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Reimagining urban science for global sustainability: Five strategic research areas

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Abstract

Non-technical summary. Cities, as complex systems, are faced with increasingly diverse and connected challenges across social, economic, environmental, and health domains. To help cities address these challenges, the Future Earth Urban Knowledge-Action Network developed a cross-disciplinary urban research agenda through expert elicitations and extensive consultation. Five research themes to guide urban sustainability research were identified including: (1) advancing urban sustainability transformations, (2) ensuring equity, (3) boosting innovation in low to lower-middle income countries, (4) managing complexity and systemic risks, and (5) navigating environmental change. Advancing this agenda will require collaboration across disciplines and geographies, transdisciplinary coproduction, and enhanced support to urban science.

Technical Abstract. Cities and urban regions are at the forefront of transformations toward global sustainability. As urbanization accelerates, there is increasing demand for cities to play multiple, complex and synthetic roles across social and environmental domains within and beyond their boundaries, for example driving economic development while mitigating and adapting to global environmental changes. To help cities in meeting this challenge, urban science, a rapidly growing field that includes inter- and transdisciplinary research, needs to expand and evolve, with clear priorities. Combining expert elicitation and community consultation, the Future Earth Urban Knowledge-Action Network developed a strategic research agenda for urban science for the next decade. The urban science research agenda describes five critical research themes for scientific advances: (1) accelerate urban sustainability transformations, (2) ensure equity and inclusivity, (3) amplify innovation from the low to lower-middle income countries, (4) negotiate complexity and systemic risks, and (5) navigate environmental change. Under each research theme, we review the state of the art, identify remaining gaps, and outline key research questions needing to be addressed to advance science toward urban transformations. Interconnections across, and enabling conditions to advance, these priority research themes are discussed.

Social media summary. Globally co-designed urban research agenda reveals pressing priorities for sustainability and resilience.

1. Introduction

Cities are the battleground for sustainability due to their disproportionately large contributions to global environmental impacts (Bai et al., 2017; N. B. Grimm et al., 2008), and increasingly due to their potential as transformative agents (Bai, 2025). As major drivers of global change, cities have a prominent role in enabling the Earth's transition to sustainability (T. M. McPhearson et al., 2021). Understanding the complex dynamics across social, economic, ecological, and technological change is critical to gaining new insights that can allow us to more effectively plan and govern cities for inclusive well-being.

The vast majority of urban population growth is expected in Asia and Africa (UN DESA, 2018, 2024) where there is also greater vulnerability to climate change impacts (UN-Habitat, 2024). Moreover, urban expansion results in long-term effects on rural areas and the livelihoods of rural populations (Güneralp et al., 2020). Nonetheless, while populations of most cities continue to grow, there are also many that are aging and shrinking (Haase et al., 2018), requiring new paradigms in city planning and management (Jarzebski et al., 2021). Institutional capability gaps, financial constraints, and inadequate planning amidst rapid growth (or debilitating shrinkage) often exacerbate urban poverty and inequity (UN-Habitat & ESCAP, 2015) and present significant challenges to many cities in low and middle income countries. These gaps are exacerbating urban poverty and inequity (UN-Habitat & ESCAP, 2015).

Increased exposure to climate change impacts and other hazards brings additional challenges to local and regional resilience and sustainability (Revi et al., 2022). Yet, it is in cities that significant opportunities for systems change, and even transformation, exist (Bai et al., 2019). Innovative solutions are emerging, from both developed, high-income cities and rapidly urbanizing regions in Asia, Africa, and Latin America as well as from local, decentralized, and community-led initiatives from around the world (Nagendra et al., 2018). In response to such challenges and opportunities, urban science must also evolve and transform, tackling new questions and incorporating new methodologies to learn from emerging solutions and bring in diverse perspectives (T. M. McPhearson et al., 2021; Webb et al., 2018). We define urban science as a scholarly field that encompasses multi-, inter-, and trans-disciplinary approaches to (i) understand the drivers and impacts of urbanization, (ii) unravel the complex interplays of social, economic, ecological, and technical aspects across spatial and temporal scales, (iii) explore dynamic behaviors and change trajectories of urban systems, and (iv) identify and test actionable solutions for policy and practice, with the aim to inform and guide cities toward sustainable, prosperous, just, and resilient futures.

The challenges and opportunities faced by cities and urban areas are increasingly recognized in global policy circles. The Intergovernmental Panel for Climate Change (IPCC) will release its Special Report on Climate Change and Cities as part of its 7th Assessment Cycle in 2027. Urban topics are also featured prominently in the scientific outcome of the IPCC-IPBES workshop in 2021, which advocated for a climate-biodiversity-society nexus approach (Pörtner et al., 2021). Urban areas offer a tremendous opportunity to address many UN Sustainable Development Goals (SDGs). Yet, progress is less than optimal. For example, reports on SDG 11 "*make cities and human settlements inclusive, safe, resilient and sustainable,*" indicate that most of low-and middle income countries are lagging behind on almost all the targets, in particular on reducing slums and improving air quality (Habitat & Women, 2016). Consequently, the UN Economic and Social Commission for Asia and the Pacific (ESCAP) suggested developing a national roadmap to achieve SDG 11 (UN-Habitat & ESCAP, 2015) in close collaboration with cities. To meet the aspirational goals set by global policy processes, cities are increasingly required to play multiple, complex and integrative roles across social, economic, environmental, and health systems. This calls for an integrated approach focusing on synergies and co-benefits across domains (Bai, Surveyer, et al., 2016; Schaeffer et al., 2025). Due to globally connected production, consumption and trade systems, the social and ecological impacts of urbanization go far beyond the administrative or regional ecosystem boundaries (Elmqvist et al., 2019; N. B. Grimm et al., 2008; Swilling et al., 2018). This highlights the mandates as well as potentials for cities to shape global sustainability through responsible production and consumption choices (Swilling et al., 2018).

Urban Science has an essential role to play. Yet, urban policy and practice is insufficiently informed by science and evidence (Frantzeskaki et al., 2021) for reasons. The lack of localized data and knowledge is often identified by local policy makers and practitioners as a key barrier to informed decision making (Neves et al., 2020; UN-Habitat, 2014; UN-Habitat & ESCAP, 2015). In addition, politics can get in the way, science and evidence may not always be welcome when they reveal inconvenient truths, and may be subjected to cherry picking or deliberate overlooking by policy makers (Harris et al., 2024). Furthermore, to increase uptake, urban science itself needs to become more policy relevant, through coproducing with urban decision-makers and practitioners (Bai et al. 2024), in areas such as climate mitigation and adaptation (Franco et al., 2024; Frantzeskaki et al., 2025), disaster and risk management (Costa et al., 2024), air quality improvements (Yan et al., 2025), water pollution abatement (Yang et al., 2021), biodiversity and ecosystem conservation (Chung et al., 2021), sustainable mobility (Winkler et al., 2023), waste management, efficiency in resource use and sustainable consumption practices (Swilling et al., 2018), and safeguarding health (Ebi et al., 2020).

There have been significant developments in urban science over the past two to three decades in conjunction with other disciplines, such as urban studies, sustainability science, sustainability transitions, land system science, urban ecology, resilience studies, and urban climate mitigation and adaptation. Increasingly, works are moving toward addressing issues within a broader systems approach (Bai, Surveyer, et al., 2016; McPhearson, Pickett, et al., 2016), an essential development to tackle complex interlinked problems. Yet, apart from few pioneering studies, urban science remains largely insufficient in terms of its scope, depth, and geographic cover to meet the challenge of guiding urban policy and practice (Creutzig et al., 2024) And as (Taylor & Hurley, 2016) noted in relation to urban practitioners' use of urban research, "not a lot of people read the stuff."

This paper stems from a horizon scanning initiative of the Future Earth Urban Knowledge-Action Network (Urban KAN), with the aim to identify key research priorities of urban science over the next decade. Future Earth is an organization that convenes researchers and scholars from all parts of the world, across different societal and academic sectors to work together and advance science for sustainability over a number of topical issues (Sioen et al., 2024). The Urban KAN is one of Future Earth's Global Research Networks. The Steering Committee of the Urban KAN has led the development of this urban science-focused research

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agenda, a co-production effort that engaged a broad community of urban scientists and practitioners and guided by the following overarching questions: (1) What frontiers of urban science are pivotal to advance to better inform policy and practice in ongoing global urbanization? (2) How can we connect across a variety of disciplines and actors to tackle complex, interrelated issues? (3) How can we reorient our science to support urban sustainability and facilitate timely transfer of knowledge to action? (4) How can we re-imagine our global ambition for urban science, and share it widely, building a broad-based scientific community? (5) How can we facilitate timely flow of information on urban social and ecological shifts to the scientific community and practitioners so that policy formulation keeps pace with these shifts?

2. Method

The research agenda was developed as follows: First, an expert workshop that involved consultations among the members of the Urban KAN Steering Committee and representatives from the broader urban research community was convened. This was followed by further review and elicitation conducted by the authors to ensure critical insights were embedded in the agenda. The draft priority areas and key research questions identified based on the workshop were a community consultation took place in dedicated sessions at an online Urban Forum on 14 December 2021 and at the Sustainability Research and Innovation Congress 2022 on June 21st, 2022. Discussions were held and a survey was widely distributed after the Congress session (the survey was closed on 29 August 2023). Further community consultation took place at a dedicated Webinar (held on Sept 14th, 2022). Survey respondents were asked to rank the pre-developed research questions within each overarching theme according to urgency and importance. Survey respondents did this by allocating points to each research question based on their perceived priority within the given themes. The allocation of points reflected a participant's ranking, with higher-ranked options receiving more points. Following the completion of the voting phase, the accumulated points for each research question were tallied (see S1 Empirical methodology Equation A-1), and the sum was divided by the total number of participants engaged in the ranking poll (see S1 Empirical methodology Equation A-2). This computation yielded an average, thereby establishing a ranked score for each research question in a structured sequence.

Survey participants were also asked to add in research questions from their own expertise. This outreach activity resulted in 37 responses that provided empirical insights. Further details on this empirical testing are described in Supplementary Material S1. The outcome of the workshops and the survey responses are synthesized and complemented by a targeted literature review organized by the authors within each theme to illustrate the rationale, context, significance, and state of the art of each theme. The review supporting the research agenda was conducted by subject experts using key words per identified priority research area to critically link the research area with on-going research (similar to methods applied by (Bustamante et al., 2023; Ebi et al., 2020; Schaeffer et al., 2025), prioritizing most recent original publications as well as to contrast with expert judged novelty for the research agenda. In total, 120 research questions were considered while establishing the research agenda. The full list of research questions by overarching themes is in Supplementary Material S2.

Table 1. Guiding research questions and ranking for "accelerate urban sustainability transformations"

No.	Research questions	Score
1.1	What kind of political, institutional, social, and economic knowledge and practices can hinder or facilitate accelerated transitions?	4.8/6.0
1.2	What are the disruptive elements, including new concepts, tools, mechanisms, leaders, and social, economic, cultural, technological, and institutional innovations that accelerated the transition toward sustainability, in both urban North and South? What are the well-known solutions and elements and tipping points that can bring about solutions that we are not using effectively?	4.7/6.0
1.3	What is the role of systems approach and integration in urban systems to accelerate possible solutions in urban transitions?	4.2/6.0
1.4	How do we sustain momentum for innovative and sustainable practices, i.e., building positive inertia in varying and changing social, economic, institutional, and political cycles and contexts? How can we leverage the above understanding for the rapid transition toward a sustainable, resilient, liveable, inclusive urban future?	3.7/6.0
1.5	What are the new roles and responsibilities of different actors in the transition process? How can we mobilize these stakeholders at different scales for orchestrated action toward desirable urban futures?	3.5/6.0
1.6	How can urban science respond in a timely way to observe, record, assess, evaluate, build, and share transferable knowledge from innovative practice and experiments?	3.2/6.0

3. Priority research themes

Five priority research themes were identified: (1) accelerate urban sustainability transformations, (2) ensure equity and inclusivity, (3) amplify innovation from the low to lower-middle income countries, (4) negotiate complexity and systemic risks, and (5) navigate environmental change. These overarching themes not only elucidate important scientific questions but also point to the need to build stronger science-policy-practice linkages to harness various forms of knowledge and speedy implementation of integrated knowledge across disciplines and sectors (Harris et al., 2024). The rationale, significance, state-of-knowledge, and core guiding research questions for these overarching themes are presented below and in Tables 1–5, with the rating of the ranking assigned.

3.1. Accelerate urban sustainability transformations

Proximity of actors and resources in the urban context makes cities ideal loci for testing and realizing accelerated transitions (Frantzeskaki et al., 2021). Despite the many innovative practices and experiments at city level, transitions toward sustainability are at best slow and not at the scale that is required. Traditional scientific approaches to knowledge generation typically operate over long timeframes that are not geared to the urgent responses needed to address current global urban challenges. An acceleration of policy and planning responses to global sustainability challenges is thus needed, with due consideration not to leave already marginalized populations behind, exacerbating existing inequalities or creating new ones (Gupta et al., 2024).

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Table 2. Guiding research questions and ranking for "ensure equity and inclusivity"

No.	Research questions	Score
2.1	How can equity, inclusively, and justice be embedded at the core of urban sustainability transitions?	3.2/4.0
2.2	What are levers for equitable and just transition to sustainability?	2.9/4.0
2.3	How do we address potential tensions between the need to accelerate and scale up sustainability solutions and the time investment needed to engage and include community voices?	2.7/4.0
2.4	How have we reached a revamped equity discourse?	1.3/4.0

Table 3. Guiding research questions and ranking for "amplify innovation from LLMIC"

No.	Research questions	Score
3.1	How can we recognize, support, and enhance institutional, governance, finance, human and technological capacity in the LLMIC to amplify innovation?	4.4/6.0
3.2	How do we recognize, value, and integrate knowledge in diverse forms globally, particularly in the LLMIC?	4.0/6.0
3.3	How can we recognize, support, and enhance institutional, governance, finance, human and technological capacity in the LLMIC to amplify innovation?	4.4/6.0
3.4	How can to leverage disruptive, non-networked, non-centralized infrastructure technologies and systems in the LLMIC for equity and leave no one behind?	3.6/6.0
3.5	How to be most cost-effective and build on human capital rather than information capital?	2.9/6.0
3.6	How do we identify, monitor, regulate, and transform the interconnectedness of the global north and LLMIC via geopolitical, economic, and consumption circuits and impacts?	2.9/6.0

Table 4. Guiding research questions and ranking for "negotiate complexity and systemic risks"

No.	Research questions	Score
4.2	How do communities and social organizations solve immediate challenges through tinkering and experimentation? And how can this be supported and leveraged for responding to uncertain futures?	2.7/4.0
4.3	How can the recognition of the interconnectedness of urban system components and subsystems be better managed to maximize urban mitigation and solutions that address both climate mitigation and adaptation?	2.6/4.0
4.4	How can design, engineering, and planning learn from Big Data and analytical potential for sustainability transformations?	2.1/4.0

Table 5. Guiding research questions and ranking for "navigate environmental change"

No.	Research questions	Score
5.1	How can urban systems integrate mitigation and adaptation efforts for more sustainable and resilient development?	4.6/6.0
5.2	How can urban areas contribute to better planetary health, including through air quality and ecosystem health?	4.0/6.0
5.3	How can the impact of urbanization on terrestrial and marine biodiversity loss and habitat fragmentation be reduced?	3.6/6.0
5.4	What are ways for urban areas to improve land-use efficiency while increasing greenery and reducing climate impacts?	3.5/6.0
5.5	How can urban areas navigate global environmental change and reduce environmental impacts across scales?	3.4/6.0
5.6	How can water use be managed while increasing urban freshwater ecosystem services for better water quality?	2.9/6.0

There is ample evidence that natural systems change in a non-linear manner with tipping points (Armstrong Mckay et al., 2022), but the level and pace of actions are lagging. Delaying actions fuel the urgency to act as the window of opportunity starts to close. In climate, for example, an increased urgency to take climate action is represented in cities' agendas, with many cities declaring a climate emergency (Salvia et al., 2023). These cities prepare daring plans and proposals to be put in action such as implementing nature-based solutions and mobilizing social movements (e.g., coastal retreat from at risk coastal settlements in Staten Island, New York as part of a wider planned relocation effort or transforming historic urban parks in Copenhagen into stormwater capture to reduce risks from urban flooding). These seeds of transformation in cities are signs of hope (Loorbach et al., 2020) but their emergence and resulting implementation remain regionally uneven: While those cities with sufficient governance, resources, and knowledge capacities take advantage of these seeds of transformation to trigger and scale transformative agendas (Pereira et al., 2020), the rest of the cities worldwide lag behind.

Research shows many solutions (e.g., increasing self-sufficiency or choosing building materials with lower net emissions) are already available and that they have already proven to be effective in dealing with climate change (Lin et al., 2021). Therefore, the challenge is how to accelerate their uptake and eventual mainstreaming. While several frontrunner cities and businesses are taking actions to address climate, biodiversity, and resource challenges by setting science-based targets, many more need to follow urgently (Bai et al., 2022). Yet, often existing policy and planning efforts are not capable of supporting immediate and fast-paced actions. In addition, even if strong sustainability goal-driven governance is possible, many challenges remain in identifying and navigating tradeoffs between different goals and targets. A proactive approach to accelerating transitions is also essential to reduce the need for reactive quick fixes that are less effective and often result in maladaptation.

Historical research on socio-technological systems and how they transform revealed that novelty—in the form of new practices, technologies, or institutions—is key to achieving transition (Loorbach et al., 2017). Many of our infrastructure systems have undergone such pathways of transformation, e.g., shifting from decentralized wastewater systems to centralized ones, or more recently, transitions toward renewable energy systems that become more prominent in the energy mix and facilitate the creation of self-organized energy communities (Wittmayer et al., 2020). Contemporary transformations however seem to be more complex. Multiple forms of innovations reconfigure current ways of

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organizing and practicing: governance and financial innovations such as crowdfunding, participatory budgeting, and citizen councils, innovations in knowledge production and sharing such as citizen science and digital platforms, societal innovations such as time banking and slow food movements, and technological advances in, for example, artificial intelligence. These innovations and advances across a diversity of arenas—bio-regional, socio-economic, and governance contexts—offer opportunities for transformative changes to tackle multiple sustainability issues while also presenting new regulatory challenges. In addition, the vastly different trajectories of urbanization being experienced in the rapidly urbanizing global South opened the space for innovations in technical solutions, partnership models, financing mechanisms, and service delivery strategies that may be applicable at different levels in different contexts (Nagendra et al., 2018). Shared visions and goals for a desirable future, while recognizing various underlying values and world views is a critical step in identifying implementation pathways and transformative solutions (Bai, van der Leeuw, et al., 2016; McPhearson, Iwaniec, et al., 2016).

In this context, there are four promising new concepts or recent developments that can inform an accelerated transformation to more sustainable futures:

i) Social tipping: Social tipping research focuses on the potential of certain social changes to bring about large scale system change through self-reinforcing processes. Theoretical frameworks are proposed to understand how various actors, enabling factors and mechanisms can trigger such cascading effects (Farmer et al., 2019; Otto et al., 2020; Winkelmann et al., 2022). Bai (2024) proposed a method to identify anticipated tipping points via peer effect, using EV adoption in Shanghai as a case study. Still, while identifying a tipping point retrospectively is relatively easy, doing so before the tipping occurs remains a challenge.
ii) Nexus approach across domains: By focusing on multiple domains, a nexus approach aims to harness synergies and avoid tradeoffs, thereby has the potential to accelerate transformation. The water-energy-food nexus is perhaps the most studied nexus (Chan, 2015; Newell, 2020). More recently, a climate change-biodiversity-society nexus proposed by the IPBES and IPCC Joint Workshop in 2020 (Pascual et al., 2022; Pörtner et al., 2021), the IPBES report on Transformative Change Assessment (O'Brien et al., 2024), and IPBES NEXUS Assessment across biodiversity, water, food and health (McElwee et al., 2024), started to receive much attention.
iii) Collaboration across cities and actors: There is a strong case for cities to be altruistic, as doing so not only benefits recipients but also themselves (Bai, 2024). In addition, more and stronger collaborations across actors must be explored to achieve rapid and large scale transformation (Oke et al., 2021). For example, as two key subnational actors in sustainability, a stronger collaboration across cities and businesses is essential for living within the safe and just Earth system boundaries. There is untapped climate mitigation potential in stronger city–business collaborations, especially when ambitious targets can be aligned among co-located cities and companies such as for electrification of transportation and district heating/cooling (Kılkış, Bjørn, et al., 2024).
iv) Linking cities to planetary targets: Mobilizing cities and businesses to set ambitious targets is essential to achieve global level goals, such as staying within the planetary or safe and just Earth system boundaries (Bai et al., 2022; Rockström et al., 2023). Cross-scale translation of planetary or Earth system boundaries and subsequent science-based target setting can ensure the grand sum of targets and actions conducted by all actors remain within the designated boundaries (Bai, 2024; Bai et al., 2022; Bjørn et al., 2021; SBTN, 2020).

To advance research to accelerate urban sustainability transformations, we identify six guiding research questions as in Table 1. See Supplementary Material S2 for the full list of 29 research questions.

3.2. Ensure equity and inclusivity

Ensuring equity while enhancing sustainability are intertwined dual challenges for cities, both in response to existing issues and for future planning. Cities concentrate socio-economic opportunities but also often generate pronounced inequalities that can reduce human wellbeing. In the context of rapid urban population growth, ensuring equity and inclusivity while achieving greater resource efficiency and lower ecological footprint is a critical task for political leaders, policy makers, practitioners and communities. There have been strong calls globally for justice to be a core dimension of urban sustainability transitions. The first five Sustainable Development Goals (UNGA, 2015), poverty reduction, food security, health, education, and gender equality are all primary equity outcomes from sustainable urbanization, supported by further SDGs, such as water, energy, work, infrastructure, climate action, and sustainable cities. Beyond the SDGs an array of policy frameworks, such as the IPCC AR6 climate report, the UN New Urban Agenda or the World Bank Sustainable Cities Framework Program 4, articulate clear ambitions for greater urban inclusion. Such frameworks are complemented by civil society movements emphasizing "the right to the city" (Harvey, 2003), or notions of justice such as environmental justice, the "just city" (Fainstein, 2014), "housing justice" (Roy et al., 2020) or decolonial "dwelling justice" (Porter & Kelly, 2022), and more recently climate justice (Bustamante et al., 2023). However, many critical research questions await answers.

The Sustainable Development Goals aim to "end poverty in all its forms everywhere" as the number one global challenge by 2030. Cities typically offer more economic opportunities than rural areas (Young, 2013), due to broader and deeper labor markets with complex exchange networks, including greater gender inclusivity (Evans, 2019). However, cities are also sites of labor exploitation that often exhibit inequalities in the distribution of income and wealth disparities influenced by social stratification. Because cities concentrate wealth, urban inequality tends to increase with city size (Castells-Quintana et al., 2020). Given ongoing urbanization, urgent research is needed on urban economic inequality (e.g., poverty and class inequalities), its drivers, and solutions. This includes direct urban poverty alleviation through employment as well as indirect channels such as access to education (Nasir et al., 2020), mobility services (Farré et al., 2020), commuting structures (T. Li et al., 2021), infrastructure (including digital infrastructure (Macaya et al., 2021), and inclusive urban governance. Further research is needed on gender disparities in entrepreneurship and participation (Tripathi, 2023). Emerging programs that focus on cities through a degrowth perspective (Kaika et al., 2023) must attend to the implications of urban inequality. Likewise, urban strategies to reduce environmental demand and mitigate climate change must address class-based inequities (Huber, 2023).

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Equality in available urban services, such as housing, health, education, transportation and amenity has long been part of the discourse and practice in urban planning. Environmental justice is becoming central to urban sustainability and is central to equity incorporating also accessibility concerns of available infrastructure services and benefits. It recognizes the adverse distributional consequences of urban environmental externalities, such as toxic wastes, pollutants, and environmental hazards, within the context of wider movements for social justice (Collins, 2014). New iterations of this research program in the US have deployed racial and decolonial perspectives on climate justice (Fitz-Henry, 2022). Subsequent analysis has broadened the environmental justice frame to address climate impact disparities (Mitchell & Chakraborty, 2018), within adaptation justice, and within wider systemic approaches to human-environment systems (Henrique & Tschakert, 2021).

Recent decades have seen growing recognition of urban social justice gaps across various demographic groups. An array of novel theoretical and conceptual approaches has been developed to understand distributive justice, procedural justice, and the need to recognize systemic and structural vulnerabilities, incorporating local, traditional, and indigenous knowledge. Such perspectives examine how socio-demographics, land-markets and institutions shape residents' experiences of urban land use, service access, and climate vulnerability. Distributional inequality can result from formal planning or unintended gentrification. Historically, land use in some cities has segregated minorities, exposed poorer communities to flooding, and sited toxic or offensive land-uses in disadvantaged areas. The latter is related to the accumulation of the wealthy in areas where the availability and the delivery of urban services, such as green spaces, education, health, and transportation, are improved, whilst leading to soaring land prices and the displacement of the poor. The lack of participation, or policy co-design, from impacted communities and/or ineffective participation exacerbates urban inequality.

Inequities in access to environmental resources, such as water and energy, as well as to various ecosystem services in cities, have already been considered at length in the literature (Shih, 2022). More recently, such inequities are increasingly studied in the context of climate change. Importantly, In the context of climate justice, in addition to pre-existing injustices (Collins, 2014), new inequalities may emerge from lack of adaptation justice (Bustamante et al., 2023). For example, cities increasingly use nature-based solutions as low-cost investments or insurance to build resilience to climate change (Frantzeskaki et al., 2019; Hahn et al., 2023; McPhearson et al., 2025, 2023), e.g., runoff abatement and heat mitigation in cities. However, implementation of these often prioritizes the protection/benefits of affluent areas and leads to displacement of the poor. This phenomenon is called "green climate gentrification" (Anguelovski et al., 2019) and should be regarded as a form of maladaptation. Given the manifold transformations occurring through global environmental change, including via climate change vectors but also resource degradation and exhaustion there is a critical necessity to better understand factors behind urban inequalities and the mechanisms to alleviate them, whether conventional or radical (T., M. McPhearson et al., 2021).

Ensuring access to water and sanitation for all is linked to multiple dimensions of equity; however, progress remains limited with 2 billion people still expected to live without access to safely managed drinking water in 2030 (UN, 2024), especially in rapidly growing cities where growth exceeds infrastructure development. These disparities in service delivery hinder inclusive water, sanitation, and hygiene planning (Luwe et al., 2022; Robinson et al., 2024). These services are also plagued by chronic inequities, particularly in historically colonized areas (Lue et al., 2023), leading to public and political disengagement, worsening procedural inequities (Rodina et al., 2024). Inadequate low-quality, unsafe, and poorly maintained public facilities in poorer communities heighten health risks, especially during floods, heavy rain, and heat waves (Anthonj et al., 2024). Women and girls are disproportionately impacted (Anthonj et al., 2024) with cascading socio-economic effects (Robinson et al., 2024).

Housing is a key driver of urban inequality (Berry, 2023) both through its direct impact on social reproduction and as a vehicle for financialized asset accumulation (Rolnik, 2017). Spatial residential segregation can also restrict access to jobs, education, and services while increasing exposure to climate risks like floods, fires, and cyclones. Some examples provide lessons to mitigate NIMBY when implementing environmental infrastructure, such as the Hiroshima Naka Incineration Plant where parts of the plant are made public domain and noise is mitigated so that appreciation for and understanding of the infrastructure is increased (Asokan et al., 2024). Socio-economically disadvantaged populations are often concentrated in areas with environmental degradation and inadequate infrastructure. Informal settlements often face heightened risks due to poor infrastructure, weak structural integrity, and proximity to hazards (French et al., 2021). Research must examine the processes driving informal housing and the governance and institutional pathways to achieve equitable policy solutions. Research is also required on viable institutional mechanisms for large-scale, regulated and sustainable social and affordable housing solutions. Processes of housing financialization and rentierism must be addressed through regulatory and governance reforms to protect both homeowners and tenants, especially from predatory financial instruments and actors. Finally, further research is needed on the environmental impact of housing, exploring degrowth (Kaika et al., 2023; Nelson et al., 2019) and circular economy (Horne et al., 2023), as well as the financial and carbon costs of new construction and rebuild versus reuse and retrofit (Ding & Ying, 2019).

More recent post-human environmental justice perspectives highlight cities as habitats for diverse ecologies. Notions of ecological justice now include multi-species justice (Celermajer et al., 2021; Pineda-Pinto et al., 2021) and allied notions of "stewardship" (Mumaw & Mata, 2022). These justice frameworks call for greater recognition of diverse values (Pascual et al., 2023), including indigenous and non-conventional perspectives. Policy research is needed to address urban inequality and promote future justice.

To advance research to ensure equity and inclusivity, four guiding research questions emerge as given in Table 2. See Supplementary Material S2 for the full list of 26 research questions.

3.3. *Amplify innovation from low and lower-middle income countries*

Much of the future urbanization and associated challenges, opportunities, and innovation will occur in low and lower-middle income countries (LLMIC). This challenge should be placed at the core of urban scientific efforts. Centralized governance structures often hinder local transformations. Transitions in the urban North are facilitated in part by greater power and capacity by civil society. In contrast, many cities in the urban South are dependent on state capacity. Urban South already has rich urban knowledge, often derived from local experience and practice, in terms of empirical

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knowledge and frameworks on how to achieve sustainable growth along with social justice. LLMIC urban innovations offer valuable learning opportunities. However, the influential well-cited literature on urban sustainability still predominantly emanates from the urban North, for example on topics related to adaptation and mitigation in cities (Sharifi et al., 2025), limiting the integration of LLMIC grassroots innovations into policy. Knowledge transfer should move beyond North-South linkages to include interactions between South-South and South-North, indigenous, and community-based approaches (Nagendra et al., 2018). Recentering global urban sustainability science in LLMICs requires collaboration, capacity-building, and multi-directional knowledge exchange that recognizes, enhances, supports, and shares LLMICs scientific capacity.

Overall, research on innovation in urban regions of LLMICs has received less support and funding, yet their urban sustainability innovations span ecology, governance, and technology—often self-driven by active citizens (e.g., Sierra Leone's Freetown smartphone app that incentivizes tree planting and monitoring by urban residents to increase biodiversity and resilience and sustain livelihoods that depend on these green areas). Given the high population densities and deep inequities in cities of the global South, urban ecological restoration projects often fail to get off the ground, or remain top-down with little grassroots support (Wantzen et al., 2019). Connecting ecological projects with culture and poverty alleviation improves community acceptance, as seen in restoration projects in riverine urban regions of Brazil (Hordones et al., 2025) and communities contemplating relocation due to climate change in Fiji (Yoshida et al., 2025). In cities where migration from rural regions to cities is high, participatory management and quality resettlement is important to be combined with conservation efforts. Integrating ecology and social justice supports lasting sustainability in LLMIC cities (Wantzen et al., 2019). Formal institutional mechanisms for community engagement can result in innovative partnerships for the governance and management of urban blue-green infrastructure, creating enabling conditions that foster citizen stewardship of urban nature as found in the rejuvenation of urban lakes in Bangalore and in the urban forest restoration in Gurugram in India (Lele & Sengupta, 2018; Pant, 2018).

Innovative financing is crucial for urban revitalization. Often, governments can raise initial project funds through loans, grants, and co-financing but struggle with long-term funding. Latin America, China, and India use joint development and property taxes to sustain transit investments (Venter et al., 2019). Cities in LMMICs can innovate transit more freely, avoiding car-centric urban lock-in. For instance, in cities in Chile, where walking remains the predominant approach of transport especially for low-income communities, there has been an increase in community innovation in public design of streets to improve walking infrastructure (Herrmann-Lunecke et al., 2020). Such innovations as those described above can be built on top of an infrastructure that already incorporates a high degree of walkability, without first reversing urban design intended for private automobiles.

Technological innovations have the capacity to enhance urban sustainability and wellbeing, but require local adaptation. Examples from COVID response in Kochi city in Kerala, India indicate that Smart Cities could leverage technology to achieve last mile connectivity only when they harnessed "people to people relationships" through Civil Society Organizations at ground level (Chakravarty & Mathew, 2025). India's technology focused Smart City Mission (SMC) with its reliance on centralized Special Purpose Vehicles (SPVs) for management has been criticized for reducing public participation and exclusion of the poor, bypassing municipal processes and creating digital divides (Das, 2024). High density, youth demographics, and frugal innovation drive LLMIC urban sustainability, as seen in pandemic vaccine production (Reddy, 2022). As a result, Global South cities use technology innovatively but there is a need to supplement with local insights (e.g., related to safety and equity that may otherwise not be captured). In such cases, pairing databases with local perceptions helps to provide three-dimensional views of urban challenges. In Cape Town, NGOs combined GIS and community assessments to map sanitation safety issues for women. Such information could then be integrated, coded and provided to city officials to help them plan, as well as to community members to enable them to challenge ill-designed city plans with a sound foundation of good data (Borie et al., 2019).

A combination of innovations in approaches to LLMIC cities need tailored innovations in ecology, governance, and technology. Such challenges include aspects like high population densities, high migration, demographic distributions skewed to the young, and low overall incomes—however, these challenges can also become opportunities for innovation because of the creative mixing brought in by migrants, demographic dividend with high densities of young people, informal community organization and inexpensive resources—along with the opportunities provided by mobile internet and banking systems, and an informal environment that encourages local entrepreneurship (Andres et al., 2021; UN-Habitat, 2024). Unlike global North cities, cities in LMMIC countries are often not yet locked-in to unsustainable pathways of private car-oriented transport, or inefficient urban and building design, making it easier to design sustainable transit systems and green housing, for instance (UN-Habitat, 2024). Keeping local context, culture and principles of social justice in mind seem to be important for innovations to succeed in these regions over the long term.

In addition, in the realm of climate change, renewable energy is considered one of the strong mitigation measures, and at the same time, an area where technological innovation occurs. In the literature on renewable energy technologies and associated infrastructures (RET), not only the technological aspect but the social aspect has also been studied recently (Batel, 2020; Ukoba et al., 2024). Researchers emphasize that social science has been very prolific in the last decades in publishing research that attempts to better understand the social acceptance of RET. It is highly possible that alongside cities in the global North, cities in LLMIC also face opposition to RET, not only in cities from the global North. It is equally important to carefully understand the social aspects such as the perceptions and beliefs of citizens and local communities in LLMICs while amplifying technological innovation.

To advance research to amplify innovation from LLMIC, six guiding research questions emerge as given in Table 3. See Supplementary Material S2 for the full list of 20 research questions.

3.4. Negotiate complexity and systemic risks

Cities are human dominant, dynamic and evolving systems, demonstrating a high level of complexity and interdependencies (Bai, Surveyer, et al., 2016; Batty, 2013; Chester et al., 2023)). Complex systems also have emergent properties that can create additional sources of uncertainties (Liu et al., 2007), making it difficult not only to understand how and why cities struggle to fix persistent and long standing problems, but also to innovate solutions that can be flexible enough to change over time as the

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complex nature of urban systems shift, morph, and evolve (Alberti et al., 2018). Such uncertainty can challenge planning, design, and management (Chester et al., 2023; Güneralp & Seto, 2008).

This complexity challenges current urban governance, planning, and management structures that, despite global diversity, tend to have similar traits suited for less complex systems. These approaches often address only subsystems such as transportation, energy supply, or climate resilience, when disturbances and extreme events (e.g., climate-driven) can impact multiple systems simultaneously or cascade between subsystems (Dodman et al., 2022; Revi et al., 2022). For example, when Hurricane Sandy hit the eastern seaboard of the United States in 2012, cities including New York City saw disruptions in communications, transportation, and energy systems, cascading to impact fuel, food, and water availability. When Hurricane Maria struck the island of Puerto Rico in 2017, multiple subsystem failures devastated residents, ecosystems, and infrastructure (Eakin et al., 2018).

Cities not only face internal uncertainties (Bai, van der Leeuw, et al., 2016; McHale et al., 2015). Teleconnections and telecouplings across systems further challenge even the notion of cities as bounded systems because of how they expand the concept of urbanity (McHale et al., 2015) demonstrating increasingly tight connections across linked urban-rural systems (as seen during COVID-19, city dynamics are interconnected both globally and locally (McPhearson, 2020).

Making sense of urban system entanglements requires governance institutions to understand the nature of complex urban systems, but also their own role within it (Chester et al., 2023). It also forces a rethinking of urban planning to embrace flexibility, uncertainty, and non-stationarity as fundamental to urban life, and the future of urban life (Alberti et al., 2018; Chester et al., 2023). Fundamentally, urban systems, because of their inherent complexity, require new approaches that are not focused solely on efficiency as a means to sustainability (Elmqvist et al., 2019), but rather require modularity and redundancy and allow adaptive response to allow for flexibility, experimentation, and system innovation (Chester et al., 2023; T. M. McPhearson et al., 2021). Resilience efforts in one area must not undermine others (Elmqvist et al., 2019).

Disruptions, extreme events, and disturbances of all kinds, including economic, social, political, climatological, and more, challenge not only planning, but everyday urban life (Dodman et al., 2022). Understanding the complex relationships between urban development patterns and the processes that maintain ecosystem function and resilience in urban areas requires new frameworks and a new urban science (McPhearson, Iwaniec, et al., 2016).

Urban ecology in the late 1990s brought forward some of the first attempts to integrate a diversity of approaches from a broad set of disciplines to advance understanding of cities as complex, coupled human-natural systems (Alberti et al., 2003; Bai, Surveyer, et al., 2016; Grimm et al., 2000; McPhearson, Pickett, et al., 2016). Urban scientists introduced mathematical rigor to the exploration of common urban properties across the world's cities and as high-resolution data have become increasingly available (Creutzig et al., 2022), urban science is delivering new insights for planning and policy-making. Yet the application of complexity to a budding transdisciplinary urban science remains at early stages, especially in the context of urban practices, policy, and planning.

Recognizing complexity requires a shift from viewing cities only as social-technological systems or social-ecological systems but rather as fully dynamic interacting social-ecological-technological systems, or SETS (Grimm et al., 2015; McPhearson, Iwaniec, et al., 2016; McPhearson, Pickett, et al., 2016) involving the interactions and coevolution of social systems, living systems, and built and digital systems.

Complex adaptive systems hold the potential for emergent learning behaviors that support innovation (Folke et al., 2005; Lindsay, 2018). Social and organizational learning (Mcleod, 2020) can foster social cohesion and local stakeholder agency (Johannessen, 2017). These processes include active participation for social change, consciously designed co-creation processes, learning by doing, and nurturing communities of knowledge and practice (Mendoza, 2016). Especially in rapid change situations, such learning can enable adaptive capacities and system resilience (Berkes, 2017; Folke et al., 2005). Diversity in knowledge systems and stakeholders coupled with iterative learning and action cycles can enable "doing the knowing" (Collins, 2014). Bridging institutions and policy entrepreneurs are important as science-policy-practice interfaces (de Kraker, 2017). Robust and inclusive monitoring, tracking and feed-back systems are a precondition for looped learning processes to build adaptive capacities and urban system resilience (Azouz & Salem, 2023). These understandings are vital for foreseeing participatory processes that result in positive shifts (van der Wal et al., 2014).

We bring forward five aspects to be considered in tackling urban complexity:

1. Polycentric governance structures are needed that not only break down domain siloes but engage the public sector in codesign that leverages multiple forms of knowledge and innovation (Ostrom, 2010). Governance structures and practices thus need to recognize the interdependency across multiple domains of urban systems and create institutional arrangements fit to tackle these challenges.
2. Moving beyond traditional "fail-safe" approaches (Kim et al., 2022) is needed to deliver "safe-to-fail" solutions in the Anthropocene. Infrastructure investments and design are plagued by a 20th century paradigm that still builds to specified challenges, for example levees and storm barriers that are built to deal with storm surges of a specific magnitude, but when design specs are exceeded, fail catastrophically. Green infrastructure as nature-based solutions is an example of more safe-to-fail systems that can be built with uncertainty in mind (McPhearson et al., 2023), and that are envisioned and designed from the beginning as approaches that recognize the role of infrastructure in transforming cities for resilience (Gilbert & Shi, 2023), but situate urban nature as central to innovating solutions to address diverse, and growing challenges.
3. Climate change and weather-related extreme events, financial disturbances, disease outbreaks and more can manifest and operate across and between multiple spatial and temporal scales requiring solutions to consider how to deploy and prepare for effective response at multiple scales.
4. Big data, computation and AI create opportunities for understanding complexity in ways never before possible (Ilieva & McPhearson, 2018). AI, for example, offers ways to use machine learning, deep learning, and generative approaches together with massive new and emerging data streams to learn patterns that can improve understanding and decision-making of urban processes (Creutzig et al., 2022). On the other hand, AI algorithms are very sensitive to initial data conditions, and as is now increasingly understood, can often exacerbate gender and other

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inequity or biases because of poor initial sampling, model building, or bias in the original coding (Galaz et al., 2021), which can create bias in urban policy making turning actions even more maladaptive.
5. Urban tinkering can be an approach for experimentation and learning and evolution over time (Elmqvist et al., 2018), bringing in the evolutionary context of living organisms as a strategy to dealing with complexity over time.

To advance research on complexity and governance of urban systems five guiding research questions emerge as given in Table 4. See Supplementary Material S2 for the full list of 24 research questions.

3.5. Navigate environmental change

The process of rapid urbanization and the way cities are currently designed and built creates environmental impacts within and beyond their boundaries—climate change, land use change, biogeochemical cycles, loss of biodiversity and ecosystem decline, waste production, and pollution of air, water and soil, waste—many of which have human health and wellbeing impacts within and beyond cities (N. B. Grimm et al., 2008). Recent decades have seen further exacerbation of existing problems and emergence of new challenges, driven by the complex interactions across environmental domains and with socioeconomic factors. For example, in addition to the effect of global warming, urban land use and air pollution cause heavy rainfall, resulting in unprecedented flooding in cities (Shi et al., 2017). Thus, while environmental problems are long standing and have attracted numerous research, understanding, managing and navigating through environmental change remains one of the top priority research themes.

In the context of a changing climate, local policies for mitigation and adaptation, their estimated emissions and risk reductions (Franco et al., 2024), and co-benefits are critical, including for air quality (Ulpiani et al., 2025) and SDG linkages (Pradhan et al., 2025). Cities often require addressing environmental changes jointly and co-designing visions together with their citizens and stakeholders in collaboration, including for climate neutrality (Kılkış, Ulpiani, et al., 2024). Priorities in the process of navigating environmental change can also vary given the diversity of urban areas and diversity of vulnerabilities across neighborhoods, encompassing those with the largest carbon footprints (Sun et al., 2022) and lower emitters where vulnerabilities may be greatest. Cities can be holders of opportunities to navigate through global and local environmental changes by providing solutions and actions.

Recent decades have seen significant growth in the literature linking urbanization and cities to local, regional and global environmental change (Bai et al., 2017). Starting from biodiversity, patches of urban areas were seen even in 12.6% of global protected areas in 2015 (G. Li et al., 2022). In the future, about 13.2% to 19.8% of global protected and 93% of the Global 200 ecoregions may be affected by urban expansion (G. Li et al., 2022). The total biodiversity footprint depends on those impacts that occur either directly in urban areas or due to activities that take place in urban areas with research gaps remaining (Mcdonald et al., 2018). Biodiversity richness, including terrestrial and marine biodiversity (Jenkins & Van Houtan, 2016) depends closely on the interactions of urban areas with the local, regional and global environment. Marine litter, including plastic debris from coastal cities (Baudena et al., 2022), further extends the bounds of urban impacts on biodiversity. Better protecting the intactness of biodiversity (Schipper et al., 2020) and bending the curve of biodiversity loss (Leclere et al., 2018) requires concerted effort, including through compact urban form, ecological corridors, and environmentally conscious consumption patterns.

Over the 20th and early 21st centuries, almost 90% of urban source watersheds servicing 309 large cities experienced water quality degradation (McDonald et al., 2016). In addition, around 44% of these large cities had a moderate or severe decline in their source watershed. Overall, the median population density in urban source watersheds increased by 5.4 times (McDonald et al., 2016), further driving changes in water quality. Another study spanning over 2,000 watersheds for 317 cities found that average pollutant yields have increased by 40% for sediment pollution, 47% for phosphorus, and 119% for nitrogen (Chung et al., 2021). By 2050, more than 1.7 billion people and up to 2.4 billion urban inhabitants are expected to face perennial or seasonal water scarcity, up from 933 million in 2016 (He et al., 2021). Most of the water-scarce urban population resides and will reside in the Global South, particularly India and China (He et al., 2021). Large cities are also involved in moving about 504 billion liters of water daily from source watersheds across 41% of the land surface (McDonald et al., 2014).

The land on which urban areas are situated represents precious natural capital, biomes, and carbon sinks. While about 0.6 million km^2 in 2000, the total urban land area can range from 1.1 million to 3.6 million km^2 under different scenarios by the end of the 21st century (Gao & O'Neill, 2020), primarily driven by economic growth in some countries like China (Bai et al., 2012), and population growth in others (Mahtta et al., 2022). Better urban policy, planning and design will continue to be critical in shaping spatial urban land patterns (Gao & O'Neill, 2020). These decisions, in turn, have implications for climate action. Globally, however, land consumption is slightly faster than population growth (Schiavina et al., 2022). Efficient development trajectories were more prevalent in the "Global South" than the "Global North" (Schiavina et al., 2022), while requiring more improvements in all regions. Moreover, the places where new urban inhabitants will reside can exacerbate exposure to climate impacts. Currently 193 large cities with 1 million plus inhabitants are located in water-scarce regions (He et al., 2021). In contrast, up to 1.1 billion urban inhabitants resided in low elevation coastal zones globally in 2015 with 300 million residing in the higher risk zone of less than 5 meters above sea level (MacManus et al., 2021).

Breathable clean air is a desperate need in polluted cities and a valuable asset in greener ones. A potential trade-off of better spatial connectedness and exposure to high $PM_{2.5}$ concentrations if additional measures are not taken can be observed (Liang & Gong, 2020). Based on the most recent air quality database of the World Health Organization, less than 10% of the 6,743 settlements assessed had annual mean levels of particulate matter PM_{10} or $PM_{2.5}$ concentrations within global air quality guidelines (WHO, 2024). While annual mean PM_{10} or $PM_{2.5}$ concentrations were relatively constant across mega-cities in the last years, trends differed widely in cities with various sizes, developmental levels and different geographic regions (WHO, 2024). For a 10% increase in $PM_{2.5}$ concentrations, years of life lost can increase by about a factor of 1.6 or more (Juginović et al., 2021). Beyond human health, environmental change, including air pollution, impacts urban plant phenology (Zhou, 2022). Collective flourishing of living beings within urban ecology requires a planetary health outlook while minimizing all environmental pollution types, including air pollution (Gabrys, 2020).

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Urban areas are pivotal for climate action based on both climate mitigation and adaptation (Dodman et al., 2022; Revi et al., 2022). Greenhouse gas emissions attributed to urban areas continue to increase based on existing trends of urbanization. Urban emissions from a consumption-based emissions perspective were 25 $GtCO_2$-eq in 2015 and 29 $GtCO_2$-eq in 2020 (IPCC, 2021). With insufficient action based on moderate to low mitigation efforts to change these trends, global consumption-based urban CO_2 and CH_4 emissions can rise to 34 $GtCO_2$-eq and above by 2050. Only with ambitious and immediate mitigation effort will urban areas be able to have near net-zero CO_2 and CH_4 emissions with about 3 $GtCO_2$-eq of consumption-based emissions in 2050 (Gurney et al., 2022; IPCC, 2021). Shifting to renewable energy, active and shared mobility, reducing food waste, and dematerialization (Swilling et al., 2018) take place among numerous demand side measures, including technology adoption and use of more efficient infrastructure (Creutzig et al., 2022). Climate change impacts in urban areas already affect health, livelihoods and infrastructure (IPCC, 2021). Transport, water, sanitation and energy systems in urban areas are and will continue to be impacted by extreme and slow-onset events, the increasing severity of which will depend on climate action (IPCC, 2021).

To advance research to enable cities to navigate environmental change, five research questions emerge as given in Table 5. See Supplementary Material S2 for the full list of 21 research questions.

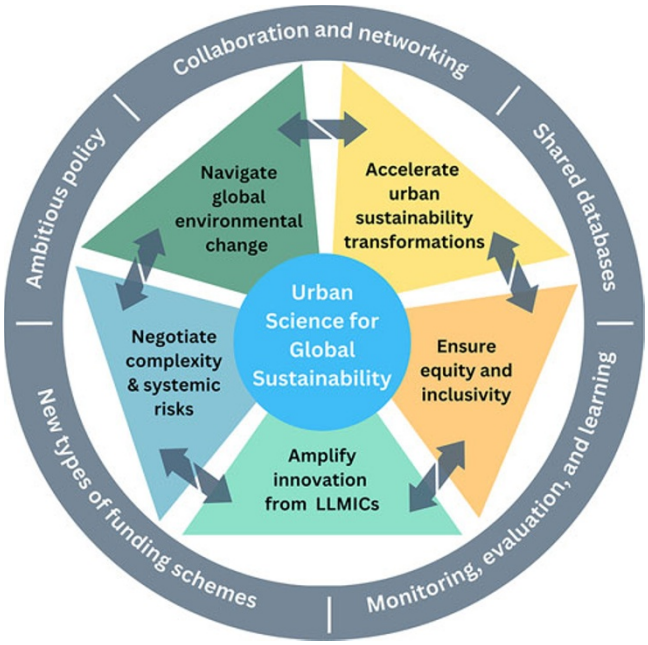

Figure 1. Conceptual illustration of five overarching research themes needed to reach global urban sustainability. The circle highlights key considerations to enable implementation of the research agenda. A full list of research questions for each theme can be found in Supplementary Material S2.

4. Discussion

We have presented five priorities for research on urban sustainability in this paper. These priorities involve interrelated challenges; therefore, addressing them require a systems approach (Bai, Surveyer, et al., 2016) in urban research and practice, as well as collaborations across various actors, sectors, and knowledge systems (Feagan et al., 2025; Harris et al., 2024; Kılkış, Bjørn, et al., 2024). A change is needed in how we do such research to ensure accelerated adoption of new knowledge. Anticipatory policy making requires experts in different fields to engage in scenario modeling that can help envision different futures for communities. A recurrent finding from the review is that co-design processes are at the heart of long-term planning efforts in cities. Cities can significantly benefit from such transdisciplinary processes that enable partnerships with non-governmental organizations and decisions being tailored to residents' needs. Partner organizations may provide various services or start activities to fill in gaps identified during the process, rapidly shifting to take up scientific insights and stakeholder needs (Harris et al., 2024).

Recognizing inherent interlinkages across these priority themes, and the need for a different approach in urban research, we have asked the question: Are there essential cross cutting elements for advancing these research areas? We identified five of them as most important (visualized alongside the priority themes in Figure 1): collaboration and networking, shared databases, ambitious policies, and monitoring evaluation, and learning (MEL), as well as new types of funding schemes. Each of these needs is discussed below, taking into account the realization of the main guiding research questions. The priority themes can also support relevant initiatives and visions, including a systems approach to just and equitable action in urban climate resilient development as emphasized in the Global Research and Action Agenda on Cities and Climate Change Science (GCoM, 2024).

To foster collaboration and networking, there is a need to establish and support networks. Such spaces where best-practices from experiences and outcomes are shared and discussed can trigger new ways of thinking. The Future Earth Urban Knowledge-Action Network is building such a community and over the past few years has grown from its inception to 467 members on February 14th, 2025. Network members have participated in various research and science-policy activities and are increasingly finding ways to collaborate with each other and beyond. Network members also participate in Future Earth's cross-Global Research Networks, where experts from different disciplines come together to discuss and explore new types of interdisciplinary research. The development of this research agenda aligns with the objectives of the Urban Knowledge-Action Network to connect experts across (sub)disciplines (both within and outside of Future Earth) to work together, apply for funds, and communicate their research and results.

Shared databases are needed for researchers and decision makers to work across geographies. These shared databases need to be built and follow standards to increase opportunities for comparative research. All too often, databases are managed by individual cities, governments, or private entities, with time consuming processes to access each, sometimes at a high price. A shared global database, developed in a common language, with standards that make it convenient to operate (input and maintain) and conduct research on, new studies can be conducted, which can accelerate learning for urban sustainability and utilized for collaborative decision making in cities (Liu et al., 2022).

Ambitious policies encouraging transformations are needed. Transforming policy and planning systems that direct and fund urban actions is essential to achieve the Paris Agreement, prevent biodiversity collapse, and ultimately safeguard human and planetary health (Ebi et al., 2020). Systems transformations require pathways to transition from one system to another and carefully designed and enacted policies can play pivotal roles in enabling such transformations. Research shows that co-design

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among stakeholders is essential for successful implementation of such urban policies and to ensure that nobody is left behind.

Monitoring, evaluation, and learning are critical for making informed decisions and interventions when negative outcomes are observed (Juhola et al., 2023). Learning from the processes and outcomes will also avoid maladaptive interventions that end up costing society with increased impacts and costs.

New types of funding schemes are needed to address interrelated urban challenges. National funding agencies are focused on funding researchers based in their own countries on national priorities with limited cross-national funding schemes available. Structural challenges make it difficult for organizations such as the Belmont Forum to bring in a large number of funders willing to contribute to the same themes, as well as to fund researchers from LLMIC. While increasingly individuals in funder roles indicate their willingness to engage, national governments set the regulatory frameworks for how and when funds should be allocated. Funding schemes that combine government, philanthropy, and private sector funds may be needed to allow for advances in urban research and innovation for global sustainability. Another way to entice funders is with a broadly supported global urban sustainability research agenda, which can bring about momentum, rational to connect with priorities identified on the global scale, and credibility for new research endeavors to be supported by conventional funders (as was seen with (Ebi et al., 2020)). A recent development by the International Science Council focuses on Mission Science with a strong co-design process, flipping the model of how research is funded (International Science Council, 2023) providing opportunities for rapid implementation to accelerate advancements on the SDGs.

While the research agenda we propose here serves as an overarching guide for the urban research community, it is meant to be neither comprehensive nor fixed in time. The research agenda will have to evolve as challenges facing cities change over time. Moreover, differences in priorities among cities will inform implementation of various aspects of the agenda in different local contexts. Nevertheless, the proposed agenda may increase synergistic opportunities and collaboration within and among cities to inform and guide them toward sustainable, prosperous, just, and resilient futures.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/sus.2025.10025.

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