Chapter 11
Anticipatory Resilience Bringing Back the Future into Urban Planning and Knowledge Systems

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Abstract Anticipatory thinking is a critical component in urban planning practices and knowledge systems in an era of unpredictability and conflicting expectations of the future. This chapter introduces "anticipatory resilience" as a futures-oriented knowledge system that intentionally addresses uncertain climate conditions and explores alternative, desirable future states. It suggests a portfolio of tools suitable for building long-term foresight capacity in urban planning. Examples of knowledge systems interventions are presented to explore the trade-offs, constraints, possibilities, and desires of diverse future scenarios co-generated in settings with people that hold different perspectives, knowledge, and expectations.

Keywords Resilient futures · Climate change · Urban planning · Anticipatory capacities · Knowledge systems

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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_11

11.1 Introduction

Thinking about the future of cities is the central focus of this book. Rapidly changing social, technological, environmental, and climate conditions pose unique challenges to the way urban planners, decision-makers, designers, and citizens think, plan ahead, and take actions to build cities that are resilient to future change. Resilience and disaster scholars alike expect governments, institutions, and civic organizations to anticipate future risks and the occurrence of shocks and stresses in a proactive manner to mitigate and adapt (Baud and Hordijk 2009; Aguirre 2006). Yet, although anticipation is considered an important component of both urban planning and resilience, the concept in both fields would benefit from moving beyond a bias toward quantitative predictive modeling, and toward the capacity building practices that allow different actors in the city to engage with planning long-term resilient futures (Myers and Kitsuse 2000; Boyd et al. 2015).

In this chapter, we are concerned with making anticipation a central practice in adaptation and resilience research, planning, and action in cities. Indeed, cities have a long history of imagining and planning for the future. Since the times of Kevin Lynch and Le Corbusier, urban planners and designers have conjured up different ideas and images of what cities can and should look like. The very purpose of planning is to prepare for future activity (Myers and Kitsuse 2000). We question, however, the extent to which the knowledge systems currently employed by planners to think about the future are capable of building anticipatory resilience. Knowledge systems are the social and institutional practices, tools, and norms that organizations use to generate, validate, circulate, and use knowledge in decision-making, policy, and design (Miller and Muñoz-Erickson 2018). Cities need to become more ambitious about how they factor the high unpredictability and uncertainty of climate change into their knowledge systems. City planners and policy-makers need a more effective future-oriented approach that enables them to comprehend present and future complexity (Ratcliffe and Krawczyke 2011).

We promote a systematic and rigorous exploration, understanding, and imagining of plausible and desirable futures that enable cities to consider the wide-reaching implications of design policy and planning choices. Anticipatory resilience is also crucial in disaster planning if communities and governments are seeking not to just "bounce back" after a shock or disaster, but to use that moment as a 'window of opportunity' to transform urban communities along more sustainable pathways (Eakin et al. 2018). Thus, organizations must rethink their knowledge systems (Feagan et al. 2019; Muñoz-Erickson et al. 2017) to anticipate impending change and shape a preferred future condition. To help cities address this challenge, we draw upon the ideas, practices, and techniques used in the fields of anticipation and futures research to suggest ways that knowledge systems integrate foresight.

We begin with a discussion on why climate uncertainties and complexities pose such a difficult challenge to urban planning and why the traditional risk-based knowledge systems are not well suited to handle these uncertainties. We then present

the main argument for a more sophisticated and ambitious definition of anticipation to help planners think about the future of cities differently in the face of deep uncertainties. Contrary to the near-term future that the urban planning field typically works with, the future that anticipatory resilience deals with is nonimmediate (far enough away to be deeply uncertain), opening a big space for a variety of actors to put their differences on the table and collectively come up with a vision to act on (Alvial-Plavicino 2015). We finish by showcasing a portfolio of foresight methods for designing future-based knowledge systems capable of building anticipatory resilience, using examples from the Urban Resilience to Extremes Sustainability Research Network (UREx SRN). The result is a strengthened ability for practitioners and communities to explore, deliberate, and steer future pathways while embracing the uncertainties associated with climate change. In other words, against tendencies to "wait and see" or leave the long-term future in the hands of the biggest players, we put forward an approach that builds the capacity of practitioners and researchers from various sectors to come together and talk about the visions we need today to create the policy frameworks, knowledge systems, and governance relationships for a resilient tomorrow.

11.2 The Challenge of Deep Climate Uncertainty

Unlike risks, which can be reduced by quantifying the "likelihood" or probability, "uncertainty" is a state of knowledge where probabilities or likelihoods cannot be confidently defined and quantified (Stirling and Scoones 2009). Climate change uncertainties go beyond trends and changes in future atmospheric conditions. New forms of uncertainties around local capacities to respond to climate change and the effectiveness of responses, including changes in human behaviors, also pose a challenge to urban planning. Stults and Larsen (2018) recently reviewed climate adaptation planning literature and identified thirteen types of climate-related uncertainties that local city planners are facing. These uncertainties were grouped into four categories, including: (1) uncertainty in future climate conditions; (2) uncertainty in climate-related behaviors and political decisions external to the municipality; (3) uncertainty in climate-related local coping capacity; and (4) uncertainty in effective local responses. While most scientific work efforts have focused on reducing sources of uncertainty in future climate conditions and climate-related behaviors and political decisions, these uncertainties are outside a city planner's direct influence. Therefore, city planning efforts to apply uncertainty reducing-techniques for these uncertainties will be fruitless since they fall outside the local solution space.

On the other hand, although coping capacities and effectiveness of responses (Categories 3 and 4 above) fall under the direct influence of local planners, there are also large knowledge gaps that further complicate these types of uncertainties (Stults and Larsen 2018). With respect to, for instance, our urban infrastructure—roads, buildings, water, power, etc.—there is unpredictability in the extent to which it can adapt to accelerated climate change. This is because of the decades and centuries that

our infrastructure has had to withstand the building of interconnecting infrastructure, embedding of new hardware, and most recently, implementation of new technologies (e.g., sensors and computing, automation) (Miller et al. 2018; Chester and Allenby 2018). Similarly, knowing the conditions that enable communities to effectively cope with changing climate conditions is difficult to ascertain (Stults and Larsen 2018), especially when many of the analytical approaches used to evaluate community vulnerability and adaptive capacities are limited to static, place-based attributes and miss other important, dynamic dimensions of coping capacities (Eakin et al. 2018).

Finally, the uncertainty surrounding the climate change discourse in the adversarial American political arena is further compounded by resilience as a concept that also engages normative dimensions in urban planning. In other words, how *should* we develop resilient cities? There is an extensive debate in the resilience academic literature as to whether the concept of resilience should be used as a descriptive concept of system change, or whether it is a normative concept because of the power dynamics that shape resilience policies and outcomes (Brand and Jax 2007; Olsson et al. 2015). We take the position here that any application of resilience in practice will be political and involve negotiations of diverse actors and interests on what are desirable and preferred pathways of transformation (Harris et al. 2018). It is precisely because anticipation deals intentionally with the normative dimensions of envisioning the future—the expectations, values, imaginations, desires—of society collectively that it offers a powerful framework for resilience planners to "open-up" and engage with the politics of resilience as they plan for the future. Applying strategic foresight with aspirational tools offers a way to ask the "resilience of what, to what, and for whom?" that many resilience scholars are asking for (Meerow and Newell 2016).

Exploring the politics of urban resilience with foresight also facilitates the leveraging of postdisaster reconstruction stages to build long-term transition pathways toward sustainability-oriented visions (Brundiers and Eakin 2018). Sustainability scholars argue that having a negotiated and articulated vision of an alternative development pathway prior to an event will make it possible for willing actors to take advantage of "windows of opportunity" after disasters and carry forward the ideas and strategies, even in the midst of significant hardship and loss (Eakin et al. 2018). On the other hand, the absence of transformative visions prior to an event usually results in powerful interests taking advantage of postdisaster recovery to further the status quo in the name of "building back better."

11.3 Limits of Risk-Based Knowledge Systems

How planners deal with risk and uncertainty is a crucial differentiating factor between planning practices and the forward-looking approaches required to address climate change. Although planners, both in academic and professional circles, have had a special relationship with the future (Myers and Kitsuse 2000), in practice, the dominant approaches to exploring the future have been tools for projections and

forecasts to acquire predictive knowledge about the future, or as Quay (2010) calls it, the "predict and plan" approach. *Projections* are described as accounting systems that rely on hypothetical assumptions of the past and then expect or project the same trends or behaviors to continue into the future. They usually contain conditional terms such as "if/then" statements about the future (Myers and Kitsuse 2000). While they are not technically predictive, planners often mistake them as such (Isserman 1984; Myers and Kitsuse 2000).

Forecasts, on the other hand, are predictive and provide planners with a likelihood about a future state or behavior derived using statistical calculations and models (Isserman 1984; Myers and Kitsuse 2000). The best example is a weather forecast that uses observable, quantitative data to characterize current weather conditions and predict future atmospheric conditions with computer models. Because forecasts are based on a model, the quality of their results represent a best guess about the future and depend on the assumptions and the input data that were used in that model. With respect to physical urban planning, including land use, transportation, and water infrastructure, forecasts are used to examine trends over time or a desired future state and then design the infrastructure needed to serve that future.

Tools like projections and forecasts are risk-based knowledge systems that underlie the "predict and plan" approach and are not sufficient to address the conditions of deep climate uncertainty. As Selkirk et al. (2018) explain, while linear and quantitative modes of knowing the future are useful in a wide range of settings, "they structure our engagement with the future down to a limited number of model runs, numbers, or decimal points" (p. 6). The future can be more complex and dynamic than numbers fully account for (Ibid). Different from the "predict and plan" approach, anticipatory resilience recognizes that some aspects of the future are unknowable and different from the present, and therefore a systemic understanding of how multiple trends and visions will extend forward and interact with one another is useful to shape new possibilities and patterns of behavior in the process.

11.4 Toward More Anticipatory Resilience

Anticipation is an act of looking toward the future, or being forward-looking. At an individual level, we may think of anticipation as "knowing what is coming" or "getting ahead of ourselves." Expectations play a central role in anticipation because how we come to know the future (e.g., tools, values, cultures, etc.) guides what we expect from it, and in turn, helps to shape present and future action (Selkirk et al. 2018; Selin 2008). Expectations, then, are key in understanding, building, and enacting anticipatory capacity (Alvial-Palavicino 2015). Yet, understanding expectations of the future is only part of anticipation. To act in an anticipatory way means to act in relation to the future—and knowledge of emerging transformations—such that what we expect of the future changes our decisions or behaviors today (Polasky et al. 2011). As Poli (2017) puts it, a weather forecast in itself is not anticipatory,

but taking an umbrella as a consequence of watching the weather forecast is an anticipatory behavior.

At a societal or collective level, anticipation means that the "future" is made actionable by a set of societal arrangements, attitudes, and interventions (Alvial-Palavicino 2015). Commonly discussed in the literature as anticipatory capacity or anticipatory governance, anticipation refers to a model of decision-making under very high uncertainty (Quay 2010). Scholars of emerging technologies and responsible innovation define anticipation as the ability to rehearse future possibilities prior to "diving into the future" to help steer technology and development towards socially desirable situations (Guston 2014; cited in Alvial Palavicino 2015). The field of sustainability transitions anticipates long-term visions to develop transition pathways and actions toward those visions (Boy et al. 2015; Wiek and Iwaniec 2014). Anticipation is thus concerned with extended time horizons, where the future is open-ended and unpredictable. Building foresight capacity—or what some describe as "futures literacy" (Larsen et al. 2020)—is a key goal in anticipation, allowing us to imagine alternative futures and test courses of action before we deploy them (Fuerth 2009; Wachs 2001).

Visioning and scenario building efforts have tried to gain traction in the planning field in recent years, but the absence of specific strategies for achieving goals and the inability of these efforts to become anything but wish lists for the future has received much criticism, citing them as shortsighted and hollow (Myers and Kitsuse 2000). In their review of 44 US local climate adaptation plans, Stults and Larsen (2018) found that none of these plans used scenario planning or other techniques to explore the future. This finding confirms the observation made by Myers and Kitsuse (2000) that the field of planning has lost sight of the future, despite its future-oriented characterization in the literature (Myers and Kitsuse 2000).

Anticipatory resilience uses tools and practices that enable long-term foresight planning. This approach explicitly calls for reflexivity, or the self-awareness to reveal the assumptions and intentions one makes about what the future will look like, to clearly articulate and negotiate the politics and unintended consequences that are embedded in creating alternative futures, and to recognize when changes in our knowledge systems or actions are necessary to steer away from maladaptive or unjust outcomes. Adaptability through monitoring, feedback, and learning are therefore key elements of this anticipatory approach (Boyd et al. 2015).

11.4.1 Portfolio of Future-Based Knowledge Systems

Bengston (2019) and Stirling (2004) have reviewed a variety of methods and techniques from the field of future studies that are relevant to our discussion. In Fig. 11.1, we show common future methods and techniques in relation to their utility for resilience planners to engage with uncertainty, time horizons, and dimensions of the future. Exploratory tools represent those used to know and articulate the future in a more "open" way, based on visions, aspirations, and expectations, rather than just on what the data tells us could happen. The most common tools are qualitative

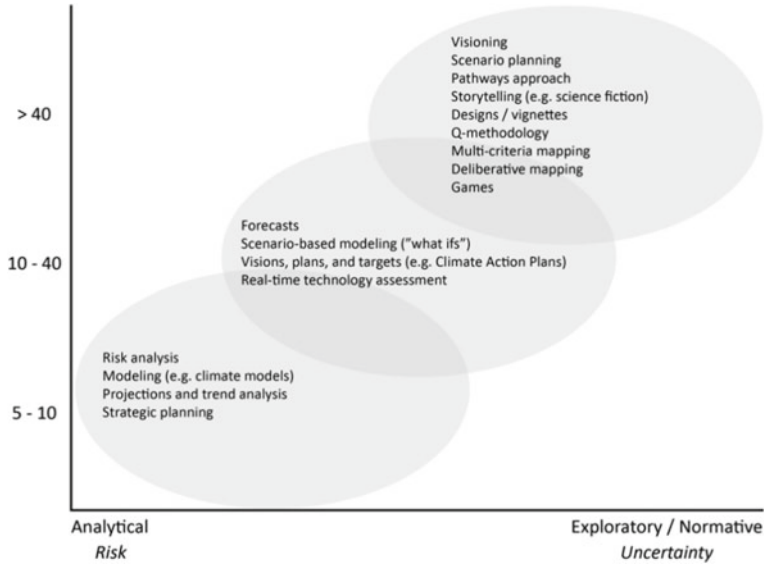

Fig. 11.1 Future methods and techniques and their utility in engaging with uncertainty, time horizons, and dimensions of the future

and include visioning and scenario planning. As a practice to represent and evoke a shared preferred image of the future to guide action, *visioning* has been used in the development of master and general plans for cities. A commonly cited example is the Atlanta's Vision 2020, a regional visioning effort that the city carried out in the early 1990s. Visioning has also been used as a way to encourage citizen involvement in a collaborative process toward shared understanding and optimistic picture of a plausible future (Myers and Kitsuse 2000).

Scenario planning is the practice that helps give action to these visions by aiding planners in developing narratives or stories to specify the sequence of actions and events that impact planning decisions and lead to the desirable state, or vision (Myers and Kitsuse 2000). Scenario planning is the most well-known future practice, having emerged from the military in the 1950s and been widely applied in business corporations by the 1970s as a form of strategic planning (Bengston 2019). Scenario planning allows input of qualitative measures into quantitative forecasts and merges technical and participatory planning to help address uncertainty in creative ways (Chakarborty and McMillan 2015). Visioning and scenario planning are therefore not meant to be predictive, but to instead allow qualitative and quantitative modes of knowing to come together and mutually inform each other. The pathways approach is another useful method employed by the climate adaptation community to support decision-makers and communities in envisioning alternative scenario pathways, which are to be met through a sequence of adaptation actions and triggers that are managed and monitored over time (Wise et al. 2014; Barnett et al. 2014). Scenario and pathway approaches are useful analytical techniques that support the exploration of a variety

of uncertainties and long-term horizons and connect them with specific short-term actions in a dynamic way (Haasnoot et al. 2013).

In addition to visioning and scenario planning, there are a number of future research methods that use more imaginative or creative techniques to foster "out-of-the-box" thinking when exploring potential futures. *Games* are participatory and creative techniques—including cards, board games, role-playing exercises, and online games—for active learning, creating foresight, and problem-solving. The Urban Sustainability Directors Network (USDN) uses the "Game of Floods" to help city practitioners think about a variety of planning and action scenarios to address flood risks in their cities (Baja 2019). *Storytelling* and science fiction are methods for creative and imaginative exploration of the future. Stories can describe plausible futures and connect the present to the future using narratives that link cause and effect and illustrate the consequences of key events, decisions, or technological innovations. Miller et al. (2015), for instance, found storytelling to be a valuable method to open deliberation and scenario development to a diverse group of energy and nonenergy professionals about the future of energy in Arizona in 2050.

Because exploring potential futures is an open-ended activity, visions and scenarios should be generated and deliberated using *participatory frameworks* so that the futures are co-produced, and inclusive of multiple voices, perspectives, and knowledge systems. In addition to participatory action methods, Stirling (2004) suggests a number of decision-analytic techniques that facilitate the evaluation of trade-offs among multiple values and discourses, including "Q methodology," "multicriteria mapping," and "deliberative mapping." Quantitative scenario-based modeling is sometimes used in combination with the scenario narratives to explore outcomes or trade-offs of the strategies and interventions that are part of the narrative. The methods and techniques presented all have their strengths and limitations. Therefore, instead of adhering to one single approach or tool to explore the future, we recommend a portfolio that includes a variety of tools and methods to explore futures.

11.5 Examples of Knowledge Systems Interventions to Build Anticipatory Resilience

We made knowledge systems innovations toward building anticipatory resilience as part of the Urban Resilience to Extremes Sustainability Research Network (UREx SRN; https://UExSRN.net) in three ways. One is through a scenario development approach that we carried out in nine cities in the USA and Latin America to articulate and explore the implications of positive futures for urban resilience. As we describe in greater detail in Chap. 6, this approach begins with an analysis of existing governance framings, perspectives, knowledge, and values that different actors, including government, civil sector organizations, academia, and private sector groups, have

with respect to climate resilience and the future of the city. Along with other assessments of existing social, ecological, and technological conditions [e.g., existing municipal strategies (Chap. 3) and vulnerability analysis (Chap. 4)] these were used in a co-production process with local researchers and practitioners to define a set of climate and urban challenges (e.g., extreme heat) and themes (e.g., energy security), as well as to identify a diverse set of stakeholders to work on these context-based scenarios for their city's future (Chap. 7). During the participatory process, participants worked in small groups with trained facilitators to collectively define a vision and goals for a very long-term horizon—all the way out to the year 2080. Through a series of structured activities, participants also defined short- and mid-term actions, the specific locations where these actions would need to take place, and the linkages between strategies necessary to realize their long-term vision.

The combination of analytical and exploratory techniques and activities we used to guide the co-production of positive futures over very long-time frames (to 2080) helped "open up" discussions about the uncertainties and challenges that cities face, while allowing participants who do not normally work together to think "outside the box" about what very transformative strategies might entail, including social equity outcomes. We used activities designed to stress test the scenarios (e.g., disaster cards) and trigger changes in actions that could lead to maladaptive outcomes. Opening up the future through this structured process allowed participants to navigate uncertainties and different values in a safe space where differences were encouraged to spur innovative ideas. Not surprisingly, navigating these value differences was often a challenge and deliberations sometimes got very heated. These conflicts were often about short-term barriers posed by the current system (e.g., zoning code regulations), so when participants were reminded that the very long-time frame being discussed allowed for transformative thinking, their perceptions shifted again towards common values and the creative innovations needed to move forward in radical ways. In the end, some of the scenario interventions were successful in producing future visions that became guides for short-term actions, while some stayed at the discussion level. Nevertheless, for a number of our UREx cities, the scenario process served as an archetype for how to plan using anticipatory practices and opened up a new space to negotiate the various values and meanings of a resilient city.

Our second innovative knowledge system intervention to build anticipatory resilience was the UREx SRN Resilient Coastal Cities (RC2) Innovation Labs, where we engaged city practitioners, neighborhood residents, NGO leaders, resilience researchers, engineers, and data visualization specialists in Miami, San Juan, and Baltimore to co-design an integrated data visualization platform. The goal of the Innovations Labs was to help increase anticipatory capacities through access, use, and sharing of information and data on resilience to coastal climate risks. With support from the National Science Foundation's Smart and Connected Communities program, these Innovation Labs served as spaces for participants to evaluate the suitability, relevance, and quality of different data visualization tools with respect to the various knowledge systems practices of their organizations, such as by developing reports to meet municipal code standards or to explore different sea-level

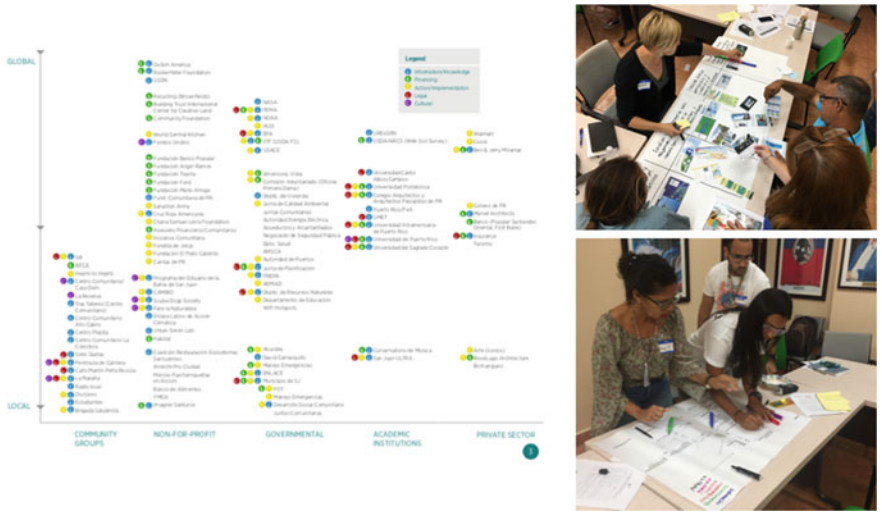

Fig. 11.2 Innovation Lab activities in the community of Santurce in San Juan, Puerto Rico. Participants classified different types of data and visualizations according to their relevance to different use cases, including climate education, implementation of adaptation strategies, or development of future coastal scenarios (top right). Participants also created an actor map of the various governmental and nongovernmental organizations and institutions carrying out climate adaptation and resilience initiatives in Santurce following Hurricane María in 2017 (left and bottom right)

rise scenarios (Fig. 11.2). The Labs resulted in a prototype of what a smart knowledge system could look like, a system by which local needs are prioritized through community empowerment. Such a system would allow for the evaluation of existing vulnerabilities and the anticipation of potential futures by employing data visualizations and connecting different governance sectors, communities, and knowledge systems across the three Atlantic coastal cities.

A final intervention was a Resilience Governance Workshop in Portland, Oregon. The UREx team had worked closely with City of Portland practitioners and identified organizational barriers and the need for innovation in governance as critical areas for resilience. The workshop was designed collaboratively with practitioner partners and focused on building transformative governance principles into resilience governance proposals generated in the workshop. The workshop produced four proposals for resilience governance structures. Based on the exercises, groups were challenged to integrate issues of foresight and anticipation, including learning and experimentation, diversity of communities and knowledge types, and the ability to identify and unlock path dependencies and mal-adaptations in terms of how organizations think about the future and uncertainties. The results from this workshop will be further developed and incorporated into resilience planning in the City of Portland.

11.6 Conclusion

Developing transformative pathways for sustainable and resilient cities hinges on the ability of city officials, policy-makers, businesses, scientists, civic leaders, and residents to think, know, and decide on future strategies in an era of unpredictability and conflicting expectations of the future. True resilience can only result from genuinely transformative ideas, policies, and practices concerning how societies go about reducing risk (Tierney 2014). Although planning for the future is at the core of urban planning, current risk-based knowledge systems that rely on predictive approaches are not enough to address the complexities and uncertainties that climate change brings for cities. Anticipation is a critical component of building resilience but needs to be better embedded in urban planning practices and knowledge systems. We have argued for an anticipatory resilience approach to future-based knowledge systems that intentionally explores alternative desirable future states and have offered suggestions for a portfolio of tools suitable to building long-term foresight capacity in urban planning, including scenario planning, games, storytelling, and multicriteria mapping, to name a few. We have presented three examples from the UREx SRN of knowledge systems interventions where we used a combination of foresight tools that resulted in multiple urban futures, transformative governance structures, as well as an integrated data visualization platform to help explore these futures. We contend that future-based knowledge systems are suitable to explore the trade-offs, constraints, possibilities, and desires of different future scenarios co-generated in settings with people from different perspectives, knowledge, and expectations.

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