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Urban planning and IPCC-like city assessments integration for climate-resilient cities

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Abstract

The rapidly intensifying effects of climate change on urban settlements demand that cities move to the forefront of resilience planning. Climate extremes, from heatwaves to flooding, are increasingly testing the adaptability limits of urban systems and the vulnerability of their populations. Recognizing the unique position of cities, the IPCC's seventh assessment cycle has prioritized urban areas in its upcoming Special Report on Climate Change and Cities. The IPCC report underscores the potential of cities to act as agents of climate adaptation and provides a framework for cities to build

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climate-resilient systems. Cities are positioned to pioneer practical, integrative solutions that blend climate sciences with urban planning, establishing frameworks that align economic growth, health equity, environmental sustainability, social justice, and effective governance. This opinion piece explores how cities, by positioning themselves as hubs for innovation, policy reform, and community collaboration, can transform climate vulnerabilities into opportunities for community resilience and sustainability, especially by becoming more-than-human cities, setting examples on the global stage.

Keywords
Urban planning, climate resilience, social justice, sustainable development goals, IPCC

Urban areas face unprecedented vulnerability to climate change, acting as the epicenters of both risk and opportunity. Climate extremes such as intense heatwaves, wildfires, destructive hurricanes, and floods are increasingly common, intensifying risks for urban centers where population density, infrastructure, and economic concentration exacerbate the impacts of climate change events. Globally, climate-related disasters impose economic losses estimated at $200 M per day, according to the World Meteorological Organization, a figure that continues to grow with the escalating frequency and severity of extreme weather (Shine, 2023). Meanwhile, the health impacts of climate change span a broad spectrum of morbidity and mortality, including cardiovascular diseases, cancer, kidney disorders, mental health challenges, and other conditions (Romanello et al., 2024). For cities, this growing threat is compounded by social inequities and infrastructural limitations, underscoring the need for cities to play a proactive role in addressing the climate crisis.

To support this transition, the IPCC's *Special Report on Climate Change and Cities* will be organized around six critical focus areas, each addressing core aspects of urban resilience, adaptation, and mitigation. These focus areas—Biophysical and Environmental Factors, Impacts and Risks, Sectoral Development and Adaptation, Energy and Emissions, Governance and Policy, and Social Cohesion and Equity—collectively provide a comprehensive roadmap for cities to address the interlinked challenges of climate resilience (IPCC, 2024). The report emphasizes that cities must transcend traditional growth-oriented planning models and embrace resilience-based frameworks that integrate science, community needs, and long-term sustainability goals.

The imperative of convergent resilience frameworks

Considering compounding climate risks, the need for a convergence framework is paramount (Ye and Niyogi, 2022). This convergence approach aims to integrate urban planning, climate science, public health, environmental policy, and social equity to construct a holistic and adaptive strategy. Cities must navigate the complex interactions between environmental systems, human health, and infrastructure resilience, all of which are impacted by climate change. The IPCC's *Special Report on Climate Change and Cities* underscores this in its *Biophysical and Environmental Factors* focus area, which examines how urban systems influence and are influenced by natural processes, from hydrological cycles to urban heat islands. By understanding these biophysical dynamics, cities can implement measures that mitigate environmental stresses, improve air quality, and manage stormwater, reducing overall vulnerability to climate impacts.

To operationalize these insights, cities must adopt governance structures that promote cross-departmental collaboration, support resilient decision-making, and address urban vulnerabilities from multiple angles. The report's *Impacts and Risks* focus area will delve into these compounded

climate risks, highlighting the vulnerabilities of critical urban infrastructure, such as energy and water systems, and examining the cascading effects on the food-energy-water-health nexus. Recognizing these compounded risks allows cities to prioritize adaptation strategies, ensuring that infrastructure is resilient not only to today's climate but also to future extremes. Through this convergence, cities can foster resilience that addresses both immediate and structural vulnerabilities, supporting health equity, economic stability, and environmental integrity. In many cases, however, funding or other initiatives are needed to operationalize insights and prioritize adaptation strategies to foster resilience. Initiatives and investments such as the Federal Sustainability Plan and the Infrastructure Investment and Jobs Act (IIJA) (Public Law 117-58, also known as the "Bipartisan Infrastructure Law") in the United States have advanced climate readiness within federal agencies, while supporting new infrastructure programs and expanding existing initiatives. The "Bipartisan Infrastructure Law" spans fiscal years 2022 through 2026 for federal entities as well as local governments to be eligible to compete for funding, which is critical for credible action needed to implement various climate adaptation strategies. Arguably more resources are still needed globally to foster resilience of urban systems in the wake of climate change.

As urban planners and policymakers navigate the increasingly complex landscape of climate resilience, there is a pressing need for a unifying guiding principle—or a "North Star"—to align research, policy, and practice. This guiding framework should prioritize sustainability, equity, and evidence-based decision-making, ensuring that efforts to address climate change are both cohesive and effective. Without this guidance (or North Star), the field risks fragmentation, where siloed initiatives may fail to consider broader societal implications or miss opportunities for transformative action. By embracing a shared vision rooted in these core values, urban planning, and climate science can synergize their strengths, leveraging predictive models, community-driven approaches, and global collaboration to build resilient urban systems. This North Star would serve as a compass, not only anchoring resilience strategies in ethical and practical considerations but also ensuring their adaptability to emerging challenges and opportunities in a rapidly changing world.

Cities as integrators: Mobilizing science, policy, and practice

The role of cities as integrators is essential to creating cohesive responses to climate adaptation. Cities bring together a diverse network of policymakers, scientists, engineers, health professionals, business leaders, and residents, each with unique insights and resources, to co-create climate solutions that are both innovative and scalable. By integrating multiple sectors, cities can serve as models for urban resilience, where collaborative efforts support adaptive infrastructure projects and nature-based solutions that respond to both environmental and social needs. This is underscored by the IPCC's focus area on *Sectoral Development and Adaptation*, which assesses the capacity of cities to adopt nature-based solutions like urban greening, green/white roofs, and wetland restoration to enhance resilience while creating livable spaces (Scott et al., 2016).

Additionally, by promoting cross-sector collaboration and leveraging public-private partnerships, cities can address the *Energy and Emissions* focus area of the IPCC report, which emphasizes that cities are key contributors to global greenhouse gas emissions and must lead in energy transition efforts (Solecki et al., 2024). Cities can reduce their carbon footprint by transitioning to renewable energy sources, improving urban energy management, and establishing carbon accounting mechanisms that enable transparent reporting and accountability. As hubs of innovation and adaptability, cities can bridge knowledge and policy across sectors, becoming catalysts for resilience and sustainability that other urban areas can emulate.

Modernizing building codes and governance for urban resilience

Building codes and governance structures form the backbone of urban resilience, yet many cities operate under codes that fail to account for escalating climate risks, which will be exacerbated in most urban systems with existing vulnerabilities Updated building codes can mandate climate-resilient materials, energy-efficient designs, and features that support sustainable urban environments, such as flood-resistant structures and permeable surfaces. The IPCC's *Governance and Policy* focus area stresses that effective governance is essential for cities to achieve climate resilience, outlining the importance of climate finance, supportive regulatory frameworks, and alignment with the Sustainable Development Goals (SDGs). By facilitating public-private partnerships, attracting investments, and creating incentives for sustainable practices, cities can foster an environment where resilience is embedded within urban systems.

While there is a global effort for climate action encouraged by the United Nations, many companies, educational institutions, and financial entities have pledged to attain "net-zero emissions," yielding zero emissions in the atmosphere. More locally, cities and towns have been instrumental in developing climate action plans to reduce or eliminate carbon dioxide emissions. The built environment alone accounts for 40% of carbon dioxide emissions, of which approximately 27% is attributed to building operations and 13% from the embodied carbon in construction materials (Kelley 2023). Considerable data and research exist for climate adaptation strategies, however, implementation of these strategies has been limited due to factors like economics, sometimes controversial political views, and social justice ramifications. There is a need for more uniform guidance for planning, land use, design, and sustainable development practices to support climate adaptation strategies. Professionals focused on the built environment, including but not limited to, architects, engineers, building inspectors, and the construction sector, play a vital role in catalyzing a movement towards developing uniform guidance to address the modernization of building codes and governance for urban resilience.

Governance reforms should also ensure transparency and community engagement, allowing residents to co-design resilience planning and decisions. Zoning laws, infrastructure investments, and emergency response protocols can be reoriented to support compact and sustainable growth patterns, which not only reduce sprawl but also limit and reduce exposure to environmental hazards. When aligned with updated building codes, these governance reforms create urban landscapes that are prepared for the challenges of a rapidly changing climate, protecting both people and infrastructure while promoting inclusive and adaptive growth.

Bridging socioeconomic disparities for equitable resilience

The unequal distribution of climate impacts within cities underscores the need for an equitable approach to resilience. Vulnerable communities—such as low-income families, the elderly, marginalized populations, and under-resourced groups—often bear the brunt of disproportionately distributed climate risks due to systemic inequities in housing, infrastructure, and access to resources. Recognizing this, the IPCC's focus on *Social Cohesion and Equity* stresses that climate adaptation efforts must prioritize social equity, ensuring that resilience strategies are inclusive and benefit all urban residents. By addressing these socioeconomic and health disparities, cities can reduce climate vulnerability and foster stronger, more cohesive communities.

Equitable urban planning should prioritize resilient housing, green infrastructure, and accessible public transit in underserved areas, ensuring all residents have access to safe, sustainable environments. Cities should also implement inclusive planning processes that engage marginalized communities, incorporating their voices into resilience strategies that directly impact their lives. In

doing so, cities can bridge the "resilience divide," making climate adaptation a universal right rather than a privilege. Through equitable resilience, cities can build cohesive urban systems where social justice and environmental health reinforce one another.

Convergence of urban planning and climate science: A blueprint for future resilience

The intersection of urban planning and climate science provides cities with a powerful framework to tackle the complex challenges of climate change. By leveraging the ever-growing geospatial data, predictive climate models, and community-focused design principles, cities can factor in climate risks in decision-making and implement adaptive strategies. The IPCC's *Sectoral Development and Adaptation* focus area calls for cities to adopt adaptive planning that incorporates these insights, using fine-scale climate projections to inform zoning, urban design, and resource allocation in ways that reduce exposure to future risks such as hurricanes, flooding, extreme heat, and storms.

Aligning urban planning with science-based climate projection allows cities to implement resilience strategies that are both proactive and responsive, addressing the immediate impacts of weather extremes while preparing for their inevitable future shifts. This convergence ensures that cities do not merely react to climate risks but actively build capacity for long-term "future-proofing." It enables cities to make informed, data-driven decisions that align local resilience goals with the reality of global environmental change, setting a standard for integrated, science-informed climate actions across the nation.

Engaging stakeholders and enhancing public knowledge

Resilience is a community effort, and effective urban resilience strategies require transparent, inclusive engagement among all stakeholders. Cities can create knowledge hubs that provide accessible climate data, educational resources, and real-time information on environmental risks, empowering residents to make informed decisions and participate actively in resilience planning. The IPCC's focus on *Social Cohesion and Equity* highlights the importance of including diverse community voices in the climate adaptation process, ensuring that resilience strategies reflect the needs and priorities of all residents, especially those from underserved populations.

Through public forums, partnerships, and open data initiatives, cities can foster a culture of resilience that extends beyond government actions, building a community-driven climate movement. Stakeholder engagement should prioritize input from under-resourced communities to ensure that resilience strategies are equitable and inclusive, strengthening social bonds and creating a shared responsibility for climate adaptation. By fostering public knowledge sharing and collaboration, cities can establish a culture that values sustainability, preparedness, and collective actions.

More-than-human cities: Envisioning a shared future for all

Beyond the IPCC's focal areas, envisioning a truly sustainable urban future calls for the concept of "More-Than-Human Cities," which expands urban planning to encompass the needs and agency of both human and non-human entities (Yigitcanlar, 2018). This approach recognizes cities as shared environments where various species coexist, shaping ecological and social dynamics alike. Adopting a more-than-human perspective encourages planners to design spaces that balance human infrastructure with habitats essential for diverse life forms to thrive, enriching the urban landscape. Incorporating this more-than-human perspective addresses significant challenges such as biodiversity loss, climate change, and environmental degradation (Yigitcanlar et al., 2019). Nature-based

solutions like urban forests, green roofs, and wildlife corridors not only contribute to urban resilience against climate extremes but also provide critical habitats within the cityscape. Moreover, water-sensitive urban design elements, such as rain gardens and permeable pavements, support natural hydrological cycles and enhance the urban ecosystem's resilience. These solutions improve urban conditions by cooling cities, managing stormwater, and enhancing air quality, creating environments where both human and non-human entities benefit (Steele et al., 2019).

Recognizing the rights and needs of non-human entities can foster a more inclusive urban resilience. Governance models that incorporate non-human interests—through biodiversity action plans, habitat protections, or environmental justice frameworks—help ensure that development aligns with ecological preservation and community resilience. The more-than-human approach requires rethinking governance structures, with urban policies explicitly accounting for and prioritizing ecological health as part of the city's resilience strategy (Maller, 2021).

Ultimately, the concept of more-than-human cities proposes a vision where urban areas are designed to foster ecological interdependence and resilience. This shared urban future supports a vibrant ecosystem, where human and non-human communities alike contribute to and benefit from a balanced, thriving environment. By embracing a more-than-human approach, cities can become models of sustainability and inclusivity, fostering an urban resilience that respects and nurtures the broader web of life.

Concluding remarks: Cities as catalysts for a resilient future for all

Cities are indispensable to building a resilient future. The IPCC's *Special Report on Climate Change and Cities* will provide a comprehensive guide to urban resilience, emphasizing the role of cities as integrators, policy enablers, and agents of social equity in climate adaptation. By adopting updated building/zoning codes, modernized governance, and equitable resilience policies, cities can protect their populations, infrastructure, and environments from the escalating impacts of climate change.

The convergence of urban planning, climate science, and social equity—enhanced by the perspective of more-than-human cities—establishes a powerful blueprint for advancing climate resilience at both local and global scales. By embracing these principles, cities can turn climate challenges into opportunities for resilience, building adaptive urban systems that stand as models of sustainability. Through these integrative efforts, cities not only safeguard their own urban communities and ecosystems but also ignite a global movement toward a resilient and sustainable future.

As cities worldwide navigate the complexities of climate adaptation, the need for adaptable, evidence-based frameworks becomes increasingly apparent. By leveraging advancements in technology and data analytics, cities can continuously update and refine their resilience strategies to reflect emerging climate risks. For instance, the integration of urban artificial intelligence, urban digital twins, and high-resolution environment modeling allows cities to monitor, simulate, and predict the impacts of various climate scenarios, empowering local governments to make proactive, data-informed, and evidence-based long-term decisions (Shaamala et al., 2024). This dynamic approach not only enhances the efficacy of resilience planning but also promotes a culture of innovation that can drive sustainable development efforts well beyond city boundaries.

Moreover, fostering global city-to-city collaboration is crucial for amplifying resilience practices. Through networks such as the Global Covenant of Mayors and the C40 Cities Climate Leadership Group, cities can share knowledge, resources, and strategies, creating a global coalition focused on urban climate resilience. This collaborative approach ensures that best practices and unique lessons learned are accessible to all cities, regardless of their economic capacity. By supporting each other through shared experiences and collective action, cities can accelerate the

shift towards sustainable urban development, fortifying their role as pivotal agents in uniting the international coalition in the fight against climate change. This united front underscores the potential of cities not only to endure climate challenges but also to lead the way in building a resilient and equitable future for all—for humans and non-human urban dwellers.

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Data availability statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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