Chapter 13: Sustainability Transformation Emerging from Better Governance

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13.1 Urban Governance and Transformations

Urbanization and urban areas are profoundly altering the relationship between society and the environment at accelerated rates, affecting our chances to create livable, sustainable, and just societies worldwide. Urban areas are key sources of resource use and pollutants globally. For instance, they emit up to 70 percent of global greenhouse gas, or GHG, emissions (Romero-Lankao et al. 2014). However, both resource use and GHG emissions within a city are not often under the remit of local governments; rather, they are the responsibility of national governments, the private sector, and other actors. At the same time, urban populations, economic activities, infrastructure, and services are vulnerable to an array of negative environmental impacts, such as mortality from extreme heat and damages from hurricanes, storm surges, and flooding. Furthermore, environmental issues are cross-scale issues. This means that urban areas are affected by actions beyond their boundaries, and urban uses of natural resources, GHG emissions, and risks create effects far outside the demarcations of city limits (see Chapters 3 and 4). Hence, these issues are not only local governmental concerns, but require a diversity of actors across sectors and jurisdictions to network and create coalitions for climate and environmental governance to sustainably manage the use of water, energy, and other resources; to mitigate GHG emissions; and to adapt to and mitigate environmental risks.

The complex nature of environmental and climate challenges associated with the current Anthropocene era cannot be suitably dealt with by the modest and fragmented responses that are most common in urban areas worldwide. Incremental reform may prove inadequate; instead, we may require transformative responses that alter core elements of urban systems, such as energy, water, and land-use regimes *and* influence multiple interconnected domains, such as sociodemographics, economics, technology, environment, and governance

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itself, with their basic power relations, worldviews, and market structures (Park et al. 2012). The study of transformation in response to environmental change is established among scholars and communities of practice. However, it is critical to focus on the value this knowledge can add to existing environmental policy and governance in urban areas, which are both key drivers of environmental change and sources of solutions. Transformation is a concept deeply embedded in the human narrative. It conveys the notion of systemic, essential, and radical change that can affect an array of fundamental urban socioecological system domains such as sociodemographics, the economy, technology, ecology, and governance regimes (Folke et al. 2005; Romero-Lankao and Gnatz 2013; Geels and Schot 2007; Patterson et al. 2016). For instance, can the concept of transformation play a normative role in helping us purposefully move cities towards sustainability and resilience? Or should it be confined to an ex-post analysis of change in cities? And why should we focus on cities?

Many actions and strategies will be needed to trigger such transformative processes, from coordinated action by governments to innovation in the private sector, experimentation, and pressure from civil society. This is where the questions around the role of governance in shaping transformations towards urban sustainability and resilience become paramount. Are we mostly interested in understanding the links between governance and the politics of change? Are we looking into governance as part of the problem and engaging with transformations in existing city governance regimes? Is our emphasis on governance that creates the conditions for transformation to emerge, or on actively fostering transformation processes? (Patterson et al. 2016) What exactly must be transformed; why, how, by whom, and in whose interest; and, what factors drive or trigger the necessary transformations?

Rather than suggesting the most appropriate range of responses needed to achieve transformational actions and policies, this chapter sets the stage for Part III and builds on previous work to identify both opportunities and challenges that city officials and private and civil society actors face in their efforts to develop governance solutions that support sustainable and resilient urban development. This chapter will start with the definition of key terms (for example, urban governance), and of main approaches to the governance factors shaping change towards more sustainable and resilient development pathways (Section 13.2). Many actions and strategies have been introduced to address sustainability and resilience concerns (for example, urban water management and transportation). In Section 13.3, we will briefly describe different types of actions seeking to mitigate or prevent risk and to adapt to existing and possible environmental threats and disruptions. Mitigation refers to actions aimed at reducing resource use and environmental impacts and risks; adaptation refers to actions aimed at managing these impacts, before or after they are

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experienced (Field et al. 2014). The following sections describe the nature of the actor-networks involved in designing and implementing actions (Section 13.4), and the opportunities, barriers, and limits that multilevel governance poses to local climate and environmental policy (Section 13.5).

13.2 Multilevel Governance and Transformations

Interest in transformations towards sustainability and resilience has grown considerably in recent years among researchers and communities of practice globally. For instance, it has been addressed in debates around the Sustainable Development Goals (SDGs, see Part II). It is one of the themes of Future Earth's Sustainability Research Platform. And it has become a key component of IPCC assessment efforts (Field et al. 2014). Urban governance and politics are critical to understanding and shaping these transformations for many reasons: Governance can offer both barriers and opportunities to transitioning towards urban sustainability and resilience; further, these transformations are inherently contested and political (Patterson et al. 2016; Romero-Lankao et al. 2016).

Urban governance takes place within broad socioeconomic and political contexts, with actors and institutions at multiple scales shaping the effectiveness of urban actions and responses. In particular, urban environmental governance comprises formal and informal rules, rule-making systems, and actor-networks across sectors and jurisdictions, both in and outside of government, that are established to steer cities towards sustainable resource management, environmental change mitigation and adaptation, and transitions along alternative development paths (Biermann et al. 2010).

Below, we review the main strands of literature that engage with the influence of governance in actions and strategies seeking to transition urban areas towards more sustainable and resilient development pathways. These include theories of sociotechnical transitions (Geels and Schot 2007; Rutherford and Coutard 2014) and socioecological transformability, political ecology perspectives (for example, sustainability pathways and transformative adaptation; Lawhon and Murphy 2012) and a growing body of scholarship on experimentation. These approaches provide significant, albeit partial, visions of urban transformations that aid in the understanding of the barriers and opportunities associated with the practice of urban sustainability and resilience transitions. For instance, sociotechnical transitions theory sheds light on some of the processes shaping changes in environmental management regimes, while political ecology approaches illuminate the influence of power relations among actors with different values and interests in shaping social change.

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13.2.1 Sociotechnical and Socioecological Theories of Transformation

Sociotechnical transitions theories, also called STTs, examine the multilevel processes through which socioecological and technical systems experience transformations. STTs define transformations as shifts to systemically different sociotechnical regimes of resource use and relationships with the environment (Smith and Stirling 2010; Geels and Schot 2007; Rutherford and Coutard 2014). Transformation is conceived as a series of far-reaching changes along different domains: technological, governance, economic, sociocultural, and environmental. It includes a broad range of actors and unfolds over substantial periods (50 years or longer, for example). Examples include the transition from cesspools to sanitation, from telephone to cellphone, and from internal-combustion to electric vehicles. Within the transitions literature, there is a fast-growing body of work on urban transformations. This work has evolved from situating "urban" simply as the context of new empirical examination of transition experiments to investigating urban patterns of transformation as unique to the understanding of contemporary transitions.

A *sociotechnical regime* organizes social practices and structures relationships among private, governmental, and nongovernmental actors, whose understandings of priorities, appropriate actions, and technologies are intertwined with the expectations and skills of users, with institutional arrangements, and with physical infrastructures providing energy, water, and materials. A regime is "dynamically stable" and imposes a logic and direction for incremental sociotechnical and socioecological change along established pathways of development, which, in turn, create path dependency or lock-in. Electricity and urban water management provide conspicuous examples of lock-in due to the endurance of their material structures and the sturdy techno-institutional interrelationships associated with them. While regimes are dynamically stable, they are constantly subject to drivers and pressures that can lead to their destabilization and transformation. Some of these drivers and pressures are:

Innovations and experimentations, or proactive changes such as new technologies, social experiments, and governmental or grassroots initiatives. Innovations can contribute to structural or fundamental changes in cultures, structures, practices, and relations between actors. Experimentation can nurture new technologies and create new institutions and new governance processes.

Conflict and contestation of actions around access to, use of, or redistribution of natural resources, assets, and decisions, with resulting social and environmental implications (for example, on water quality and availability, social inequality, and livelihoods); and,

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Environmental impacts and triggers in the form of natural resource depletion and scarcity, disasters, or changes in risk tolerance resulting from shifts in economic, cultural, and/or political dynamics (Romero-Lankao and Gnatz 2013).

Governance and governmental policies frequently exert an influence on transitions through *transition management*, which includes insights from complex systems and governance approaches (Loorbach and Rotmans 2010). Transition management conceives socioecologic systems, such as urban areas, as complex and adaptive. Management in this context appears as a reflexive and evolutionary governance process (Markard et al. 2012).

Socioecological systems literature has engaged with the question of how adaptive governance can enhance or foster adaptability of cities as socioecological systems. The concept of resilience, originated in ecology, is fundamental to this approach, which focuses on how much stress and disturbance an urban system can adapt to while remaining within critical thresholds before it moves to another regime (Carpenter and Brock 2008). In this perspective, urban resilience is conceived as the ability of complex socioecological systems, such as cities and urban communities, to change, adapt, and – crucially – to transform in response to both internal and external stresses and pressures (Davoudi et al. 2012; Ahern 2011). Governance of cities plays two roles within this approach. In the first one – governance for navigating change – both short-term and long-term actions seek to shield cities from hazards and disruptions, and to provide urban communities and actors with the capacity to respond to change and uncertainty. In the second role – governance for transformation – actions and policies are envisioned and implemented that create new urban systems when current conditions render existing systems unviable (Folke et al. 2005).

13.2.2 Experimentation

As noted above, innovations or experimentations can destabilize sociotechnical regimes and drive transformative change. Experimentation is a process for instigating sustainability transitions, particularly within cities, with many cases showing impacts on governance dynamics, for example from experimentation in the urban water sector (Ferguson et al. 2013; Poustie et al, 2016), in urban mobility (Späth and Rohracher 2012), and in urban energy (Castan-Broto and Bulkeley 2013). Experimentation includes lighthouse projects that have great symbolic value for urban planning and development, such as the Floating Urbanization pilot project, the Floating Pavilion in the City Ports of Rotterdam, or the eco-district Hammerby in Stockholm. Experimentation can come in the form of open-ended labs that test, or, cocreate new approaches

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or solutions to urban challenges, such as increasing community cohesion or facilitating urban regeneration through coproduced urban agendas, as well as through urban projects that can set transformative processes in motion. Experiments can be facilitated by local governments, established by public-private partnerships, or self-organized by civil society and citizens themselves, from the grassroots. Recent scholarship showcases the importance of creating both physical and institutional space for experimentation processes to take place (Castan-Broto and Bulkeley 2013; Bulkeley et al. 2016; Frantzeskaki et al. 2014, 2017; Nevens et al. 2013; Loorbach et al. 2017).

Experimentation has, in many cases, evolved into the preferred governance tool for addressing complex urban problems. This may explain the observed proliferation of experimentation as a way of governing cities for climate change across Europe, Latin America, and Asia. In particular, the empirically based research on sustainability transitions, focused on smart cities, resilient or sustainable cities, and water-scarce cities, showcases that there is merit in trial experiments and new solutions in cities. These processes create a base of evidence for effective urban solutions that tackle local manifestations of climate change. Experimentation is not limited to climate change concerns; it can also address issues of inequality and accessibility to health care, services, and education. Future urban research will need to examine how experiments addressing urban sustainability challenges contribute to urban agendas for development and what impact they have on contemporary urban dynamics in ecological, social, economic, and political domains of cities.

While there is a recognized need for new approaches to deal with political and social challenges to secure sustainable and livable urban futures, experiments and new forms of governance can enable positive transitions to urban sustainability. However, these innovations are not always welcomed by communities or by political institutions. The controversies, contestations, and conflicts that come along with experimentation are also important ingredients in the governance of urban transformations (Chapters 14 and 15). Alongside these tensions, the current manifestations of governance practices and processes need to be revised and adapted to allow institutional space for actors driving urban transformation and experimentation, which act as lighthouses for new pathways to sustainability (Chapter 16).

13.2.3 Critical Theories of Transformation

Sociotechnical transition theories have helped elucidate the barriers to and options for transformations through the interplay between governmental and private actors, social practices, and institutions. By focusing on urban resilience as an ability to bounce forward, socioecological system theories have shed light

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on cities' and urban actors' capacity to change, adapt, and – crucially – to transform in response to hazards and disruptions. However, sociotechnical transition theories, which have focused mostly on Europe and the United States, have little to say about how transitions may play out differently in the cities of middle- and low-income countries (Bulkeley et al. 2010). Similarly, scholars have suggested that socioecological system theories cannot be uncritically applied in the process of trying to understanding how social domains function. In this view, urban groups and communities have the capacity to cope, or adapt, to stresses and disruptions, but these capabilities are also shaped by social, political, and cultural processes. Socioecological approaches have often been criticized for being deterministic and for omitting the role of different levels of agency and power in creating or preventing transformational movement away from previous system phases and cycles. As illustrated by many scholars, pro-growth coalitions, unabated by powerless local authorities and civil society organizations, pose challenges to navigating towards more sustainable and resilient pathways of urban development (Fernández et al. 2016; Romero-Lankao et al. 2015).

To address these concerns, sustainability pathways approaches seek to understand transformations in ways that are sensitive to the deeply political, contested nature of urban sustainability and resilience issues (Robinson and Cole 2015; Bendor et al. 2015). This is achieved by taking into consideration diverse views of and aspirations for what desirable sustainable solutions are, and consider mechanisms to navigating trade-offs and side effects of the proposed transformative solutions. Cultural values, as well as economic and political considerations, play key roles in defining sustainability and resilience goals; acceptable risks to livelihood, property, and other things urban actors value; and outcomes. Because this perspective assumes that both sustainability and resilience are contested, dynamic, and uncertain, it puts institutions and values at the center of efforts to understand and navigate transformations towards sustainability and resilience in cities.

Political ecology scholars have criticized STTs as providing a narrow lens for viewing the processes shaping (limiting, fostering) change, with their emphasis on infrastructures, users, experiments, and technological innovations (Lawhon and Murphy 2012). Political ecology scholars suggest that STTs do not take into consideration that corporate and state leaders, scientists, and innovators of all sorts do not always hold progressive, fair, and/or environmentally friendly values and interests. For political ecology scholars, both cooperation and conflict are inherent features of decision-making in general, and transition management in particular (Lawhon and Murphy 2012). This is so because environmental policies that can aid in transition essentially revolve around who benefits and who bears the risks of actions, with a clear set of winners

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and losers. For example, large-scale power generation and trans-basin water imports can be a desirable means of dealing with energy and water scarcity for some urban elites and benefiting populations within a city, but these changes can be highly undesirable for people and places that bear the stress and hardship implied by these actions. Therefore, it is essential to ask, in the governance of any transition process: what actors and places are at stake; with whom and where power resides; what social and environmental consequences of decision-making are at play; and whose voices and narratives remain unheard?

13.3 Responses and Actions Developed and Implemented in Urban Areas

Many actions are being developed and implemented worldwide with the purpose of providing urban sustainability solutions that address issues such as water and energy management, flood mitigation, other environmental protections (air quality), and cleaner and affordable transportation systems, to name a few. It is increasingly clear that ensuring the future sustainability of the planet requires that these strategies and plans address the consequences of a changing and uncertain climate. Such impacts manifest differently, are experienced uniquely in urban areas (and, at even finer resolutions, are experienced differently among different urban populations), and must be dealt with accordingly – in specific ways that are embedded in the sociopolitical and economic realities that characterize an urban space at local scales.

Urban climate responses include climate change mitigation and adaptation actions, also called resilience actions. These responses range from short to long term, from local to regional, and vary widely in their effectiveness and outcomes. They also include the following domains:

1. Understanding the problem: For instance, if the goal is to mitigate GHG emissions, an inventory will provide a baseline against which mitigation targets can be assessed. A focus on reducing vulnerability will require assessments of the damage to property, disease, and loss of livelihoods that urban populations may face under a changing climate.

2. Incremental responses: For example, mitigation actions focused on municipal government buildings and vehicle fleets are the most common approaches used by city officials worldwide. It is also very common among cities to start with adaptation actions that build on ongoing disaster risk management (Barrero 2013).

3. Broader, longer-term responses that seek to change urban form, institutions, and social practices are equally important. Examples of these include:

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a. Infrastructural investments that: (i) decrease vehicle kilometers traveled, foster mixed-use development, improve destination accessibility, and reduce distance to transit. These goals are achieved by concentrating development and, hence, reducing energy use by vehicles and the stress associated with driving (Hamin and Gurran 2009); (ii) discourage growth in risk-prone areas and protect or restore ecosystem services such as water infiltration, flood protection, and temperature regulation. These actions may help create synergies between mitigation and adaptation by influencing resource use and emissions, and by fostering the resilience of people and places;

b. Actions that build capacity by enhancing the resources and options afforded to populations from diverse socioeconomic groups to use environmentally friendly sources of energy, food, or water, and to adapt to environmental threats, such as those induced by climate change;

c. Actions that reduce exposure to environmental and climate threats, or that mitigate risk (such as dikes and barriers, or multiple-use green ways).

4. *Transformative responses* that create shifts in energy, water, transportation, and land-use regimes, growth ethos, production and consumption practices, and worldviews(Field et al. 2014). Some of these actions target the underlying drivers of resource use, emissions, and vulnerability, such as a shift from centralized electricity fueled by fossil fuels to decentralized, rooftop solar energy, or a focus on integrating environmental and local disaster risk management concerns with an inclusive and pro-poor urban development agenda, as exemplified by Manizales (see Chapter 15). As such, transformative actions hold the potential to promote a more systemic shift towards sustainable and resilient urban development (Shaw et al. 2014; Burch et al. 2014).

This section reviews some of the climate responses (with a focus on adaptation or resilience efforts) that occur in cities of multiple regions and typologies, setting the stage for the following section, which analyzes the governance and decision-making processes and structures that have enabled – or constrained – their development and implementation. Our brief description of these responses provides useful entry points to juxtapose global problems and local solutions or vice versa, and the multiscale governance processes involved. Such actions are diverse in nature and scope, can range from small- to larger-scale efforts, and include a variety of tools and approaches for implementation.

Actions to increase adaptive capacity to threats – including, but not limited to, climate-induced flooding from heavy rainfall events or storm surges, heat waves, or water scarcity and drought – ultimately affect urban areas and populations, but how and at which scale they are developed can vary. Urban

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households and communities, for example, have long implemented measures to adapt to changing environmental conditions and specific threats by drawing on local knowledge, consistent with sociocultural practices. These are numerous and particularly common in low-income and developing nations where large-scale poverty exists and the institutional capacities to adapt are much weaker. Examples of adaptation practices include innovation in water collection and retention in times of drought, changing precipitation patterns, or saline intrusion; adaptation to agricultural practices through altering the timing and types of crop grown; tree and vegetation planting for storm water absorption or heat mitigation; and the construction of pole or stilt housing in flood prone, high-risk urban areas. It is still unclear how to scale up adaptation actions and institutionalize them within local and regional policies, and in doing so, if the adaptation actions are appropriate for these larger scales. Conversely, more comprehensive and thoughtful decision-making efforts that include a range of urban stakeholders can also reduce cases of maladaptation that occur due to ad hoc coping strategies and actions that sometimes conflict with broader socioeconomic and environmental conditions (Schaer 2015).

Adaptation to climate threats is as complex as the urban system, and it is proportionately challenging to develop and implement at the city or regional level, requiring approaches that are multidimensional and include actors at multiple scales. Citywide adaptation and risk mitigation responses often employ a range of approaches that can include either soft or hard infrastructure measures, or a combination of both, to adapt to specific climate change impacts. For example, to mitigate effects of the microclimate in cities (such as urban heat island), cities are beginning to utilize cool pavements (light-colored surfacing or permeable pavements); cool roofs (often categorized as "white," "blue," or "green" roof strategies to differentiate the approaches); increasing vegetation abundance; and reducing waste heat (Gartland 2012). Coastal cities, often plagued by extreme flooding due to sea level rise, storm surges, and hurricanes, may utilize hard engineering approaches such as sea walls or levees, or turn towards nature-based solutions or ecosystem-based adaptations, including restoring natural wetlands or mangrove ecosystems to buffer the effects of extreme wind and flooding. These "softer," ecosystem-based approaches, which are viewed as more cost efficient, comprehensive, and multifunctional by design, have gained popularity as a response to the negative associations of "hard" adaptations, which are prone to being inflexible, costly, and inadequate for addressing a range of interests or perspectives of the problem the action seeks to address.

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13.4 Multilevel Actor-Networks

As indicated in our introduction, environmental – and particularly climate – changes are socially and environmentally pervasive phenomena. Therefore, they challenge actors from different sectors and jurisdictions to create multilevel governance networks and coalitions. Rather than being homogeneous, these groups frequently hold different values and interests, create shifting alliances, and have varying levels of power. This heterogeneity poses challenges for coherent and legitimate urban climate change governance, as actor-networks play multiple and changing roles in urban environmental governance: some provide energy, food, and water resources; others function as facilitators of interactions within and between cities; and yet others define dominant environmental discourses more broadly. The climate change arena offers examples of the relevance of actor-networks, with many urban actors independently committing to mitigation and adaptation, even in the absence of national climate change policies. Furthermore, some actors from the private sector are addressing climate change within their own companies, or are forming partnerships to achieve a common goal. The myriad of actors involved means that, in many cases, suboptimal outcomes will be created.

Actors and their governance arrangements operate in a complex web of interactions, a pattern that had been captured using the notion of *interplay*. The concept of interplay sheds light on the interdependence of institutional arrangements at varying (vertical interplay) and similar (horizontal interplay) levels of organization (Young 2002). These interdependences create policy challenges. The actors involved in the governance of environmental change in cities frequently have very diverse mandates, operate at different time scales, and use different expertise or understanding of the climate issue. For instance, in Cape Town, South Africa and Mexico City, Mexico, officials have pursued climate change mitigation, but the effectiveness of their actions has been constrained by differences in ruling parties and political cultures that constrain structured interactions and collaborations (Holgate 2007; Romero-Lankao 2007). In larger urban areas as diverse as New York, Mexico City, Dakar, and Buenos Aires, which comprise two or more local and state authorities, each authority can act only within its boundaries. This means that the overall impact of their policies may be limited unless there is horizontal collaboration among neighboring authorities, or an overarching strategic metropolitan authority exists to ensure citywide action (Solecki et al. 2011).

For diverse reasons frequently related to authoritarian culture or jurisdictional boundaries, environmental authorities seldom interact with development authorities, and tiers of government seldom collaborate. Priorities in

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urban planning are dominated by economic concerns, with environmental concerns frequently taking the back seat. As a result, the design and implementation of a sustainability plan depends on strong administrative leadership, as well as on whether the commitment of the various implementing actors is guaranteed and how long-term decisions are made.

Actor-networks have appeared that link city officials, private sector actors, community organizations, and academics, to create more coordinated, international approaches to sustainability and resilience challenges such as those posed by climate change (Betsill and Bulkeley 2004; Andonova 2010). ICLEI's Partners for Climate Protection program and the C40 are examples of increasingly important global networks that influence responses to sustainability challenges (Andonova 2010) by providing financial resources as well as opportunities for learning and sharing experiences, tools, and lessons. Notwithstanding the promise of these networks, the interactions among participant actors and the effectiveness of their actions are constrained by the wide differences in jurisdictional remit, organizational culture and structure, and political context.

Actors and actor-networks vary in the extent to which they can influence the framing of sustainability issues, the governance of climate and environmental change, and the resources to implement actions. This inequality is best illustrated by the fact that those urban populations that are most vulnerable to climate change are often not those who are responsible for the majority of GHG emissions. Climate and environmental change also have the potential to exacerbate existing societal inequalities in terms of income distribution; access to resources and options to pursue livelihoods; and capacity to effectively respond to environmental and social threats (Romero-Lankao et al. 2015). A growing body of research reveals that climate and environmental change governance strategies and actions can create or recreate (un)just decision-making processes and outcomes or result in an (in)equitable distribution of risks and resources (Hughes 2013).

13.5 Multilevel Governance Poses Opportunities and Barriers to Local Policy

While city officials are at the forefront of acting on global environmental challenges such as climate change, existing scholarship points to a variety of opportunities, barriers, and limits to the implementation of coordinated and cross-sectoral actions. Many environmental and climate plans need to be holistic and comprehensive; yet, the siloed, shorter-term nature of decision-making poses political, cultural, and professional challenges to horizontal and vertical

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coordination between actors, who usually are scattered across sectoral agencies, utilities, and city-administrative departments (Kern et al. 2008), and work on short planning horizons.

Scholarship has also found that the expertise required to address sustainability challenges frequently remains concentrated in environmental departments. This makes cross-sectoral and cross-jurisdictional coordination within the organizational hierarchy of city government particularly challenging, as environmental bodies usually have limited remit over and capacity to implement actions in key development areas, such as energy, transportation, land planning, and finance (Kern et al. 2008; Romero-Lankao et al. 2015).

Fragmentation in governance systems is driven by more than the physical separation of actors. The implementation of climate and environmental policies is also constrained by a multitude of formal and informal institutional barriers, such as the varied visions, values, interests, and decision-making power of involved actors (Agrawala et al. 2011). Addressing fragmentation as a cross-sectoral planning concern is fundamental if unwanted trade-offs are to be avoided and potential synergies created (Wejs 2014).

Other factors – such as leadership, legal frameworks, scientific information, leadership, the ability to self-organize and mobilize knowledge, and support for the implementation of sustainable solutions – also shape urban actors' capacity to implement effective actions. While the influence of each factor varies with context, a key area for future analysis are the conditions under which the inadequacies of different combinations of factors function as barriers to effective urban governance. Here, we will briefly touch on some of these.

The legal context in which urban governance takes place plays a key role in determining the extent to which climate and environmental actions, regulations, and programmatic priorities are legitimized, incentivized, prioritized, or demonized. Legal frameworks can also mediate the relationship between decision-makers, the private sector, and the broader public as they provide political structures (or not) for participatory planning and decision-making according to prevailing political norms and cultures. For instance, absent or inappropriate laws dealing with climate adaptation and mitigation can be a hurdle to investments in "climate-proofed" technologies or warning systems. However, it can take a lot of time and energy to change legal frameworks, as this entails complex negotiations across sectors and national to local political levels of decision-making.

The creation of and access to new, city-specific, socially relevant scientific information and local knowledge is fundamental for effective decision-making, particularly in the arena of climate change, where climate projections, GHG inventories, and vulnerability assessments are vital for setting baselines against which progress towards mitigation and adaptation targets can be evaluated.

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The availability, communication, and use of information are essential for effective governance. These are not mere technical exercises of collection and insertion of information into the policy process; rather, they are politically determined by power relationships between levels of government, and between government, the private sector, and grassroots actors (Romero-Lankao et al. 2015). Problems of access to usable information are particularly substantial. For instance, an international survey on climate change policies shows that, for 40 percent of surveyed cities, lack of information on the local impacts of climate change is a major challenge to climate change planning and implementation (compared to the 27 percent who report being challenged by a lack of data on GHG emissions)(Aylett 2013a).

Behind the efforts of many cities that are taking steps to address climate change and other sustainability concerns lies the work of leaders, often termed *policy champions*, who frame climate and other concerns as policy issues and put them onto the political agenda (Betsill and Bulkeley 2007). Effective leadership strategies comprise the capacity to leverage resources from national and international networks, to create and promote the right framings of complex issues (such as climate mitigation as a means to save money and promote green growth), to create collective consensus, and to institute a shared understanding about the policy direction of a city (Cashmore and Wejs 2014). For instance, scholarship has found that leadership from a mayor, from senior elected officials, or from senior managers is a fundamental enabler of successful climate mitigation strategies (Aylett 2013b). However, for the leadership of individuals to persist, it must be complemented by legal and regulatory changes, by investments in institution building (Hughes and Romero-Lankao 2014), and by a strong civil society (see, for example, Manizales).

13.6 Concluding Remarks

While local governments face many obstacles, they also possess a variety of instruments and policy options for governance, such as land-use planning, transportation systems, building codes, and closer ties to constituents working on the ground. These instruments can help strengthen and trigger action by other levels of government and by private and civil society actors. The level of independence and capacity to govern sustainability and resilience varies across urban areas, but there are still many potential and often untapped possibilities available to urban actors to create effective actions. Urban actors vary in their levels of leadership, access to information, legal mandates, and financial resources. Thus, most innovative approaches will unavoidably need to consider both bottom-up and top-down strategies that can help nurture

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innovations and experiments to achieve sustainable, effective, and fair urban environmental governance.

The remaining chapters in this section look closely at the governance of environmental change and transformations through different forms of experimentation. They examine the actors driving experimentation to shed light on the conditions, momentum, and institutional contexts in which experimentations operate and how they affect the dynamics of urban change. The authors also engage with the conflicts and contestations arising from dominant interests vested in space accessibility and use in cities, all of which are related to different narratives and perceptions about what desirable and inclusive development looks like in cities.

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