either "primary" or "supporting".

Six primary case studies feature in multiple empirical chapters (Chapters 3–5) across this thesis, as well as in the more conceptual work with which the thesis closes (Chapter 6). These cases have been analysed in greater depth. The author of this thesis was the lead researcher (i.e. conducted primary research) for all primary case studies and is the lead author (i.e. carried out the required analyses, writing) of any related work (including that which features in this thesis). Since the waste and housing sectors are particularly understudied in the transitions literature (Oates et al., 2022), these sectors were identified as particularly relevant for primary work; two empirical chapters therefore zoom in on case studies from East Africa and India for each of these sectors respectively (Chapters 4 and 5).

TABLE 1.1 Overview of case studies

ID	Case study	Country	City	Sector[(i)]	Featured thesis chapters	Author's involvement in research and related publications
1	Dockless bicycle-sharing scheme	China	Shanghai	Transport	6	Supporting researcher and co-author
2	Sponge cities programme		Wuhan	Water	6	Lead researcher and author
3	Waste picker cooperative	India	Ahmedabad	Waste	3, 4, 6	Lead researcher and author
4	Community-led participatory housing		Kochi and Trivandrum	Housing	4, 5, 6	Co-lead researcher and lead author
5	Residential rooftop solar		Delhi	Energy	6	Supporting researcher and co-author
6	Participatory slum upgrading	Kenya	Nairobi	Housing	6	Lead researcher and author (publications pending)
7	Energy efficient affordable housing	Mexico	Hermosillo	Housing	6	Co-lead researcher and lead author
8	Bicycle-sharing scheme		Mexico City and Guadalajara	Transport	6	Supporting researcher and co-author
9	Locally-led adaptation plan		Xalapa	Water	6	Supporting researcher and reviewer
10	Land registration programme	Tanzania	Dar Es Salaam	Housing	3, 5, 6	Lead researcher and author
11	Community-led participatory housing		Dar Es Salaam	Housing	3, 5, 6	Lead researcher and author
12	Solar-powered streetlights	Uganda	Jinja	Energy	3, 6	Co-lead researcher and co-author
13	Local waste-to-briquettes enterprise		Kampala	Waste	3, 4, 6	Lead researcher and author

Notes: (i) 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

Both these six primary cases and a further seven supporting cases are drawn on for theoretical and illustrative contributions that are used to suggest options for the extension and refinement of transitions theory (Chapter 6). The author was involved in these case studies in different ways (see Table 1.1), though always as either lead or supporting researcher.

A detailed description of each case study and its accordance with the selection criteria identified above can be found in the Appendices.

1.3.2 Methods for data collection and analysis

This thesis takes a mixed methods approach, drawing on methods and methodologies including discourse analysis, case studies and grounded theory. Data collection included both desk-based research (secondary data) and fieldwork (primary data). Desk-based research included a literature review, the gathering and analysis of policy documents, and a corpus-assisted discourse analysis. This method (explained further in Chapter 2, Section 4) involves combining quantitative linguistic analysis to identify statistically significant keywords, sequences of words, and linguistic patterns, with the more qualitative aspects of discourse analysis to interpret the way significant discussions are being framed.

The majority of empirical data was gathered through an embedded case study approach (Yin, 2017), where the regime of a particular UBIS in a particular city constituted the larger unit of analysis and non-conventional UBIS delivery models subunits of analysis. Data for these case studies was collected in various ways (see Table 1.2), primarily through semi-structured key respondent interviews and supported or triangulated with a variety of supplementary material gathered through focus groups, site visits, policy analysis, and extensive literature reviews.

TABLE 1.2 Overview of methods

Method	Number for primary cases	Total (including supporting cases)
Semi-structured interviews	67	145
Site visits	14	20
Focus groups	1	1
Multistakeholder workshops	0	4
Surveys	0	2 (with a total of 7,275 respondents)

Note: A breakdown of the specific methods used per case study can be found in Appendices.

1.3.3 Research paradigm

This research departs from a position of ontological and epistemological reflexivity in that it calls for the "analysis and revision of the very conceptual and methodological frameworks being used to investigate the urban process" (Brenner & Schmid, 2015). Inspiration is taken primarily from relativism, (social) constructivism and critical (urban) theory. This approach also builds on postcolonial urban studies that critique Euro- and American-centric traditions and call for theoretically reflexive interventions rather than ideological totalisations (Brenner & Schmid, 2015).

Relativism posits that reality is constructed and understood differently based on cultural, social, and contextual factors. This ontology is suitable for exploring how infrastructure and service delivery systems in the Global South are designed and operated according to local customs, practices, and societal needs, rather than Western-imposed standards. It does not seek to categorise one organisational form as better than another (Lawhon et al., 2018) but rather seeks to highlight that different service delivery pathways can be considered equally valid even if they exist outside of the academic mainstream.

Constructivism asserts that knowledge is constructed by individuals through interactions with their environment and society (Kukla, 2000). It emphasises the subjective nature of knowledge, recognising that different people may construct different understandings of the same phenomenon based on their experiences and contexts. Critical theory focuses on understanding and challenging power structures, inequalities, and injustices within society (Fraser et al., 2023). It emphasises the role of social, political, and economic factors in shaping knowledge and seeks to promote social change and emancipation. These epistemological stances can be merged to acknowledge that knowledge is socially constructed, and simultaneously to critically examine how dominant power relations and existing societal structures influence this construction. It is significant in terms of understanding how knowledge is created and maintained in ways that reinforce or challenge existing power dynamics. Such a blend of epistemological perspectives (Santos & Meneses, 2019) is appropriate for this research because it aims to understand how Southern infrastructures are perceived in accordance with dominant knowledge systems whilst also uncovering and challenging the structures that have led to the adoption of these ways of knowing even in contexts where they may not be suitable.

Primarily qualitative methods, with an emphasis on engaging with local stakeholders, are most suitable for reflecting the perspectives and experiences of those directly affected by the infrastructure being studied (Camfield et al., 2009). This aligns with the critical constructivist emphasis on the co-construction of knowledge and the importance it places on reflexivity in the research process. The research is thus positioned to explore how Southern experiences may transcend the boundaries imposed by Western theoretical conventions (Parnell & Robinson, 2012), exploring contextually grounded criteria for effective infrastructure and service delivery, such as accessibility, affordability, sustainability, and cultural relevance. The relativist ontology acknowledges that there are multiple valid ways of achieving infrastructure goals (Lawhon et al., 2018). This perspective supports the recognition of innovative and context-specific solutions that are effective in the Global South but may not align with Western standards.

1.3.4 Validity, bias, and data management

Guaranteeing the rigor and reliability of the findings of any research study is paramount. This section briefly addresses three critical aspects of research integrity: validity, bias, and data management. Validity ensures that the research most accurately reflects what is being studied; the mitigation of bias where possible – and the declaration of bias when it is unavoidable – safeguards against the misrepresentation of data and its analyses; and robust data management practices protect the integrity and security of the data and research participants throughout the research process.

For the purposes of this research, internal validity is interpreted in a postmodern sense to mean that the findings are valid at least for the context from which they have been derived (Bleijenbergh et al., 2011). External validity, taken as the extent to which the results of this study apply more broadly to similar or other contexts, is more complex, due in part to the constructivist epistemological stance outlined above, but is taken to mean the extent to which the results of this study can be considered plausible and credible (Findley et al., 2021). In this research, internal and external validity have been ensured in various ways: firstly, through triangulation, meaning findings were corroborated through multiple data sources; secondly, by putting in place clear inclusion criteria for case studies, which contextualises empirical findings, allows for comparability, and also helped to minimise selection bias; and finally, through transparent methodological procedures that went through multiple thorough peer-review processes.

When driven by such normative goals as those surrounding the sustainability agenda, bias is unavoidable. To mitigate bias at the level of the researcher, reflexivity was practiced throughout the research process, with regular self-assessment and critical reflection on the role of the researcher. The frameworks and the underlying assumptions were made explicit and were embedded in literature to give the reader the best possible understanding of the and to increase the interpretive validity (i.e. the degree to which the researcher interpreted and represented participants' thoughts and viewpoints accurately) (Johnson, 1997).

The data used in this thesis was collected through a combination of semi-structured interviews, surveys, site visits, policy document analysis, and literature searches (see also Tables 1.1 and 1.2 and Appendices). All data collection procedures were conducted in accordance with university protocols. Where possible, data is made available and open access through the university's research repository (DOI links are available for specific chapters). All data is anonymised. A Data Management Plan (DMP) was produced in consultation with and approved by the Data Steward of the author's host institution and is available on request.

Further reflections on and assumptions related to validity, bias, data management, and other methodological and managerial challenges are made explicit on a chapter-by-chapter basis.

1.4 Thesis outline

1.4.1 A paper-based thesis

This thesis is based on five academic journal articles (see Table 1.3), each of which constitutes one chapter. The chapters are linked to the aforementioned research questions as follows: the second chapter responds primarily to the first sub-question; the third chapter to the second sub-question; the fourth and fifth chapters both address the third sub-question through different cases; and the sixth chapter seeks to combine findings related to questions two and three (see Figure 1.5 for a visual outline).

Each chapter has been published as a peer-reviewed paper, meaning there is some repetition (for example in the introduction sections), as well as minor inconsistency in terminology throughout.

1.4.2 Chapter synthesis

1.4.2.1 Chapter 2: Conceptualising sustainable UBIS in transitions literature

Chapter 2 involves a corpus-assisted discourse analysis of the sustainability transitions literature on UBIS, conducted to tap into prevailing representations and conceptions of sustainability as it pertains to UBIS. Findings show that achieving sustainability in UBIS is discursively framed as a predominantly institutional and economic challenge. This results in a top-down techno-managerial transition approach that favours the application of technical fixes to environmental problems, often neglecting – or even at the expense of – social dimensions of sustainability. This chapter also serves to

substantiates claims that empirical data in transitions research originates primarily in Northern Europe, with comparatively few studies on transitions taking place in the Global South. However, it also shows that, though the few studies with a Southern focus still tend towards techno-economic solutions, they engage to a greater degree with social issues such as justice and equality, indicating the possibility of developing the transitions field further by testing its application in Southern contexts.

1.4.2.2 Chapter 3: Theorising UBIS transitions in the Global South

Chapter 3 attempts to exploit the multiple opportunities presented by testing a key transitions framework – the Multi-Level Perspective (MLP) – in the Global South. On the one hand, it contributes to diversifying the range of case studies in transition studies by drawing on illustrative examples of UBIS from Uganda and India. On the other hand, it contributes to the further development of the MLP by identifying opportunities to pay greater attention to the social dimensions of sustainability. It usefully highlights the ways in which niche service delivery models can contribute to the transition towards a more socially and environmentally sustainable cities, but also shows that the framework requires some refinement, particularly with regard to the core analytical concepts of niche and regime.

1.4.2.3 Chapters 4–5: Alternative organisational forms for the delivery of urban basic infrastructure services in the Global South

Chapters 4 and 5 present the results of research that contributes both to the refinement of transitions frameworks (as called for in chapter 3) as well as more broadly to empirical understandings of non-conventional organisational arrangements for UBIS delivery. These chapters each zoom in on a particular UBIS, specifically the two most underrepresented in transition studies to date, namely waste and housing. Chapter 4 explores two examples of alternative waste management practices: the Self Employed Women's Association (SEWA) in Ahmedabad, India; and the Lubaga Charcoal Briquette Cooperative Society (Luchacos) in Kampala, Uganda. Chapter 5 takes case studies from the housing sector: in Kerala, India, a community-based organisation called Kudumbashree that led the local implementation of a national slum-upgrading programme (Basic Services for the Urban Poor (BSUP)); and in Dar Es Salaam, Tanzania, both the nationally-led 20,000 Plots Project and the locally-led Chamazi Housing Cooperative. Each chapter highlights the governance characteristics that enabled or constrained the success of the UBIS delivery.

1.4.2.4 Chapter 6: Organising UBIS for climate and development

Chapter 6 presents a synthesis of the conceptual and empirical evidence gathered on the organisational arrangements being employed to deliver UBIS in Southern cities. It draws on findings from the previous chapters as well as an analysis of 13 case studies from cities across East Africa, Asia and Latin America that illustrate how unorthodox infrastructural practices often (attempt to) connect both social and environmental aspects of sustainability in the practice of delivering UBIS. It draws conclusions regarding the potential of different governance arrangements and reflects on the implications of these results theoretically, in the context of Southern Urbanism, and for the field of sustainability transitions. It offers a set of theoretical propositions for the further refinement of the MLP framework.

1.4.2.5 Chapter 7: Conclusions

The thesis ends with a conclusions chapter, where the research questions are answered. It closes by reflecting on the limitations of the study and offering recommendations for further research, policy, and practice.

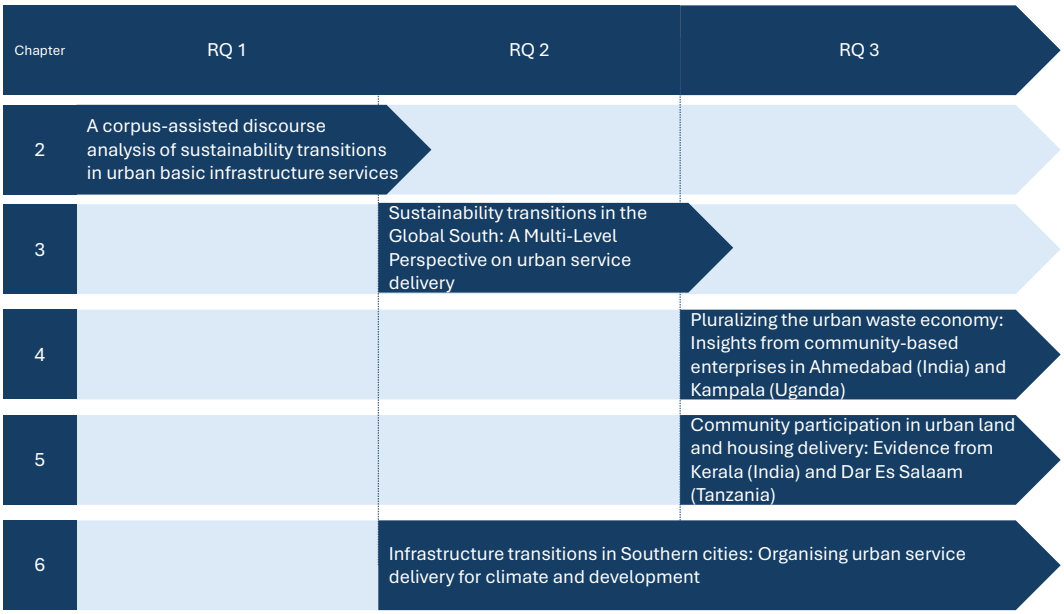

FIG. 1.5 A visual outline of the thesis structure. Source: Author.

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TABLE 1.3 Overview of publications

Chapter	Main research sub-question	Title and reference	
2	How are sustainability transitions in UBIS currently conceptualised?	A corpus-assisted discourse analysis of sustainability transitions in urban basic infrastructure services (Oates et al., 2022)	
3	What are the gaps and opportunities of applying transitions frameworks to UBIS in the Global South?	Sustainability transitions in the Global South: A multi-level perspective on urban service delivery (Oates, 2021)	
4	How can alternative organisational arrangements in Southern cities contribute to sustainable UBIS delivery?	Pluralizing the urban waste economy: insights from community-based enterprises in Ahmedabad (India) and Kampala (Uganda) (Oates et al., 2023)	
5	How can alternative organisational arrangements in Southern cities contribute to sustainable UBIS delivery?	Community participation in urban land and housing delivery: Evidence from Kerala (India) and Dar es Salaam (Tanzania) (Oates et al., 2024)	
6	How can theoretical and empirical contributions from the Global South inform the transition to sustainable UBIS?	Infrastructure transitions in Southern cities: Organising urban service delivery for climate and development (Oates & Sudmant, 2024)	
7	All	Resilient infrastructure as an accelerator of transformative climate action in cities (Chapter 6 - UN Habitat, 2024)	

	Synopsis	Publication	Methods	Data/case studies	Publication date
	Engages with the definition of sustainability commonly adopted (explicitly or implicitly) in transitions studies.	European Journal of Spatial Development	Corpus linguistics analysis	Database of articles from systematic literature review	2022
	Draws on empirical data from two cases of experimental urban basic infrastructure service delivery from Southern cities to provide insights for the use of the Multi-Level Perspective on transitions.	Regional Studies Regional Science	Grounded theory and two comparative case studies	Illustrative data from SEWA, Ahmedabad and MDF, Jinja	2021
	Studies the role that local (often informal) entrepreneurs play in service delivery in Southern cities, and the potential for such niches to interact with regimes, particularly by problematising the "opportunity or necessity" entrepreneur dichotomy.	Environment and Urbanization	Two comparative case studies	Qualitative data collected on case studies: SEWA, India and Luchacos, Uganda	2023
	Problematises the assumption that the state should be either a provider of housing, or that it should enable the market to do so, by exploring case studies of cooperative or community-based housing provision.	Land	Two comparative case studies	Qualitative data collected on case studies: Kudumbashree, India and Chamazi, Tanzania	2024
	Explores the relevance of transitions theory in the context of non-conventional urban infrastructure service delivery in Southern cities.	Urban Planning	Multiple case studies	Meta-analysis of case studies and theoretical reflection (see also appendices)	2024
	A contribution to a bi-annual report on the state of the world's cities, in which information from this thesis was used as background input for the named chapter. The chapter explores the interactions between urban infrastructure and climate change.	UN Habitat World Cities Report	N/A	N/A	2024

2 A corpus-assisted discourse analysis of sustainability transitions in urban basic infrastructure services

This chapter has been published as:
Oates, L., A. Edwards, A. Ersoy & E. van Bueren (2022). A corpus-assisted discourse analysis of sustainability transitions in urban basic infrastructure services. *European Journal of Spatial Development*. DOI: 10.5281/zenodo.6965763.

A full list of the peer-reviewed articles that were included in the corpus is available via the 4TU.ResearchData repository (DOI: 10.4121/20424645).

ABSTRACT Basic infrastructure services – water and sanitation, waste collection and management, transport, energy, and housing – form the foundation upon which cities are built. Sustainable and equitable provision of services is key to combating climate change, eradicating poverty and meeting targets set out in international sustainability agendas. However, even as the language of the sustainability transitions literature is being appropriated by governments, social movements and practitioners, the concepts of sustainability and sustainability transitions remain ill-defined and often narrowly applied. A corpus-assisted discourse analysis of the sustainability transitions literature on urban basic infrastructure services is conducted to tap into prevailing representations and conceptions. Findings show that the delivery of sustainable urban services is discursively framed as a predominantly institutional and economic challenge, favouring a top-down techno-managerial approach to transitions that applies technical fixes to environmental

problems at the expense of social dimensions of sustainability. While some studies, such as those with a focus on the Global South and/or water and sanitation services, engage to a greater degree with issues such as justice and equality, they still tend towards technical and economic solutions. An integrated approach encompassing all dimensions of sustainability and a broader understanding of infrastructure services not as separate, single-purpose technologies but as part of interconnected systems with multiple social, economic and environmental objectives is needed if humanity is to transition to a more sustainable urban future.

2.1 Introduction

Cities are engines of economic growth, sites of innovation, and provide spaces for social transformation and political inclusion. This is the case since urban areas concentrate technical, political and human capacity, which they attract and retain due largely to the availability and quality of infrastructure and the associated urban service delivery (USD) (Boex et al., 2016). The sustainable provision of basic infrastructure services is therefore fundamental for maintaining and improving the living standards of urban citizens, managing a city's ecological footprint, and harnessing opportunities for prosperity. USD encompasses the (mostly) physical, engineered systems that make a city, as well as the totality of interactions, rules, norms and values that govern those infrastructures. Urban basic infrastructure services (UBIS) include water and sanitation, waste collection and management, transport and energy, which "form the foundation on which human settlements are built and function" (Satterthwaite, 2014, p. 3), as well as housing, the primary means by which citizens access the other services (Satterthwaite, 2020).

UBIS are directly or indirectly responsible for a significant proportion of greenhouse gas emissions (Müller et al., 2013; Williams, 2013), yet their efficacy is also key in building the resilience of urban areas and their citizens to environmental shocks such as those caused by climate change. The transition to more environmentally sustainable and socially inclusive forms of USD is therefore urgently required in order to achieve the objectives of the Sustainable Development Goals (SDGs) and the Paris Agreement, an imperative which has become all the more prominent in recent years as the COVID-19 crisis exposed the failings of the neoliberal development model (Dutch Footprint Group, 2020). It is widely agreed that standalone interventions will be insufficient to address these challenges at the required scale.

Accordingly, theory and practice are increasingly focused on sustainability transitions. 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). Sociotechnical systems – including for example energy supply, water supply, and transportation 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 *sustainability* transition, therefore, refers to the evolution of both social and technological institutions towards sustainability (Köhler et al., 2019).

Yet precisely what sort of sustainability transition could lead to more economically, environmentally and socially sustainable USD remains unclear. Within transitions studies, no single definition of sustainability has been agreed upon, and studies rarely make their interpretation of the term explicit (Fischer-Kowalski, 2011). Those that do, typically refer to the Brundtland definition of sustainable development (Frantzeskaki et al., 2012), a different, though related, concept defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 4). The term *transition* (or *transformation*) remains similarly ill-defined: it is often unclear what sort of transition is sought, by and for whom (Scoones et al., 2020).

Beyond purely definitional issues, sustainability transitions in USD remain a relatively young subject with acknowledged conceptual gaps (Geels, 2011). Almost two decades since the first publication appeared in this field (M. K. Weber, 2003), it is worth taking stock of the state of the art by teasing out "incompleteness, hidden assumptions, unthought-of consequences [and helping] keep open for reassessment that which may otherwise slide into taken-for-grantedness" (Corvellec et al., 2021, p. 1). Accordingly, the objective of this chapter is to offer an investigation of academic discourse in the field of sustainability transitions in USD. This is not only an academic exercise: with the language of sustainability transitions theory increasingly being appropriated by governments (e.g. "innovation policies"), research and policy organisations (e.g. "Coalition for Urban Transitions") and social movements seeking to challenge the current system (e.g. "Transition Network") (Feola, 2020; Swilling & Annecke, 2012), how the notion of sustainability is interpreted and how sustainability transitions are envisaged in USD research is of paramount importance.

In this context, a broad and perhaps the most universal definition of sustainability is used: that of the United Nations, which encompasses economic, environmental and social dimensions underpinned by institutional dimensions of sustainability (Figure 2.1). These pillars were explicitly embedded in the formulation of the United Nations' SDGs (UN, 2012) and, despite some criticism of their theoretical foundations (Purvis et al., 2019), largely guide contemporary sustainability research and policy.

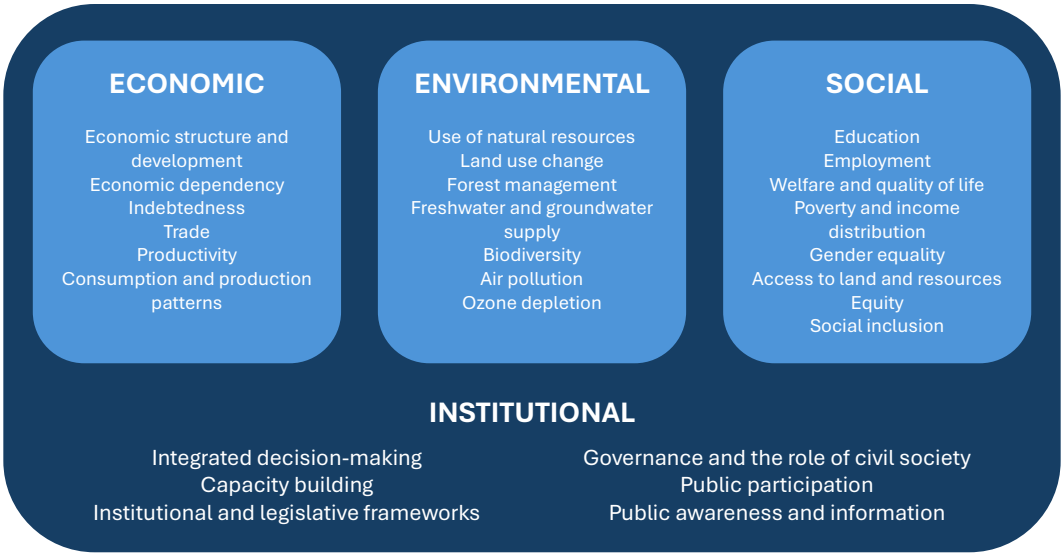

FIG. 2.1 Dimensions of sustainability, adapted from United Nations (2001). Source: Author.

Against this backdrop, it has been asserted that sustainability transitions theory is too narrowly focused on technological innovation, economic efficiency and ecological considerations at the expense of social issues (Block & Paredis, 2019; Hegger et al., 2007; Lankoski, 2016). Moreover, research has been critiqued for focusing on specific infrastructure technologies without locating them within the entire system of social, economic, environmental and institutional inputs that determine the sustainability of USD (Corvellec et al., 2013; Oates et al., 2018) and for being primarily developed and applied in cities of the Global North (Markard et al., 2012; Oates, 2021; Wieczorek, 2018).

This chapter analyses academic discourses on sustainable USD and their intersection with the UN's four dimensions of sustainability with a view to accessing the prevailing conceptions of sustainability, pinpointing the types of sustainability transitions envisaged for USD, and simultaneously identifying blind spots or gaps in the field. It specifically asks how sustainability transitions are envisaged in academic discourses

on UBIS, and how they manifest differently in different geographical regions and for specific urban services. Systematic insight into the prevailing conceptions will enable the description of the perceived scope of the field as well as its discursive limits. It is hoped that a broader understanding of sustainability transitions can ultimately help both theorists and practitioners to harness co-benefits across all four pillars of sustainability: economic, environmental, institutional and social.

The remainder of this chapter is organised as follows. Section 2 briefly discusses discourse-analytic approaches as they have been applied to sustainability transitions theory. Section 3 describes the data, and the corpus-assisted methodology employed to collect and analyse it. Results are presented in Section 4, distinguishing between general findings, and findings specific to one UBIS sector and to one geographical region. Finally, Section 5 links the chapter's main findings to the UN dimensions of sustainability and concludes with implications for transitions research.

2.2 Discourse analysis and sustainability (transitions) theory

In its broadest sense, discourse can be described as language-in-use (Blommaert, 2005, p. 2), although discourses can also be conceptualised in a more Foucauldian manner as ways of "constructing objects and concepts in certain ways, of representing reality […] with attendant consequences for power relations" involving for example gender, class or ethnicity (Baker & McEnery, 2015, p. 5). Discourse analysis has been fruitfully applied in previous environmental and sustainability research, largely with a view to identifying different strands or typologies within institutional, activist or media discourses. For example, (Dryzek, 2013) distinguished between four types of environmental discourses: sustainability, survivalism, problem solving and green radicalism. (Stevenson, 2019) identified three international discourses on sustainable development: radical transformationism, cooperative reformism and statist progressivism. Focusing specifically on transition discourse, (Audet, 2016) used a qualitative coding approach to identify two main discursive strands: localism and technocentrism.

In recent years, a handful of climate and sustainability researchers involved with discourse-analytic approaches have engaged in interdisciplinary research with corpus linguists (Feola & Jaworska, 2019; Grundmann & Krishnamurthy, 2010). Broadly, corpus linguistics involves the analysis of a large body of machine-readable texts that, due to its size, defies analysis by hand (McEnery & Hardie, 2011, p. 2). Corpus-assisted discourse studies (CADS) (Baker et al., 2008; Partington, 2006; Partington et al., 2013) bring together primarily qualitative discourse analysis with essentially quantitative corpus linguistics in a complementary fashion (McEnery et al., 2006, p. 111). While discourse analysis emphasises the situated nature of language as shaped by the behaviour and attitudes of social actors, corpus-linguistic techniques can help to avoid some of the pitfalls of traditional discourse analysis:

> The principles of representativeness, sampling and balance which underlie corpus building help to guard against cherry-picking, while corpus-driven techniques like keywords help us to avoid over-focussing on atypical aspects of our texts. Corpus techniques can thus reassure readers that our analysts are actually presenting a systematic analysis, rather than writing a covert polemic (Baker & McEnery, 2015, p. 4).

A CADS approach is used to analyse academic discourse on sustainable USD. To systematically uncover discursive patterns in the corpus and identify representative illustrations of those patterns, the classic corpus techniques of keywords, collocations and concordances is used. *Keywords* are words that are more salient in one corpus than in another corpus. They are seen as robust indicators of the dominant discourses in a corpus, i.e. what the corpus is "about" (Bondi & Scott, 2010). Keywords are identified by comparing the relative frequency of a lexical item in one corpus to its relative frequency in a "reference corpus" to identify words that are statistically over- or underrepresented. The reference corpus is often one of the freely accessible mega-corpora that are seen as representative of a notional "standard", such as the British National Corpus (BNC), or a subset of the corpus under investigation in order to tease out discursive differences more precisely (Baker, 2004). The chosen reference corpus for this research is the BNC, and subcorpora are created by dividing the main corpus in various ways to answer the research questions.

While keywords provide an "entry point" to the data (Baker, 2004), *collocations* reveal more about the associated values and discourses. Collocations are sequences of words that occur in a corpus statistically significantly more frequently than would be expected if the words were arranged randomly. As preferred patterns of discourse in a given community of practice, collocations are lexical associations that have been reified through repeated use and can thus be seen as indicative of dominant ideologies (Stubbs, 1996, 2001).

Keyword and collocation analysis are essentially quantitative techniques that lead into an analysis of *concordances*, which highlight given lexical items and the surrounding words in a text. Accessing every instance of a word in its original context allows the research to become more situated and qualitative, facilitating the selection of representative examples for illustrative purposes.

Finally, this approach is combined with frame analysis (Goffman, 1974), which is concerned with how an issue is defined and what effect this has on discussion of the issue, for example by drawing attention to particular aspects and obscuring others. The sociological notion of "frame" refers to the culturally determined constructs by which people make sense of reality. In this article, the four pillars of the United Nations' definition of sustainability (Figure 2.1) are considered as frames in Goffman's sense. The intention is not to pass judgement on the UN definition of sustainability but rather use it as a departure point from which to reflect on what is (or is not) currently assumed to constitute sustainable USD, and what dimensions may require further attention. Deductively mapping keywords, collocations, and concordances in relation to this definition provides insight into whether the discursive framing of sustainable USD is relatively balanced, or is skewed in favour of one or more of the pillars of sustainability.

2.3 Data and methods

2.3.1 The corpus

A corpus of academic discourse in the field of sustainable USD was created by searching two online academic databases, Scopus and Web of Science, based on title, abstract and keywords in June 2021.[1] All articles published in English in the field of sustainability transitions focusing on at least one of the aforementioned UBIS – water and sanitation, waste collection and management, transport, energy, or housing – were extracted.[2] To ensure the research is from within the field of sustainability transitions as opposed to merely using its language, research must utilise at least one of the key analytical frameworks associated with transitions studies, as identified by (Markard et al., 2012). More specifically, only papers which utilise the Multi-Level Perspective, Strategic Niche Management and/or Transition Management were included. Studies using the Technological Innovation Systems framework were excluded due to its explicit focus on discrete technologies rather than broader patterns of transformation (Wieczorek, 2018). This chapter is more interested in transformations relating to the organising principles of UBIS than a specific technological innovation.

The search yielded 202 results, which were then manually screened in order to exclude duplicates and papers that were not peer reviewed, did not focus explicitly on a basic infrastructure service or were not urban in scope. The main corpus comprises the remaining 107 articles,[3] consisting of a total of 953,779 words, with an average of 8,913 words per article excluding references (see Table 2.1).

1 The search string was as follows: (“sustainability transition” OR “sociotechnical” OR “socio-technical” OR “transform*”) AND (“multi-level perspective” OR “multilevel perspective” OR “transition management” OR “strategic niche management”) AND (“urban” or “city” OR “cities”) AND (“waste” or “water” OR “sanitation” OR “energy” OR “transport” OR “mobility” OR “housing”).

2 Social services such as education, healthcare, childcare, urban planning and public safety are of course also fundamental to human development but are not included here.

3 A full list of the peer-reviewed articles that were included in the corpus is available via the 4TU. ResearchData repository (DOI: 10.4121/20424645).

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TABLE 2.1 Description of main corpus and subcorpora

Corpus	Number of texts	Number of words
Main corpus	107	953,779
Geographical subcorpora		
Global North	70	624,634
Global South	30	267,781
Other	7	61,364
Total	107	953,779
Sectoral subcorpora		
Energy	33	294,266
Housing	8	62,358
Transport	37	338,549
Waste	2	15,574
Water and sanitation	26	237,586
Other	1	5,446
Total	107	953,779

Notes: The category "other" refers to articles that did not identify a specific focus, either geographically or by sector.

Though the earliest record was published in 2003, three-quarters of the articles were published between 2015 and 2021, indicating the burgeoning current interest in, yet relative adolescence of, sustainability transitions in USD. All articles were converted to .txt files for further analysis, with the references removed to ensure that the lexis contained therein would not skew the results.

In addition, several subcorpora were created, including for those articles primarily focused on the Global North (n=70) versus the Global South (n=30), excluding those without a specific focus country (n=7). For the purposes of this chapter, the Global North includes countries classified by the United Nations as developed economies and economies in transition, while the Global South includes those classified as developing economies (UNDESA, 2021).[4] Close to half of all studies (n=45) were conducted in Europe, perhaps reflecting the provenance of the most cited authors, many of whom come from or are based in the Netherlands, Scandinavia and the United Kingdom (Markard et al., 2012). Asia was the second most studied continent (n=18), yet two-thirds of studies in this region concerned China (n=12), with the rest of South and South-East Asia comparatively neglected. Africa and Latin America

4 The authors recognise that both the term and the concept of the Global South are contested. Increasingly, the term "Global South" is also understood as a way to conceptualise a deterritorialised political economy of the uneven processes of economic development generated by capitalism and colonialism.

are similarly underrepresented in this review, with only two records from each, though it is also important to note the English language limitation may affect this, with Latin American research in particular likely to be published in non-Anglophone journals. Still, this is in line with previous assertions that transitions processes in the Global South are a relatively new area of study (Oates, 2021; Wieczorek, 2018). The most studied countries were Australia (n=12), China (n=12), the United Kingdom (n=7) and Germany (n=6).

The articles were also divided into subcorpora based on the basic infrastructure service under investigation. All but one article focused on a single sector. Transport (n=37), energy (n=33) and water and sanitation (n=26) were the most common, between them accounting for more than 90% of all studies. Housing (n=8) and waste management and collection (n=2) were comparatively neglected. As such, the latter two were not included in the corpus-based discourse analysis since the associated subcorpora are not large enough to draw conclusions from, though given that transitions thinking is by definition a systemic perspective, the relative neglect of these sectors is in itself noteworthy.

2.3.2 Data analysis

All analyses were performed using AntConc (Anthony, 2020), a freely available corpus-analysis software tool. First, a keyword analysis was performed of the main corpus compared against the BNC. The top 100 most distinctive keywords were deductively coded using the four dimensions of the UN definition of sustainability: economic, environmental, social, and institutional. As shown below, in addition to these four frames, two further themes were inductively identified as being particularly noteworthy: (i) technical, and (ii) spatial and temporal context. Illustrative concordances of the most statistically significant collocates for each keyword were then calculated and extracted. This quantitative coding process combined with a qualitative analysis of significant collocates allowed the access of dominant discourses and conceptions of sustainability within the transitions literature. Next, using the same method, keywords, collocations and concordances were extracted for each of the two regional and three sectoral subcorpora compared to the rest of the corpus to reveal discursive patterns and interpretations of sustainability distinctive to each geographical region and basic infrastructure service under investigation.

2.4 Results

2.4.1 Primary corpus findings

The first 100 most distinctive keywords are shown in Table 2.2, and with their coded associations in Figure 2.2. As noted, keywords are those that are statistically significantly overrepresented in one corpus compared to another. In this case, these keywords illustrate the "aboutness" of the sustainability-transitions corpus as compared to a corpus of general British English (the BNC).

TABLE 2.2 100 most distinctive keywords in main corpus cf. BNC, listed alphabetically

Access	Electric*	Municipal	Sector
Activities	Environment*	National	Smart
Actor*	Experiment*	Network*	Social
Alternative	Future	People	Societal
Area*	Global	Perspective	Solar
Biogas	Governance	Place	Solutions
Bus	Government	Planning	Space
Business	Green	Policy*	Stakeholders
Capacity	Grid	Political	State
Car	Growth	Power	Strategy
Carbon	Group*	Practices	Structures
Challenges	Implementation	Pressure	Supply
Climate	Individual	Private	Support
Community*	Industry	Problems	Sustainable
Companies	Initiatives	Process*	System
Conditions	Innovation*	Production	Technical
Construction	Institution*	Project	Technology*
Current	Issues	Public	Time
Cycling	Knowledge	Regional	Users
Demand	Learning	Renewable	Vehicles
Development	Local	Resources	Vision
Dynamics	Management	Role	Years
Economic	Market	Scale	

*Notes: (i) Words removed from the lists of most distinctive keywords include: terms appearing in or closely related to the search string (e.g. multilevel, regime, service); words appearing frequently but only in one record (e.g. ropeway, jeepney); words clearly related to research (e.g. study, research); proper nouns (e.g. China, Curitiba); and function words, including articles, auxiliary verbs, conjunctions and prepositions. (ii) Lexical items with the same base lemma are combined e.g. plurals (technology and technologies) and derivative forms/modifiers (democracy and democratic), indicated by *.*

2.4.1.1 Institutional frame

The institutional frame included terms that can be associated with the political or social organisations involved in policy making or implementation (e.g. *actors*, *government*, *power*[5], *role*, *stakeholders*, *state*), the ways in which their decision-making processes may be carried out (e.g. *management*, *perspective*, *results*) and the availability of information (e.g. *capacity*, *knowledge*, *learning*). Since transitions research is often critiqued for failing to adequately engage with issues of power and governance (Loorbach et al., 2011), it is notable that the institutional frame figures so prominently. Exploring the collocates[6] of *governance* revealed that it is most frequently paired with *experiment* (and its associated lemmas, i.e. derivative forms), a phrase that appears a total of 218 times, for example in the following excerpts:

> These findings further explicate the importance of well-designed and organised **governance experimentation**, for this allows the development of concurrent and embedded social learning situations, which together have the potential to create momentum for socio-technical system change (Bos et al., 2013, p. 410).

> There is a need to better connect differentiated place-based processes of experimentation with the wider forms of **governance experimentation** that structures and conditions these differentiated urban responses (Hodson et al., 2017, p. 5).

The discourses surrounding governance and policy experimentation for transitions and its benefits in advancing social learning (Bos et al., 2013; R. R. Brown et al., 2013; Wutich et al., 2020) and supporting the accelerated diffusion of infrastructural reconfigurations (Hodson et al., 2017; McLean et al., 2016) are suggestive of a somewhat flexible approach to governing uncertain transition processes. Other lexical associations in the institutional frame are, however, more indicative of a techno-managerial approach (*implementation*, *management*, *planning*, *process*, *sector*), characterised by the deployment of a range of corporate-style strategic policy tools linked to governance and sustainability indicators (Guibrunet, 2021).

5 Power in this corpus could be used in two distinct ways: power relations between stakeholders, or power to generate energy. Checking its collocates showed that it was most frequently associated with the word relations and also often with the terms politics and dynamics, and so it is included here in relation to governance. However, it also appeared frequently with words such as wind, combined and solar to refer to power generation.

6 A collocate is a constituent component of a collocation, e.g. the collocation governance experimentation is made up of collocates governance and experimentation.

2.4.1.2 Economic frame

This techno-managerial approach is reflected, too, in the prevalence of keywords coded under the economic frame, particularly those related to the activities of the private sector (e.g. *market, business*, *company*, *economic*, *industry*). This corresponds to the increasingly widespread application of neoliberal policies aimed at the privatisation and financialisation of municipal services based on the assumption that private companies are more efficient than state agencies (Mazzucato, 2011). Indeed, the collocates of *market*, for example, show that much research is concerned with how fundamental change might be influenced by factors such as market *reforms*, the market *share* that innovations have or may be able to achieve, competition amongst (new) market *players*, and market and consumer *preferences*.

Tariff reforms are essential in order to create a more favorable **market** environment for RE [renewable energy] to make a business case (Mah, 2020, p. 19).

The rise of piped water was a catalyst that stimulated the diffusion of a range of hygienic products, such as water closets, baths, showers, washing machines, washing bowls. Although these products already existed before piped water, their **market** share was greatly stimulated by piped water (Geels, 2005, p. 392).

All these countries have different strengths and weaknesses regarding their innovative ability, **market** structure, and consumer preferences, and a forthcoming technological shift would represent different opportunities and risks for each (Steinhilber et al., 2013, p. 537).

2.4.1.3 Environmental frame

The strong discursive focus on economic factors is tempered to an extent with environmental considerations through research related to building a green economy. The collocates for keyword *green* reveal that it is used primarily in two ways. Firstly, it refers to specific infrastructures related to the built environment (e.g. *building*, *construction* and *housing*).

Financial returns have been shown to drive the **green building** innovations and fundamentally improve building energy consumption of the structure in the long-term (Jiang & Payne, 2021, p. 2).

Secondly, it is also commonly associated with economic terms (e.g. *economy* and *growth*), suggesting a commitment to an urban transition that involves continued economic development whilst simultaneously reducing negative environmental externalities:

ULEV-policies since the 2010s represent a stronger climate change strategy, which are motivated by the hope of creating "**green growth**" potential for the UK car industry (Geels, 2018, p. 99).

This ideology is increasingly critiqued for its failure to engage with discussions around whether fundamental transformation is possible within a capitalist system (Feola, 2020) and for its narrow interpretation of environmental challenges as climate change. The presence of other environmental keywords – such as *carbon* and *climate* – suggest that much research is specifically focused on the transition to low-carbon USD but pays less attention to a wider range of environmental issues such as biodiversity loss or land use change.

2.4.1.4 Social frame

Aspects relating to the social dimension of sustainability are similarly underrepresented. *Community, people, social* and *societal* are the most relevant keywords in this frame, though other terms may have a secondary connection to issues related to social sustainability and social justice (e.g. *power*, see also footnote 5) or may be linked indirectly to social aspects of sustainability transitions. For example, *cycling* is a mobility form which has wider societal benefits (Sudmant et al., 2020). The most statistically significant collocates for *societal* are *embedding* and *acceptance*, reflecting a concern with how to increase the uptake of specific technologies:

While there seems to be broad agreement that restrictions for private cars are inevitable to enable a real transition towards multimodal transport, many of the interviewed actors doubt that such measures will find the necessary political and societal acceptance (Schippl & Arnold, 2020, p. 12).

2.4.1.5 Additional frames

Two new themes, in addition to the four UN pillars of sustainability, have also been identified. Firstly, the prevalence of keywords relating to technology (e.g. *technical*, *technolog** and *smart*) may reveal something about how the transition to more sustainable USD is envisaged. The collocates for *smart* reveal that it is often associated with specific infrastructural technologies such as *meter* and *grid*, as well as with *city* (i.e. smart city). On the one hand, this is unsurprising in a literature focused on socio*technical* transitions. On the other hand, it corresponds with the notion that technologies and innovation, rather than concepts and guiding principles, form the most frequent starting point in addressing challenges to the delivery of basic infrastructure services (Hegger et al., 2007), whereby technical solutions underpin progress towards a more sustainable future (Clark et al., 2004). The excerpts below are illustrative of a discourse that suggests smart technologies may solve sustainability challenges:

Alongside the role out of **smart** grids and appliances, this future envisages widespread application of novel and disruptive materials and products (for example, vacuum panel insulation and phase change materials) to improve the energy performance of existing buildings (Dixon et al., 2018, p. 257).

The second newly identified frame concerns spatial and territorial configurations of USD and their temporal context. Some of the keywords are used primarily in describing case studies (*area*, *years*), while others serve as reminders that urban infrastructure is grounded in place and time:

This highlights variable **place**-based capability to shape experimental processes and variable effects (Hodson et al., 2017, p. 9).

The inclusion of keywords from *local*, *municipal* and *regional* to *national* indicates that urban infrastructure is influenced by rules and regulations across spatial scales, and not just at the city level:

While **municipal** governments are constrained by federal and provincial definitions of e-bikes, they do have some authority to implement by-laws (Edge et al., 2020, p. 203).

The regime defining the energy sector is influenced by the relation between […] policies and regulations (from **municipal**, **national**, supranational levels) (Bukovszki et al., 2020, p. 5).

2.4.1.6 Interim conclusions: Primary corpus

The coding of keywords from the primary corpus into different frames has shown that lexical items associated with institutional and economic factors appear most prominently. The environmental frame is less prevalent and where it is used, it is most frequently in relation to a green economy, suggesting environmentally sustainable UBIS are conceptualised within the economic growth model advanced by the existing capitalist system. Similarly, the social frame is less salient and is conceived less in terms of benefits to society and more with a view to establishing societal acceptance of initiatives and technologies. In addition to the four UN frames, a prevalent technological frame and a frame concerned with the spatial and temporal context of USD were also identified.

Connections are visualised in Figure 2.2, which shows for illustrative purposes how the keywords have been mapped onto the respective frames. It highlights for example where there are overlaps and reveals, in particular, a high degree of overlap between the economic, institutional and technological frames. It also shows the relative smallness of both the environmental and social frames.

2.4.2 Subcorpora findings

2.4.2.1 Dominant discourses per UBIS sector

As previously mentioned, more than 90% of the papers in the primary corpus focus on the sectors of energy, transport and water and sanitation. The distinctive keywords for these three subcorpora are shown in Table 2.3.

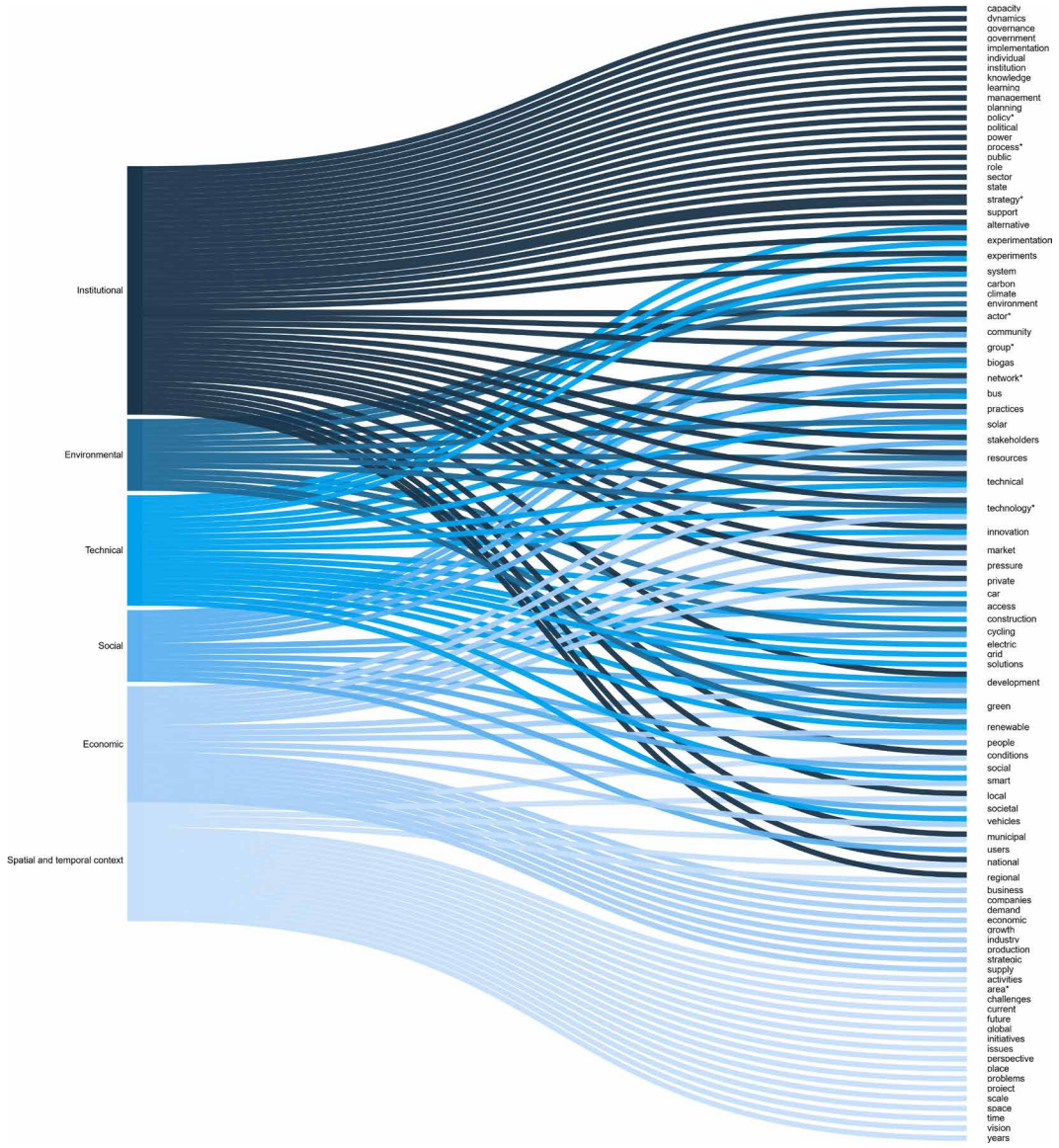

FIG. 2.2 Associations between frames (left) and keywords (right). Source: Author; Data visualisation produced using sankeymatic.com.

TABLE 2.3 50 most distinctive keywords per subcorpus based on UBIS, alphabetically

UBIS	Distinctive keywords
Energy	Affordances, biogas, biomass, carbon, CHP [combined heat and power], coal, community*, company, consumption, council, DH [district heating], district, eco, economy, electricity, electrification, EPC [energy performance contracting], experiments, food, fossil, gamma, garden, gas, generation, geothermal, grid*, heat, heating, industrial, intermediary*, lifecycle, local, meter, milieu, national, networks, nuclear, periphery, production, progression, PTA [public transport authority], PV [photovoltaics], renewable, resilience, smart, solar, storage, subsystems, SWH [solar water heater], wind
Transport	Auto, automakers, automated, automobil*, automotive, AV* [Automated Vehicle], bicycle*, bike*, bus, car*, carsharing, charging, congestion, constituencies, cycling, cyclists, drive, electric, epistemic, EV* [Electric Vehicle], fleet, future, justice, LEVs [Low Emission Vehicles], MaaS [Mobility as a Service], megacities, metro, modal, mode*, motorcycle, multimodal, parking, passenger, private, public, rail, road, route*, safety, sales, scooter*, sharing, taxi*, traffic, transit, travel, trip*, upscaling, vehicle*, walking
Water and sanitation (WASH)	Blue, brown, capacity, catchment, champions, change, contamination, democra*, desalination, drainage, drinking, drought, frontrunners, governance, groundwater, harbour, harvesting, hygiene*, initiative, institution*, IWRM [Integrated Water Resource Management], learning, management, monitoring, municipalities, navigational, NGO [Non-Governmental Organisation], organisational, piped, port, principles, process, rainwater, recycling, reuse, river, sanitation, science, sensitive, shadow [network], storm, stormwater, SUWM [Sustainable Urban Water Management], swimming, treatment, wastewater, waterway, WSUD [Water Sensitive Urban Design]

*Notes: Lexical items with the same base lemma are combined e.g. plurals (technology and technologies) and derivative forms/ modifiers (democracy and democratic), indicated by *.*

In the energy subcorpus, the relative dearth of both social and institutional terminology, and the presence of a wide range of specifically technical terminology (*biogas, CHP, DH, PV, renewable, smart, solar, storage, SWH, wind*), suggests that the energy transition is principally envisaged as a technology-based switch from fossil fuels to renewables and low-carbon fuels:

> Specific technologies and strategies for increasing resiliency include building microgrids on critical infrastructures, modernizing transmission and distribution through **smart grids**, installing powerlines underground in high wind areas, increasing battery storage and onsite backup generation, **combining heat and power** systems, and implementing stricter vegetation management (Ko et al., 2019, p. 10).

Similarly, the keywords in the transport subcorpus also show a clear trend towards the technical dimension of sustainability, e.g. *automated, AV [automated vehicle], EV [electric vehicle], LEV [light electric vehicle],* and *MaaS [Mobility as a Service]*. Again, technological fixes focusing on the physical aspects of infrastructure are prominent in this literature, in particular in relation to making cars greener:

> As **EV's** emerge on the market, a physical infrastructure for recharging marks an essential feature for **EV** uptake. Here, strategies emphasise the rolling out of charging stations in advance (Held & Gerrits, 2019, p. 17).

Such technologies are intended to reduce emissions, but also to be profitable. As such, they often have costs attached, likely precluding access by some populations. Such business models may also continue to encourage excessive consumption. Further, private electric vehicles do not address traffic congestion, nor do they encourage urban planning to move away from sprawling cities designed with private car ownership in mind.

On the other hand, the keyword analysis also reveals attention for mobility modes that are linked to social and environmental benefits, including *cycling, multimodal, public* and *sharing*. Shared cycle schemes, for example, are low cost, compatible with existing transport infrastructure and familiar to most populations.

In the water and sanitation sector (WASH), institutional aspects are prominent. Particularly noteworthy are keywords *frontrunners* and *champions*, with many studies focused on specific good practices in water infrastructure transitions such as Integrated Water Resources Management (IWRM), Sustainable Urban Water Management (SUWM) and Water-sensitive Urban Design (WSUD). These frameworks are designed to coordinate the management of land and water resources in a given catchment area while maximising social welfare benefits and minimising negative ecological externalities.

Frontrunners possess the ability to utilise visions, integrate new concepts into policy narratives and nontechnical components to promote **SUWM** to highly influential leaders (Poustie et al., 2016, p. 136).

Although this is difficult to precisely quantify given the diffuse nature of urban **stormwater** pollution, the proliferation of **WSUD** schemes across Melbourne, the ongoing funding and increasingly stringent regulatory requirements all indicate a more effective transition overall (Werbeloff et al., 2017, p. 5855).

Ecological terminology relating to the environmental dimension of sustainability, such as *catchment, drought, rainwater* and *river*, also appear more prevalently here than in other UBIS subcorpora. This is likely because, perhaps more so than for any other UBIS, the provision of water is dependent on the functioning of natural ecosystems.

2.4.2.2 Dominant discourses based on geographical focus

The distinctive keywords for the Northern and Southern subcorpora are shown in Table 2.4. In the North, where issues such as carbon lock-in are of key concern (Erickson & Tempest, 2015), there is a clear trend towards technology-related aspects, such as *biogas*, *MaaS*, *wood*, *desalination*, *AVs*, *nuclear* and *automated*, all of which can be linked to technically innovations designed to allow humanity to maintain current lifestyles in a greener way. To a lesser but still notable extent, this is replicated in the South, through keywords like *electrification*, *EVs*, *green* and *hybrid*.

TABLE 2.4 50 most distinctive key words per subcorpora based on geographical scope

Region	Distinctive keywords
Global North	Agenda, authorities, automated, AVs [Autonomous vehicles], biogas, blue, car-sharing, champions, council, decentralised, democra*, densification, desalination, diesel, district, electricity, experimental, experimentation, foresight, fossil, freight, initiative, institutionalisation, intermediaries, learning, MaaS [Mobility as a Service], mayor, multimodal, municipal*, networks, nuclear, organisation*, parking, planning, professional, providers, public, radical, reconfiguration, resilience, scenario*, scooter, sectoral, sharing, solutions, stormwater, structuration, upscaling, wood.
Global South	Adoption, agencies, aid, bike, civil, compliant, contamination, cooperatives, cosmopolitan, cycling, delta, developers, distributive, donor, eco, electrification, enterprises, EVs [electric vehicles], firm*, foreign, formalisation, government, green, hybrid* implementation, inadequate, income, inequalities, informal, injustice, justice, leapfrog*, manufacturers, megacities, ministry, modernisation, motorcycle, NGO* [non-governmental organisation], peri, poor, power, protection, rationalisation, residents, reuse, sanitation, subsidy, unsustainability.

*Notes: Lexical items with the same base lemma are combined e.g. plurals (technology and technologies) and derivative forms/ modifiers (democracy and democratic), indicated by *.*

It is generally accepted that cleaner technologies will be ineffective without good governance. Both sets of keywords demonstrate a high incidence of keywords related to the institutional dimensions of sustainability. However, the specific institutional aspects highlighted for each region differ. In the North, there is a prevalence of keywords that seem to reflect high levels of formalised planning and state involvement, such as *authorities*, *council*, *institutionalisation*, *municipal**, *planning* and *professional*. In the South, certain institutional keywords suggest that a wider array of actors (should) have a role in transitions (e.g. *aid, cooperatives, donor, foreign, informal, NGO*), yet from a critical perspective, these keywords also draw attention to discourses of dependence. Further, keywords such as *formalisation, modernisation* and *rationalisation* suggest that much transitions research focuses on how cities in the Global South can replicate the development pathways of high-income countries, although conversely the keyword *leapfrogging* also points to the opportunity for lower-income countries to skip less efficient, carbon-intensive phases of development:

Linking **leapfrogging** analysis with a socio-technical perspective implies that environmental problems associated with urbanisation and industrialisation may be avoided by **leapfrogging** to cleaner technologies from the outset (Yu & Gibbs, 2018, p. 4).

There also appears to be greater awareness in Global South-related texts of social issues arising in transition processes, such as *justice*, *inequalities*, and *injustice*, as well as greater attention for less technologically intensive aspects of UBIS such as *cycling* and *reuse* (of materials, waste and wastewater) that are linked to both social and environmental benefits beyond the mitigation of greenhouse gas emissions:

The refusal of the State to legitimise the operations of motorcycle taxis as a public transport conveyance is a case of recognition **injustice**, considering that motorcycle taxis have proven to be *viable mode of public transport* and therefore deserve recognition as such in the existing laws (Sunio, 2021, p. 12, emphasis in original).

2.4.2.3 Interim conclusions: Subcorpora

Keywords from the UBIS subcorpora revealed a strong preoccupation with technological solutions designed to make energy and transport infrastructure greener. The WASH sector, by contrast, encompassed institutional and environmental factors too, through the proliferation of keywords related to good practice frameworks and attention to the link between water provision and natural ecosystems respectively. In terms of the regional subcorpora, in the Global North an emphasis on technical innovations underpinned by formal, often state- or private-led planning is apparent, compared to USD transitions involving civil society and foreign participation in the Global South.

2.5 Discussion and conclusions

The foregoing corpus-based discourse analysis of 107 academic articles on sustainability transitions in UBIS endeavoured to provide insight into how sustainability transitions are envisaged in academic discourses in UBIS, how these manifest differently across infrastructure sectors and geographical regions, and what conceptual or empirical blind spots may warrant greater attention.

2.5.1 Conceptions of sustainability transitions

The UN definition of sustainability encompasses economic, environmental and social dimensions underpinned by institutional dimensions of sustainability (Figure 2.1). These findings provide quantitative evidence to substantiate the claim that much research on sustainable urban infrastructures neglects the environmental and social dimensions. Instead, transitions towards more sustainable USD are often discursively framed in institutional and economic terms, as well as in terms of an additional, technologically focused frame.

Advances in technology have the potential to create opportunities to develop more efficient infrastructure, for example by using renewable energy to power homes, buildings and motorised vehicles. Yet an overreliance on technology as a "silver bullet" can also lead to a host of practical and ethical dilemmas (Arcanjo, 2019; Sudmant et al., 2021). Technology itself can exacerbate existing inequalities and injustices within and between cities or create new ones (Diep et al., 2019; Sunio, 2021), and technological lock-ins and path-dependency can contribute to unsustainable consumption patterns, dependence on private cars, public budget overruns and financial crises (Markard et al., 2012; Savaget et al., 2019). Though these analyses revealed minority counter-discourses – for example, on the potential pitfalls of implementing smart technologies without also paying attention to good governance(Britton, 2019; Canitez, 2019; Pangbourne et al., 2020) – these were heavily outweighed by purely technology-focused discourses. At the same time, previous research suggests that technical solutions that neglect social aspects are likely to maintain existing power imbalances and ensure that large parts of society remain marginalised and discriminated against (Bosomworth et al., 2017; Singh, 2018).

Instead of a narrow conception of sustainability transitions as revolving around technology (or, for that matter, any of the four UN pillars of sustainability in isolation), transitions should be approached holistically and "emplaced" (R. R. Brown et al., 2013; Feola & Jaworska, 2019). This implies that considerations of the spatial and temporal context of USD (our second newly identified discoursal frame) must go beyond merely recognising local practices. Instead they must pay greater attention to how wider discourses and policies on UBIS transitions interact with such practices (R. R. Brown et al., 2013) and can support alternative and perhaps more experimental ways of organising USD, such as citizen-led, community-based or needs-driven service configurations (Monstadt & Schramm, 2017; Moretto et al., 2018; Oates, 2021), which are often associated with improved environmental sustainability (Ranzato & Moretto, 2018) as well as accessibility and equity of USD (Jaglin, 2014; McGranahan, 2013). Greater engagement with such arrangements could thus help to redress the neglect of the environmental and social dimensions in the sustainability transitions literature.

2.5.2 Sustainability transitions discourses per sector

The dominant techno-economic discourse was clearly apparent in research on both the energy and transport sectors. With the energy sector responsible for an estimated 35% of anthropogenic greenhouse gas emissions, making it the largest emitting sector, and transport responsible for 14% (IPCC, 2014), this discourse may reflect a predilection for large-scale technical fixes designed to cut carbon emissions in line with multilateral global agreements. The techno-economic focus also revealed a preoccupation with USD models that, while green, also generate value, most often measured in monetary terms. This can disadvantage USD performed by small local enterprises, communities or individuals, which in comparison are considered risky investments (van Welie & Romijn, 2018), and can (continue to) promote a cultural preference for consumption and private property ownership. In the transport subcorpus, for example, numerous studies explored the individual ownership of private autonomous and electric vehicles, which makes car- and bike-sharing schemes less viable (Geels, 2012) and reduces the incentive for states to invest in public transport improvements. By contrast, discourses in the water and sanitation sector paid comparably more attention to environmental and social aspects, though primarily in relation to specific good practice frameworks such as IWRM, SUWM and WSUD. Such practices are often promoted by states and multilateral agencies, and can still be considered part of a techno-managerial paradigm in their reliance on planning and engineering.

2.5.3 Sustainability transitions discourses per geographical region

Our findings provide quantitative evidence to substantiate assertions that research on sustainability transitions neglects the Global South in terms of volume, and also reinforces discourses of dependency on international development assistance and the associated enforced compliance with externally imposed rules and Northern norms. This echoes earlier research on dominant ideologies whereby innovation is expected to emerge in the Global North and "trickle down" to Southern countries (Coenen et al., 2012), despite increasing evidence that innovations in USD also emerge in Southern cities (Jaglin, 2014; Oates, 2021), which have a "unique but often overlooked capacity, to innovate and experiment for sustainability" (Nagendra et al., 2018, p. 3). These findings tie in with existing calls for more and better theoretical and conceptual engagement with the urban areas of the Global South, including the need for a critical turn that pays greater attention for power relations, diverse worldviews and inclusivity (Feola, 2020; van Welie & Romijn, 2018) and a focus on just transitions, whereby sustainability initiatives and interventions are explicitly viewed as an opportunity to reduce global inequities (Swilling & Annecke, 2012).

2.5.4 Methodological reflections

The methodological approach used here is novel in the sustainability transitions field and made it possible to tap into the abovementioned critical perspective: the strength of corpus-assisted discourse studies (CADS) lies in "questioning what is taken for granted, indicating problematic discursive practices […] and challenging dominant ideologies and normative assumptions" (Barakos & Unger, 2016, p. 3). At the same time, some limitations of this research should be acknowledged.

First, the size of this chapter's corpus, though considerable, precluded country level geographical analysis. Each subcorpus must remain large enough in terms of "tokens" (words) to ensure statistically valid results, hence the division into sustainability transitions discourses pertaining to the supra-regional Global North and South, despite the potential differences between countries within each region. This may be a revealing avenue for future research.

Second, due to word limitations, only discursive differences across corpora are reported, rather than (also) similarities. Although this risks emphasising differences at the expense of shared discoursal patterns, it allowed the identification of both the focal points and blind spots of research on sustainable USD differentiated by sector and region.

Finally, although a CADS approach helps to reduce the impartiality common to discourse analysis (Feola & Jaworska, 2019), the selection of concordances for qualitative analysis remains a subjective process (Baker & McEnery, 2015). Indeed, different researchers may well draw different conclusions from the same corpus. Nevertheless, the corpus-assisted techniques used here made it possible to draw conclusions from large samples of data, thereby adding validity to previous claims made in the field of transitions studies.

2.5.5 Concluding remarks

If research on sustainability transitions is to contribute to meeting international targets like those set out in the Sustainable Development Goals and the Paris Agreement, an integrated approach is required that treats the respective pillars of sustainability not in isolation from one another but as distinctive yet interrelated parts of the same system (Purvis et al., 2019). This study investigates dominant academic discourses and conceptual gaps with a view to fostering a broader understanding of (transitions towards) sustainability. It is hoped that these findings draw attention to the need to systematically address all dimensions of sustainability in USD research, thereby informing possibilities for a more holistic and equitable response to global sustainability challenges.

3 Sustainability transitions in the Global South

A Multi-Level Perspective on urban service delivery

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ABSTRACT

Urban sustainability in low- and middle-income countries is rarely studied from a sustainability transitions perspective, though 90 percent of projected population growth between 2018 and 2050 will be in cities of the Global South. Using principles from grounded theory, this chapter explores the relevance of the Multi-Level Perspective (MLP) – a prevalent analytical framework in sustainability transitions theory that has primarily been applied in the Global North – for the study of infrastructure in the Global South. It draws on empirical data collected through case study research in the cities of Ahmedabad, India and Jinja, Uganda, which have adopted innovative socio-technical approaches to service delivery that respond to the challenges presented by urbanisation, climate change and inequality. Applying the MLP to these cases shows how niche innovations by non-state actors in waste management (Ahmedabad) and solar energy (Jinja) can increase access to services, reduce ecological footprints, and empower socially excluded groups, in spite (or because) of landscape pressures such as poverty, informality, and limited institutional capacity. The observed benefits are attributable not only to technological but also organisational innovation. These findings may help to develop a more flexible understanding of the types of urban transitions needed and the ways in which those transitions could be achieved. Lessons from alternative socio-technical configurations in the South could be informative for any city looking for service delivery models that better serve contemporary environmental and societal needs.

3.1 Introduction

Urban service delivery exists at the nexus of social and technical systems (Ersoy & Alberto, 2019), and encompasses the (mostly) physical, engineered systems that make a city, as well as the totality of interactions, rules, norms and values that govern these infrastructures. Accordingly, its reconfiguration has been identified as a way to address complex global challenges including poverty, inequality and climate change. The role that urban service delivery could play in the transition to sustainability – and the achievement of the Sustainable Development Goals (SDGs) – is thus an increasingly important area of scientific inquiry.

A sustainability transition is a "fundamental transformation towards more sustainable modes of consumption and production" (Markard et al., 2012, p. 955). Originating in the study of large technical systems, the Multi-Level Perspective (MLP) is a transitions framework that is often used for exploring the sustainability of infrastructure configurations (Geels, 2002). Put simply, the MLP posits that a transition may be brought about through interactions between three different levels: niches, regimes, and landscapes. Niches are protected spaces where innovative activity takes place; a socio-technical regime is an established set of rules, norms, and institutions that guides the use of particular technologies and practices; and landscape refers to exogenous events and trends such as political developments, social relationships, demographic changes and climate change, which may exert pressure on or generate opportunities within the incumbent regime.

The MLP and transitions theory more generally have been developed and applied predominantly in Northern Europe, where urban services are largely provided via formal, large-scale, centralised infrastructure regimes. Conversely, its use in non-OECD countries has been relatively limited (Markard et al., 2012).[7] However, the majority of growth between now and 2050 will take place in the towns and cities of the so-called Global South, a term most often used to refer to countries classified by the World Bank as low- and middle-income.[8]

7 For exceptions, see cf. (Ockwell et al., 2018).

8 Increasingly, the term "Global South" is also understood as a way to conceptualise a deterritorialised political economy of the uneven processes of economic development generated by capitalism and colonialism (for a full discussion on this, see (Mahler, 2018)).

Large parts of the population in Southern cities live in poverty. At least 881 million people worldwide live in slums,[9] where access to basic urban services is inadequate or non-existent. Due in part to limited human and financial capacity, and motivated by modernist visions of the city, government authorities seek to attract private and donor financing for the construction and maintenance of "modern" infrastructure. The resulting trend towards the privatisation and financialisation of municipal service delivery leads to differentiated access, where only those who can afford to pay for a service experience its benefits. These inequalities manifest in the development of "heterogeneous infrastructure configurations" (Lawhon et al., 2018), where a variety of non-state actors play a significant role in the local delivery of urban services.

The extent to which the analytical constructs of the MLP are applicable to the socio-technical conditions of the urban service delivery regime in the Global South is unclear. For example, it is difficult to identify a coherent, uniform infrastructure regime where significant tensions exist between top-down and bottom-up service delivery (Furlong, 2014). Despite this, (Wieczorek, 2018) finds that studying sustainability in the Global South with a transitions lens can constructively highlight the interplay between macro-, meso-, and micro-scale dynamics in developing contexts.

This chapter applies principles from the MLP in two Southern cities – Ahmedabad, India and Jinja, Uganda – to case studies of innovative urban service delivery that generate economic, social and environmental benefits. In doing so, it contributes to diversifying the range of case studies in transition studies, and to the further development of the MLP framework. The chapter closes by reflecting on how such models can contribute to the achievement of the SDGs.

9 In reality this number is likely to be even higher due to data deficiencies and the thresholds for the assessment of certain criteria being set too low (for further details, see (Satterthwaite, 2016)).

3.2 Approach

The methodological approach combines principles from grounded theory with case study research conducted between May and August 2018, which included key informant interviews with stakeholders from national and local government, local firms, academia, and civil society (16 in India, 23 in Uganda), site visits, and document analysis. A grounded theory approach is useful for interrogating bias in existing theoretical frameworks – namely to explore the relevance of the MLP outside of Northern Europe – and linking to illustrative empirical data allows insights to emerge deductively. Two case studies of innovative non-state-led urban service delivery are investigated, pragmatically selected to represent geographically, culturally and technologically different settings: a waste picker trade union and cooperative in Ahmedabad, India; and a solar streetlight project in an informal settlement in Jinja, Uganda. The purpose of this chapter is not to study these cases in detail, but to link theorisations of sustainability transitions, and the MLP specifically, to observations based on the realities of urban service delivery in the Global South.

3.3 Solid waste and solidarity: SEWA, India

The Self Employed Women's Association (SEWA), established in 1972 in Ahmedabad, Gujarat, is a trade union of 1.5 million informal women workers from across 16 states in India. Women pay an annual membership fee of 5 Rupees (USD0.07) to join the organisation, which advocates for improvements in its members' wages and working conditions. Members also form trade-specific cooperatives that provide developmental benefits, including childcare facilities, access to credit, and social security.

Waste picking is one of many occupations supported by SEWA. The International Labour Organisation estimates that India's informal waste sector employs around 1.7 million waste pickers who recover around 20 percent of recyclable waste (ILO and WIEGO, 2017), making them a vital component of the nation's waste management regime. Despite this, waste picking is performed by some of the most marginalised citizens and waste pickers are frequently discriminated against based on their caste, gender and income status.

Between 2004 and 2009, the Vejalpur district government in Ahmedabad employed informal waste pickers organised by SEWA to provide recycling services for more than 45,000 households. This had the dual effect of increasing the women's earnings from around 1,500 rupees (USD21) to 6,000 rupees (USD84) per month and achieving recycling rates of up to 70 percent.

In 2009, Vejalpur was incorporated into the jurisdiction of the Ahmedabad Municipal Council (AMC), which issued a strict tender for municipal solid waste management and awarded the contract to private companies in place of SEWA's members. The redirection of work away from the informal sector and towards private operators is emblematic of a wider national policy shift towards more technology-intensive solutions, driven by national programmes such as the Swachh Bharat ("Clean India") Mission and the Smart Cities Mission. Both offer incentives for the use of smart solutions to urban infrastructure challenges like waste-to-energy technologies, despite the fact that such strategies in India have dramatically under delivered, and they overlook opportunities for recycling, value creation and poverty reduction.[10]

Social benefits such as poverty reduction and inclusion must be considered alongside the technical aspects of service delivery. The initial success of the Vejalpur model demonstrates how easily this can be done when governments ensure that regulations include social as well as economic and environmental values. The state should also consider replicating and upscaling emerging good practices as well as emerging technologies, such as organising informal workers into cooperatives and including them in public–private partnerships.

10 Many existing waste incineration plants in India are operating below capacity due to the relatively low calorific value and high moisture content of urban waste. This means that net energy recovery is often negative, a problem that operators sometimes attempt to overcome by substituting recyclable waste like plastic, which emits harmful pollutants when incinerated. Waste-to-energy plants, designed to reduce greenhouse gas emissions from both the waste and energy sectors, may in fact produce more emissions than they save, and at the same time deny the informal sector access to recyclable materials.

3.4 Solar power and empowerment: MDF Jinja, Uganda

Jinja in eastern Uganda is one of five cities included in the Government of Uganda's Transforming the Settlements of the Urban Poor in Uganda (TSUPU) programme. As part of TSUPU, a Municipal Development Forum (MDF) was established in the city, with the intention of bringing together local government, the urban poor, and other stakeholders to align urban development priorities.

Together with the National Slum Dwellers Federation of Uganda (NSDFU), the MDF conducted participatory enumeration in the informal settlement of Kibugumbata, home to 6,000 people. The mapping exercise generated discussions about the settlement's challenges with both income generation activities and safety after dark, prompting deliberations on the solar streetlights that were being rolled out in the centre of Jinja.[11] Despite initial reluctance from Jinja Municipal Council (JMC) to implement solar streetlights in a less central location, the MDF was able to earmark 20 solar streetlights for Kibugumbata, with financial contributions from Slum/Shack Dwellers International and JMC itself.

Uganda's national energy mix consists primarily of hydropower for electricity, meaning the climate benefits of solar-powered streetlights are less significant than in countries with more carbon-intensive grids.[12] However, the societal benefits are evident. Five local youths were trained as solar technicians and led the project installation in March 2018. Since then, local residents report feeling safer, and business owners are able to operate for up to an additional five hours per day. The solar technicians receive a stipend from JMC for maintaining the streetlights, and have also found work with domestic clients elsewhere in the city. The municipality's willingness to invest in the informal settlement has generated a perceived increase in tenure security.

11 At the time, Jinja's city centre roads and roadside infrastructure were being updated as part of the World Bank-funded Uganda Support to Municipal Infrastructure Development (USMID) programme, which commissioned solar-powered streetlights.

12 Hydropower currently generates 450 MW of the 600 MW of electricity consumed nationwide per annum. However, hydropower stations in Uganda (and East Africa more widely) are concentrated in the Nile river basin, where an expected impact of climate change is significant rainfall variability. This may threaten Uganda's future energy generation capacity.

In order to maximise the co-benefits of transitions, cities must look beyond the environmental aspects of sustainability to trigger wider organisational and institutional change. The spillover effects of the energy transition can go far beyond emissions reductions: linking distributed technologies to new forms of social organisation can offer new ways of meeting energy demand, whilst simultaneously empowering marginalised groups and creating meaningful multistakeholder partnerships to tackle urban development challenges. This case is particularly relevant for Ugandan cities since the devolution of service delivery to city authorities has led to irregularities in electricity supply,[13] meaning municipalities must look for new ways to both meet the basic needs of residents and power municipal infrastructure.

3.5 Rethinking niche, regime and landscape

Through the lens of the MLP, the cases described in the previous sections can be conceptualised as niche innovations. SEWA's cooperative model offers a protected space for informal workers to organise effectively, controverting the drive for privatisation and mechanisation under the existing waste management regime. The MDF has built a socio-political network that supports innovation in both technology (solar powered streetlights) and process (participatory identification of urban planning priorities). Applying the MLP to these cases helps to expose the ways in which niche, regime and landscape dynamics interact to bring about specific policy preferences and service delivery models, yet the analysis has also highlighted areas where the framework may require further refinement.

Conventionally, a niche is a safe space for actors to engage around a new and novel technology (Geels, 2002). However, activities like those practiced in the case studies could be expected to contribute to regime change not (only) by developing novel technologies, but by demonstrating new ways of organising for social change.

13 Municipalities in Uganda remain reliant on central government transfers for revenue, yet opposition parties control a number of Ugandan cities, a situation known as vertically-divided authority (Resnick, 2014). Partisan struggles thus further weaken the already insubstantial capacity of the state. In Jinja, streetlights were turned off in 2017 when the city's debt to its electricity provider exceeded 1 billion Ugandan shillings (USD268,000).

By forming a trade union of informal workers, SEWA exemplifies how service delivery arrangements can become settings of "social struggle" by exposing inequalities and promoting social inclusion (Addie et al., 2020, p. 13). The MDF, while centring its attentions on a specific infrastructure intervention, targets injustices by giving a voice to those who are often excluded from urban planning processes. This substantiates claims that it is innovation in governance as well as discrete technologies that will lead to broader patterns of transformation (Markard et al., 2012).

A regime is typically understood as a *uniform* set of technologies linked to established regulations, infrastructure, user practices etc. (Geels, 2002). While it is important to note that the cases presented here are not necessarily wholly aspirational futures – waste picking, for example, is dangerous, stigmatised and poorly paid work in its current form (Dias, 2016) – they do highlight the coexistence of multiple, overlapping service delivery mechanisms within the regime (Furlong, 2014). For portions of the population that are unable to access formal infrastructure, an array of non-state, informal and community-based providers like SEWA and the MDF offer crucial services, often at little or no extra cost to the state. Engaging with the *non-uniform* and hybrid reality of service delivery in many cities of the world requires some flexibility in the way regimes are understood, but would significantly strengthen the analytical value of the MLP in the Global South.

More broadly, explicitly recognising and leveraging the institutional heterogeneity of urban service delivery in the Global South could generate insights on alternative, post-capitalist forms of organising in landscapes where (political) power is currently centralised and social relationships are primarily exclusionary and oppressive (Ramos-Mejía et al., 2018). These findings would also be relevant in the North, where cities are increasingly seeking alternatives to the "modern infrastructural ideal" (Graham & Marvin, 2001, p. 387) that better serve contemporary environmental and societal needs. This is illustrated by the energy transition, with the pathway to net-zero expected to involve a structural shift from centralised to distributed energy generation.

The success of SEWA and the MDF would not have been possible without support from municipal government, while SEWA's subsequent troubles after 2009 show how having that support withdrawn can immobilise environmentally and socially promising niche activities that do not conform to existing regimes. Like India, many states exhibit policy level commitment to reconfiguring infrastructure regimes based on environmental needs but this often competes with developmental priorities of an economic nature. Driven by the desire to attract private and donor financing, and further influenced by modernist development ideals, this results in a tendency towards large-scale infrastructure interventions linked to privatisation,

financialisation, and (ecological) modernisation. Failing to address corresponding socioeconomic challenges can severely disadvantage already marginalised groups – as evidenced by the AMC's dismissal of SEWA in favour of partnerships with private operators – and lead to an unjust transition (Swilling & Annecke, 2012).

Innovative service delivery models like those practiced by SEWA and the MDF, on the other hand, offer an opportunity to move beyond seeing infrastructure as having a single purpose, to seeing it as aiding a range of social, environmental and economic objectives that represent multiple values. Such an approach aligns with that of the SDGs, which were designed to bypass siloed solutions and move towards tackling environmental and developmental challenges in a more integrated and holistic way.

3.6 Conclusions

This chapter has considered the value of using the Multi-Level Perspective to understand sustainability transitions in the Global South by engaging with two case studies of innovative non-state-led urban service delivery: a waste picker cooperative in Ahmedabad, India; and a solar streetlight project in Jinja, Uganda. Analysing these cases through the lens of the MLP has usefully highlighted the ways in which niche service delivery models can contribute to the transition towards a more socially and environmentally sustainable urban future, in spite of – or perhaps in response to – landscape pressures such as poverty and inequality.

Results also suggest, however, that the framework requires some refinement, particularly with regard to the key analytical concepts of niche, regime, and landscape. Deepening interpretations of these concepts – for example, through a greater engagement with organisational as well as technological niche innovation, and by elaborating upon the co-existence of multiple, overlapping systems within regimes – could significantly increase the value of the MLP, not only in the Global South. This would allow the MLP and the field of sustainability transitions as a whole to better respond to the intersecting global challenges of urbanisation, infrastructure access, climate change and inequality.

Though not its main intention, the chapter also highlights policy implications for the sustainable delivery of urban services, most notably that national and regional governments must encourage and empower local authorities to systematically partner with the full range of stakeholders, including and especially the urban poor, to realise the co-benefits that transitions in urban service delivery can generate.

It is important to note that the cases explored here reflect the conditions of the spatial, temporal and socio-political context in which they originated. There is a need for further research to reflect on the value of the MLP for Southern cities, as well as the wider region. More broadly, this links to discussions on "worlding" urban theory, a concept which speaks to the need to "recover and restore the vast array of global strategies that are being staged at the urban scale around the world" (Roy, 2011, p. 10). Indeed, the challenges of overstretched utilities, public budget cuts, and environmental degradation are not unique to any one city, nor region. In this sense, studying infrastructure transitions in the Global South could both prompt greater theoretical reflection, and inspire urban service delivery models that better meet not only environmental but also societal needs, globally.

4 Pluralising the urban waste economy

Insights from community-based enterprises in Ahmedabad (India) and Kampala (Uganda)

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ABSTRACT The delivery of urban basic infrastructure services is often guided by the modern infrastructure ideal, which aims for technical innovation, economic efficiency and uniformity through long-term, centralised management approaches. In rapidly growing urban centres of the Global South, however, heterogeneous infrastructure configurations have long involved multiple systems in varying degrees of coexistence. This chapter explores how community-based enterprises – organisations that aim not to turn a profit but rather to generate human wellbeing – contribute to, complement or conflict with wider municipal solid waste management strategies. It does so through two case studies, focused on Luchacos, a local enterprise turning waste into briquettes in an informal settlement of Kampala, Uganda; and the Self-Employed Women's Association (SEWA), a cooperative of waste pickers in Ahmedabad, India. Drawing on empirical data and policy analysis, the research finds that, given the necessary state support, community-based enterprises can contribute to a range of sustainability and development objectives.

4.1 Introduction

Urban basic infrastructure services (UBIS) are fundamental for maintaining and improving the living standards of citizens, managing a city's ecological footprint, and harnessing opportunities for prosperity (Oates et al., 2022). These services include water and sanitation, waste collection and management, transport, and energy, as well as housing, which is the primary means by which citizens access the other services (Satterthwaite, 2020). Satterthwaite describes these infrastructures as forming "the foundation on which human settlements are built and function" (Satterthwaite, 2014, p. 3). However, rapid population growth and the associated pace of urbanisation are placing significant pressure on the provision of UBIS, a challenge that is exacerbated by the adoption of fiscal austerity measures, high levels of social inequality, and environmental concerns, most notably climate change.

Delivering UBIS sustainably in the face of these challenges has often been framed as a matter of stimulating technical innovation and achieving economic efficiency and uniformity through long-term, centralised management approaches. In the rapidly growing urban centres of the Global South, however, service provision has long constituted multiple systems in varying degrees of coexistence (Furlong, 2014). The ways in which pervasive socio-economic and environmental problems can be addressed within these "heterogeneous infrastructure configurations", as they are termed by Lawhon and other scholars, has become a significant area of enquiry (Lawhon et al., 2018, p. 3), with much attention given to the roles played by non-state and local actors.

This chapter therefore aims to explore the extent to which community-based enterprises in Southern cities are enabled to participate in the sustainable and inclusive delivery of UBIS in contexts characterised by infrastructural heterogeneity. It does so by exploring two community-based enterprises operating in the municipal solid waste management (MSWM) sector: the Self Employed Women's Association (SEWA), a cooperative and trade union of women waste pickers in Ahmedabad, India; and Luchacos, a small enterprise that turns household waste into briquettes in Kampala, Uganda. Each case is embedded within an analysis of the policy context in which it operates. Specifically, the chapter aims to answer these questions: *in what ways and under what circumstances can community-based waste enterprises aid the transition to more sustainable and inclusive municipal solid waste management strategies; and how are the activities of such enterprises supported or constrained by the governance arrangements and policy context within which they exist?*

Following this introduction, the chapter reviews the concepts of heterogeneous infrastructure configurations and community-based enterprises, then situates these within the context of the municipal solid waste management (MSWM) sector in Southern cities. Next, the case studies are presented, and the opportunities and challenges associated with community-led UBIS delivery models are discussed. The chapter concludes with a call for theory, practice and policy to incorporate a broader range of approaches to the delivery of UBIS in planning for environmentally sustainable and socially inclusive cities.

4.1.1 Heterogeneous infrastructure configurations in Southern cities

Ninety percent of all population growth to 2050 will take place in cities of the Global South (UNDESA, 2019), where at least 1 billion people already live in slum-like conditions,[14] many of them with little or no access to formally provided infrastructure and services (UN, 2022). In the face of chronic service deficiencies, a host of initiatives of varying degrees of formality and with varying levels of state support has evolved to provide critical and life-sustaining services to citizens. The majority of residents in Southern cities access UBIS – or augment their access – via these decentralised and often informal channels, which have long existed alongside the more formal, centralised networked systems (Furlong, 2014, p. 201). Scholars increasingly refer to these diverse arrangements as "heterogeneous infrastructure configurations" (Lawhon et al., 2018; Sseviiri et al., 2020).

The under-provision of infrastructure and services is typically characterised as a failure of the state (Truelove & Cornea, 2021), with a set of modernist interventions seen as the ultimate solution. At the core of this normative agenda has been the assumption that infrastructure provision should be centralised, universal, and uniform – what Graham and Marvin have called the "modern infrastructural ideal". However, these authors also note that greater engagement with critical urban geographies in the last two decades has brought about a more relational "infrastructural turn" (Graham & Marvin, 2022): nowadays, the unprecedented scale and complexity of global infrastructure deficits, against a backdrop of pervasive socio-economic and environmental instability, is leading to the increasing recognition that achieving the modern infrastructural ideal is neither feasible nor, in some cases, desirable.

14 In reality this number is certainly even higher, due to data deficiencies and the thresholds for the assessment of certain criteria being set too low (see Satterthwaite, 2016).

It has become increasingly apparent that business-as-usual infrastructure development is not sufficient to produce the socio-economic or environmental outcomes necessary to meet the goals of global sustainability agendas like the Sustainable Development Goals (SDGs) or the Paris Agreement. Infrastructure – especially in the buildings, transport, and energy sectors – is directly or indirectly responsible for 79 percent of greenhouse gas emissions (Thacker et al., 2021). Yet even at this scale of operation it has failed to reach all populations equally. This is in part demonstrated by the growth of so-called slums, which, as Schäffler and Swilling note, is "perhaps the most striking representation of a global infrastructure crisis that has beset an increasingly resource-constrained world" (Schäffler & Swilling, 2013, p. 256). In the Global North, too, unequal access to adequate infrastructure has been identified as a key driver of social injustice (Burgum, 2019; Wakhungu et al., 2021).

Accordingly, increasing attention is being paid to the role of "other", non-governmental actors in providing UBIS. The opportunities associated with smaller-scale, self-built and community-based UBIS delivery systems, organised by actors including citizens and citizen-led cooperatives, non-governmental organisations (NGOs), and micro, small and medium-sized enterprises (MSMEs), are increasingly being considered as possible, radical alternatives to the modern infrastructural ideal (Coutard & Rutherford, 2015; Pieterse & Thieme, 2022). While there has been considerable work on the motivations, resources, and (economic) results of community-based actors, fewer studies have explored the linkages between such enterprises and the formal policy environment in which they operate (Chen, 2016) – an avenue of enquiry that is particularly relevant with regard to urban service delivery, so often perceived as being regulated by the state.

4.1.2 Community-based enterprises in diverse urban economies

Community-based enterprises can be understood as organisations whose aim is not to maximise private profit but to contribute to the generation or enhancement of community well-being, particularly for marginalised groups (Gibson-Graham & Cameron, 2007). Though these enterprises may involve different constellations of actors, key is that they are not state-led but are controlled to a large extent by citizens who are explicitly or indirectly attempting to experiment in building more just, human-centred, non-capitalist economic relations (*ibid*). Despite this, community-based enterprises are – like capitalist enterprises – most often assessed based on their ability to turn a profit and succeed without indefinite (financial) support from a government, donor or philanthropic entity.

Such forms of enterprise are often presented as involving labour practices and livelihoods that are variously labelled as informal, non-standard, vulnerable or peripheral, particularly when they are established in Southern cities. The positioning of these practices as unconventional, or as failures, can be traced to a school of thought which considers capitalist economic practices the most efficient, modern, dynamic and innovative way to provide goods or services (Gibson-Graham & Dombroski, 2020). This perspective overlooks the diverse range of economic and infrastructural practices that actually interact to deliver UBIS, particularly outside of areas serviced by the state (Lawhon et al., 2018), such as in informal settlements. Indeed, 61 percent of the employed population globally are estimated to work in informal business or activities (Bonnet, 2019), while MSMEs make up 90 percent of the private sector in developing economies (Hussain et al., 2012), employ up to 78 percent of the working population, and account for approximately 29 percent of national gross domestic product (GDP) (Ayyagari et al., 2011). As urban theory derived from the Global North is deconstructed through the study of the lived realities in Southern cities, it is increasingly accepted that community-based practices are not marginal, nor are they features of a transitional phase during which Southern cities catch up and converge with their Western counterparts. Rather, community-based enterprises are, and will remain, an integral part of the Southern city (Ferguson & Li, 2018; Pieterse & Thieme, 2022).

Despite this being increasingly widely accepted, high rates of entrepreneurial activity in the Global South are still frequently attributed to there being a large number of so-called "necessity enterprises" – businesses said to be started by those who have no other alternatives, usually as a way to meet their basic needs (Acs, 2006). Factors contributing to this include a high poverty rate, too few conventional job opportunities, and high barriers to gaining formal employment. Citizens are said to be pushed into enterprise formation for want of a better alternative. Necessity enterprises are often reported as having no effect on national economic growth and are thus considered to have a negligible or even detrimental impact on development – when analysed by traditional economic means. This is in contrast to the "opportunity enterprise", which emerges in response to a gap in the market or a good business opportunity and which contributes to economic growth by adding to GDP. If entrepreneurship and innovation policies put in place by governments assess niche activities based only on their economic performance, profit margins or technological prowess, support will invariably be skewed towards initiatives that replicate capitalist economic practices, albeit perhaps those with "a green flavour" (Castán Broto, 2022).

On the other hand, when formed in response to a specific infrastructural gap, community-based enterprises can be associated with specific societal outcomes such as the improved accessibility, equity and environmental performance of urban service delivery (Jaglin, 2014; McGranahan, 2013; Ranzato & Moretto, 2018). They can also lead to broader and more meaningful engagement on a structural level, for example by opening communication channels between formerly disconnected citizens and local government representatives (Ernstson et al., 2014; Gillard et al., 2019). Given adequate support, initiatives that are led by or involve the participation of local enterprises or community-based organisations can create jobs, bolster local economies, and empower citizens. Such arrangements are often associated with positive environmental outcomes too, for example the sustainable use of natural resources (Ranzato & Moretto, 2018). They have also been shown to bring about institutional change (Wamuchiru, 2017a), for example by creating new partnerships that may endure beyond project boundaries (Oates, 2021). Of course, there are trade-offs: community-based enterprises often struggle to access finance or upscale their activities, and power imbalances between small-scale, local actors and other stakeholders can persist if left unaddressed (Ndezi, 2009). However, the afore-mentioned ecological and developmental benefits suggest that inclusive interventions to support community-based enterprises in Southern cities may address some of the fundamental drivers of vulnerability (such as poor public health, precarious livelihoods, social exclusion, degraded natural environments), and accordingly could both reduce urban inequality and enhance community resilience to climate change (Dodman et al., 2023).

4.1.3 Informal economies and waste management

Municipal solid waste management (MSWM) is one of the most pressing challenges urban centres face. Cities will produce an estimated 2.2 billion tons of waste per year globally by 2025, almost double the 1.3 billion tons produced in 2012 (Hoornweg & Bhada-Tata, 2012). Improvements in waste management are therefore essential for delivering on climate goals like those set out in the Paris Agreement. The waste sector directly accounts for approximately 3–5 percent of global greenhouse gas emissions. In addition, the inadequate collection, transportation, treatment, and disposal of solid waste poses severe risks to the economy, society, and the environment. These risks are especially pronounced in Southern cities, particularly in informal settlements, where waste management services are not available to large parts of the population. The accumulation of waste causes disease, provides a breeding ground for vermin and parasites, and leads to pollution of the air, water, and land. Improper waste management frequently results in the buildup of refuse in drainage channels and rivers, degrading local ecosystems and exacerbating flooding and the risk of vector-borne diseases such as dengue fever and malaria (Ezeh et al., 2017).

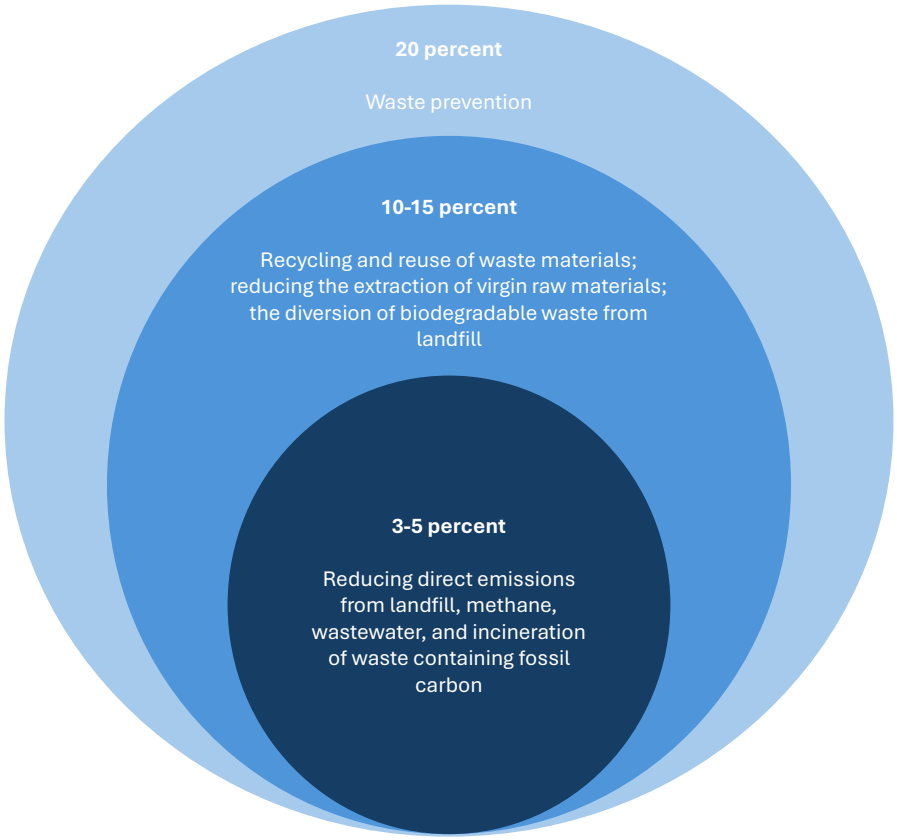

FIG. 4.1 Percentage of global greenhouse gas emissions that could be avoided by making interventions at different stages of the waste hierarchy (Oates et al., 2019).

Meanwhile, reductions in the amount of waste that needs managing can also have far reaching positive effects. Indirect mitigation measures such as the recycling, reuse, and prevention of waste material could reduce overall greenhouse gas emissions by as much as 20 percent (International Solid Waste Association, 2015; Papargyropoulou et al., 2015) (see Figure 4.1). Recycling and reuse activities can also stimulate the local economy, with the transition to a "circular" economy generating up to an estimated 25 million new jobs worldwide (*ibid*).

In low-income contexts, the state does not always have the capacity, resources or political will – or some combination thereof – to provide basic services like waste management. Partly in response to this, most national governments implement neoliberal policies that encourage the privatisation and decentralisation of service delivery under the guise of increased efficacy (Gibson-Graham & Dombroski, 2020).

As a result, service provision responsibilities are increasingly devolved from the state (Tukahirwa et al., 2013). In the MSWM sector, this commonly manifests in partnerships with large private companies known for technology-intensive solutions such as waste-to-energy plants. This approach has been lauded for its efficiency advantages but, in reality, has not always been successful, particularly in the Global South. For example, it is common for Southern cities to generate waste streams containing a larger proportion of organic waste than of non-biodegradable materials: such compositions are not suitable for waste-to-energy technologies because they are too wet to combust. In addition, high-tech solutions require large upfront capital investments and operational expenditures that low-income countries often struggle to finance (Tukahirwa et al., 2013).

Technology-led approaches to waste management also place little value on the complex ecosystem of (often informal) actors involved in waste management in many Southern cities. An estimated 15–20 million people worldwide work in the informal waste sector, most of them self-employed informal waste pickers or informal service providers involved with community-based organisations and small enterprises (ILO and WIEGO, 2017). Though it is often dangerous and heavily stigmatised work, in some cases the informal waste sector has been known to achieve recycling rates comparable to – and sometimes better than – those in high-income cities. For example, 30 percent of materials are recovered by the formal sector in Rotterdam, the Netherlands, while the informal sector recovers 27 percent in Delhi, India, 31 percent in Quezon City, the Philippines, and 85 percent in Bamako, Mali (UN Habitat, 2010b). Such enterprises are also an important source of livelihoods for low-income and other marginalised urban residents. Community-based organisations and small enterprises involved in waste management disproportionately employ women – who often do not have the same range of income-earning opportunities as men – and citizens from other vulnerable groups, such as migrants.

4.2 Data and methods

This chapter draws on mixed methods research conducted in the cities of Ahmedabad, India and Kampala, Uganda between May and August 2018.[15] It is based on a total of 33 semi-structured interviews (16 in India and 17 in Uganda) with a wide range of stakeholders working in or closely with the MSWM sector (see Table 4.1), as well as site visits to the premises of MSWM enterprises and landfill sites, and a walk-along on a waste picking route. In addition, the authors conducted an analysis of the policy environment in each case and an extensive review of relevant case-related documentation, including policy documents, contracts, legal proceedings and organisational reports.

TABLE 4.1 Methods for Chapter 4

Stakeholder	Method and identifier			
	India		Uganda	
National and state government	2 interviews	ING1-2	2 interviews	UNG1-2
Municipal government	4 interviews	IMG3-6	3 interviews	UMG3-5
Micro, small and medium enterprises	2 interviews	IEN7-8	7 interviews	UEN6-12
Civil society	5 interviews	ICS9-13	3 interviews	UCS13-15
Academia	2 interviews	IAC14-15	2 interviews	UAC16-17
Other	1 focus group with SEWA members Walk-along on a waste picking route Site visits to: – Gitanjali Cooperative – Pirana landfill	IFG1 IWA1 ISV1 ISV2	Site visits to: – Kiteezi landfill – Luchacos – Plastic Recycling Industries – Two unnamed waste initiatives	USV1 USV2 USV3 USV4-5

15 These case studies have previously been published as policy briefs as part of a series on frontrunning climate actions around the world. The series aims to strengthen the evidence on the economic and social implications of low-carbon, climate-resilient urban development. They are available at: https://urbantransitions.global/publications/?select-publication-series[]=frontrunners.

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4.3 Ahmedabad, India and the Self Employed Women's Association

4.3.1 The context

The improvement of waste management and sanitation has been a cornerstone of Prime Minister Narendra Modi's Bharatiya Janata Party (BJP) government. The BJP's flagship program, launched in 2014, was the Swachh Bharat ("Clean India") Mission (SBM), which has received widespread attention primarily due to the far-reaching awareness-raising media campaign made possible by high-level political support. Designed in part to complement SBM, the Smart Cities Mission of 2015 is a central government program designed to stimulate urban renewal in 100 Indian cities by using technology-driven development to improve sustainable and inclusive core infrastructure.

Both missions offer incentives for the use of smart solutions to urban infrastructure challenges such as waste-to-energy technologies, despite the fact that such strategies in India have thus far dramatically under-delivered, and also overlook opportunities for recycling, value creation, and poverty reduction [IAC14] (see also (Hoornweg & Bhada-Tata, 2012)). India's informal waste sector employs an estimated 1.7 million waste pickers who recover around 20 percent of recyclable waste (ILO and WIEGO, 2017), making them responsible for a significant proportion of the nation's recycling efforts and contributing to a recycling system as efficient as that of many high-income countries. Despite this, the work is generally performed by some of the most marginalised members of society and waste pickers are frequently discriminated against based on their caste, gender, and income status [ICS9-11, IWA1].

Despite progress under SBM, many city governments in India are unable to manage the volume of waste produced. The average municipality spends between Rs. 70 and Rs. 150 (US$1-2) per capita per year on solid waste management (Ghatak, 2016): for comparison, this is less than 1 percent of what is spent in Rotterdam in the Netherlands. The subsidies available through SBM and Smart Cities for waste management technologies, as well as other private and donor investments, have therefore been particularly attractive to municipalities.

4.3.2 The case study

The city of Ahmedabad in the state of Gujarat was part of the first cohort of Smart Cities. Ahmedabad is India's seventh-largest city, with a population of 6.5 million. Though the city has a reputation for pioneering urban management [ING1, IMG3], having implemented the first large-scale Bus Rapid Transit (BRT) system in India, it faces human, financial and technical resource constraints similar to those of other cities. Despite this, it aspires to become "resource efficient and zero waste" by 2031, through efforts led by the city's local government, the Ahmedabad Municipal Corporation (AMC) [IMG5].

Approximately 50,000 informal waste pickers work in Ahmedabad, of whom around 60 percent are women [ICS9]. Many are members of the Self Employed Women's Association (SEWA), a trade union and cooperative of mostly low-income women who work in the informal economy. SEWA advocates for improvements in its members' wages and working conditions. It was established in 1972 in Ahmedabad, and nowadays counts more than 2.1 million members from across 16 states. For an annual membership fee of 5 rupees (US$0.07), members have access to trade-specific cooperatives that provide benefits including childcare facilities, access to credit, and social security [ICS9-11, IFG1].

SEWA's members live primarily in rural areas and most are employed in agricultural activities. In Ahmedabad, however, women waste pickers are particularly active. Under the umbrella of SEWA, they are involved in various activities including forming agreements with textile mills, office buildings and households regarding the collection of waste, lobbying the AMC for recognition, and managing several waste-related cooperatives [ICS9, IFG1]. The largest of these is the Gitanjali Cooperative, established in 2010, which turns recyclable waste into usable products, mostly stationery and clothing. Gitanjali received initial financial assistance, business advice and in-kind contributions (in the form of machinery) from three partners: WEConnect International, a global network that connects women-owned businesses with investors; Accenture, a multinational professional services firm; and Gopi Stationary, a local stationary company [ISV1] (see also (Buvinic et al., 2017)). Accenture still provides an annual contribution to the women's salaries. The cooperative now sells its products both domestically and internationally. Its revenues have been increasing year by year, but it would not yet be viable without Accenture's financial support.

Between 2004 and 2009, prior to the formal establishment of the Gitanjali Cooperative, SEWA entered into partnership with the Vejalpur *nagar palika*, at that time a self-governing ward of the greater Ahmedabad district, to provide recycling services for more than 45,000 households. With an upfront investment of just

Rs. 16,000 (US$230)[16], the *nagar palika* authority provided equipment including handcarts and gloves to the 400 waste pickers involved in the program, who also received a monthly government-provided salary of approximately Rs. 1,125 (US$16) and an additional Rs. 1,000 (US$14) from household user fees (Rs. 10 per household per month) [IMG6] (see Table 4.2). The women reported also being able to generate additional income through the sorting and sale of recyclables [IFG1]. SEWA organised capacity-building activities related to customer service and the use of the equipment. This model had the dual effect of increasing the women's overall monthly earnings from around 1,500 rupees (US$22) to 6,000 rupees (US$88) and achieving recycling rates of up to 70 percent [ICS9-11, IMG6]. The women also reported enjoying the vastly improved occupational health standards and feeling more secure in their employment – thanks both to a regular salary and the recognition of their work afforded by being contracted by a government agency [IFG1].

TABLE 4.2 Financial overview of 2004-09 partnership between Vejalpur and SEWA

Component	Cost	Funding source
Equipment	Rs. 16,000 (one-off)	Upfront investment from *nagar palika*
Waste pickers' monthly salary	Rs. 1,125	Nagar palika
	Rs. 1,000	Households (Rs. 10/household)
Cooperative membership	Rs. 5/annum	Waste pickers

In 2009, Vejalpur was incorporated into the jurisdiction of the AMC. Despite the apparent success of the partnership between SEWA waste pickers and the *nagar palika*, the AMC issued an invitation to tender for MSWM activities, ultimately awarding recycling work in Vejalpur to private companies in place of SEWA's members [IEN7-8]. A key part of the new arrangement required contractors to transport waste directly from "door/gate to dump" (Ahmedabad Municipal Council (AMC), n.d.). SEWA's waste pickers were not able to participate in the procurement process, primarily because a clause required potential candidates to make use of "innovative technology" and vehicles – a condition that the mostly low-income women were unable to meet [ICS9-11, IFG1]. Furthermore, as a result of the door/gate to dump strategy, there was significantly less waste on the streets citywide; a positive outcome in terms of cleanliness and efficiency, but waste pickers effectively lost access to their primary livelihood. Local government representatives assert that SEWA members were given the opportunity to participate but were "unwilling to modernise their practices"

16 This and other exchange rates in this chapter are based on those in May 2018.

[IMG4]. However, the redirection of work away from the informal sector and towards private operators is undeniably emblematic of a wider national policy shift towards more technology-intensive solutions, driven by national programs such as the Swachh Bharat ("Clean India") Mission and the Smart Cities Mission [ICS9, IAC14].

4.4 Kampala, Uganda and the Lubaga Charcoal Briquette Cooperative Society

4.4.1 The context

The city of Kampala – the capital of Uganda and its largest urban area, with a population of 3.5 million as of 2020 – generates around 2,200 tons of solid waste per day, amounting to almost 840,000 tons per year [UMG3]. This is expected to double at least by 2030 [UMG3, UCS13], in line with exponential population growth to 5.5 million by 2030. Around three-quarters of the city's waste is organic and biodegradable, and a further 15 percent consists of recyclables including plastics, paper, metal and glass (Okot-Okumu & Nyenje, 2011). The waste sector is the city's second biggest contributor of greenhouse gas emissions after energy generation – 28 percent of citywide emissions come from landfill, waste incineration, and solid waste management collectively (Lwasa, 2013).

The average annual municipal expenditure on solid waste management in Kampala is UGX 8.5 billion (US$2.25 million) [UMG3]. On average, this provides for half of Kampala's generated waste to be collected – two-thirds of this by the Kampala City Central Authority (KCCA) and one-third by private entities commissioned by KCCA [UMG3]. It is then dumped, usually without treatment, at the city's official dump site, Kiteezi [UMG4]. The uncollected half ends up in one of Kampala's 59 illegal dump sites, 133 unofficial temporary storage sites, or 35 official temporary waste storage locations[17] [UCS13] (see also (Kinobe et al., 2015)). Still more is burnt or

17 (Kinobe et al., 2015, p. 198) identify three types of dumping sites: (i) official temporary storage sites are those served daily by KCCA and/or its operators, most often found at market areas, public parks, near large public organisations, and by busy roadsides; (ii) unofficial temporary storage sites are those not officially identified as collection points served by KCCA and/or its operators but there is a daily collection schedule, although this is not always reliable; and (iii) illegal dump sites are places where waste is dumped and not collected by KCCA and/or its operators at all.

thrown into waterways, where it accumulates and blocks drainage channels. This is particularly the case in areas classified as slums, which house approximately half of Kampala's population (World Bank, 2017).

Officials estimate that there are currently around 3,000 people employed in the informal provision of solid waste management services in Kampala, as well as more than 100 formally registered companies, of which many are micro or small enterprises [UMG5, UCS13-14]. These actors are part of well-established but not always formal value chains for various waste streams. In some cases, KCCA has provided grants or non-financial support to these initiatives, for instance by allocating land that they can use to sort and treat waste. Various actors involved in recycling, turning waste into renewable energy sources, and raising awareness regarding the prevention and reuse of waste materials believe that utilizing and upscaling this existing ecosystem has the potential to improve the efficiency of the waste sector in Kampala, reduce the sector's greenhouse gas emissions, and provide sustainable livelihoods for the urban poor [UAC16; UCS13-14].

This conviction has been recognised in national policy. The National Urban Solid Waste Management (NUSWM) Policy of 2017 aims to establish national leadership on and clarify relevant legislation pertaining to MSWM. It also aspires to facilitate collaboration with diverse non-state actors, a goal that is complemented by the MSME Policy of 2015, which was designed to create a supportive policy environment for scaling up formal and informal MSMEs. However, decentralisation imperatives of recent decades have increasingly devolved responsibilities for the provision of public services to municipalities, and indeed the Local Government Act (LGA) of 1997 specifies that waste management in Kampala is the concern of KCCA. The LGA also specifies that it is an offence to remove, collect or disturb solid waste in containers, effectively making informal waste picking an illegal activity. This policy incoherence was cited as a key reason that officials at the local level favour partnerships with formal actors [UMG4] – there are no clear guidelines for partnering with community-based enterprises set out in the NUSWM policy, while in contrast the rules prescribed by the LGA are familiar and well-established [UCS14, UAC16].

4.4.2 The case study

The Lubaga Charcoal Briquette Cooperative Society, or Luchacos, is a registered company that has been operating in an informal settlement of the Lubaga division of Kampala since 2006. It produces biomass briquettes from organic waste, which are

then sold as an affordable source of energy for cooking to low-income households. Annually, 192 tons of waste are either collected by Luchacos employees or delivered to the organisation by the 1,200 households in nearby informal settlements [UCS13]. This waste is enough to produce 24 tons of biomass briquettes each year. The briquettes are sold either to the participating households, who receive a discount, or to local institutions and other users. Though small-scale, the enterprise is the primary source of income for its 20 employees, who report that their work has significantly reduced the extent of the solid waste challenge in the Lubaga Parish [UEN6]. An analysis of their gross margins reveals that Luchacos turns a modest but positive profit (Wafler, 2019), making it a viable enterprise by conventional economic standards.

Luchacos credits some of its success to its participation in the project "Knowledge in Action for Urban Equality" (KNOW), an ESRC-funded program working across nine countries, with city-level teams working on specific cases of co-production, including in Kampala (KNOW Kampala). KNOW Kampala has focused on capacity building in waste economies, and Luchacos was one of several community-based organisations selected to form a multi-stakeholder partnership with Makerere University, ACTogether Uganda (a local NGO), KCCA, and the Ministry of Land, Housing and Urban Development. Luchacos received seed funding, material and the opportunity to participate in a series of co-creation and co-production sessions. In addition to offering support in the early stages of business formation, KNOW Kampala stated the aim of creating platforms for transformative policy discussions between communities, academia and policy makers.

However, like many municipal authorities in East Africa, KCCA faces severe resource constraints [UNG1] and seeks partnerships with the private sector in order to provide urban services at as low a cost to the municipality as possible. Though ostensibly such partnerships could involve community-based waste enterprises, the processes for partnering with a single, formal company are more straightforward than coalitions involving multiple or informal actors: for example, to participate in public procurement processes, waste management candidates are required to provide bank guarantees of at least UGX 5 million (US$1,325) and have access to motorised vehicles. Community-based waste enterprises like Luchacos are therefore unable even to apply to be considered as part of KCCA's formal strategy for managing waste. Furthermore, new technologies such as waste-to-energy generation, though expensive, are attractive for being modern and relatively simple to construct and operate. Though officials report that contracting service delivery work to smaller private and civic actors is a necessary and attractive option [UMG3], including in the waste sector, national policies continue to favor partnerships with large, formal actors [UCS15, UAC17].

In this context, the commercial viability of organisations like Luchacos is severely constrained. Though there is a growing market for waste-based products, community-based organisations and small enterprises are often unable to scale up their operations. For example, the United Nations Refugee Agency in Uganda has shown serious interest in purchasing large quantities of briquettes from Luchacos, but the organisation is unable to meet the demand without upfront capital investment and new machinery [UCS13]. These are almost impossible to secure for Luchacos employees, most of whom are themselves residents of informal settlements with little or no formal education and limited, if any, access to formal finance systems [UAC17].

4.5 The multiple economies of community-based waste enterprises

Local involvement in waste management can stimulate both informal and formal economic development (Dodman et al., 2023), for instance through creating green jobs, like those offered by the Gitanjali Cooperative, and providing products in a more affordable or environmentally sustainable manner than might otherwise be the case, like the briquettes produced by Luchacos. Though the economic benefits were not calculated as part of this research, it is easy to imagine that they go beyond the creation of local livelihoods by offering public services, at little or no additional cost to the state, that might otherwise be financed through tax revenue (Gidwani, 2015). This includes not only the contribution to MSWM but also the occupational and social health services that Gitanjali offers its members, for example. Furthermore, embedding low-emissions measures into local realities and existing livelihoods, for example by working with waste picker cooperatives to improve the efficiency of waste separation and recycling, has been proposed as a way to maximise the potential synergies between climate and developmental outcomes (Colenbrander et al., 2016). Such initiatives therefore offer the potential to deliver not only financial but also social and environmental benefits.

At the same time, it is important to avoid what Banks et al describe as the "celebration of the tenacity of otherwise marginalised groups who exist amidst social, economic, political and geographic exclusion" (Banks et al., 2020, p. 223). Informal urban development frequently results in geographical marginalisation, severe basic service deficits, and exposure to poor and hazardous environments, while in informal employment, exploitation and human rights abuses are common, working

conditions can be appalling, and social protection is often non-existent (Oates et al., 2018; Pieterse, 2000). Informality is viewed by some as a bitter but necessary response to a system that excludes vast portions of the population, yet within which they must exist to survive. Undue faith in the self-help ideology could further orient policy towards economic neoliberalism (Ballegooijen & Rocco, 2013), shifting the responsibility of service provision onto citizens and organisations like SEWA and Luchacos. This is particularly pertinent for SEWA, given the disproportionate impact on (poor) women who are most likely to perform crucial unpaid labour, often under the rhetoric of women's empowerment (Miraftab, 2015). Endorsing the creation of green jobs like those of SEWA and Luchacos without simultaneously addressing the occupational health and marginalisation of waste workers could put the environmental agenda in cities like Ahmedabad and Kampala strongly at odds with social justice efforts (D. Brown et al., 2014; Dodman et al., 2023). Indeed, the majority of the trade-offs between different the Sustainable Development Goals (SDGs) are attributable to a reliance on economic growth to generate human welfare at the expenses of environmental sustainability, or vice versa (Pradhan et al., 2017).

Both cases also highlight how excessive professionalisation or formalisation (for example, of public procurement procedures) can prohibit the participation of low-income groups (Fieuw & Mitlin, 2018). In many countries in the Global South, national waste management policy – and policy related to the delivery of public services more generally –is currently biased towards technological solutions (Tvedten & Candiracci, 2018). This is in line with imaginaries of modernity and progress that such urban infrastructure is thought by many to represent (Gibson-Graham & Dombroski, 2020; Nilsson, 2016). As experienced by both SEWA and Luchacos, this often precludes community-based strategies to participate in tendering processes, severing them from the support and resources they require to continue their activities. Similarly, professionalisation could lead to – or result from – efforts by formal actors to capture the value of the informal waste economy, effectively restricting access to a resource on which waste workers have long relied and dispossessing them of their livelihoods (Samson, 2019). To avoid this, governments could consider replicating and upscaling emerging good practices, such as encouraging informal workers to organise into trade unions and cooperatives and including them in public–private partnerships. Indeed, if systemic injustices are not recognised and addressed, community-based actors will remain less well-positioned to compete with conventional market actors, as shown by the diminishing returns in both cases as the respective municipal authorities pursue modernisation agendas.

Even still, problematizing the modern infrastructure ideal, and by extension traditional dichotomies – such as formal/informal (service provision), necessity/opportunity (entrepreneur), and socio-economic/environmental (sustainability) – creates space to interrogate a far broader range of options in urban service delivery (Lawhon et al., 2018). A governance challenge will be to create space for diversity and self-organisation (Loorbach & Shiroyama, 2016) while consistently addressing underlying structural exclusion. Going forward, policymakers in Southern cities could better support community-based and informal enterprises in their efforts to provide waste management services, create jobs, and contribute to poverty alleviation (Muheirwe et al., 2023) but this must be done whilst ensuring that necessary social protections and regulations are in place (Gidwani, 2015; UN Habitat, 2016a).

4.6 Key findings from SEWA and Luchacos

SEWA in Ahmedabad and Luchacos in Kampala both demonstrate ways in which community-based waste enterprises generate value through the re-use and recycling of waste resources, despite being small-scale and localised. While they may not explicitly contribute to economic growth when quantified in terms of GDP, they act in places not served by public agencies, generate employment opportunities for citizens who would be otherwise unlikely to find employment in the formal economy, and provide a safety net for the urban poor. In these ways, such enterprises generate benefits for society that are more challenging to measure in capitalist economic terms but that are no less valuable than the tangible financial gains generated by profit-driven enterprises. However, the case studies also highlight potential trade-offs for waste enterprises and their employees or members, some of which are exacerbated by an unfavourable policy environment. Table 4.3 summarises the key findings from each case study.

TABLE 4.3 Summary of key findings from case studies in Chapter 4

SEWA, Ahmedabad	
Technical and/or organisational innovation	– Trade union that lobbies for informal women workers' rights and facilitates the formation of trade-specific cooperatives, such as Gitanjali Cooperative
Main actors and key partnerships	– Trade union – Informal workers (SEWA members) – Ahmedabad Municipal Council (AMC) – Trade-specific cooperatives, such as Gitanjali Cooperative (also involved WEConnect International, Accenture and Gopi Stationary) – Vejalpur ward contract SEWA for door-to-door waste collection (2004-09)
Economic benefits	– Increased pay for Vejalpur waste pickers – from 1500 rupees (US$21) to 6000 rupees (US$84) per month, plus any extra from selling recyclables – Secure salary – Small businesses created from cooperatives (e.g., Gitanjali Cooperative makes and sells paper)
Environmental benefits	– Reuse of waste materials to create e.g., paper – Up to 70 percent of Vejalpur's waste recycled
Social benefits	– Stable working hours – Improved occupational health – Upskilling of workforce – Access to benefits such as childcare, healthcare, legal aid and capacity building – Efforts in achieving greater gender equality
Trade-offs	– Waste work remains dangerous and heavily stigmatised
Political and economic viability	– Preference for technological solutions reflected in policy and through availability of subsidies – Waste pickers not able to participate in tender processes due to inability to meet minimum technical requirements – Gitanjali Cooperative not yet viable without support from Accenture
Luchacos, Kampala	
Technical and/or organisational innovation	– Micro-enterprise producing biomass briquettes from organic waste, which are then sold as an affordable source of energy for cooking to low-income households
Main actors and key partnerships	– Luchacos employees (informal settlement dwellers) – Makerere University – Kampala City Central Authority (KCCA) – ACTogether Uganda – Ministry of Land, Housing and Urban Development – Knowledge in Action for Urban Equality (KNOW) Kampala, an ESRC-funded program designed to foster capacity building in the city's waste economies
Economic benefits	– Job creation – primary source of income for 20 employees
Environmental benefits	– Annual reuse of 192 tons of waste that is either collected by Luchacos employees or delivered by households – Replaces charcoal
Social benefits	– Capacity building – Affordable energy source for participating households
Trade-offs	– Briquettes still do not provide clean energy when used indoors (can lead to respiratory and other health problems)
Political and economic viability	– Policy incoherence between national and municipal levels disadvantages small-scale (informal) actors – Viable with modest but positive profit margins but too little to invest in the equipment needed to scale up – Unable to participate in tender processes without more "modern" equipment

4.7 Thinking beyond the waste sector

On thinking through heterogeneous infrastructure configurations, Lawhon et al. suggest that a key analytical entry point is to consider "*whether and under what conditions these alternatives are more adept at responding to conditions of precarity*" (2018: 8). Both SEWA and Luchacos perform cost-effective service delivery that relieves the burdens on municipalities in cities where waste management is under-resourced and unreliable (Gidwani, 2015). Such enterprises are also inherently important because the people pursuing them are typically those who are left behind by conventional development models, as are many of their clients. Considering social benefits such as poverty reduction and inclusion alongside the techno-economic aspects of service delivery could help cities to work towards global sustainability goals. This can be done when governments prioritisee socio-cultural as well as economic and environmental values.

This research has implications beyond the MSWM sector for cities pursuing sustainability goals more generally. The findings suggest the need for new ways of understanding and assessing the performance of community-based enterprises, which may not conform to the dominant capitalist economic paradigm. For example, it is accepted that many things that add to GDP can be harmful: while the conversion of forests or the presence of polluting industry both contribute to economic growth in terms of GDP, neither conserved forests nor clean air have any market value. Similarly, community-based service delivery initiatives are not always considered viable when measured solely in terms of profit margins. Classifying enterprises as worthy of support only if they contribute to economic growth could be seen at worst as a subtle way for multilateral agencies and national governments to reinforce problematic economic norms and models. However, where national and municipal governments are willing to cultivate inclusive organisational forms as well as sustainable technologies, they could reduce policy barriers for community-based enterprises. This may offer an opportunity to steer urban transitions along more sustainable and inclusive pathways.

SEWA and Luchacos both demonstrate the potential for citizens to contribute to service delivery – but also highlight the vulnerability of many of the populations that do so. Formally recognizing the role of such initiatives and making it both legally possible and physically safe for them to participate in service delivery might improve the quality of life of some of the most marginalised citizens at the same time as it complements formal service provision systems that do not reach all citizens equally. At the grassroots level, replicating successful organisational approaches could help to upscale promising emerging practices. Encouraging informal workers to unionise or

form cooperatives (like SEWA) and work in multistakeholder partnership with other local actors (like Luchacos did through KNOW Kampala) are fine examples. These organisations could then be supported through both financial and non-financial aid. Non-financial support could be organisational, such as offering partnership opportunities and capacity-building, and/or practical, such as granting land rights or providing equipment. Financial incentives that would allow community-based initiatives to increase productivity might take the form of subsidies, or finance could be channelled to grassroots initiatives by reforming public procurement policies to allow them to participate in tender and contracting processes. At the national level, the integration of a more multi-stakeholder, holistic approach to waste management should be recognised in coherent policies that facilitate structural collaboration with community-based enterprises as part of citywide service delivery strategies (Muheirwe et al., 2023; Satterthwaite et al., 2015).

The proposed support for community-based service delivery initiatives need not be in opposition to much needed work on improving the social and environmental performance of networked infrastructure (Schramm & Ibrahim, 2021). Taken alone, such community initiatives may not be transformative: they do not always tackle the underlying drivers of social injustice, nor can they reduce emissions at the scale required to avoid catastrophic climate change. For example, decarbonizing the electricity grid accounts for up to half of all urban mitigation potential to 2050 (Coalition for Urban Transitions, 2019), while transport is responsible for 14 percent of global greenhouse gas emissions (IPCC, 2014) – yet even when carbon-intensive and polluting, such infrastructures provide vital services for millions of urban citizens. Further research could explore connections between local, place-based service delivery initiatives and large-scale, formal infrastructure networks, and the implications of these overlapping regimes for urban inclusion/exclusion (Lemanski, 2021) and managing climate change.

4.8 Conclusions

This research explored the extent to which community-based waste enterprises might aid in the transition to more sustainable and inclusive municipal solid waste management strategies, in the context of heterogeneous infrastructure configurations in Southern cities. Much theoretical and empirical work on the transition to more sustainable urban infrastructure has focused on the generation and diffusion of innovations that can be upscaled and commercialised (Savaget

et al., 2019), on technological efficiency (Moss & Marvin, 2016), and on management approaches that tend to rely on long-term centralised governance arrangements (Savaget et al., 2019). In contrast, the cases presented in this chapter are emergent, place-based, and organised around relatively low-tech micro-level innovations that are not necessarily intended for the profit-oriented market. They involve various self-organised agents and, directly or indirectly, tackle institutionalised inequalities through the provision of basic services.

Though it is also necessary to engage in more normative discussions around whose responsibility it is to ensure universal access to UBIS, the reality in Ahmedabad and Kampala – as in many cities of the Global South – is that poverty and a shortage of public funds will continue to be a problem for years to come. Similarly, informality cannot (and, arguably, should not) be eliminated. Despite or because of such challenges, small-scale community-based waste enterprises are creating livelihoods and forging new partnerships whilst recycling and reusing waste resources. Inclusive waste management strategies that support those who work in informal or small-scale enterprises could generate multiple socio-economic and environmental benefits in a sector notorious for appalling conditions and the vulnerability of workers. These enterprises may or may not be considered successful when analysed by traditional economic means. Yet they contribute undeniably to multiple sustainability objectives when considered within a particular spatial and temporal context (Oates et al., 2022).

The intention of this research is not to endorse any one social or technological intervention at the expense of another (Lawhon et al., 2018, p. 3). Indeed, as Gibson-Graham and Dombrowski (2020, p. 20) explain, "there is no sense in dictating or designing one grand action strategy, *because that impulse is where many of the world's problems might be traced to* – forms of imperialism embedded in a Eurocentric understanding of the world requiring abstraction and universalism" (see also (Escobar, 2018)). Similarly, the goal is not to romanticise UBIS provision models borne out of poverty and inequality (Rocco & Ballegooijen, 2019). Rather, by building on contributions from the literatures on heterogenous infrastructure configurations and diverse economies, this research speaks to the need for policy, practice and theory to recognise and incorporate a broader range of approaches to the delivery of urban basic infrastructure services. Doing so could inform possibilities for more sustainable and inclusive responses to urban challenges in which diverse and dynamic service delivery models are deployed not (only) as technological artefacts, but as instruments designed to improve both human and environmental conditions in cities.

5 Community participation in urban land and housing delivery

Evidence from Kerala (India) and Dar es Salaam (Tanzania)

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ABSTRACT Current approaches to the provision of shelter, largely driven by national governments and/or the commercial private sector, continue to fall short of what is needed to reduce housing deficits. The number of people without access to adequate housing continues to grow, especially in cities of the Global South. Increasing attention is being paid to alternative models for organizing land and housing delivery, such as those led by, or at least including, civil society. This paper considers two national land and housing programmes – the 20,000 Plots Project in Tanzania, and Basic Services for the Urban Poor (BSUP) in India – alongside community-led housing initiatives from each country. It explores the extent to which community participation in housing delivery can have social and environmental advantages when compared to "business as usual" methods and finds that, given appropriate state support, community-based and civil society actors (including organisations of the urban poor) have significant potential to contribute to acquiring land, building homes and improving the quality of life of vulnerable segments of the population. The paper echoes calls for community-led housing to become a recognised part of formal housing policy whilst emphasising the need for theoretical refinement of the process so as to prevent it from being captured by prevailing market-led narratives.

5.1 Introduction

5.1.1 Background

It is widely recognised that secure land tenure and property rights are necessary for improving the livelihoods of the poor (Deininger et al., 2006), achieving gender equality (Meinzen-Dick et al., 2019), reducing environmental degradation (Agrawal & Ostrom, 2001), generating economic growth (Dowall & Ellis, 2009), building resilience to external shocks (Oxfam et al., 2016), and allowing people to lead healthy, productive and dignified lives. Housing serves as the primary means by which residents access services and employment and exercise their citizenship (Rocco & Ballegooijen, 2019; Satterthwaite, 2020), and is an essential component of building sustainable human settlements.

Conversely, insecure land and property rights are a primary contributor to global poverty and inequality, and indirectly contribute to a wide range of global environmental challenges (Meinzen-Dick, 2009). Providing – or enabling the provision of – adequate housing thus remains an urgent priority for governments worldwide. The international community has established targets related to the provision of adequate housing for all, most notably in the Sustainable Development Goals (SDGs) and the New Urban Agenda. In many countries, however, current approaches to tackling this challenge are falling far short of what is required to reduce national housing deficits (Daniel & Hunt, 2014; Ram & Needham, 2016). Further, these approaches frequently fail to address (and in some cases, even exacerbate) major global sustainability challenges including climate change and structural inequality.

Though universally relevant, the challenge is perhaps most pronounced in the rapidly growing cities of the Global South, where informal settlements are considered "the most striking representation of a global infrastructure crisis that has beset an increasingly resource-constrained world" (Schäffler & Swilling, 2013, p. 256). Globally, more than one billion people live in informal settlements, many of whom have limited or no access to decent housing, legal tenure, or adequate basic infrastructure services such as water and sanitation (UN Habitat, 2016b). With formal housing provision unable to keep pace with demand, and additional barriers like affordability and legal status precluding access to the formal market for low-income and other disadvantaged groups, large portions of the population occupy land that may be peripheral or poorly connected to the wider urban area, hazardous or illegally settled, and live in poorly constructed homes that are unable to withstand even minor shocks (Sandhu, 2015).

Since neither public nor private provision of housing has been sufficient in the Global South, many communities and households have found themselves the primary actors in housing processes (Bredenoord & van Lindert, 2010; Tipple, 2015). Under the right conditions, active community participation in and multi-actor partnerships for the provision of housing and other urban basic services has been found to have positive societal and environmental impacts (Agrawal & Ostrom, 2001; Gillard et al., 2018; Oates et al., 2020; Patel, 2013). This paper aims to explore, through a case study approach, the circumstances under which community involvement in housing programs can produce more environmentally friendly, economically attractive, and socially inclusive housing when compared to "business as usual" methods that are most often led by (a combination of) the state or commercial private sector. City-level case studies from Dar es Salaam (Tanzania) and Kochi and Trivandrum in the state of Kerala (India) are presented alongside a national land and housing program from each country. Ultimately, this paper seeks to a add to a growing body of evidence demonstrating the potential of community-based organisations to contribute to the provision of adequate shelter and, more generally, the importance of place-based approaches to building inclusive cities that are embedded in wider multilevel governance structures (Bredenoord & van Lindert, 2010; Wamuchiru, 2017a). Here it is worth briefly denoting the interpretation of "provision", which is deliberately broad, and encompasses processes related to community building, land delivery and land holding mechanisms, housing construction, and associated governance structures (Mullins & Moore, 2018). Similarly, reference to the participation of communities in housing provision is used to signify "a wide array of […] forms of collective self-organised housing […] defined by high levels of user participation, mutual help and solidarity and different forms of crowd financing and management, amongst others" (Czischke, 2018).

The rest of this paper is structured as follows. The next section provides a brief overview of dominant understandings of shelter provision and their critiques, highlighting the trajectory towards more participatory, multi-stakeholder approaches. Section 3 describes the materials and methods of data collection, while Section 4 presents key findings from the case studies. Section 5 extracts the broader implications of these cases for land and housing programs, and closes by echoing calls for state-supported community-led housing initiatives to become a recognised part of formal housing policy (Bredenoord & van Lindert, 2010; Sengupta, 2010).

5.1.2 Public housing provision – state or market?

Post-war housing delivery policy can be broadly characterised by a transition from state-led to market-led policy approaches in both the Global North and South (Sengupta et al., 2018). With superior access to financial resources, technical capacity, and legal powers, the nation state has played a critical role in the provision of housing since the end of the Second World War. Especially in Europe, governments were expected to build and manage public services and infrastructure, including housing – particularly housing for the poor. This model was replicated in much of the rest of the world, including the Global South, with varying degrees of success.

In a few cases, government-led land and housing programs have been especially effective. In Singapore, for example, more than 80% of the population live in high-density government-provided apartments (Singapore Housing Development Board, 2021), while Rwanda's 2009–2013 Land Tenure Regularisation program – land being one of the most important inputs into the housing process – is hailed as one of the most successful large-scale land reforms ever undertaken by a low-income country (Ngoga, 2019). However, many other state-led shelter-related programs have had disappointing results. While the underlying reasons for this are often case specific, some themes emerge across the literature. Motivated by reducing capital costs and increasing efficiency, government-provided homes are often of poor quality. Influenced by the post-war trend towards motorisation, the de-densification of urban cores, and separation between housing and commercial spaces, public housing is often located on cheap, peripheral land, sometimes without connections to jobs, services, or existing social networks. As a consequence of institutional weaknesses, many housing programs suffer from corruption and mismanagement (Satterthwaite, 2020).

In response to these failings, and as part of a much broader global agenda of liberalisation and structural adjustment, from the 1980s many national governments transitioned to a so-called "enabling approach" – that is, enabling markets to work for housing regimes (Sengupta et al., 2018). This approach seeks to create conditions in which a wide range of non-governmental stakeholders, primarily the commercial private sector, play significant roles in supplying housing (Sengupta et al., 2018; UN Habitat, 1988; Wakely, 2014; World Bank, 1993; Yap, 2016). Global institutions like the United Nations and the World Bank began advocating for countries in Africa, Asia and Latin America to adopt this strategy when critics of state-led approaches stressed that the informal sector, was supplying far more homes than the public sector in most of the Global South (Amis, 1984; Payne, 1982). National governments worldwide have since gradually withdrawn from the direct provision of housing, instead introducing various programs and policies intended to incentivise the market to supply housing for all citizens, including low-income populations (Dowall, 1989).

The performance of the enabling approach in both Northern and Southern cities is a source of controversy. The housing deficit remains vast, with the affordable housing gap estimated at 330 million urban households and expected to grow to 440 million households, affecting 1.6 billion people, by 2025 (King et al., 2017). Informal settlements, too, continue to grow: while the overall proportion of the urban population living in informal settlements decreased between 1990 and 2014, the *absolute* number of residents increased by 28 percent in the same period (UN Habitat, 2015), driven by population growth and migration, and exacerbated by the ever-increasing income and access inequality across all sectors of the economy for which neoliberal reforms are largely blamed (Amin & Cirolia, 2018). Such reforms have resulted in the financialisation of housing, described in 2017 by the UN Special Rapporteur on adequate housing as "structural changes in housing and financial markets and global investment whereby housing is treated as a commodity, a means of accumulating wealth and often as security for financial instruments that are traded and sold on global markets" (UN, 2017). This process is not specific to the housing sector, nor to low-income countries (R. Weber, 2015): the 2017 Grenfell Tower fire in London, for example, has become infamous not just for being the largest residential fire the United Kingdom has seen since the Second World War, but also for being "symbolic of an unequal urban landscape closely tied to material and aesthetic norms around property ownership and entitlement" (Burgum, 2019) (p. 458). However, it is in low-income countries that the privatisation of housing and urban infrastructure service delivery more generally has most spectacularly failed to generate the anticipated benefits.

5.1.3 Alternative approaches to housing provision

There is as yet no clear resolution to the debate on whether or not the state should directly provide housing, indicated by broad agreement that neither the state nor the market has succeeded in delivering satisfactory outcomes (Sengupta & Ganesan, 2004). Research on the provision of basic infrastructure services argues that these failings are not only "because of some inherent contradiction between private profits and public good, but because neither public nor privately operated utilities are well suited to serving the majority of low-income households [...] and because many of the barriers to service provision in poor settlements can persist whether [...] utilities are publicly or privately operated" (Budds & McGranahan, 2003) (p. 87). Indeed conventional management approaches are based primarily on socio-political structures in the Global North (Jayaweera et al., 2023). Many of the barriers that low-income households face in acquiring decent housing – for example, affordability, location, and quality of the structure – exist regardless of whether housing is delivered by public or private institutions or, as is often the case, a blend of the two.

In response to these shortcomings, in many Southern cities it is most often low-income communities and households themselves that construct and maintain their own shelter (Bredenoord & van Lindert, 2010; Tipple, 2015). A constantly growing body of work highlights the enormous but often latent potential of actors such as (coalitions of) communities, community-based organisations, grassroots agencies, and NGOs to acquire land for housing and develop suitable homes, as well as the more structural co-benefits this can generate. For example, Patel and co-authors find that participatory enumeration in India has been "a basis for engagement between communities and government on planning and development", and a process that "allows communities of the urban poor to assert their rights to the city, to secure tenure, livelihoods and adequate infrastructure" (Patel, 2013) (p. 13). Similarly, Boonyabancha and Kerr describe the Thai government's transition "from a provider of housing to a facilitator of community-driven local housing co-production" as key in having opened space for negotiation and collaboration on housing and other aspects of community development (Boonyabancha & Kerr, 2018) (p. 444). In Tanzania, Wamuchiru shows how community organisation, for example around collective savings groups, can reduce dependence on the government and create "invented spaces of citizenship, which empower formerly marginalised communities" (Wamuchiru, 2017a) (p. 562). Such initiatives – community-driven arrangements that may be informal and incremental – often better suit the social and economic conditions of the urban poor.

While the significance of community-led housing provision is nowadays well-established in academic literature, policymakers worldwide continue to embrace formal attributes of the "providing" and "enabling" frameworks described above, despite decades of experience having shown such models are insufficient in the task of addressing housing issues. At the same time, 29 percent of energy consumption and 21 percent of global carbon emissions can be attributed to residential property (IPCC, 2014), making housing a significant contributor to climate change. It is also an important signifier of urban form, which is an indicator of land use and carbon intensity (e.g. a city's density affects the total amount of land converted to support the built environment, as well as behavioural patterns related to sustainability such as car ownership) (Dodman, 2009). Housing is increasingly developed on cheaper land at the urban peripheries, thereby exacerbating spatial inequalities and contributing to urban sprawl, which is in turn associated with polluting land, promoting deforestation, and threatening biodiversity (Schuster Olbrich et al., 2022). Conventional housing approaches can be said to be failing not only for their inhabitants, but for the environment too. Exploring alternative options to mainstream housing provision can therefore be seen as a "window of opportunity for a transition to long-term urban sustainability" (Jayaweera et al., 2023). It offers the opportunity both to contribute to the achievement of global sustainability and development targets like the Paris Agreement and the Sustainable Development Goals, and to afford all humans the right to live in dignity and comfort.

5.2 Materials and methods

The comparative urban case study approach (Nijman, 2007; Yin, 2017) has risen in popularity in recent years thanks to its utility in both identifying characteristics unique to specific places and also seeking to detect broader patterns of convergence and divergence across neighbourhoods, cities, regions, or nations (Kantor & Savitch, 2005). However, cases from Europe, North America and Oceania dominate. Particularly sparse is case study literature from African cities, which are the fastest growing, and small Asian cities, which will house the largest share of the urban population by 2030 (Lamb et al., 2019). This paper draws on case studies of two large-scale national land and housing programs: in India, a national slum upgrading program called Basic Services for the Urban Poor (BSUP); and in Tanzania, a national land delivery scheme called the 20,000 Plots Project. In each country, these programs are compared with local-level community-led housing projects: in India, the implementation of BSUP by Kudumbashree – a charitable society governed by the local authorities – in the cities of Kochi and Trivandrum, in the state of Kerala; and in Tanzania, a community-led resettlement project undertaken by the Chamazi Housing Cooperative in Dar es Salaam.

The broader project within this research took places was designed to extract the lessons for the development of inclusive low-carbon cities. The case studies were therefore selected in collaboration with partners from a large international research and advocacy network, based on: (i) having been identified (by said partners, and in the literature) as “frontrunners” or examples of good practice (Burra et al., 2018; Devika & Thampi, 2007; UN Habitat, 2010a; Wamuchiru, 2017a); and (ii) exhibiting direct relationships with both climate-smart urban development and socio-economic developmental objectives. By looking at this range of initiatives happening at different scales and in different regions, it was possible to explore the roles of various levels of government and multiple stakeholders in governance processes that determine the efficacy of land and housing programs.

TABLE 5.1 Methods for Chapter 5

Stakeholders	Number of interviews (or other methods)	
	India	Tanzania
Government officials	1 [IGV1]	3 [TGV1–3]
Private companies	2 [IPC2–3]	3 [TPC4–6]
Civil society	3 [ICS4–6]	3 [TCS7–9]
Academics	2 [IAC7–8]	4 [TAC10–13]
International financing institutions	NA	1 [TFI14]
Local residents	4 site visits (Kalladimugham, Kannamula and Karimadom, Kochi; Mathipuram, Trivandrum)	1 [TLR15]; 2 site visits (Chamazi and Mabewepande, Dar es Salaam)

Primary data was collected during key informant interviews, site visits and field observations in India and Tanzania between May and October 2018. Participants were selected purposefully, based on their knowledge of and involvement in the case studies. Interviewees included community members, representatives of civil society, academics, local and national government officials, and others involved in the projects in both Tanzania and India, as well as internationally (Tanzania n=15; India n=8; see Table 5.1). Interviews with key informants provided detailed descriptions of the selected cases, including how they came into being, how they were governed, and their successes and shortcomings, as well as a general background on land and housing policy in the respective contexts. Other sources of information that were analysed include project reports, government evaluations, newspaper articles and previous research conducted by in-country research partners.

5.3 Results

5.3.1 Land for housing in Tanzania

5.3.1.1 The 20,000 Plots Project

Land is one of the most important inputs into the shelter process, yet access to land – or, more accurately, a lack thereof – is one of the most severe constraints on housing the urban poor. The 20,000 Plots Project of the United Republic of Tanzania was a land regularisation program that took place between 2002 and 2010 designed to increase the formal supply of serviced plots of land for housing, prevent the further growth of informal settlements, and reduce poverty by issuing land titles that could be used by residents as collateral (Kironde, 2015). The program is the largest land delivery scheme to ever have been undertaken in the country: over eight years, the project delivered around 40,000 plots in Dar es Salaam, and 58,590 plots nationwide, including 10,000 in Mwanza, 2,700 in Morogoro, 2,390 in Mbeya, 3,000 in Bagamoyo and 500 in Kibaha [TAC10] (Kironde, 2015).

Unusually for a land delivery program of such scale in a low-income country, where inadequate resources are typically a major barrier to the adequate supply of serviced land, the project was entirely locally financed (UN Habitat, 2010a). Tanzania's Ministry of Lands, Housing and Human Settlements (MLHHSD, the national ministry responsible for leading implementation) was able to borrow TSH 8.9 billion (equivalent to US$ 3.89 million) from the Treasury to cover upfront costs, on the basis that the planning, surveying and servicing of the land would unlock its value. As predicted, returns from the sale of plots in the first year were more than triple the initial investment, generating TSH 29.3 billion (US$ 12.79 million) of revenue for the government. A portion of the returns was earmarked for the provision of urban infrastructure: Around 1,000 kilometers of earth roads were constructed, and more than 50 town plans were designed [TAC10] (Kironde, 2015).

The program has been widely praised for reducing the cost of land purchase and eliminating corruption common in land administration procedures [TGV1, TAC10-11]. This was largely thanks to strong political backing at high levels, which also enabled the MLHHSD to mobilise public and private surveyors from all over the country to accelerate the surveying process [TGV1]. The private sector delivered around one third of all plots. This capacity coupled with the use of modern

technologies reduced the surveying time of the first 20,000 plots from more than six years – an estimate based on actual land delivery rates at the time – to just 20 months [TPC4, TAC10].

Though a nationwide program, efforts were concentrated in Tanzania's economic hub, Dar es Salaam. One area of the 20,000 Plots Project was used to resettle 1,006 households from the informal settlement of Sunna in the city centre, who were displaced by flooding in 2011 [TGV3]. Local authorities provided the displaced households with title deeds to the new plots in Mabwepande, as well as trucks for moving their belongings from Sunna to Mabwepande, building materials for the homes, and tents to live in until the homes were built. Residents reported that the incidence of diseases like malaria was now much lower, that the "*environment is healthier for children, who have space to play outside*" and "*safer for livestock [as] animals are less likely to be stolen or lost to flooding*", and that families have been able to access credit facilities now they have land titles to offer as collateral [TLR15].

However, Mabwepande is 25km from the city centre with few transport links, making many economic opportunities unreachable for low-income residents. These difficulties were exacerbated by the disregard shown to existing social networks in the resettlement process, limiting residents' access to informal service provision, such as short-term microcredit and childcare. Some households returned to informal settlements closer to the city centre, either because the new location was "*too far away from livelihoods and schools*' or they were '*too poor to construct new homes on the plots they were allocated*" [TLR15].

The 20,000 Plots Project was plagued with such challenges that prevented it from being a solution that could be sustained over the longer term, and ultimately meant the program fell short of its laudable goals of reducing poverty and preventing the further growth of informal settlements. These failings can be largely attributed to governance deficits and issues related to urban land markets, which have consistently failed to deliver for low-income groups [TAC10-11, TFI14] (Napier, 2009). Like many such projects, "*local communities were not engaged – the planners just sat in a room and worked from plain paper, not reality*" [TCS8]. Just 14 percent of the delivered plots were affordable for low-income groups (Jones et al., 2016) and though land speculation was initially controlled, nowadays, "*the plots are selling for at least 20 times as much as their 2004 prices*" [TCS8; also TAC11]. This has further incentivised the few low-income families who were able to obtain a plot to sell their land for a profit and return to more centrally located informal settlements [TGV2, TAC10]. The unmanaged urban expansion has generated sprawling, poorly connected neighbourhoods: Interviewees attribute this failing to the unregulated involvement of "*private developers, who want cheap*

land and a bigger mark-up, so they bought on the peripheries" [TAC10], and note that "*basic infrastructure wasn't connected to most of the new plots*" [TCS8]. Just 16 percent of the plots produced were high density (Jones et al., 2016), and provision of the plots was poorly integrated into wider urban development, meaning many had inadequate access to employment and or public transport services of any kind. Existing land uses were largely ignored, and the application of pre-determined, standardised plot sizes reduced the availability of agricultural land close to the city. Residents report that they were awarded compensation for the loss of farmland and of existing crops, but that it did not adequately account for longer-term losses of income, nor replace the food they grew for their own subsistence [TLR15]. Coordination between different levels of government, between different governmental departments, and between outgoing civil servants and their successors was weak, a policy challenge that has been encountered also in other African cities [TAC10] (Lamson-Hall et al., 2019): one respondent noted that "*central government came in strong but local government didn't have that same strength so implementation broke down*" [TFI14]. Nationwide, the delivery of serviced land has been especially slow since the 20,000 Plots Projects ended in 2010 and unmet demand for housing plots has continued to grow. As a result, the growth of informal settlements in Dar es Salaam and other cities in Tanzania continues.

5.3.1.2 Chamazi Housing Cooperative

A project that draws on the fiscal and technical successes of the 20,000 Plots Project while taking greater care to attend to matters of participation, inclusion and representation could have significant economic, social and environmental benefits. This could be done by engaging with community-led resettlement and upgrading initiatives in Dar es Salaam, such as the Chamazi Housing Cooperative, a community savings group that, when faced with eviction from the ward of Kurasini, collectively saved enough to buy a 30 acre plot of land in the ward of Chamazi. They received support from the Tanzania Urban Poor Federation (a local branch of Slum/Shack Dwellers International) and a local non-governmental organisation, the Centre for Community Initiatives (CCI), who provided technical assistance and helped to leverage funding equivalent to US$100,000 from The Rockefeller Foundation, granted for the purposes of demonstrating a successful relocation [TCS9].

The Chamazi development includes 42 homes, a solar-powered borehole, and a sewage system. They report average construction costs of a little over US$2,000 per home [TCS9] – dramatically low compared with the construction of an average dwelling in Dar es Salaam, which costs around US$18,000, and less than 10% of

the US$23,000 average cost of building a home in sub-Saharan Africa (Centre for Affordable Housing Finance in Africa, 2019). They used incremental construction, initially building single-story houses containing a kitchen, bathroom and living area, to which a second story could be added. This both reduced the upfront capital costs of the project, and took into account the community members' capacity to repay loans.

The Chamazi Housing Cooperative were inspired by Thailand's Baan Mankong collective housing program to apply to reduce the plot sizes in their development and were granted planning permission to develop plots of 200 square meters (half of Tanzania's usual legal minimum plot size) [TGV3, TCS9]. This had the dual benefit of making the plot of land more affordable and helping to limit urban sprawl by creating a liveable density.

The Chamazi model is not without its challenges. Like Mabwepande, it is still around 20km from the city centre and transport links are poor, limiting access to employment opportunities and services, and residents report increased household expenditure since market goods are more expensive. Both Chamazi and Mabwepande have since been surrounded by the further growth of informal settlements and respondents noted that "*it is difficult to make unplanned cities resilient to climate change*" [TAC12], raising concerns about the environmental implications of unmanaged urban expansion. This highlights the need for continued state involvement, and suggests a governmental role could be in facilitating, coordinating and co-creating initiatives that deliver on social and environmental objectives. Going forward, governments could draw on the fiscal and technical successes of the 20,000 Plots Project, incorporating participatory governance measures from community-led initiatives like Chamazi to deliver socially just and environmentally sustainable land reforms and housing programs.

5.3.2 Housing for all in India

India's national government has been responsible for a series of ambitious national affordable housing programs, including the Integrated Housing and Slum Development Program (IHSDP); the Rajiv Awas Yojana (RAY) program for a "slum-free India"; the Pradhan Mantri Awas Yojana (PMAY) Mission to provide "Housing for All by 2022"; and the Basic Services for the Urban Poor (BSUP, the case study presented here). However, many of these flagship housing programs have been characterised by poor performance arising from insufficient revenues (Nandi & Gamkhar, 2013) and non-participatory, homogenous delivery mechanisms which result in dissatisfaction amongst beneficiaries (National Cooperative Housing Federation of India, 2017).

The liberalisation of housing policy has been blamed for these shortcomings. The privatisation of land and housing programs has led to a devolution of responsibilities for housing, urban service provision and urban poverty alleviation, to local governments (Yap, 2016), yet this devolution has often not been accompanied by a devolution of financial resources (Tiwari & Rao, 2016). Furthermore, national programs have been designed from the top down, with some input from state governments but almost none from the Urban Local Bodies (ULBs, city-level authorities), who are charged with implementation and who are of course best placed to understand local circumstances.

5.3.2.1 Basic Services for the Urban Poor

India's Basic Services for the Urban Poor (BSUP) program, which was initiated in 2005 and officially closed in 2014, was a national slum upgrading initiative rolled out in 65 cities that were selected based on their population and cultural and touristic importance. BSUP was envisioned as a service delivery program, intending to improve low-income households' access to facilities such as water supply, sanitation, education, health, and social security by either relocating communities to new sites where the state had constructed mass housing, upgrading slums in-situ, or redeveloping areas with community participation. However, respondents note that in practice "*the emphasis has been on the mass construction of new dwelling units*", without consulting community members [IAC7] (Burra et al., 2018; Effective States and Inclusive Development Research Centre (ESID), 2015). This has often resulted in the construction of poor quality homes in remote locations, many of which remain unaffordable for the intended beneficiaries. As of 2020, many of the developments were still incomplete, 13 years after the program was launched, and nationwide more than 1 in 10 of all completed homes remains vacant, with occupancy rates lower than 50 percent in some states (Government of India, 2020). Research conducted in some of the informal settlements that were part of the BSUP program finds that living conditions have not been meaningfully improved (Patel, 2013).

5.3.2.2 Kudumbashree in Kerala

The southern state of Kerala has had relatively more success when implementing the BSUP program than any other state. The Government of India reports that more than 38,000 homes have been built in Kerala at an average cost of 97,500 Rupees (equivalent to US$1,340) per house, just over half the cost of an average BSUP house (158,000 Rupees, equivalent to US$2,171). Occupancy rates were almost 100 percent as of November 2020 (see Figure 5.1).

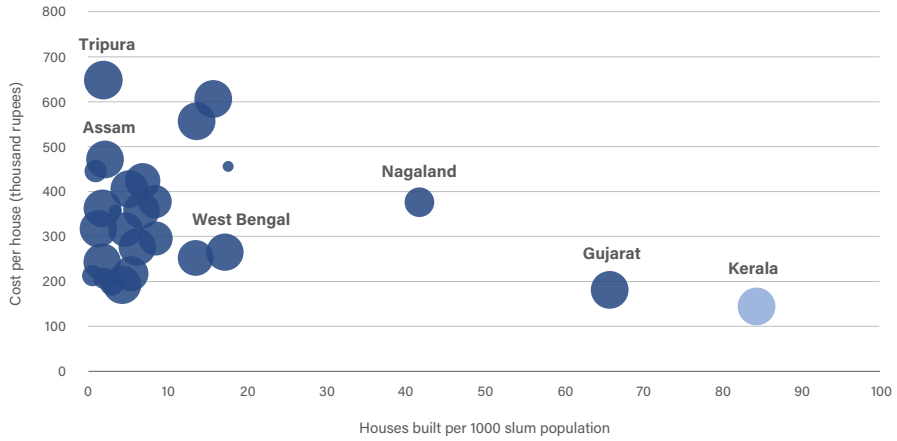

FIG. 5.1 Cost and occupancy rates of BSUP housing units by state. Note: Figure is based on houses built between the start of the program in 2005 and April 2018. The size of the bubble indicates the occupancy rate. The smallest states, Chandigarh and Sikkim, are excluded (Gillard et al., 2019).

Some attribute Kerala's success in implementing the BSUP program in part to its "*unique culture and history, [which] generated the conditions for participation*" [ICS6]. The state has a history of successful public action, as well as high literacy rates and gender equality when compared to other states, and low-income communities tend to have stronger tenure rights than they do elsewhere (Drèze & Sen, 2002). While this has implications for the generalizability of the results, there are still lessons to be drawn from the case.

In the Keralan city of Trivandrum, the implementation of the BSUP program was led by a local civil society organisation called Kudumbashree. Kudumbashree is a community-based organisation run by women, with 4.3 million members across 941 community-level societies state-wide [ICS4]. The organisation serves as a State Nodal Agency, meaning they are nominated by the State government as officially responsible for leading the implementation of certain government policies, including BSUP.

When working on the implementation of BSUP, Kudumbashree began by creating a public-private partnership between themselves, the local government and the Centre of Sciences and Technology for Rural Development (COSTFORD), a local sustainable architecture firm [ICS4, IPC2]. The coalition was required to submit a Detailed Project Report (DPR) to the national government in order to release funding, which they designed in collaboration with local communities and the intended beneficiaries. DPRs in other cities participating in BSUP were usually formulated by consultants contracted by ULBs, who in turn had little capacity to enforce good

practice, to facilitate community representation, or to cover the costs of anything more than a nominal appraisal of local needs (Effective States and Inclusive Development Research Centre (ESID), 2015). In contrast, the participatory nature of the partnership established by Kudumbashree allowed households to raise issues that were important to them in the process, including the importance of accessing schools and livelihoods, and of having affordable, culturally appropriate housing that could withstand the impacts of hot summers: as one respondent noted, "*our houses that are built today need to be able to withstand climate impacts*" [ICS4].

At the core of COSTFORD's work lies the philosophy of its founder, Laurie Baker, that vernacular architecture responds to the facts of local geography and climate, and that cost-minimisation, energy efficiency and sustainability are jointly reinforcing foundations for design (Misra, 2016). The architects used this expertise to respond to the needs identified by residents, designing sustainable and affordable homes based on indigenous Keralan architecture, incorporating the following design features: bricks instead of concrete; jali walls (brick walls with alternating gaps that allow for ventilation); small windows that do not require expensive metal grating; filler slab roofing, a technique that reduces the amount of steel and concrete needed for roof building; curved corners, which reduce the number of bricks needed in construction; and rat-trap bond masonry, a technique for wall building that uses vertical bricks to create hollow spaces that improve insulation. A respondent from COSTFORD explains that "*any slum upgrade should not be seen merely as a rehabilitation project, but as an exercise in transformation. […] People need comprehensive, life-changing solutions that suit their environment, not just better houses*" [IPC2] (John, 2015).

5.4 Discussion and conclusions

The results presented here (and synthesised in Table 5.2) are consistent with general evidence that shows that large-scale, top-down land and housing programs in their current form – whether led by public or private actors, or a mix thereof – are mostly failing to deliver adequate shelter options that overcome the spatial and socio-economic exclusion of the urban poor (Budds & McGranahan, 2003; Choguill, 2007; Nandi & Gamkhar, 2013; Tipple, 2015). In Tanzania, though the 20,000 Plots Project delivered land at a rate previously unseen in sub-Saharan Africa, it did so at the expense of many of the very citizens for whom it was intended to generate benefits, and exacerbated urban sprawl by building low-density homes on peripheral

and agricultural land. Similarly, despite the scope and budget of the BSUP mission, the results have been unsatisfactory for the majority of intended beneficiaries. Frameworks like these may have served to stimulate the activities of private developers and housing finance institutions but the outcomes of such interventions are rarely evenly distributed (Daniel & Hunt, 2014).

TABLE 5.2 Synthesis of main findings from chapter 5

Case study	Main actors and partnerships	Successes and opportunities	Challenges and limitations	Comparative synthesis
National programs				
Basic Services for the Urban Poor (BSUP), India	– Led by national government – Devolved to municipal authorities for planning of Detailed Project Reports (DPRs), who in turn mostly contracted consultants to carry out this task	– Showcased a national flagship urban program – Constructed 418,450 dwelling units	– Failed to engage local communities – Prioritised resettlement over in situ upgrading – Resulted in low occupancy rates	Top-down, large-scale programs led by national government but not accompanied by the devolution of sufficient resources to lower levels of government and civil society/ community-based actors can have unsatisfactory results (e.g., exacerbation of urban sprawl; under-occupancy of dwelling units). As a result of minimal or non-existent community participation, any success is often generated at the expense of the urban poor, despite them frequently being identified as the intended beneficiaries. The participation of the private sector can enhance the efficacy of program implementation.
20,000 Plots Project, Tanzania	– Financed upfront by the national government – Implemented by public and private surveyors, mobilised by the national government	– Reduced cost of land purchase – Minimised corruption in land administration – Included resettlement of flood-prone informal settlements	– Failed to engage local communities – Limited land speculation only temporarily – Exacerbated urban sprawl through low-density development – Ignored existing land uses (leading to loss of farmland) – Limited coordination between national and municipal government	

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TABLE 5.2 Synthesis of main findings from chapter 5

Case study	Main actors and partnerships	Successes and opportunities	Challenges and limitations	Comparative synthesis
Local implementation				
Kudumbashree, Kerala, India	– Led by the women-run community-based organisation Kudumbashree – Public–private implementation partnership consisting of municipal government, Kudumbashree, and local sustainable architecture firm Centre of Sciences and Technology for Rural Development (COSTFORD)	– Lowered per unit construction costs – Employed vernacular architecture including the use of bricks instead of concrete, jali walls, small windows, filler slab roofing, curved corners, and rat-trap bond masonry – Achieved almost 100 percent occupancy rates	– Success attributed largely to political and cultural context of Kerala, thus raising questions about replicability	Partnerships involving civil society can empower communities to participate in housing provision processes. Tailoring solutions to local contexts by allowing for flexibility in policy application, construction processes, and design standards can generate higher satisfaction amongst intended beneficiaries. However, successes are reduced when projects are not integrated with wider urban planning goals. Collaboration between civil society and local government (as in Kerala) better enabled this.
Chamazi Housing Cooperative, Dar Es Salaam, Tanzania	– Supported by Tanzania Urban Poor Federation (TUPF) – Supported by Centre for Community Initiatives (CCI) – Received funding of USD 100,000 from The Rockefeller Foundation	– Constructed 42 homes, a solar-powered borehole, and a sewerage system – Lowered per unit construction costs – Applied incremental construction techniques to allow for suitable to individual economic and personal conditions – Limited urban sprawl by decreasing minimum plot size	– Reduced connectivity to city centre due to distance and poor transport links, limiting access to employment and services – Surrounded by the further growth of informal settlements, further complicating connections to trunk infrastructure	

Collaborative planning processes involving various public and private stakeholders – like Kudumbashree in India or the Chamazi Housing Cooperative in Tanzania – tend to be more successful in addressing the needs of beneficiaries than entirely public- or private-led projects (Iuchi, 2014; Leclercq et al., 2020). Community-led, place-based, and culturally sensitive approaches can be effective, efficient and equitable ways of plugging the gaps in public or private housing provision, and for addressing wider sustainable development challenges more generally (Bredenoord & van Lindert, 2010; García, 2022; Trencher & van der Heijden, 2019), but to be properly enabled they need supporting policies embedded in multilevel governance structures

(Jenkins & Smith, 2001; Scheba & Turok, 2021). This finding is echoed in the results presented on the case of Kudumbashree, which demonstrates that state-supported but community-led housing can deliver positive results for beneficiaries and for the environment too. Meaningful multi-stakeholder collaboration that includes local public and private actors and prioritisees community members can produce cost-effective, adequate homes that are resilient to local conditions, including the effects of climate change. National, regional, and municipal governments, local architects, private firms, civil society and neighbourhood organisations and households can all contribute to achieving the challenge of delivering housing.

In Chamazi, despite some successes, a full range of benefits was not fully realised due to the lack of integration with formal planning authorities (for example, the community is a long way from the city centre, and was soon surrounded by informal settlements). Communities like the Chamazi Housing Cooperative can make valuable contributions to solving their own housing challenges given the necessary technical and financial support, not only delivering homes that not only suit the needs of the actual beneficiaries but also laying the foundations for a model of high but liveable density, which is both environmentally favourable and more affordable for the urban poor. In Tanzania, the government has attempted to replicate the cost-sharing model more widely, though with little success due to a lack of trust between them and the communities, but "*communities are willing to contribute when they know the benefits*" [TCS8]. This is consistent with existing research calling for a more inclusive and equitable approach to addressing housing challenges that pays much greater attention to both the needs of and possible contributions from the urban poor, as well as the capacity of non-conventional actors to provide technical, legal or financial assistance. This is relevant both for regular upgrading and resettlement processes (for example, the Baan Mankong program (Boonyabancha & Kerr, 2018), and the global work of Slum/Shack Dwellers International (Patel et al., 2012)) and for post-disaster responses that are likely to be increasingly common due to the changing climate (Doberstein & Stager, 2013; García, 2022; Iuchi, 2014).

Central to this approach is the role of households themselves. It has been repeatedly proven that if the delivery of low-income housing proceeds without the involvement of the intended beneficiaries, "first such housing will never materialise, second they cannot afford it, and third, even if it is built, without consultation they will be dissatisfied with it" (Choguill, 2007) (p. 147). Housing construction "*should be driven by the community and not the private sector*" [TCS7] but households should still receive support in building their homes and governments should not be allowed to forgo their responsibilities. It remains a nation state's obligation to offer its citizens equal access to land and housing, as set out in the Universal Declaration of Human Rights in 1948, which states that everyone, regardless of gender, ethnicity,

socioeconomic status or any other characteristic, has the right to "a standard of living adequate for the health and wellbeing of himself [sic] and his family" (UN, 1948). Yet state capacity in the Global South remains a challenge. Many states do not have the resources to finance housing for the urban poor, nor to sufficiently regulate the housing market (Sengupta & Ganesan, 2004), and without stringent regulation, the market will not deliver adequate housing to low income populations who cannot afford to pay market prices. Developing effective mechanisms to support all efforts to provide adequate housing – particularly the efforts of the urban poor themselves, who have, after all, the longest history of satisfying their own needs – is paramount.

A part of this challenge may be met by a clearer and more forceful case for subsidiarity in housing policy. Where national governments are uniquely positioned to raise finance, coordinate action between regions and major urban centres, develop some forms of regulations, and in some cases assist in capacities such as data gathering and management, cities are uniquely positioned to implement other aspects of housing policy, particularly those that are more contextual and place-based. Placing responsibilities for housing in the hands of urban policymakers can help to align urban development planning with urban housing provision, ensuring housing programs are appropriate for the urban context and providing more democratic legitimacy for housing policy (Aziabah et al., 2022; Rojas, 2019; Wakely, 2014).

A more holistic (re-)conceptualisation of capacity calls for moving beyond an entity-focused characterisation of housing provision as either "enabling" or "providing". The case studies in Tanzania and India show that agency for action lies not discretely in national ministries, local governments, or private corporations, nor in community organisations or households, but across these agents in ways that are unique to the social, material, historical and political context of an urban area. A respondent in Dar es Salaam noted that "*engineers and planners don't really want to hear about solutions that are not engineering-based*" [TFI14]. While both the 20,000 Plots Project and much of the BSUP program have exacerbated urban issues in large part due to their failure to look beyond technical solutions, the collaborative and innovative processes practiced by the Chamazi Housing Cooperative and Kudumbashree demonstrate how a variety of stakeholders are able to shape urban form while enhancing the wellbeing of the urban poor by leveraging local knowledge and participation. For governments, this suggests that national planning standards should be accordingly reformed to allow for greater flexibility in building design that allows actors to tailor solutions to local needs, and to formally recognise the wide variety of stakeholders who actually participate in housing provision.

These case studies necessarily present singular examples in specific contexts, and all were selected based on having had at least some positive impact on environmental and developmental goals. To claim that community-led housing provision has delivered where national housing programs have failed based on the limited data presented in this paper would be simplistic. It is also important to note that the residents of informal settlements are of course not an homogenous group (Ouma, 2023): within communities, residents will have different needs and priorities in terms of land tenure and housing (Payne, 2004), as well as different capacities for organizing and contributing to community savings groups (Pierce, 2020). In some cases, community-led participatory governance has been found to empower some at the expense of others. For example, India's Resident Welfare Associations (RWAs) are celebrated for influencing public policy, yet they tend to comprise primarily middle and high-income residents whose mobilisation has in some cases excluded low-income groups from participation or even from accessing housing in formal settlements (Chakrabarti, 2007).

While the examples of Chamazi Housing Cooperative in Dar es Salaam and Kudumbashree in Kerala are by no means perfect, replicable models, they do offer insights on possible factors that contribute to the successful provision of adequate housing. Considered alongside existing work on community-led urban initiatives, they speak to the need to mainstream meaningful participation into large-scale, top-down approaches like Tanzania's 20,000 Plots Project and India's Basic Services for the Urban Poor program, which are consistently underperforming and, in doing so, are all too often exacerbating socioeconomic and environmental urban challenges including inequality and sprawl. At the same time, embedding such place-based initiatives into wider multi-level governance structures can ensure that their successes are institutionalised, and that they are better protected against threats to which they are especially vulnerable because of factors such as their size, financial condition, or legal status. The evidence presented in this paper ultimately suggests that the efficacy and equity of national land reforms and housing programs can be improved where local authorities systematically partner with a variety of stakeholders, most notably community-based organisations. Moreover, incentivizing dense development, in non-hazardous areas, selected through community participation, coordinated with infrastructure provision, and taking livelihoods into consideration should be mainstreamed into the designs of national land and housing programs.

6 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 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 consider 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 paper assesses the potential challenges posed by applying a key transitions framework – namely the Multi-Level Perspective – in Southern contexts. The paper closes by proposing a set of theoretical propositions for future theoretical and empirical research that can advance transitions literature more broadly, which in turn highlighting the need for all cities to pursue inclusive service delivery models that are responsive to the complex and shifting landscape of climate impacts.

6.1 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 services infrastructure provides 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 to 2050 will take place (UNDESA, 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 inclusion. They are often inherently flexible and adapted to local circumstances, offering lessons for resilience-building in the face of climate uncertainty.

This paper 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 paper 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 paper 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 paper 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 paper 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 paper 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 conceptualise 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 employed 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.

6.2 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 & Annecke, 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.

6.2.1 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.

6.2.1.1 A Multi-Level Perspective on urban service delivery

The Multi-Level Perspective 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 6.1): 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 research are expanded upon in the supplementary materials.

TABLE 6.1 Analytical constructs of the MLP (Geels, 2002, 2012)

Construct	Definition
Niche	– Protected spaces that support emerging innovations – Novel innovations are intended to be used in or even replace the dominant regime
Regime	– A semi-coherent set of deep-structural rules that coordinate and guide actor's perceptions and actions – Stabilised by many lock-in mechanisms
Landscape	– A set of deep structural trends – The external structure and context within which niche and regime interactions take place – Commonly includes factors such as economic growth, wars, broad political trends, major environmental challenges, cultural and normative values

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 these 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 & Haasnoot, 2017; Lin et al., 2017) and 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 to 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).

6.2.2 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 transition 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, often developed by scholars who are based in Southern institutions. 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 6.2; these characteristics are also elaborated upon in the supplementary materials). 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 (Holgersen, 2020; Hodson et al., 2012). 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 organisations, and individuals. It stresses that many of the often creative livelihood and survival strategies undertaken by such actors are either undertaken in the context of and/or 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.

TABLE 6.2 Key characteristics of Southern Urbanism identified through a systematic literature review by (Parida & 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 characterised 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 characterised by high vulnerability	Cities that are characterised by a large part of the population are 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 marginalised 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

6.3 Methodology

6.3.1 Case selection and data collection

This paper 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: (i) be an initiative closely related to the provision of a basic urban service; (ii) intend to deliver some form of climate action, whether mitigation or adaptation; (ii) intend to deliver some form of human development benefit; and (iv) 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 materials.

The empirical data was collected during multiple phases of fieldwork in 14 cities across six countries between May 2018 and July 2023 (see Table 6.3). Methods included semi-structured interviews, site visits, multistakeholder workshops, focus groups, and the extensive consultation of policy documentation and other literature (see Appendices for a full overview and breakdown of methods per case study).

TABLE 6.3 Overview of case studies for Chapter 6

ID	Case study	Country	City	Sector[(i)]
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) 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.

6.3.2 Data analysis

The initial analysis of each case primarily 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 paper, 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 materials) 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 this evaluation ensures that the conclusions drawn, though inherently subjective, are as verifiable, transferable, reliable, rigorous, and robust as possible.

6.4 Headline results from meta-analysis of case studies

The cases demonstrate the diverse ways in which non-state actors are asserting their influence through self-organising initiatives, in response to traditional state mechanisms 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. 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 climate change. It presents vignettes from specific cases to illustrate these results.

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, BSUP) (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 of any settlements involved in the BSUP 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 (SEWA) 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 (case 3). 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 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 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 spawl and land speculation (case 10).

This coherence (or lack thereof) 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.

6.5 Situating Southern urban service delivery in transitions studies

Section 2 highlighted a set of established limitations of transition 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. 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, 2017b).

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 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 SEWA's effective recycling activities 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 in 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 prioritisee the voices and 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), and 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 (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 per cent of the urban population in developing countries – equal to almost 20 million people worldwide – is engaged in informal waste picking activities (ILO and WIEGO, 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 (Ghosh & Schot, 2019; Van Welie, 2019).

A key tenet of Southern Urbanism is that empirical differences between cities should be studied not independently of 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 conceptualised as shifts from one stable regime to another.

However, the dynamic and unpredictable nature of climate change compels the reconsideration of 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 recognises 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.

6.6 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 paper, 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 to prioritise resilience and sustainability. The scale of the climate challenges forces regimes to restructure and shift resources to climate-related priorities. Moreover, the uncertainty associated with both the impacts of and response 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.

6.7 Conclusions

Drawing on critiques from Southern Urbanism and extensive empirical data from 14 Southern cities across three continents, this paper highlights potential shortcomings in current transitions theory, stressing the need for a paradigm shift in 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 has attempted to extract a 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 simply contextual factor – is crucial. These propositions 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 but is relevant. Although research presented in this paper 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 may deserve greater consideration as much in the Global North as the Global South. These findings emphasise the defining role that so-called unorthodox infrastructures could play in building inclusive and resilient cities both in the Global South, and indeed in any city concerned with more socially just and ecologically sustainable futures.

7 Conclusions

This section concludes the thesis by first summarising the main research findings (Section 7.1). It then highlights the theoretical and practical contributions and implications of this work (Section 7.2), and closes by offering a set of reflections along with suggestions for further research (Section 7.3).

7.1 Summary of main findings

This section brings together the main findings from across each chapter into a set of overall conclusions (see also Figure 7.1). It does so by organising the findings to: describe current conceptualisations of sustainable UBIS (7.1.1); highlight the gaps and opportunities associated with transition frameworks in relation to UBIS (7.1.2); and identify some of the ways in which alternative organisational arrangements can inform sustainable UBIS delivery (7.1.3). These sub-sections correspond with the sub-research questions identified in Chapter 1. In sum, this section answers the main research questions of this thesis by demonstrating how theoretical and empirical contributions from the Global South inform the transition to sustainable urban basic infrastructure services.

7.1.1 Current conceptualisations of (sustainable) urban basic infrastructure services

This research has shown, by bringing together qualitative and quantitative forms of discourse and policy analysis, that the pursuit of sustainability in urban basic infrastructure services is primarily framed as a technical, institutional, and economic challenge. The dominant academic and policy discourses around sustainable infrastructure tend to prioritise technical fixes to environmental issues while comparatively neglecting social dimensions. Social issues and values related to

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the governance of infrastructure and the associated services delivered by that infrastructure – such as equity in terms of access to the benefits derived from accessing infrastructure services – are often sidelined in favour of economic and technical considerations related to (cost) efficiency.

This framing is not interesting only for academic purposes – it is vital for understanding the policy and practice of infrastructure delivery. Analysing the way language is used in a given context can serve to highlight the associated – and often underlying – values, assumptions, and ideologies it represents. For this reason, language is considered a key tool that is deployed to maintain and exercise power in urban policymaking (Jacobs, 2021), meaning that discourse (through language and other communicative acts) can be viewed as simultaneously both part of the policy-making process and a producer of policy (Wash, 2020). The prevalence of rationalist managerial discourses on infrastructure technologies can thus be identified as instrumental in the favouring of infrastructural solutions that suit a top-down techno-managerial approach to the transition.

These findings add to the growing body of evidence that shows how a reliance on technological solutions as a panacea for making cities more sustainable risks overlooking the critical socioeconomic and political dimensions of infrastructure development. Technical and engineering solutions to infrastructure-related sustainability challenges – such as recycling and waste-to-energy plants (e.g. like those put forward under India's Smart Cities Mission, discussed in Chapter 4), large-scale land regularisation programmes (like the 20,000 Plots Project in Tanzania, presented in Chapter 5), or the construction of utilitarian matchbox housing units (as in India's Basic Services for the Urban Poor (BSUP) programme, also Chapter 5) – are frequently touted as effective and value-free responses to infrastructure deficits. However, such approaches can in fact be seen as replicating problematic neoclassical economic ideals that regard market-led development as a key enabler of wellbeing (Dolderer et al., 2021; Robin & Castán Broto, 2021). In doing so, they may neglect community engagement processes, or fail to incorporate the needs and knowledge of intended beneficiaries. This can result in the displacement of local delivery models, or prevent certain groups from accessing infrastructure services, often without solving the challenge to which it was ostensibly implemented in response. Inflexibly built infrastructure is also most likely to result in institutional or technological lock-in, preventing the uptake of more sustainable practices in the future (Corvellec et al., 2013), or to be maladapted (Reckien et al., 2023). Maladaptation of urban infrastructure is especially likely to have detrimental effects on vulnerable and marginalised groups, where it can contribute to the further entrenchment of existing inequalities (IPCC, 2023).

FIG. 7.1 A visual outline of main research findings in relation to the research questions. The circled numbers indicate the most relevant chapter(s). Source: Author.

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These challenges are also present in the ways in which innovations in service delivery are assessed. The techno-economic focus has also shown a tendency to prioritisee urban sustainability development (USD) models that, although environmentally friendly, emphasise value generation primarily in monetary terms. Key criteria for "success" as commonly identified in this research included economic value (i.e. profit margins), efficiency (e.g. the number of units or plots delivered), and the potential opportunities for wealth creation rather than any public value created (Mazzucato, 2011). The urgency of the need for a sustainability transition can add weight to arguments for developing green infrastructure, a line of reasoning that can be leveraged to legitimise technocentric ecological engineering approaches that can be exclusionary (Diep et al., 2019). This approach can particularly disadvantage USD efforts carried out by small local enterprises, communities, or individuals, as these are often viewed as non-scalable or risky investments. Moreover, it can perpetuate a cultural bias towards consumption and private property ownership rather than contributing to the "radical rethinking of current infrastructure models" that is actually needed for urban populations to flourish (Castán Broto, 2022).

Investing in green, nature-based, and/or climate-resilient infrastructure without concern for local circumstances and affected stakeholders can result in the delivery of projects that can exacerbate existing disparities or create new ones (Ordóñez et al., 2022). For example, green infrastructures and nature-based solutions may lead to gentrification through climate urbanism, where climate action fails to take into consideration the social, economic and environmental needs of the most vulnerable or at-risk communities (Pearsall & Anguelovski, 2016). Urban infrastructural interventions designed to tackle climate change are all too often found to be "financially speculative, economically exclusive, and socially discriminatory" (Chu & Shi, 2023).

In contrast, community-led, bottom-up and participatory research focusing on the way in which urban infrastructure services are designed and delivered in Southern cities indicates a growing engagement with social issues such as justice and equality within sustainability transitions, in part because the stark inequality present in many regions of the Global South creates even greater need for an increased focus on the social dimensions of sustainable urban service delivery. Greater engagement with such contexts as those studied in this research, where techno-managerial fixes may fail to address – or even exacerbate – the challenges to which they are intended to respond, can offer new perspectives on service delivery for both theory and practice. This finding and its implications are elaborated in the following sections.

7.1.2 Transitions frameworks for urban basic infrastructure services in the Global South

The MLP has been employed at various points throughout this research to study infrastructure in the Global South. Doing so has helped to reveal the interplay between niche innovations, regime stability, and landscape pressures. It has shown how transitions thinking – and the MLP specifically – can be used to usefully interrogate the potential of urban serviced delivery models to contribute to city-level transformations in Southern cities. For example, as shown in Chapter 3, the MLP heuristic usefully highlights the interplay between niche level innovations and incumbent regimes in the context of landscape level pressures such as poverty and climate change.

At the same time, however, this research confirms general consensus within the field of sustainability transitions that the field currently underrepresents the Global South, substantiated by the findings of the corpus-assisted discourse analysis in Chapter 2. As a result, there is a danger that, when it is applied in Southern contexts, it reinforces narratives of dependency on international development assistance and compliance with externally imposed rules and norms from the Global North. This aligns with earlier research suggesting that innovation is expected to originate in the Global North and subsequently benefit Southern countries. In the context of infrastructure service delivery, this reiterates narratives of technologically-intensive, top-down, centralised infrastructural solutions combined with high-tech, economically viable niche developments that, while perhaps green, do not challenge mainstream socioeconomic models.

This research thus found that adaptations in transitions theory constructs are necessary to better suit Southern contexts and generate practical insights for building inclusive and resilient cities in the face of climate uncertainty, as shown in Chapters 3 and 6. There is growing evidence that innovations in urban sustainability development also emerge in Southern cities (Nagendra et al., 2018), as corroborated also by the case studies conducted as part of this thesis. Such innovations may or may not be instigated with transitions in mind (Castán Broto et al., 2023); nevertheless, they can offer opportunities for reimagining infrastructural good practice in the context of socioeconomic and environmental uncertainty and can also inform the further development of transitions theory constructs. This research shows that better integrating understandings of organisational niches, recognising the existence of multiple, overlapping systems within regimes, and engaging more profoundly with the landscape factors of persistent inequity and climate change could significantly increase the MLP's applicability and value in Southern cities whilst also enriching the theory more generally.

7.1.2.1 Niche

The MLP framework highlights the importance of niches as incubators for radical innovations that can challenge and eventually transform existing regimes. In the context of urban infrastructure in the Global South, this research shows that community-based enterprises (such as SEWA, Luchacos, Kudumbashree, and others) can arguably be conceptualised as niches: they offer localised, inclusive service delivery opportunities that can be integrated into broader urban sustainability strategies but they do not conform to what is generally considered – at least according to hegemonic theory and practice – "the norm".

Recognising and enabling community-based initiatives to perform within broader urban governance regimes is found to be essential for allowing them to participate in or challenge regimes and contribute to shaping more responsive urban areas. The typical protective measures discussed in relation to nurturing niches are, however, commonly focused on managerial, fiscal, or legislative interventions related to making discrete technologies competitive (Smith & Raven, 2012). The empirical case studies elaborated in Chapters 4 and 5 of this research have contributed to the discussion around how niches are not just spaces for technical innovation but are also critical for fostering socially and environmentally sustainable organisational forms. In the context of organisational as opposed to technological niches, their success depends on more transformative governance structures be put into place around physical and engineering systems (Bosomworth et al., 2017).

Specifically, this research highlighted that protecting and empowering organisational service delivery niches:

- Involves conducting meaningful stakeholder engagement that amplifies the voices of the most vulnerable in designing and implementing service delivery initiatives (e.g. by partnering with civil society organisations like Kudumbashree, Chapter 5);
- Requires fiscal and non-fiscal forms of support (e.g. handcarts and gloves given to SEWA waste pickers, Chapter 4);
- Necessitates new metrics for evaluation that go beyond traditional economic paradigms, focusing on public value such as that generated by socially and environmentally positive outcomes (see Chapter 4);
- Calls for flexible national and municipal policy (e.g. allowing communities to reduce minimum plot size, as in Chamazi, Chapter 5) that does not preclude niche models from participating based on existing regulations (e.g. preventing SEWA from participating in tender processes, Chapter 4).

These findings point to the importance of legal recognition and support for grassroots initiatives within urban governance structures. This aspect is often underrepresented in the MLP, which tends to focus more on technological and market innovations. Recognising and institutionalising the contributions of community-based enterprises and other grassroots or non-conventional actors can enhance their capacity to contribute to sustainability transitions and ensure that the benefits of these transitions are equitably distributed.

7.1.2.2 Regime

Chapter 6 showed the pervasiveness of unorthodox infrastructures across different geographical and institutional contexts, resulting in a conclusion that corresponds with existing research – namely that the distinction between niche and regime increasingly difficult to ascertain, in Southern settings especially (Ghosh & Schot, 2019; Van Welie, 2019). Though also useful to elaborate on the concept of the niche, as in the previous section, this thesis also highlights how unclear the division between niche and regime is in the context of urban infrastructure in Southern cities, where the boundaries between niches and regimes can be more fluid.

Community-based enterprises and other non-conventional service delivery models often operate in a grey area, simultaneously challenging and integrating with existing regimes. For example, SEWA's waste pickers provide a very different service to industrial-scale recycling facilities. As a trade union, they fight for recognition and rights, challenging competing claims over resources that emerge as a result of the technocratisation and financialisation of recyclable materials. At the same time, the fruitful partnership between the cooperative and municipal authorities shows readiness and capacity to integrate with state-led models under the right circumstances.

Examples like SEWA also highlight the blurred lines between those accessing and providing services, sometimes referred to as "prosumers" in the context of energy services since they are both producing and consuming energy (European Environment Agency, 2022). The research showed how this dynamic can bring together service delivery and access goals, benefitting participating individuals (for example, financially or through empowerment or sense of community) and society as a whole (by contributing to the achievement of social and environmental targets). However, the distribution of these roles also raises normative questions about where the responsibility for service provision should sit, particularly in contexts where the so-called "prosumers" are already extremely marginalised (such as in the cases

presented here, like those working at SEWA and Luchacos, and the community that purchased land in Chamazi). There could be a risk that authorities may shirk their responsibilities if non-conventional actors plug the gaps successfully.

While community-led initiatives may not address all drivers of social injustice or climate change, and nor should they be responsible for doing so, this thesis finds that they can provide a valuable complement to formal systems – a finding particularly relevant at a time when the sustained and joint contribution of all actors will be essential in making the huge changes required to achieve the necessary sustainability transitions. Many of the non-conventional service delivery models studied here – 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 infrastructural regimes. 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. Supporting alternative initiatives and improving networked infrastructure systems need not be mutually exclusive (Koepke et al., 2021). Rather this research suggests that acknowledging, legitimising, optimising, and integrating overlapping regimes can deliver benefits for society and the environment.

7.1.2.3 Landscape

Chapter 6 in particular engaged more closely with the interactions between niche service delivery initiatives and landscape level challenges, namely climate change and persistent inequality. It demonstrated that viewing climate change and development as ongoing and integrally connected to service delivery in Southern cities – rather than merely seeing them as contextual issues to be resolved in some undefined future – can help to foster innovative infrastructural visions that differ from conventional models. This is connected to critiques of framing climate change in particular as a landscape factor (Feola, 2020). Climate change is already altering societies in ways that are unpredictable, and it will continue to do so. This problematises the implicit assumption that there is a known, desired end-state towards which the transition is progressing, since the uncertainty associated with the changing climate will likely persist indefinitely and is something to which society will continuously have to adapt.

Indeed beyond the specific constructs of the MLP, this research has implications in terms of the imagined end-point of transitions. The prevailing (explicit or implicit) assumption is often that a successful transition will end with universal access to urban infrastructure services delivered by large-scale technical systems like those found in many high-income cities. This thesis challenges this imaginary in several ways. Firstly, it argues that envisioned futures should not be divorced from existing realities. The implementation of large-scale monolithic projects and programmes based on Northern urban development patterns is not guaranteed to be successful when they are not tailored to suit local circumstances (like the waste-to-energy plants in India failing to operate optimally in India due to the large organic content of the waste, in Chapter 4; or India's BSUP programme having high-rates of unoccupancy nationwide, and Tanzania's 20,000 Plots Project leading to land speculation and urban sprawl, in Chapter 5). Secondly, it shows how the pursuit of an ideologically informed pathway based on what has proven effective elsewhere is not always to the benefit of populations who are currently underserved or marginalised. Thus even where universal access to basic infrastructure services is the alleged goal of infrastructure investment, current attempts to achieve this are often still falling short. This research contends that sustainable and inclusive universal access should of course remain the ultimate objective but challenges the notion that there is only one way to achieve this. Thirdly, and in response to the previous point, this research demonstrates the (sometimes latent or unrecognised but nonetheless powerful) potential of non-conventional actors and alternative urban service delivery models to contribute to alternative infrastructural models that better suit the development needs of Southern cities and their citizens. It aims to position these alternatives not as better or worse than large-scale centralised solutions but rather as new opportunities for learning and experimentation that may help in envisaging a future other than one that replicates the carbon- and capital-intensive systems common to Northern cities.

7.1.2.4 Propositions for the further development of the Multi-Level Perspective

These findings have been developed into a set of theoretical propositions for the future of the MLP, as outlined in section 6.7 and summarised below in Box 7.1.

BOX 7.1. PROPOSITIONS FOR THE FURTHER DEVELOPMENT OF THE MULTI-LEVEL PERSPECTIVE

- Further develop understandings of niche organisational arrangements.
- Recognise the existence of multiple, overlapping, and in some cases unorthodox, systems within regimes.
- Interrogate the distinction between the concepts of niche and regime.
- Embed climate in all conceptualisations of niche, regime, landscape, and transition.

7.1.3 Alternative organisational arrangements in Southern cities and the delivery of sustainable urban basic infrastructure services

Urban infrastructure and the essential services and amenities it provides can build the social and economic resilience of citizens and communities, making them better prepared to respond to the impacts of environmental change (UN Habitat, 2024). It contributes to enhancing adaptive capacity and plays a vital role in ensuring that communities can thrive. As such, improving the provision of infrastructure and the associated services that it delivers in a way that is both environmentally and socially sustainable could be a vehicle through which to also tackle the more fundamental societal goals of reducing urban poverty and inequality.

However, despite early optimism about cities' leadership in climate action, infrastructure interventions carried out under the guise of urban adaptation and resilience-building are increasingly found to be "financially speculative, economically exclusive, and socially discriminatory" (Chu & Shi, 2023). Sustainability-related efforts, even where carried out with the best intentions, are also not without consequences and differential impacts are already being felt across urban areas (UN Habitat, 2022). For infrastructure to achieve human development as well as environmental sustainability goals, the delivery of the services provided by said

infrastructure must be carried out in an inclusive manner . This can cultivate more participatory, deliberative, non-hierarchical relations between governments and citizens, opening up possibilities for more just and sustainable futures (Oates, 2021; Routledge et al., 2018).

Both the conceptually grounded discourse analysis (Chapter 2) and the empirical case studies (Chapters 4 and 5) presented in this thesis conform with existing claims that efforts to respond to sustainability challenges – such as those posed by global environmental challenges including climate change – have focused on the technological efficiency of in urban infrastructure, sometimes at the expense of ensuring equitable access to resilient infrastructure benefits for all community members (UN Habitat, 2024). A growing body of literature, to which the chapters in this thesis seek to add, is reframing the way infrastructure is viewed, where a host of initiatives of varying degrees of formality and with varying levels of state support have evolved to fill delivery gaps (Gillard et al., 2019; Hodson et al., 2012; ILO and WIEGO, 2017; Oates et al., 2018). For example, this research shows that "niche", "non-conventional" and "place-based" service delivery models – such as community-based organisations, coalitions of civil society actors and citizens, and local enterprises – exhibit significant potential in delivering urban basic infrastructure services in ways that contribute to social and environmental sustainability goals.

The majority of residents in developing country cities access, or augment their access to, urban services and infrastructure via such decentralised and often informal channels, many of which are inherently, or have the potential to be, more participatory than conventional top-down service provision. They often serve populations that are otherwise marginalised by or excluded from formal, regulated service delivery mechanisms, and many are also low-carbon (UN Habitat, 2024).

At the same time, many informal service providers operate outside of formal regulations and standards, which can result in substandard or unsafe infrastructure, including infrastructure that may not withstand or may even worsen climate impacts. Informal workers and businesses are also likely to be more vulnerable to environmental instability than others, partly as a result of insecure livelihoods, lack of social protection, and poor or absent health and safety and occupational health regulations. They are also more likely to face challenges accessing physical and technical resources, such as land, financing, and training. These things limit the ability of workers and communities to build their physical and social capacity to respond to shocks such as extreme weather events (Dodman et al., 2023; UN Habitat, 2024).

This research shows that, given sufficient (state) support in overcoming these obstacles, non-conventional service providers can align with various sustainability and development objectives. Findings indicate that actions such as improving legal recognition, offering capacity building, and enforcing minimum labour standards for grassroots participation can simultaneously improve the quality of life for marginalised populations involved in service delivery, and complement formal service provision systems. The research also shows how new metrics that go beyond traditional capitalist economic paradigms, instead emphasising social and environmental outcomes over profit margins, may help to better evaluate the success of these initiatives, and it makes suggestions for better representing this need in sustainability transitions theory.

7.2 Contribution and implications

7.2.1 Scientific contribution

The theoretical contribution of this work is threefold. Firstly, and has already been rather extensively elaborated upon, it offers some possible conceptual extensions to the analytical constructs of the MLP, as well as a set of clear and actionable propositions for the continued development of the MLP framework (see Box 7.1). These ideas contribute to ongoing work in the transitions arena more broadly. It is hoped that these findings will provoke scholars in the field to more critically reflect on the types of transitions needed, the ways in which those transitions could be achieved, and the actors that should be involved in transition processes (Feola, 2020; Lawhon & Murphy, 2011; Sovacool, 2021).

Secondly, it adds to "an existing body of evidence challenging the development narrative of the urban infrastructural ideal", considering instead the opportunities that heterogeneous urban infrastructure configurations may offer for cities to develop in a manner better suited to contemporary societal and environmental needs (Kooy, 2014, p. 37). The suite of empirical *ex ante* analyses of diverse and often informal service delivery models can provide tools for going beyond the imagination of alternative futures, and towards enacting new forms of inclusive, adaptable, and resilient urban development strategies that fall outside of

conventional planning paradigms (Engels & Muench, 2015; Escobar, 1992; Gibson-Graham & Cameron, 2007). This further contributes to the wider discourse on urban sustainability by challenging the prevailing ideology of neoliberal modernity (Nilsson, 2016; Robinson, 2006).

Third, it responds to calls to "world" urban theory (Oldfield & Parnell, 2014; Pieterse, 2011; Robinson, 2006; Roy, 2011), which is largely developed based on empirical data from and conceptualisations of urban development processes in Northern Europe and North America. It is clear in the policy mobilities literature that the majority of policy transfer and city-to-city learning has typically been from North to South (Nijman, 2007) yet it is increasingly accepted (though still not widely enough actioned) that it is important to engage with empirical work that comes from contexts where conventional urban theories hold little relevance (Parnell & Pieterse, 2016). Many of the findings from this research could – and arguably should – be seen as relevant not only for cities in the Global South, but for all cities worldwide seeking alternatives to inequitable and carbon-intensive development pathways (Roy, 2011).

7.2.2 Guiding principles for policy and practice

Based on the research findings, the following guiding principles are proposed as considerations for policy and practice. These considerations should not be taken as prescriptive steps but rather, if applied with caution, reflexivity, and a deep awareness of their origins and limitations, may offer a framework within which to reflect on aspects that could guide more inclusive and context-sensitive approaches to urban infrastructural planning.

The findings of this research suggest that the delivery of UBIS may have the potential to contribute to sustainability objectives when meaningful multi-stakeholder engagement – particularly that which prioritises the inclusion of vulnerable groups – is enshrined in flexible national (urban) policies. Flexible national policies can, in turn, create space for empowered city authorities, fostering holistic urban planning processes that incorporate new metrics for valuing infrastructure – metrics that go beyond economic efficiency paradigms to consider the full range of values embodied in infrastructure and the services it provides (Otsuki, 2019).

7.2.2.1 Multi-stakeholder engagement

Effective urban infrastructure development relies on the meaningful engagement of multiple stakeholders, including (and especially) local communities, as well as civil society organisations, private sector actors, and various government agencies. Building cross-sectoral partnerships that put local communities at the heart of decision-making will invariably lead to more inclusive and equitable outcomes. Different actors might play different roles depending on the specific context. Academia and civil society can conduct mapping and enumeration activities and carry out capacity-building at the local level to ensure communities are able to engage in negotiation processes with formal actors. Businesses can partner with local actors to improve economic productivity and ensure their products and services are suitable for the local market. Governments might directly provide – or regulate the provision of – services, or offer support in the form of technical, fiscal, or material resources. Such a participatory approach enhances the legitimacy and sustainability of infrastructure projects, as it aligns the interests and needs of various groups, particularly those who are often marginalised in decision-making processes.

Examples: In Jinja, the national government's (World Bank-supported) Transforming the Settlements of the Urban Poor in Uganda (TSUPU) programme established the Municipal Development Forum (MDF) to bring together local government, the urban poor, and other stakeholders (Chapter 3); in Kerala, a partnership between local government, civil society (Kudumbashree), and local business (architectural firm Costford) resulted in the delivery of ecologically friendly and culturally appropriate housing (Chapter 5).

7.2.2.2 Inclusion of vulnerable groups

Any urban development must prioritise the meaningful inclusion of vulnerable groups, such as low-income communities, women, children, the elderly, and people with disabilities. These groups are often the most affected by inadequate infrastructure and climate change impacts, yet they are also those most frequently excluded from decision-making processes. To address this, cities should systematically partner with communities and civil society – both to catalogue and leverage the contribution of these groups to service delivery, and to ensure that they and other vulnerable groups benefit from interventions. Mainstreaming social science and justice considerations into studies of infrastructural change can help to amplify the needs and voices of vulnerable populations, leading to more equitable and effective infrastructure solutions not just for those groups but for all citizens.

Updating Northern frameworks that inform theory and policy to more reflexively engage with Southern contexts is also essential, and will help to contest dominant techno-managerial discourses and their underlying assumptions.

Examples: The participation of slum dwellers from Kibugumbata in Jinja's MDF led to more structural long-term engagement between the urban poor and city authorities (Chapter 3); the cooperative formed by SEWA enables the waste pickers access to increased and more reliable salaries and secondary benefits such as childcare and education facilities (Chapter 4).

7.2.2.3 Flexible national policy

Rigid national policies based on models transplanted from different institutional contexts can stifle innovation and prevent the tailoring of infrastructure projects to local conditions. Flexible and adaptive national policies are therefore essential to accommodate diverse urban contexts and enable place-based solutions that address specific local needs. National policy and regulatory frameworks should recognise and allow for different types of service provision, ensuring they do not constrain non-conventional service providers from taking positive action. At the same time, frameworks should offer ambitious and unifying direction. They should mandate the use of collaborative and participatory methods in the planning and implementation of service delivery, ensuring the consultation of diverse communities. Empowering sub-national governments is crucial, and this can be achieved by providing adequate financial transfers from central to lower levels of government and supporting capacity building activities at the city-level. Ambitious national policy that facilitates local experimentation can help avoid the pitfalls of one-size-fits-all approaches and promote more responsive and effective infrastructure solutions.

Examples: Chamazi Housing Cooperative were granted permission to reduce minimum plot size, making the homes more affordable and helping to minimise urban sprawl (Chapter 5); Kudumbashree co-produced the Detailed Project Report required to access national funding together with local communities, delivering housing that suited the needs of the intended beneficiaries (Chapter 5).

7.2.2.4 Empowered city authorities

Cities are considered frontrunners in the battle against climate change. To successfully demonstrate the leadership that they often pursue, city authorities must be empowered with the resources, authority, and capacity to engage in innovative and progressive infrastructure initiatives. Decentralising decision-making power to local governments enables them to respond more effectively to the unique needs of their communities, for example, and must be accompanied by the equivalent transfer of funding and assistance in building technical or human capacity. Specifically, procurement and tender processes should be designed so as not to adversely impact non-conventional service providers; city authorities should work with local service providers to help them meet occupational health and safety standards; and non-financial support, such as land, workspace, and materials, should be offered to local providers.

Examples: The partnership between SEWA waste pickers and Vejalpur showed how city authorities can support non-conventional service providers to achieve relatively high recycling rates at little extra cost to the state (Chapter 4); the 20,000 Plots Project was considered a success in terms of implementation due to the mobilisation of national actors but municipal actors were not sufficiently involved in the process, which resulted in various challenges after national governments withdrew, such as a failure to integrate new plots with trunk infrastructure and rising land speculation (Chapter 5).

7.2.2.5 Holistic urban planning

Holistic urban planning integrates spatial, social, economic, and environmental dimensions to create cohesive and sustainable urban environments. This approach considers the interconnections between different infrastructural sectors (e.g. across the different services of energy, transport, water, etc.) and levels (i.e. trunk and community-based infrastructure). It also promotes the integration of green, nature-based solutions with more traditional infrastructure. Holistic planning also emphasises the need for adaptive and resilient designs that can withstand future uncertainties, such as climate change impacts.

Examples: In Tanzania, both land purchased by Chamazi Housing Cooperative and land delivered under the 20,000 Plots Projects later became surrounded by the growth of informal settlements (Chapter 5); in Jinja, a national programme (Transforming the Settlements of the Urban Poor in Uganda (TSUPU)) provided municipal authorities with the capacity and incentive to partner with local organisations (Chapter 3).

7.2.2.6 New metrics for value

Traditional economic metrics often fail to capture the full range of benefits provided by non-conventional or place-based service delivery models. Instead of focusing solely on profit margins and efficiency, new metrics for assessing public value should recognise that the sustainability transition brings about changes in terms of what is valued (Taebi & Poel, 2022), that there are diverse forms of economic organisation that could be employed to give precedence to those values (Gibson-Graham & Dombroski, 2020), and that a structure which values social and environmental outcomes will lead to a more just and resilient urban future. These metrics should account for a wide range of social, economic, and environmental benefits, many of which resist monetisation and challenge conventional neoclassical ideas of how service provision should be assessed. Measures might include those related to public health, wellbeing, and environmental resilience, and might also involve a more qualitative form of assessment based on local satisfaction and sense of community. This approach challenges the prevailing dominance of economic rationalism and promotes a more holistic understanding of value that aligns with the broader goals of sustainable development.

Examples: The enterprise Luchacos is not considered financially scalable (for example, the business could not produce enough briquettes to be taken on as a supplier by the UNHCR) but does perform an important role in its local context – namely that it contributes to the reduction of waste accumulating in the informal settlement by collecting it from the streets, producing affordable and cleaner energy by turning said waste into briquettes that can be used in place of charcoal (Chapter 4); land speculation under the 20,000 Plots Project was not controlled for more than a couple of years after implementation, resulting in the return of resettled inhabitants to informal areas and suggesting that market-led logics do not lead to the most inclusive outcomes (Chapter 5).

7.2.3 Policy actions

A set of tangible policy-focused actions, primarily applicable for municipal and national governments, can be derived from the results of this research and the considerations outlined in the preceding section. The actions are outlined further below and are summarised as a set of recommended policy actions in Box 7.2.

Though a growing body of work is spotlighting non-conventional, community-based, and alternative forms of infrastructure provision (Furlong, 2014; Jaglin, 2014; McFarlane & Silver, 2017), many such practices still happen informally, illegitimately,

and/or illegally, and therefore remain undocumented. An important step in both empowering communities and equipping policymakers with the information required to leverage the benefits of (and reduce possible harms associated with) informal service provision models is thus the mapping and enumeration of activities that have conventionally fallen outside of formal records (Patel et al., 2012). It is important to note that documenting informality can also be an exercise in state power and can be harmful if, for example, used as tools to aid in evictions, demolition, or forced displacement (Ouma, 2023; Rigon, 2017). However, if done in a participatory way that involves communities and non-conventional service providers, enumeration may also be a step towards acknowledging the limitations of existing data, and ensuring that diverse knowledge systems are incorporated into planning frameworks.

Both the process (often requiring engagement between different stakeholders) and the results of such data collection can generate greater understanding of the barriers that commonly hamper the inclusion of non-conventional service providers in municipal systems. For example, inherent biases towards technical solutions can often be traced to national policy frameworks (ESID, 2015; Mah, 2020; Nilsson, 2016; Sengupta et al., 2018), such as in the Smart Cities Mission in India. This can preclude other levels of government and non-state actors, however ambitious, from taking action that may contribute to urban inclusion. Multi-level urban governance approaches that promote coherence and coordination are vital (Gouldson et al., 2015). A national policy framework that enables – and ideally encourages – non-conventional service providers to participate in citywide service delivery models is a key step towards their inclusion. Such initiatives may also face obstacles at the municipal level and thus could require additional support to allow them to flourish. This could be financial or non-financial. Financial mechanisms frequently favour large, conventional actors, which can disadvantage smaller, community-driven initiatives. The revision of state procurement processes and contracting procedures might thus facilitate more equitable access to resources (Chu et al., 2017). Non-financial support in the form of land, materials, or government contracts, can be equally beneficial and often comes at little or no cost to the taxpayer (Rojas, 2019). Distributing state resources also helps to acknowledge and legitimise the unique contributions that non-conventional actors are making to urban development.

Ultimately, environmental challenges, perhaps most notably climate change, alongside enduring socioeconomic issues like persistent poverty and growing inequity both between and within countries, are wicked problems that demand radical, holistic, and integrated solutions. These complex issues can only be effectively tackled if resilience and equity considerations are woven into the very fabric of urban development.

This thesis argues that embedding the guiding principles (as outlined in Section 7.2.2) into every aspect of urban infrastructure service delivery (by implementing the policy actions summarised in Box 7.2) offers cities a potentially transformative tool for navigating the sustainability challenges of this time.

BOX 7.2. POLICY ACTIONS IDENTIFIED BASED ON THIS RESEARCH

- Improve the coordination of urban development policies by integrating across sectors (e.g. land use, transport), government levels (i.e. national to municipal), and stakeholder dimensions (e.g. private sector, civil society as well as government)
- Make it legally and practically possible for non-conventional service providers to participate in municipal service delivery systems
- Reform national policies to reduce bias towards technical solutions
- Enable access to finance for non-conventional and community-based organisations and small enterprises that contribute to sustainable and inclusive development
- Strengthen non-financial support (including, for example, capacity building, infrastructure, equipment, land) for community-based organisations and small businesses that contribute to sustainable and inclusive development
- Support the mapping and enumeration of non-conventional service delivery models and the benefits they provide
- Ensure that environmental and equity concerns are mainstreamed into the design and delivery of service provision models

7.3 Reflections and further research

This section explores relevant but beyond the immediate scope of the study. While not directly tied to the core research questions and resulting findings, these reflections highlight critical areas for future investigation, addressing unresolved questions, emerging themes, and potential directions for advancing knowledge and practice in the field

7.3.1 A Northern critique of Northern hegemony

The departure point for this research, and indeed a point that has been stressed throughout this thesis, is that the theory and practice of urban infrastructure provision is deeply influenced by frameworks and practices that have largely been developed within Northern, neoliberal contexts that may not fully account for the diverse realities of cities across the globe, particularly those in the Global South. At the same time, however, though the findings presented throughout this work undoubtedly offer valuable insights both from and for the development of infrastructure in Southern cities, the work also originates in the very domain it seeks to challenge.

Put simply, this research is itself could be considered somewhat contradictory: it argues that Northern ideas should not be unthinkingly applied in circumstances outside their origins, yet it is conducted by a Northern scholar who draws heavily upon theory largely developed in the North.

Practically speaking, this demanded careful reflexivity in navigating the tensions between critiquing dominant frameworks while inevitably working within them. This was made difficult by the fact that some of the institutionalised perspectives that were critiqued are embedded within the very language (and perhaps particularly in the English language) that is used to deliver that critique. To clarify with some examples: the word “economy” is most commonly associated with “formal commodity markets, waged and salaried labour and capitalist enterprises focused on creating profit for owners or shareholders” (Gibson-Graham & Roelvink, 2011), yet in reality of course there are various and manifold ways in which economic activities such as trade, exchange, and labour are organised (Gibson-Graham & Dombroski, 2020). Further challenges when describing the characteristics of the case studies included: “value”, most often associated with profit (Elsinga et al., 2020; Taebi & Poel, 2022); “long-term sustainability”, often equated with business viability;

and (as discussed in the introduction) the framing of service delivery models like those studied as “non-conventional” and “alternative”, which is somewhat counterintuitive when they are in fact anything but unusual or unorthodox in many situations (Furlong, 2014).

This highlights the need for a more nuanced and context-sensitive approach, one that is open to alternative forms of knowledge and practice, particularly those emerging from local, indigenous, or non-Western traditions (Mafongoya & Ajayi, 2017). In reflecting on these challenges, it seems clear that urban infrastructure development must move beyond a one-size-fits-all approach. Instead, it could embrace a plurality of perspectives, fostering dialogue between different knowledge systems and allowing for the co-creation of solutions that are genuinely responsive to local needs and aspirations. Future research and policy development might aim to bridge the gap between Northern and Southern perspectives without making either a totalising force, thereby ensuring that urban infrastructure development is not inclusive only in its real-world implementation but also in its scholarship.

Indeed, the decolonisation of theory and practice is widely considered a crucial step towards achieving a more inclusive and equitable approach to sustainability more widely (Ghosh et al., 2021; Wijsman & Feagan, 2019), yet many of the most commonly favoured approaches for pursuing sustainability agendas are critiqued for replicating harmful historical practices (Bainton et al., 2021; Chu & Shi, 2023; Heffron, 2020). For example, regulations originating from Europe, such as Extended Producer Responsibility (EPR) laws aimed at improving the sustainability of supply chains, can inadvertently restrict the capacity of informal workers elsewhere to deliver essential services effectively (Talbott et al., 2022). This underscores the need to rethink and adapt global sustainability policies to suit local contexts but the pervasive influence of narratives connected to the neoliberal, capitalist, neocolonial paradigm often renders it challenging to even articulate alternatives.

Recognising the co-existence of diverse social logics alongside capitalism and exploring how these spaces of alterity can inform radical sustainability transitions, on the other hand, may offer new imaginaries for more just social futures (Feola, 2020).

7.3.2 The transformative potential of urban infrastructure

Future research could further refine the governance-related characteristics of UBIS presented in this thesis into a framework for transformative infrastructure, such as one that builds on the typology presented in UN's World Cities Report 2024 (UN Habitat, 2024). Such a framework might explore under what conditions infrastructure and its associated service delivery addresses the different dimensions of sustainability and how best to combine the pursuit of these goals in ways that enable the fundamental and radical reimagination of urban futures.

The possible strategies for the delivery of sustainable and inclusive infrastructure services presented in this thesis vary along a spectrum from greening existing infrastructures whilst maintaining the socioeconomic status quo, to envisioning radically different societal futures through urban infrastructure imaginaries (Oates & Verveld, 2024; Stevis & Felli, 2020; UN Habitat, 2024). This spectrum could represent the extent to which an infrastructure and/or its associated service delivery model has transformative characteristics and, if further refined, might offer a lens through which to understand urban infrastructure and its potential to contribute to a just and sustainable transition.

For example, the UBIS models that brought together environmental and human development goals could be considered to have the most transformative characteristics (UN Habitat, 2024). Ensuring that infrastructure is resilient to environmental change should be seen as a means to achieving more resilient societies, rather than an end in itself (OECD, 2018). Indeed, "equitable access to urban services is a necessary, but not sufficient condition. Cities must be transformed at a deeper level in their governance and decision-making structures, planning approaches, institutions and priorities of political leaders" (UN Habitat, 2022).

Alongside (and not instead of) the necessary long-term efforts that focus on enhancing large-scale citywide infrastructure networks, locally-grounded, informal, and/or decentralised solutions may suit certain contexts, such as in informal settlements or peripheral areas with low population density (Cartwright, 2019). Indeed off-grid systems have been found to present a feasible and viable path to universal access, particularly where they are considered in long-term planning processes (Dagnachew et al., 2017). Cities aiming to expand access to essential services could therefore consider integrating existing low-carbon alternative service providers into a comprehensive citywide system – rather than replacing them with formal or (conventionally) modernist services (UN Habitat, 2024). In

sectors like transport, water, and sanitation, public authorities could be responsible for coordinating local businesses, informal operators and community-based organisations, establishing regulatory frameworks that enable all operators to adhere to basic safety and quality standards while remaining affordable for underserved groups.

Hybrid service delivery models, where conventional networks are blended with alternative services such as those presented in this thesis, might be one way to cater to diverse income levels and address specific local needs. Such models may be particularly favourable for cities with limited resources and capacity: small-scale and gradual improvements to existing informal services, many of which may come at little or no extra (financial) cost to the authorities, can enhance the quality of and access to infrastructure services without (immediate) formalisation (UN Habitat, 2024).. Furthermore, they may offer an alternative to the carbon- and capital-intensive development trajectories commonly associated with urbanisation. Partnerships across income groups, sectors – exemplified by initiatives like Slum/Shack Dwellers International and their local federations, to which several of the cases studied here are connected (Mitlin & Patel, 2014; UN Habitat, 2024) – empower communities to address collectively identified needs and engage with local authorities, which can lead to more structural and meaningful collaboration not only with regard to infrastructure and service delivery, but also beyond (Gillard et al., 2019).

Ultimately, urban infrastructure can be a useful tool for addressing structural vulnerabilities and achieving wider human development goals. This may be particularly the case where infrastructures are designed and built, and services are delivered, based on rights-based approaches that prioritise capacity-building, the meaningful participation of the most vulnerable groups, and their access to basic services and key resources (Dodman et al., 2022; UN Habitat, 2024). Ecologically sustainable infrastructure (broadly speaking, that which can both withstand and addresses the drivers of environmental change) that delivers services in a way that contributes to broader, lasting societal change (thereby addressing the drivers of vulnerability, for example by institutionalising meaningful participation), might thus be considered “transformative” (UN Habitat, 2024).

7.3.3 Directions for future research

The findings of this work as well as the reflections outlined in the preceding subsections point to the following possibilities for future research.

This research connects with calls for more knowledge-intensive urbanist approaches that draw on understandings of how citizens organise locally, and employ livelihood and survival strategies – often in creative and innovative ways – within distinctive contexts. It has focused primarily on the potential benefits of non-conventional and place-based service delivery model, finding that a major barrier to realising these advantages was when community infrastructure were replaced in favour of, or when they were not adequately integrated with, large-scale, centralised trunk infrastructures, and that this also often resulted in the infrastructural fix failing to live up to expectations. Further research could therefore explore the value of and means for better integrating local and universal infrastructures, thereby maximising the benefits of each and minimising their trade-offs. This research does not intend to discount the role of centralised infrastructure systems in building sustainable and inclusive cities. Similarly, the intention is not "to valorise any particular social or technological intervention" at the expense of another, nor to romanticise the situation in informal settlements (Lawhon et al., 2018, p. 3; Rocco & Ballegooijen, 2019). Rather, this research speaks to the need to recognise and incorporate a broader range of approaches to urban service delivery, which can ultimately inform possibilities for a more sustainable and inclusive response to global environmental challenges.

7.3.3.1 Sustainability transitions

In continuation of the findings of this thesis, there is both a utility value and moral necessity in enhancing the applicability and inclusiveness of transitions theory for different contexts, most notably the Global South. In particular, future research should delve into the fluid boundaries between niches and regimes in Southern cities, where community-based initiatives often operate in grey areas, simultaneously challenging and integrating with existing systems. Framing these initiatives as niches undervalues the critical contribution they make to Southern cities, yet considering them regimes comes with different risks, such as the legitimisation of state withdrawal. Studies should explore how these initiatives can be legitimised and optimised within infrastructural regimes to deliver social and environmental benefits, without being relied upon to solve major social and environmental challenges for which they and their workers are often among the least responsible. This involves

rethinking the traditional emphasis on technological and market innovations to include legal recognition and support for grassroots initiatives. Researchers should also more critically engage with the concept of landscape factors, such as climate change and persistent inequality, understanding them as ongoing challenges that necessitate innovative yet adaptive infrastructural visions.

7.3.3.2 Developing Northern urban theory by learning from the South

The tension between top-down, technocratic and bottom-up, locally-led urbanism is not only relevant to Southern cites. In cities of developed countries, the most pressing infrastructure challenges tend to relate to upgrading and modernising ageing infrastructure. Still, certain places experience higher levels of relative poverty, where often already marginalised and minority groups live in areas characterised by underinvestment in urban infrastructure (Burgum, 2019; Hodkinson, 2018; MacLeod, 2018). In the North, rationalist planning has been openly critiqued since at least the 1950s, when Jane Jacobs infamously and publicly opposed the construction of a highway through a New York City park proposed by Robert Moses (Paletta, 2016).

This research extracts lessons on how the delivery of UBIS in the Global South can be organised in a sustainable and inclusive way. Further research should explore the applicability of these findings in other contexts, such as in the Far East, where under-occupation of newly constructed urban infrastructure is commonplace (e.g. China's "Ghost Cities), and in the Middle East, where enormously expensive smart solutions are often stalled due to concerns over ecological and human rights (Hilburg, 2021). In the Global North, too, carbon-intensive infrastructure systems are seemingly entrenched, yet growing dissatisfaction among citizens is putting pressure on planners and politicians to seek alternatives. The critiques of modern infrastructural norms posed by this (and much other) research, as well as the organisational arrangements discussed in this thesis, may thus serve as a source of inspiration to urban scholars and practitioners working on Northern cities. Building on this research could therefore provide input for existing approaches that are used to inform service delivery in the North.

7.4 Concluding remarks

This thesis challenges the prevailing paradigm in sustainable urban basic infrastructure services, which often prioritises technical and economic factors at the expense of social considerations. The research demonstrates that current approaches to the delivery of sustainable urban basic infrastructure services frequently overlook critical social dimensions, such as equitable access to services, participation in the delivery of services, and recognition of the knowledge and needs of different groups. It argues that these issues are particularly pronounced in the Global South, where informal service providers are pivotal in delivering essential services like waste management and housing. Yet at the same time, it suggests it is amidst these very challenges that opportunities for more sustainable solutions might be found.

Drawing on extensive empirical evidence from across three continents, this study advocates for a broader understanding of sustainable infrastructure, based not on engineering innovation but rather on the impacts it has on the humans and nature with which it co-exists. It highlights the contributions of community-based enterprises and other so-called non-conventional actors in the Global South, who participate in unorthodox service delivery models that operate in spaces that challenge traditional boundaries – integrating formal and informal systems, bridging top-down and bottom-up approaches, and rethinking public and private sector roles. Addressing these complexities requires organisational arrangements that transcend such binaries and centre equity and inclusion.

Ultimately, this research aligns with increasing calls for reimaging the way we design, implement, and assess the sustainability of urban basic infrastructure services, moving beyond traditional economic metrics to encompass the full range of social and environmental outcomes associated with urban services. It envisions a future in which urban infrastructures are seen not just as physical, engineered structures, but as powerful vehicles for achieving both environmental sustainability and social inclusion in cities worldwide.

Appendices

Detailed case study overview

This section provides further details on each of the case studies referenced in this thesis, including a brief description of the infrastructure initiative studied, its adherence to the selection criteria outlined in the introduction, and the methods specific to that case study.

ID No.	Case study	Description	
1	Bicycle-sharing scheme, Shanghai, China	The world's largest bicycle-sharing scheme is being managed as part of China's first urban cycling strategy. Through a set of policies and regulations that are supporting the integration of cycling into the wider transport network and prioritise cycling safety, policymakers are helping to maximise the benefits of urban cycling.	
2	Sponge cities programme, Wuhan, China	The programme encouraged cities to adopt green and blue infrastructure (based on natural areas and water elements) rather than grey infrastructure (based on concrete and steel). Wuhan – a pilot "sponge city" – has shown that green and blue infrastructure can be employed both quickly and cost-effectively to increase the resilience of urban areas to a changing climate.	
3	SEWA, Ahmedabad, India	In Ahmedabad, a city of about 6 million people in western India, an estimated 50,000 people work in hazardous conditions to gather, sort and recycle waste. In 2004, the Self-Employed Women's Association (SEWA) entered into a contract with a self-governing suburb of Ahmedabad to collect and segregate waste from more than 45,000 households. SEWA provided training to the waste pickers, the local government covered the upfront investment to cover administrative costs and equipment, and households paid small user fees to SEWA members. This contractual arrangement substantially improved the working conditions and incomes of the informal waste pickers. Earnings increased from about Rs. 1,500 (US$20) to Rs. 6,000 ($80) a month, the workers' occupational health vastly improved and 2,000 of their children received school scholarships. The programme also increased the efficiency of waste collection: 70 per cent of all waste was recycled through this programme.	
4	Kudumbashree housing cooperative, Kerala, India	In Kerala the involvement of a community-based organisation (Kudumbashree) helped improve implementation of the BSUP Mission (a policy to support upgrading informal settlements in 65 Indian cities). In Kochi and Trivandrum, Kerala, India, municipal government and community partnerships on house building projects have led to better quality new housing stock while reducing costs and environmental impacts. It finds that by placing participation at the heart of their processes, these cities have achieved 100 per cent occupancy rates (of BSUP housing - delivered under national housing policy) at a lower cost, while also cutting carbon emissions and providing economic benefits. Nationwide, BSUP costs and occupancy levels the same as that in Kochi and Trivandrum could save Rs. 118 billion (US$1.71 billion), or build an additional 816,000 homes. Kudumbashree is structured as a three-tiered hierarchy operating at the neighbourhood, ward and municipal scale, thereby providing formal links between low-income groups and decision-makers at various levels. This structure provides a route for low-income citizens to feed their priorities into political decision-making and for governments to engage in dialogue with urban residents. Improving access to knowledge and decision makers in this way can build adaptive capacity and strengthen democratic governance.	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Transport	An assessment of data on more than two million trips made by bicycle shows that bike sharing in Shanghai reduced fine particulate matter (PM2.5) and nitrogen oxides (NOx) emissions by 2.7% and 0.9%	Prevented an estimated 23 premature deaths each year considering the impact of increased cycling on air quality, exercise	20 interviews (14 users, 3 transport experts, 3 PS); technical analysis based on dataset from bicycle-sharing scheme operator
	Water	More than CNY 4 billion (almost US$ 600 million) cheaper than an alternative (i.e. grey infrastructure-based) approach to increasing the city's resilience to flooding	Wider social and environmental benefits, such as reduced carbon emissions, improved public health, enhanced natural cooling and improved biodiversity conservation	6 interviews (2 PS, 3 AC, 1 LG); 2 multistakeholder workshops; policy analysis; literature review
	Waste	Waste pickers in Ahmedabad prevent about 200,000 tonnes of carbon dioxide equivalent (CO2-e) emissions annually — the equivalent of removing 130,000 cars from the road each year. A typical waste picker in Ahmedabad has a negative total carbon footprint of 4 tonnes CO2-e — mitigating the emissions of two average Delhi citizens, one average global citizen, or one-third of the average New Yorker.	Earnings increased from about Rs. 1,500 (US$20) to Rs. 6,000 ($80) a month, the workers' occupational health vastly improved and 2,000 of their children received school scholarships.	16 interviews (5 CS, 4 LG, 2 AC, 1 NG, 1 SG), 1 focus group, 2 site visits to dumpsites and waste picking routes; examination of legal contracts, court cases, and organisational reports; economic analyses to estimate the contribution of the informal sector to reducing greenhouse gas emissions.
	Housing	Many of the design features address growing climate impacts and risks: the new houses use less steel and concrete (which are very carbon intensive) and have better insulation and ventilation.	Involving urban residents in planning, designing and building has ensured that the houses are culturally appropriate; easy to build; inexpensive to live in; and located close to jobs, services and amenities.	8 interviews (1 NG, 2 PS, 3 CS, 2 AC)); 4 site visits

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ID No.	Case study	Description	
5	Residential rooftop solar distribution by BSES Radjhani, New Delhi, India	BSES Radjhani is the largest distribution company in New Delhi, with 2.3 million customers. It operates in the south and west of the city. As of March 2018, it had 22MW of metered solar connections in operation. As in the rest of India, the residential sector represented the smallest proportion of its customers (15 per cent). In an effort to boost residential uptake, BSES Radjhani has embarked on a plan to aggregate solar capacity among its customers to attract investment. In 2018 it demonstrated the viability of the utility-led community solar model by installing single-point delivery systems to groups of community-owned buildings. This system allows solar PV systems to be installed on multiple rooftops and then connected to the grid through a single metering point. Because power flows in both directions are aggregated, consumption costs and production benefits can be shared among all of the households living in each building. In several instances, such as the Shiv Bhole housing society, third-party investors and the distribution company funded these installations; the lower monthly electricity costs were immediately available to the community. The involvement of distribution companies and community-level intermediaries provided assurances to both customers and investors.	
6	SPA Mukuru, Nairobi, Kenya	SPA status can be awarded by Nairobi City County Government to indicate that conventional planning regulations do not apply in the designated area. In the case of informal settlement upgrading, this demonstrates a formal acknowledgement that conventional upgrading activities are not adequate to deliver effective results and more innovative, inclusive methods should be employed. Where physical/technical infrastructures are most often taken as the entry point for upgrading programmes, the approach here is to give greater attention to social and governance processes	
7	EcoCasa, Hermosillo, Mexico	The Mexican government has put in place a range of policies and programs to increase the supply, and improve both the quality and affordability of housing. The EcoCasa program, launched by the national government in 2013, was one of the first pilot programs under the Nationally Appropriate Mitigation Actions (NAMA) for housing prepared for the Paris Agreement on Climate Change. By reducing the costs of both developing and acquiring low-carbon houses, the NAMA has the dual objective of reducing greenhouse gas emissions from the housing sector and improving living conditions for citizens, and particularly for low-income families.	
8	EcoBici, Mexico City, Mexico	Various cities in Mexico, including Mexico City and Guadalajara, have put in place public bike sharing schemes to improve last mile transport options. The bike sharing schemes in these cities cover respectively 3% and 5% of the total area - though relatively little, analysis shows the schemes are key parts of the transport systems. The state government owns the bicycles and docking stations, while local companies operate the schemes.	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Energy	Annual CO2 offset of 12 tCO2-e	240 jobs, energy tariff reduction resulting in annual savings of up to US$66 per household	15 interviews (PS, LG, RG, NG, CS, TU); policy analysis
	Housing	Improved drainage; incorporation of green open spaces (serves recreational purposes too)	Increased access to basic services; recognition and participation in upgrading process	12 interviews; 2 multistakeholder workshops; 4 site visits
	Housing	In Sonora state Hermosillo-based developer Derex partnered with a local architect to create “Bosco”, a well-located neighbourhood with a liveable density and high satisfaction among residents. The Bosco neighbourhood shows how the next iteration of housing policy can incorporate these elements, and help to develop a more integrated approach to urban planning in Mexico	As of 2019, EcoCasa had financed 79 developers to build 57,859 energy efficient homes for 267,456 citizens in Mexico, and had certified 66,864 homes. The national government estimates that the total mitigation potential of these developments is 1,812 ktCO2e over the homes’ lifetime.	13 interviews (3 IFI, 4 NG, 1 ML, 1 AC, 4 PS); 2 site visits; technical analysis of quantitative measures of performance and a satisfaction survey of more than 7000 people living in EcoCasa.
	Transport	Contribution to reduced air pollution and other environmental benefits associated with the use of non-motorised transport	Increased physical activity generating health benefits; improved connectivity	12 interviews (1 NG; 2 LG; 7 PS; 2 AC); survey on bicycle scheme use completed by 275 users

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ID No.	Case study	Description	
9	Xalapa Local Adaptation Plan, Mexico	The city of Xalapa was one of the first places in Latin America to prepare, publish and institutionalise a local climate action plan. Several years and two governmental changes later, its experiences with the delivery and updating of that plan show how sustained collaboration, long-term vision and incremental implementation can promote and build transformational change, with benefits for urban resilience, wider processes of urban development, and for society at large.	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Water	Critical factors that have enabled Xalapa to navigate the challenges of successfully implementing urban climate action include: the initial push by national and state-level governments to develop climate policies; the early institutionalisation of climate action in formal sets of actors and targets; the maintenance of political will and ambition across successive governments; continual technical capacity-building of members of government; the development of partnerships between municipal authorities and national government; high levels of participation in international initiatives; and the creation of opportunities for public participation. The factors that led to success in Xalapa can inform urban climate action in other mountain contexts and more widely	This case also shows how the adoption of ecosystem-based approaches as an introduction to nature-based solutions (NBS) can help to create synergies with other interventions focused on infrastructure, technology and governance. Local adaptation efforts need to adopt a mix of policy instruments to reduce vulnerability	Reviews of related research, as well as of risk assessments and vulnerability analyses, and of evaluations of practical actions relating to the implementation of green and grey infrastructures and other related policy and governance changes. Particular attention is paid to developments in institutional frameworks from the national to the local level. Interviews and discussions were also undertaken with key local actors (public officers and non-governmental organisation (NGO) representatives)

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ID No.	Case study	Description	
10	20,000 Plots Project, Dar Es Salaam, Tanzania	The 20,000 Plots Project is the largest land delivery scheme that has ever been undertaken in Tanzania. The project was designed and led by Tanzania's Ministry of Lands, Housing and Human Settlements Development (MLHHSD), in response to estimates that the informal sector was producing 19,000 plots per annum to make up for the gap between the number of officially available plots and the number of applications for land received by the authorities. By 2010, the project had delivered around 40,000 plots in Dar es Salaam, and 58,590 plots nationwide. This was done using modern technology and multi-stakeholder implementation which reduced the surveying time of the first 20,000 plots from around six years to just 20 months. The project was entirely locally financed: the MLHHSD borrowed TZS 8.9 billion (US$3.83 million)8 from the Treasury to cover upfront costs, recognising that the planning, surveying and servicing of the land would unlock its value. Returns of TZS 29.3 billion (US$12.64 million) – more than triple the initial investment – were generated in the first year of the project through the sale of plots.	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Housing	By providing plots outside of the most flood-prone areas of Dar es Salaam, the 20,000 Plots Project reduced the risk of flooding by nearly two-thirds for more than 29,000 households. In a typical year, this translates into 16,200 fewer households having to deal with flooding. However, at the same time, almost 8,000 plots were located in moderate or high-risk flood areas and just 14% of the plots formalised were affordable for low-income groups. The project exacerbated urban sprawl by prioritising the development of low-density, peri-urban plots, and failed to involve communities at any stage. These issues can largely be attributed to major governance deficits.	Following devastating floods in December 2011, the government relocated 1,006 displaced households from the flood-prone informal settlement of Suna and allocated them formal land in Mabwepande under the 20,000PP. In addition to title deeds, the government provided trucks for moving belongings, building materials, tents, and temporary sanitary facilities in the then undeveloped plots. Six years later, interviewed residents of Mabwepande reported that, compared with Suna, the incidence of disease – particularly malaria – is much lower. The planned peri-urban environment is healthier for children, who have space to play, and safer for livestock, as animals are less exposed to flooding and theft. Perceptions of drug use and criminality have been reduced, and families report having been able to use their titles to access credit facilities, which have then been used to invest in education and productive assets, as well as to enhance resilience to future shocks by upgrading their housing. Profits were put towards the provision of rudimentary infrastructure in project areas. Almost 1,000 kilometres of earth roads were constructed, and more than 50 town plans were designed.55 Some of the revenue was used to kickstart replications of the project in other municipalities. By 2010, the project had delivered around 40,000 plots in Dar es Salaam, and 58,590 plots nationwide (including 10,000 in Mwanza, 2,700 in Morogoro, 2,390 in Mbeya, 3,000 in Bagamoyo and 500 in Kibaha).	15 key respondent interviews (1 NG, 2 LG, 3 PS, 3 CS, 1 local residents group, 4 AC, 1 IFI), 2 x site visits to housing developments, reviews of the academic literature, and expert reports from local consultancies and government agencies

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ID No.	Case study	Description	
11	Chamazi, Dar Es Salaam, Tanzania	A community displaced by the port development formed a housing cooperative and collectively saved enough to buy a 30-acre plot of land in the ward of Chamazi. . In Kurasini, 300 families faced resettlement due to the redevelopment of the port area in 2007. With support from the Tanzania Urban Poor Federation (TUPF), the community formed a housing cooperative and collectively saved enough money to buy a 30-acre plot of land in the ward of Chamazi. A local NGO – the Centre for Community Initiative (CCI) – provided technical assistance and loans to help the community develop a masterplan that included a variety of land uses, allocating space for a market, horticultural activities, a health centre and a school. CCI and TUPF worked with Slum/Shack Dwellers International to leverage US$100,000 of funding from The Rockefeller Foundation for the purposes of demonstrating a successful relocation.	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Housing	Inspired by Thailand's Baan Mankong collective housing programme, Chamazi Housing Cooperative applied for and was granted planning permission to develop plots of 200 square metres (half of the legally ordained minimum plot size). To reduce the capital costs of the project, and since the capacity of community members to repay loans was low, they adopted an incremental approach to housing construction. This allowed owners to develop their housing based on their own needs and resources, with maximum flexibility.60 This involved initially building single-storey houses (containing a kitchen, a bathroom and a living area) to which a second storey could be added later – reducing upfront costs and also likely overall costs, with interest. This model lays the foundation for high but liveable density, which is both environmentally favourable and more affordable	Between 2007 and 2012, the Chamazi Housing Cooperative constructed 42 homes, a solar-powered borehole, water points and a sewerage system. This equates to construction costs of a little over US$2,000 per home – dramatically low compared with the construction of an average dwelling in Dar es Salaam, which costs around US$18,000, and less than 10% of the US$23,000 average cost of building a home in sub-Saharan Africa	

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ID No.	Case study	Description	
12	Solar streetlights, Jinja, Uganda	Solar-powered street lighting has particular benefits for informal settlements. In Kibugumbata, Jinja, the co-production of solar-powered street lights has created jobs in the solar sector for a vulnerable population while helping to strengthen existing livelihoods by allowing trading to continue outside of daylight hours and enhancing safety and security in the area. Such multi-stakeholder models – which include local residents, non-governmental organisations (NGOs), and local and national government – can transform the relationship between the urban poor and the state, contributing to more sustainable and inclusive urban development. One settlement where the MDF and NSDFU have been active is in Kibugumbata. This 8-acre slum, home to 6,000 people, has literally been 'put on the map' of the city government's development plans. The availability of better data and formal recognition enables all levels of government to channel public investment into deprived areas in a more systematic and inclusive manner, such as through the co-production of plans and the co-financing of infrastructure	

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Energy	Solar streetlights 20 have been installed by the NSDFU with support from an NGO – ACTogether – in the informal settlement	e a financial contribution from JMC and to grant development permission for the road reserves (the land adjacent to the roads used for signage and drainage etc.). Five youths from Kibugumbata were trained to become solar technicians and took control of the technical aspects of the project. The poles were manufactured locally, and the rest of the technology was bought from a firm in South Africa, costing an average o f4 million UGX (~1,000 USD) per light. The 60-watt LED lights illuminate two of the main streets in the informal settlement where businesses operate. According to local residents, there have been no recorded instances of serious crime and residents feel safer. Business owners are able to trade for an additional five hours per day and have many more customers due to the streets being busy again, with the extra trading reported to be equivalent to around an extra $20 per day. The five solar technicians have continued to receive work maintaining the lights in the informal settlement (for which they receive payment from the JMC) and elsewhere in the city (for paying customers), and they have also branched out into domestic solar systems. This spill-over effect of the solar transition was visible in the settlement, where households with photovoltaic panels and batteries at home had access to, and were selling, energy services such as phone charging. The pole manufacturers are awaiting an order from JMC and SDI for their next projects	13 semi-structured interviews (2 NG, 6 LG, 5 CS), site visit and 10 unstructured interviews with local residents

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ID No.	Case study	Description	
13	Luchacos waste collective, Kampala, Uganda	A consortium of individuals and community-based organisations, which collectively form a registered company that operates in the Lubaga division of Kampala. The organisation uses organic waste to produce biomass briquettes, which are then sold as an affordable source of energy for cooking to (mostly) low-income households. formed in 2006, when KCCA identified the Lubaga Parish informal settlement as a candidate for a donor-funded programme which sought to turn environmental problems into development opportunities. Community members were asked to identify their most pressing concerns and highlighted waste accumulation (and the associated issue of flooding). Together with KCCA and the donors, the community decided to build upon an existing but rudimentary initiative to turn organic waste into briquettes. KCCA and their donors then facilitated training in business skills and provided support in upgrading the briquette-making technology. An average of 192 tonnes of waste is either collected by Luchacos employees or delivered to the organisation by one of the 1,200 households in nearby informal settlements. This waste is enough to produce 24 tonnes of biomass briquettes.	

Notes: For methods identifiers, NG = National government; SG = state government; LG = Local government; CS = Civil society; AC = Academic; PS = private sector; IFI = International financing institution

	Connection to case selection criteria			Methods
	Primary UBIS	Climate action	Development impact	
	Waste	Currently, 79.4 percent of households in Kampala use charcoal, consuming an estimated 236,908 tonnes per year. Kampala currently generates 1,170,190 tonnes of waste every year, of which 78 percent is organic. If all organic waste was used to produce biomass briquettes like those made by Luchacos, almost half of all charcoal use could be replaced. This could save 570,000 tonnes of wood (equivalent to roughly 100 hectares of forest), which in Uganda could sequester anywhere between 9,000 and 55,000 tonnes of CO2e, directly accounting for 1.3–7.7 percent of Kampala's total emissions	The briquettes are sold either to the participating households, who receive a discount, or to local institutions and other users. Though small-scale, the enterprise is the primary source of income for its 20 employees. It has significantly reduced the extent of the solid waste crisis facing the Lubaga Parish. Although hard to quantify due to a lack of reliable data, this would be expected to reduce the health risks facing residents, including both the incidence of disease and the severity of flooding due to refuse blocking drainage infrastructure.	15 interviews (2 NG, 3 LG, 7 MSMEs, 3 CS, 2 AC) and 5 site visits to waste facilities

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Curriculum vitae

Lucy Oates is a scientific researcher and policy analyst with experience in academia, local and national government, and international consultancy. Her interdisciplinary expertise spans the fields of global development, urban studies, sustainability transitions, and human geography.

Lucy holds an MA in Geography from the University of Edinburgh, United Kingdom (awarded 2012) and an MSc in International Development Studies from the University of Amsterdam, the Netherlands (awarded 2016).

From 2012 to 2015, Lucy worked as a graduate traffic engineer at Transport for London, UK, where she experienced firsthand the intricacies of local (municipal) government.

In 2015, Lucy returned to university to acquire a Master's degree in International Development Studies, from which she graduated *cum laude*. For her graduation project, she spent 10 weeks conducting research on forest-based livelihoods at the peri-urban fringe in Hue, Viet Nam, together with the Viet Nam-based office of Tropenbos International.

Following the acquisition of her MSc, Lucy took on the role of Coordinator of LANDac (the Netherlands Land Academy), based at Utrecht University, the Netherlands. Her role involved the day-to-day management of a multi-stakeholder, multi-year research consortium whose aim was to enable the formulation of evidence-based policy for equitable and sustainable land governance in the Global South. Lucy organised and/or hosted various knowledge sharing events at the science-policy interface, including LANDac's annual international conference, side events at the World Bank Land Conference in Washington DC, and roundtable discussions in the Netherlands and the Philippines.

In 2018, Lucy joined the University of Leeds, UK as a Research Fellow on "Frontrunners", a research programme funded by the Coalition for Urban Transitions (CUT) and the then UK Department for International Development (DFID) to showcase examples where climate and development goals were brought together in urban projects. Working with in-country academic partners, she conducted in-country case study research in China, India, Rwanda, Tanzania, and Uganda, and virtually supported research in Mexico.

In late 2019, initially alongside (and drawing upon) her work with the Coalition, Lucy began pursuing a PhD in governance for sustainable urban development at Delft University of Technology. She became a Delft Global Fellow, making her part of a university-wide group working on global challenges. She spent three months researching a participatory slum upgrading programme in in Nairobi, Kenya, with Nuvoni Centre for Innovation Research and colleagues from the Institute of Housing Studies (IHS) of Erasmus University, Rotterdam, the Netherlands. In addition to her research, Lucy was also involved in various teaching activities: she supervised one Urbanism Master's thesis; she supervised several groups participating in the Architecture Bachelor's course "Area development in the metropolitan landscape"; she co-led the second-year Master's course "Metropolitan Solutions" at the Advanced Metropolitan Solutions (AMS) Institute in Amsterdam; and she supervised a group participating in the first year Master's course on "Living Labs" at the same institution. Lucy also delivered guest lectures for the MOOC "Rethink the City" and the summer school "Planning and Design for the Just City".

Alongside her academic duties, Lucy collaborated with a colleague from IHS to write a chapter on "Resilient infrastructure as an accelerator of effective climate action in cities" for UN Habitat's flagship bi-annual World Cities Report, which was launched at the 12th World Urban Forum in November 2024. This chapter draws extensively on the empirical and conceptual work upon which Lucy's PhD is based.

In September 2023, Lucy took on the position of "Researcher – Just Transitions" at the Netherlands Environmental Assessment Agency (PBL), where she currently works in the sector "Global Sustainability". In her latest role, Lucy seeks to explore the challenges and opportunities of mainstreaming equity and social justice considerations into policy regarding the sustainability of the living environment, with a focus on foreign and development policy.

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Sustainability transitions in urban basic infrastructure services

Organising principles from Southern cities

Lucy Oates

Urban infrastructure and the essential services it provides – energy, housing, transport, waste management, and water – are fundamental for human and ecological wellbeing. As urban populations grow, particularly in the Global South, equitable and sustainable service delivery is increasingly identified as a strategy for addressing both environmental and socioeconomic development challenges. Existing frameworks for sustainability transitions often prioritise technological innovation at the expense of social, political, and organisational dimensions of infrastructure. Likewise, mainstream approaches to infrastructure development favour large-scale, centralised, technology-driven solutions, overlooking the diverse service delivery arrangements that characterise many Southern cities. This thesis addresses this gap, combining empirical case studies with critical discourse analysis to explore how community-led and hybrid service delivery models contribute to inclusive and sustainable urban development. First, it examines how academic and policy discourses reveal a bias towards technocentric, Global North-focused perspectives on sustainable infrastructure. Next, it draws on case studies from 14 cities from across Africa, Asia, and Latin America to explore the delivery of essential services by community-based organisations, cooperatives, and informal service providers. Often considered "unorthodox," such models can – given appropriate state support – contribute to improving service accessibility, mitigating environmental impacts, and empowering marginalised communities. Finally, these findings are used to propose refinements to sustainability transitions theory, including the Multi-Level Perspective. The thesis concludes that policy, practice, and academic theory must shift away from a narrow emphasis on technological solutions or economic efficiency, embracing broader approaches to urban service delivery that can benefit both human wellbeing and environmental sustainability in cities worldwide.

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