Chapter 12
A Vision for Resilient Urban Futures

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Abstract A fundamental systems approach is essential to advancing our understanding of how to address critical challenges caused by the intersection of urbanization and climate change. The social–ecological–technological systems (SETS) conceptual framework brings forward a systems perspective that considers the reality of cities as complex systems and provides a baseline for developing a science of, and practice for, cities. Given the urgency of issues we collectively face to improve livability, justice, sustainability, and resilience in cities, bringing a systems approach to resilience planning and policymaking is critical, as is development of positive visions and scenarios that can provide more realistic and systemic solutions. We provide a vision for more resilient urban futures that learns from coproduced scenario

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Z. A. Hamstead et al. (eds.), *Resilient Urban Futures*, The Urban Book Series,
https://doi.org/10.1007/978-3-030-63131-4_12

development work in nine US and Latin American cities in the UREx SRN. We find that developing an urban systems science that can provide actionable knowledge for decision-making is an emerging, and much needed, transdisciplinary research agenda. It will require true boundary-crossing to bring the knowledge, skills, tools, and ideas together in ways that can help achieve the normative goals and visions we have for our shared urban future.

Keywords Anticipatory resilience · Co-production · Social-ecological-technological systems (SETS) · Urban systems science · Visioning · Urban futures

12.1 Bringing Positive Futures into Research and Practice

Much of the discourse around urban and global futures tends to be dystopian, featuring visions of environmental and societal collapse along with business-as-usual forecasts. Negative outlooks, scenarios, and projections across mainstream press, political statements, and academic literature are abundant in popular narratives and, for most of us, dominate the discourse about our future (Bennett et al. 2016). Dystopian forecasts at both local and global levels make it difficult to develop actionable plans and policies for generating more positive futures. Despite the role of cities as global nodes of transformational innovation, such dystopian discourses pervade the discussion and visions of the future of cities. Although the dramatic speed and scale of urbanization is driving the articulation of the twenty-first century as the time when we will live on an urban planet (Elmqvist et al. 2019), it is also recognized as a time bringing about both perverse challenges as well as critical opportunities for fundamental transformations of how we build, design, plan, and govern our cities.

Instead of dystopian visions, we need to imagine and coproduce (see Chap. 7) shared positive visions that can support the development of more transformative plans, policies, and actions to guide our decisions now toward the building of a longer term, more just, more resilient, and more sustainable world. In short, positive visions are critical to guide urban planning, motivate actions, inspire innovative strategies, and move toward transformative change. Negative discourse around urban futures often leaves little reason to invest in long-term social and environmental goods, nor does it recognize the vast possibility within existing creativity and innovation that already drives much of development in cities (McPhearson et al. 2017).

In the Urban Resilience to Extremes Sustainability Research Network (UREx SRN), we showcase how researchers and practitioners can come together to craft visions of resilient urban futures. These positive futures are intended to explore radical departures of the status quo—when small tweaks are not enough. The entire process is about creating opportunities for stakeholders to anticipate, imagine, and scrutinize the plausible pathways to desirable futures. The focus on positive futures in UREx SRN was realized primarily through a scenario coproduction process conducted in each of the nine network cities (Chaps. 6 and 7). Key learnings from conducting this work in nine US and Latin American cities show (a)

the urban social–ecological–technological systems (SETS) context that both present-day patterns and processes, as well as future visions, plans, and scenarios need to examine and work within, (b) a need to understand the structural inequities built into people's present experiences and histories, (c) how both science and practice need to advance systems approaches together as part of visioning work, and (d) the critical need for practice to put goals and strategies into action for transformation.

12.2 Thinking in Systems

Cities face multiple risks that can overlap in space and time. For example, immediately following Hurricane Sandy that made landfall on the East Coast of the USA in September 2012, a cold front with Arctic air blew into the region and created severe heating challenges in a region where Sandy left millions without power and thus no access to heat. In 2020, policies intended to decrease health and mortality impacts of the COVID-19 pandemic in New York City induced a radical shift in the locations where people needed services (primarily in their homes and apartments), affecting demand for energy, transit, and green spaces. This shift, in turn, created the potential for increased exposure to weather-related (e.g., heat) extremes, producing both overlapping and interdependent risks for communities. Tornadoes on April 12th, 2020 in the US Southeast and extreme winds and rain on April 13th, 2020 in the US Northeast caused flooding and power outages, highlighting the urgency of examining ways in which cities are increasingly facing risks that overlap in space and time. Thus, strategies to build resilience to one event may actually decrease resilience to another event happening at the same time and place (Elmqvist et al. 2019). Interdependent vulnerabilities highlight the need to build adaptive capacity through a SETS lens and to address fundamental transformations in multiple social, ecological, and technological-infrastructure domains at the same time.

Recognizing the complexity of SETS dynamics provides a conceptual foundation for examining how SETS components can be mobilized together, and how they interact to generate resilience (Grimm et al. 2015; McPhearson et al. 2016; Grabowski et al. 2017; Markolf et al. 2018). In the UREx SRN, the SETS framework explicitly acknowledges the interactions and interdependencies among the social–cultural–economic–governance systems (Social), climate–biophysical–ecological systems (Ecological), and technological-engineered infrastructural systems (Technological) that drive urban patterns and processes. Furthermore, these components need to be understood from a systems perspective to address key risks and understand where opportunities for solutions can be harnessed that synergize across S, E, and T dimensions of urban systems. Opening up the space to bring systems thinking into future visioning and scenario development can help us better understand the linkages, relationships, feedbacks, and planning in complex systems (Iwaniec et al. 2014). When we examine resilience strategies and visions from a SETS perspective, we can better see and imagine solutions to overlapping and cascading urban risks and vulnerabilities at multiple scales.

Clearly, the potential impacts of weather-related extreme events will add complexity to emergency response and require updated resilience planning. This means cities have to rethink adaptation and resilience strategies, such as using cooling centers to provide auxiliary cool space for those without air conditioning while also ensuring a safe space for aggregated residents during a pandemic. Increasing frequency and intensity of extreme events also highlights the need to move beyond emergency response toward building even longer term, anticipatory strategies to transform cities for disaster risk reduction. For example, co-produced scenarios in the URExSRN have imagined resilient urban futures where cities have invested heavily in green infrastructure as a nature-based solution to cool cities and reduce heat exposure, and decreased reliance on air conditioning and other twentieth century technologies for coping during extreme events. Transforming cities to be resilient to a potential extreme climate change future means thinking systemically and beyond status quo efforts to upgrade infrastructure or increase the availability of traditional technologies.

One of the key challenges cities face when designing, visioning, planning, or creating policy for resilient futures is the nature of uncertainty, surprise, and nonstationarity in the climate system, as well as the dynamic nature of complex urban systems (Box 12.1; Fig. 12.1). Traditional infrastructure aimed at mitigating the impacts of extreme events was designed according to predict-and-prevent logic rather

Fig. 12.1 Participants uncover randomly assigned "disaster cards" to consider features of resilience and how the scenarios withstand unexpected disturbances. Image credit: the authors

than a resilience-building logic, leaving cities vulnerable (Tyler and Moench 2012). Weather-related extreme events exist on the outer boundaries of meteorological distributions; the ranges of precipitation, temperature, and other weather phenomena that have been observed in the past (see Chap. 2). The dynamic nature of urban SETS now calls for more flexible and safe-to-fail designs (Ahern 2011) where both grey and nature-based infrastructure systems are conceived as flexible, multifunctional, and better to adapt to a world characterized by unpredictability. For example, a challenge facing urban infrastructure systems is that they are relatively inflexible, rigid, and long-lasting, including the institutions that manage and maintain them. Yet, there is uncertainty and changing levels of utilization, which occur during the lifetime of any infrastructure system (Chester and Allenby 2018). Typically, infrastructure systems are designed to meet demands decades into the future, but accurately anticipating, projecting, and capturing the complexity of future demands and system characteristics are tough—especially when disruptive technologies, climate uncertainty, and changing behaviors are considered (Markolf et al. 2018).

This complexity is not only true of infrastructure systems but also of governance systems. To build anticipatory capacity and resilience into governance and institutions across SETS will require very different ways of thinking about urban systems (Box 12.1; Fig. 12.1). We must also consider how to harness emergent properties of complex systems for resilience (Egerer et al., in press). In the UREx SRN project, we bring the element of surprise and combined or cascading risks into scenario development precisely to ensure that visions articulated for resilient urban futures consider solutions that can be adaptive and flexible to uncertain futures.

Box 12.1 Using 'disaster cards' to identify features of resilience

The visions articulated by practitioner-researcher teams during scenario development workshops are subjected to large-scale disturbances or shocks to assess flexibility and the ability to adapt to uncertainty. During a visioning workshop in San Juan, Puerto Rico, a variety of disturbances ranging from energy, transportation, and communication disruptions, to increases in sea-level and temperatures, financial crisis, pandemic, mass migration to the mainland, and an influx of climate refugees were random-ly assigned as 'disaster cards.' The co-produced scenario would thus ex-perience large shocks in an unpredictable order, and workshop partici-pants were asked to assess how the social-ecological-technological sys-tems components depicted in the scenario fared. Asked to consider which parts are more or less affected and what mechanisms and attributes ac-tors conceded capacity to withstand, adapt, learn, or self-organize, the teams ultimately identified features of resilience before further refining the scenarios.

12.3 Future-Making as Privilege

If we understand our present conditions as the result of past decisions, the act of naming and imagining future possibilities needs to be recognized as a form of privilege. Future-making is an exercise in agenda setting; that is, the production of alternative futures sets the parameters of what is possible, even desirable, for a society. This is the purview of few. There is a need to reflect on the equity implications associated with the exercise of imagining positive futures as a way of influencing policy. Science fiction writer William Gibson said that the future was unevenly distributed, and, in the context of creating positive urban futures, the unevenness implies that not everyone has access to the tools and venues to imagine these alternatives. Indeed, we note that the ability to imagine alternative futures is offered to those who already enjoy a degree of influence in municipal decision-making and are therefore likely to reproduce the status quo (Turnhout et al. 2020; Jagannathan et al. 2020). It is imperative that marginalized communities are included in the process of imagining positive futures and have access, time, and resources to shape this conversation. The ability to think in the long-term is a form of privilege; those most vulnerable live in a reactive mode, needing to figure out how to survive the day to day, much less being able to plan for their future.

We cannot fully understand the nature of the problems, we are trying to solve for present and future generations unless we understand how problems—particularly climate inequity and environmental racism—were produced in the past. Through historical processes of economic change, ecological change, politics, and power, institutions have created vulnerabilities to weather extremes and inscribed climate inequities into the built environment (see Chap. 2). Since institutions are designed to replicate themselves, routinizing equitable solutions first requires examining the ways in which social separateness forms unequal climate burdens and is embedded in planning, policy, scientific, and economic practices. Therefore, future scenarios that are contextualized in a place-based historical awareness—in which people articulate not only the local narratives that form positive community identity and civic pride but also the exclusions and subordinations that persist today—hold more potential for shared resilient futures than do a historical scenarios.

Environmental justice theory offers conceptual tools for unpacking ways in which multiple and compounding forms of injustice exist in institutions (Bullard 1996). Future-making should link together material goals (such as energy affordability) with procedural goals (such as high rates of participation in the energy rate-making process among historically disenfranchised communities) that can sustain distributional outcomes (such as equitable access to low-cost renewable energy in all neighborhoods across a city). These linkages should be based on an understanding of ways in which distributional, procedural, and other forms of injustice are mutually reinforcing (Meerow et al. 2019). Vulnerability mapping and other tools for assessing environmental benefits and burdens (see Chap. 4) provide a starting point for articulating distributional patterns. These patterns of vulnerability express the ways in which structural inequality manifests in SETS. Visualizing these patterns enables

Fig. 12.2 Central Maryland timeline depicting multiple dam constructions, major drought (1930), and redlining from 1937 onward. Image credit: the authors

communities to consider how distributions may be misaligned with cultural values. The distributional patterns of vulnerability also provide an entry point for asking more fundamental questions about the processes that produce patterns of climate inequity and how to avoid reproducing such processes in the future (Box 12.2; Fig. 12.2).

Box 12.2 The importance of the past in navigating the future

To emphasize how the historical context of each city has shaped its current situation, UREx SRN workshop participants reflect on major extreme events (natural and anthropogenic) extending back to the previous century. Building up to the present, these events are placed on a timeline and collectively examined to help identify correlations and any missing interdependencies between events. The notion of the future is thus conceptualized as an interpolation or 'linear unfolding' of the past. Across the network cities, past weather events and large-scale construction (namely dams and road infrastructure), alongside housing discrimination and residential segregation, have left low-income neighborhoods and communities of color disproportionately exposed to high heat, pollution, and severe weather. By jointly considering how past events, decisions, and actions have shaped the present, groups are better positioned to co-produce novel long-term goals for just and sustainable futures.

12.4 Developing an Urban Systems Science and Urban Systems Practice

The SETS framing brings forward a systems perspective that considers the reality of cities as complex systems and provides a baseline for developing a science of and practice for cities. A fundamental systems approach is essential in advancing our understanding of how to address critical challenges caused by the intersection of urbanization and climate change. It must be inclusive of social, ecological, and technological components, examine their interactions, and harness this complexity to imagine, plan, and develop strategies for more just and resilient futures. Given the urgency of issues, we collectively face to improve livability, justice, sustainability, and resilience in cities, bringing a systems approach to resilience planning and policymaking is critical, as is development of positive visions and scenarios that can provide more realistic and systemic solutions.

The complexity and diversity of cities inevitably bring up a plurality of perspectives, values, visions, and knowledge systems that define what cities are or should be (Muñoz-Erickson 2014). This places a demand for a transdisciplinary urban systems science and practice that harnesses and puts into action a diverse array of knowledge, rationalities, and ways of thinking to develop resilient futures. Scientific data, quantitative risk analysis, and computational models are important to such transdisciplinary science, but not sufficient. Intangible, nonmaterial flows and dynamics of urban systems, such as how different people experience risks or how they connect and interact with other groups in the city to build their social capital, are challenging to measure and model. James Scott (1998) uses the Greek term *métis* to describe the local practical knowledge that people, including those most impacted by changes in the environment, generate from learning and making sense of their contexts, but that cannot be codified or quantified. The diverse knowledge that city residents, business owners, planners, and professionals build from their lived experiences, including the practical strategies they employ locally to thrive in dynamic urban environments, is a crucial part of the *métis* needed to advance resilient urban futures. There is an urgent need for an urban systems science that includes these multiple forms of knowledge as legitimate and equal in the research process (Romero-Lankao et al. 2018).

The process of coproduction actively engages multiple voices and knowledge systems in the collaborative production of knowledge and solutions for urban sustainability and transformation. Collaborative approaches can be time consuming, politically uneven, and oftentimes messy (Turnhout et al. 2020). Yet, by integrating and explicitly deliberating diverse ways of knowing and perceiving, this approach makes the complexities, uncertainties, and needs of the system more evident than traditional planning and scientific approaches (see Chap. 7). This process also creates potential for a pluralistic urban systems science that engages decision-makers and local stakeholders directly in the creation of positive future visions, thus enabling an inclusive and anticipatory process to gain a more prominent role in urban practice and planning. The urban planning community, including decision-makers and local stakeholders, are fundamentally future-makers. Yet, in practice, the urban planning

community is not making use of the wide array of anticipatory tools and approaches available to explore very long-term urban futures in the context of climate change (see Chap. 11). Understandably, planners and decision-makers prioritize risk-based assessments and near-term solutions in order to address urgent and pressing needs, and to do so within their terms of office. Although relatively rare, opportunities to craft long-term solutions of transformative change are essential for overcoming wicked, persistent, and emergent resilience challenges.

We seek to position the coproduction of resilient urban futures within urban systems science as an anticipatory knowledge practice to address the current deficit of futures thinking in urban planning and decision-making. Mainstreaming anticipation into organizational routine and practices requires institutional change. This may involve the redesign of a municipality's governance structure to harness and expand on already existing expertise and capacities across different units and departments, or the creation of new governance structures that explicitly embed future-making tools (i.e., scenario planning, storytelling, gaming, multicriteria assessments) and coproduction approaches into their organization's planning efforts (see Chap. 11). A key challenge is to go beyond one-time coproduction initiatives toward a routine practice within the organization's knowledge-making and decision-making processes such that strategies and solutions are not driven by crises; instead, they are continuously explored, stress-tested, and evaluated during times and spaces that allow for deep exploration of uncertainties and the generation of creative work.

At an individual level, engaging in the coproduction of urban futures allows actors to experience different roles and gain new capacities. Urban planners can gain core competencies of future-making, including creativity, imagination, and storytelling that enable visions to extend beyond extrapolation and into radical transformative pathways. However, although many planners have technical training in projecting future scenarios based on computational modeling, these models can still fall into the trap of representing future scenarios that simply conform to what has already been envisioned. Positive visioning processes are fundamental to comprehensive, neighborhood, and other types of planning, but if community leaders and residents are not engaged in imaginative work, then plans may lack ambition. In our work, community leaders and residents are civic knowledge producers, contributing crucial insights about how the city works and the vulnerabilities that its communities experience, and thus can help produce anticipatory knowledge alongside scientists and planning experts. Planners, scientists, community members, and residents alike can gain an expanded view of their cities through these processes and develop a future literacy that they can also take back to their respective communities. We suggest that futures work, which engages creativity, be explicitly embedded in professional practice, educational curriculums, and community capacity-building as a core competency to improve overall adaptive capacity.

To ensure broad representation, futures visioning work will need to creatively activate diverse technologies, designs, and engagement mediums. In the UREx SRN, the scenario development process integrates creative storytelling through narratives, drawn vignettes, and design renderings, along with a data visualization platform for quantitative data, into the development of SETS future visioning (Fig. 12.3).

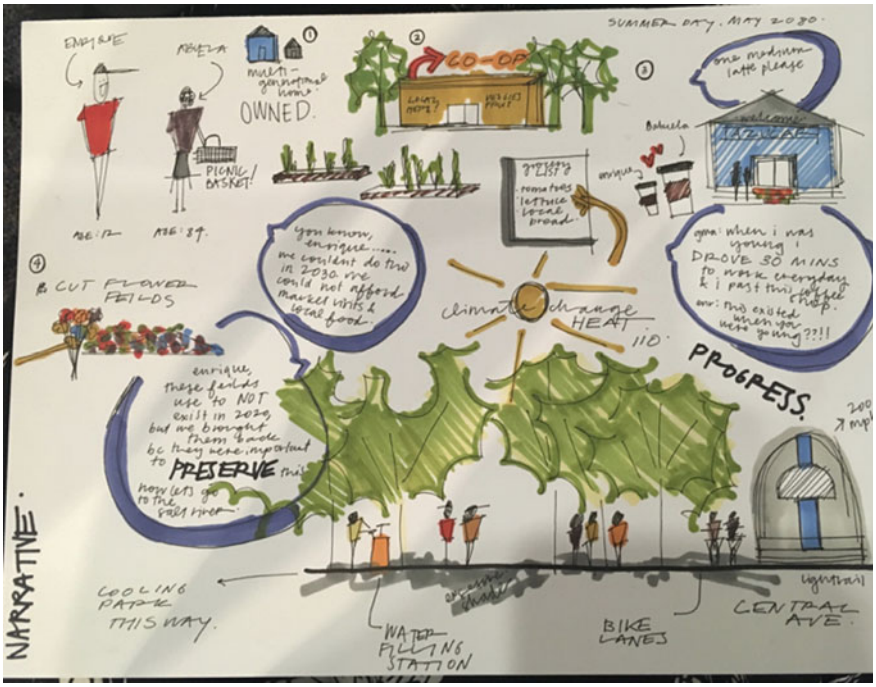

Fig. 12.3 Conceptual design illustrating aspects of a positive future vision for South Phoenix in 2080 captured during the scenarios workshop. *Image credit* Ian Klane

The increasingly wide availability of new technologies—including artificial intelligence, social media, gaming, creation of city digital twins, use of mobile apps to advance creative approaches, participatory mapping, and apps for sharing strategies and creating narratives and stories—provides new opportunities for engaging diverse knowledge systems and bringing positive visioning into workshops, community meetings, classrooms, and the private sector. These are also emerging as essential tools for engaging younger generations and bringing these important voices into coproduction of positive visions.

12.5 Positive Visioning for Resilience and Transformation

Overcoming persistent and emerging challenges, such as pervasive social and environmental injustice, require more than a responsive approach to change, instead demanding fundamental social, ecological, and technological transformations (Iwaniec et al. 2019). In turn, transformation requires major leaps forward and true game-changing strategies. Positive futures are critical to provide motivation, aspiration, and a basis to initiate real action and guide change. They serve as

wayfinders to guide a course of action toward ambitious, positive trajectories that meet normative goals for society and the systems they are embedded in. Crafting visions of resilient urban futures through participatory processes fulfills a vital function in research, planning, and decision-making, providing a shared space to develop and assess strategies to transition from the current state to a desirable future state (Iwaniec et al. 2020).

Further developing an urban systems science that can provide actionable knowledge for decision-making is a transdisciplinary research agenda. It will require true boundary crossing to bring the knowledge, skills, tools, and ideas together in ways that can help achieve the normative goals and visions we have for our shared urban future. And yet for many city decision-makers, more discussion and focus needs to be placed on the value of scenarios, how to use them as a baseline for coproduction with communities, how to interpret them, and how to make sense of visions and projections that have embedded uncertainty. Not only do we need to advance an urban systems science for resilience, sustainability, and justice but also an urban systems practice, where decision-makers are thinking in systems, and where research is codesigned with practice.

Cities are already thinking about alternative and more desirable futures. Fundamentally, visions serve as a basis for all strategic planning in cities worldwide—covering scales all the way from the local, neighborhood level to city, state, and federal scales. Cities are being reimagined, reinvented, and shaped by dominant concepts and imaginaries that serve as a common vision to guide the visioning process and content of the visions. Can we utilize visioning processes as a driver of transformational change? Can we create an urban systems science that brings multiple forms of knowledge together? We argue that positive futures are critical to cocreating opportunities and generating realistic pathways for transformation toward sustainability. Coproduction enables incorporation of diverse sectoral, cultural, and disciplinary viewpoints into plausible and desirable future visions. Research and practice are beginning to create positive visions, develop future scenarios, generate pathways, create plans, and initiate implementation projects for improving urban sustainability, resilience, and human livelihoods in cities (McPhearson et al. 2017). This is encouraging but must be expanded. Positive futures are an opportunity to dig deeply into the key tensions and challenges to bring communities together to create shared visions or even to create pluralistic visions within which to reveal underlying conflicts, trade-offs, and tensions. Further, our approach and SETS framework provide key opportunities for building an urban systems science that can inform urban practice and, together, envision a positive, resilient urban future and chart pathways to get there.

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