Cities and the Governing of Climate Change

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Abstract

Studies of the urban governance of climate change have proliferated over the past decade, as municipalities across the world increasingly place the issue on their agendas and private actors seek to respond to the issue. This review examines the history and development of urban climate governance, the policies and measures that have been put into place, the multilevel governance context in which these are undertaken, and the factors that have structured the posibilities for addressing the issue. It highlights the limits of existing work and the need for future research to provide more comprehensive analyses of the achievements and limitations of urban climate governance. It calls for engagement with alternative theoretical perspectives to understand how climate change is being governed in the city and the implications for urban governance, socioenvironmental justice, and the reconfiguration of political authority.

Contents

Climate change: changes in the earth-ocean-atmospheric system resulting from the introduction of greenhouse gases from anthropogenic sources

Adaptation: implementation of measures to reduce current and future vulnerabilities to the impacts of climate change

Mitigation: the reduction of GHG emissions and their capture and storage in order to limit the extent of climate change

INTRODUCTION

Perhaps one of the most surprising responses to climate change over the past two decades has been the growing involvement of municipal governments and other urban actors in efforts to reduce emissions of greenhouse gases (GHGs) and increasingly to adopt adaptation measures. Traditionally conceived as a global problem requiring global solutions, the urban politics of climate change has been a key factor in challenging research and policy communities to reconsider how the governance of global environmental problems takes place (1–4). This article reviews the debates concerning the role of cities in governing climate change and assesses the wider implications for our understanding of (urban) environmental governance.

Research on the development of urban climate policy and governance began in the mid-1990s (e.g., 5–8) and focused on single case studies predominantly of cities in the United States, Canada, Europe, and Australia (e.g., 9–16), although important work has more recently been conducted in Asia, South Africa, and Latin America (17–21), and the research community has begun to examine issues confronting urban climate adaptation in the global South (e.g., 22–25). As the research on urban responses to climate change has grown, so too has recognition of the potential importance of the city as a site for addressing the issue. Both the International Energy Agency (26) and the Stern Review (27) suggest that cities may be responsible for up to 75% of global emissions of carbon dioxide from anthropogenic sources. Although, as discussed below, these figures are highly contested (28–29), the urban concentration of GHG emissions is perhaps not surprising—given the increasing proportion of the world's population that lives and works in cities and the ways in which energy demand, buildings, waste and water services, as well as industrial processes are centered in urban locations (30). Cities in the North, and increasingly in rapidly industrializing countries, may therefore represent a significant proportion of global emissions. For example, London's emissions of GHGs are estimated at 44 megatonnes or 8% of the United Kingdom's total in 2006 (31) and are considered to be on a par with those of some European countries such as "Greece or Portugal" (32, p. 1). At the same time as the debate on the mitigation of climate change has grown, there has been an increasing recognition that issues of adaptation are also critical for cities. Urban vulnerabilities to climate change are particularly acute in the global South, where processes of global environmental change may not only lead to extreme events but also exacerbate chronic problems of poverty and environmental stress (24, 30).

In seeking to understand the potential of urban climate governance and its implications, the research community, mirroring the policy world, has primarily focused on issues of mitigation. Accordingly, in assessing the work in the field to date, this review also concentrates on the issue of mitigation, but also

discusses the growing literature on adaptation. It examines the three areas of work that have dominated the field: examining policy responses to climate change in the city; seeking to explain the governance of urban responses to the issue; and assessing the reasons why the realities of urban mitigation and adaptation efforts frequently fail to live up to the rhetoric. This review considers these aspects of the debate in turn, offering a summary and critique of current analyses and suggesting potential avenues for future research. The first section of the article considers the history and nature of urban responses to climate change. It reviews the evidence of the history of urban engagement with climate change, the critical role of transnational networks in this process, and the subsequent development of climate policy and initiatives. The second section examines the approaches that have been used to explain how the governing of climate change is taking place in cities. What is apparent from this analysis is that urban climate governance is a complex process driven by the intersection of the specific challenges of the issue itself and the reconfiguration of political authority across multiple levels and between public and private actors. To date, much of this literature has viewed the multilevel context within which urban climate governance is taking place as relatively static and benign. More recent work, however, takes a more critical approach, seeking to understand how and why cities have become a site for governing climate change and the implications this may have both for how we conceptualize the city and for our understanding of the nature of public and private authority. For all the promise of the growing involvement of cities in addressing climate change, authors have consistently pointed to a gap between the rhetoric and reality of urban responses. The third section of the article reviews the two key issues that have been found to lie at the heart of this issue—the institutional capacity of municipalities to act on climate change and the political economy within which such approaches are framed and implemented. However, more fundamental questions concerning the political economic context within which such struggles take place, and the sociotechnical networks through which policies are mediated, have to date been neglected in the literature. Taking these issues into account requires a more nuanced concept of the city as a site within which climate governance is taking place, one which recognizes the complex interaction of the social, material, economic, technical, and political within and between different spheres of authority.

URBAN RESPONSES TO CLIMATE CHANGE: A REVIEW OF THE EVIDENCE

In seeking to understand how cities are responding to climate change, the research community has focused on two key issues: (*a*) the history of the development of municipal responses and (*b*) the assessment of the strategies and actions that have been deployed in cities in response to the issue.

The Emergence of Urban Responses to Climate Change

Turning first to the development of urban climate governance, scholars have drawn attention to the changing politics and geographies of municipal responses. A first wave of municipal responses to climate can be identified from the literature starting in the early 1990s as individual cities, predominantly in North America and Europe, began to engage with the issue. For example, Lambright et al. (8) document how climate change emerged in Toronto following the international conference On the Changing Atmosphere—widely regarded as a policy catalyst for the international science community and nation-states—held there in 1988 and the subsequent championing of the issue by a senior politician. In the United Kingdom and Germany, pioneering local authorities, including those in Leicester, Kirklees, Newcastle, Heidleberg, Munich, and Frankfurt, developed climate change policies on the basis of their history of engagement with issues of energy conservation and the growing popularity of

CCP: Cities for Climate Protection

the discourse of sustainable development (5, 12–13).

Given their small-scale and incremental nature, these individual efforts may have gone largely unnoticed by the research and policy communities concerned with global environmental issues if it had not been for the involvement of many of these pioneering municipalities in transnational networks. In the early 1990s, preceding the Rio United Nations Conference on Environment and Development, three different transnational municipal networks were formed. The International Council for Local Environmental Initiatives, now known as ICLEI Local Governments for Sustainability, organized the Urban CO_2 Reduction Project, funded by the U.S. Environmental Protection Agency, the City of Toronto, and several private foundations, with the aim of developing city-level plans and tools for the reduction of GHG emissions (8, 12). Subsequently, this program was expanded into the Cities for Climate Protection network, which has grown internationally over the past two decades to include over 1,000 members worldwide (33), accounting for "approximately 15% of global anthropogenic greenhouse gas emissions" (34). A second, the Climate Alliance, was founded in 1990 as an alliance between European cities and indigenous peoples and now has some 1,100 members in 17 European countries with a concentration in Germany, Austria, and the Netherlands. Its aim is to reduce emissions to 50% below 1990 levels by 2030 and protect the rainforest through partnerships and projects with indigenous rainforest peoples (35). A third, energie-cités, was initially formed in 1990 by 6 local authorities, including Besacon (France), Newcastle (United Kingdom) and Manheim (Germany), involved in a European Union (EU) project. With the support of the European Union, additional participants were sought, and in 1994 with 16 members from across Europe, the network was formally constituted as an association of municipalities. By the end of the 1990s, concentrations of urban responses to climate change were taking place in Europe, driven by the Climate Alliance and energie-cités' networks, as well as in North America and Australia, where the Cities for Climate Protection (CCP) network was beginning to expand (9–12, 16). In the main, national governments and the emerging international regime for governing climate change showed little interest in these activities at this stage (12), though in both Japan and Sweden research has found that local governments were encouraged by national authorities to develop climate change strategies and were provided financial assistance to this end (36, 37).

Since the early 2000s, a second wave of municipal action on climate change can be identified encompassing a new generation of municipal networks and a more geographically diverse range of cities (38–40). The municipal networks that have been established over the past decade are significantly different from their predecessors in three key ways. First, many networks are now nationally organized. In part, this reflects the changing organizational structure of municipal networking. Transnational municipal networks have established regional or country-based campaigns, such as the CCP program in Australia or the energie-cités' network in Poland, while national networks have also been established, most notably the U.S. Mayors Climate Protection Agreement (**http://www.usmayors.org/climateprotection/documents/mcpAgreement.pdf**). Although it was in 2000 that the U.S. Conference of Mayors first noted the significant role that mayors could take in addressing climate change, it was in 2005 that the Mayor of Seattle, Greg Nickels, challenged mayors across the United States to take action on the issue (38, p. 142). Following an initial agreement among 10 of the leading U.S. cities on climate change, a further call to action attracted over 180 mayors, and by 2009 over 900 mayors had signed the Climate Protection Agreement (38, p. 143). This approach has been replicated globally, most recently with the launch in 2009 of the European Covenant of Mayors, which now has more than 1,000 members. In addition, research has found that once

examples of climate change strategy and action have been developed nationally, "attention shifts to these cases" (41, p. 353) rather than to international examples. In Sweden, of 184 responding municipalities, "72% stated that they cooperate with other actors in networks dedicated specifically to climate issues or where climate was included as one issue among others. . .[and] networking was most frequent among towns and cities within Sweden" (36, p. 542).

A second feature of the new generation of municipal climate networks is the way in which they mobilize private actors alongside the (local) state (42). For example, the C40 Cities Climate Leadership Group has bought together 40 of the world's global cities to address climate change (39). This network was instigated by the Mayor of London and the Climate Group and was formed by 18 cities in 2005 as a parallel initiative to the Group of Eight (G8) Gleneagles summit on climate change. In 2007, this network entered into a partnership with the Clinton Climate Initiative (CCI) and expanded its membership to include 40 of the largest cities in the world. Private actors are central to this network, for example, in the form of collaboration with Microsoft to produce software for GHG emissions accounting at the city scale and in the CCI's Energy Efficiency Building Retrofit Program, which brings together cities, building owners, banks, and energy-service companies to reduce GHG emissions from large corporate buildings. Third, a number of grassroots networks are now emerging that have an explicit urban focus (43). Here, the most notable is the Transition Towns movement, which began in 2006 in Totnes, United Kingdom; by 2008, it had some 100 communities as members, which were primarily in the United Kingdom but also included some in the United States, Australia, Japan, and Chile (43). These developments suggest that it is no longer adequate to consider the urban governance of climate change solely from the perspective of municipal authorities but that it is necessary to consider how, why, and with what implications other actors are seeking to govern the climate through the city (42). In addition, urban networks have taken a more overtly political stance toward the issue, seeking to position cities as critical sites for addressing the issue of climate change or even opposing national governments (as in the United States and Australia), and in so doing have advanced claims for the strategic importance of urban governance (39). The growing weight of this movement was evident at the 2007 Conference of the Parties to the United Nations Framework Convention on Climate Change in Bali, where representatives from municipalities formed a substantial constituency and signed the Bali World Mayors and Local Governments Climate Protection Agreement, drawing together for the first time the diverse networks discussed above.

Global city: a city with particular strategic economic or political importance

Alongside this new generation of urban climate networks, researchers have identified the growth and diversification of the cities involved. First, a new engagement with issues of climate change has been identified among global cities. Although the pioneering municipalities that engaged with the issue in the 1990s tended to be medium or small cities (35), the past decade has seen climate change become a policy issue for capital cities and large metropolitan areas (39). Second, there has been a growing involvement from cities in the global South (28–29, 42). Although the CCP program has sought to expand its membership in regions such as Asia and Latin America, new networks, including C40, CCI, and the Resilience Network, have explicitly targeted cities in middle- and low-income nations. At the same time, mainstream development organizations—most notably the World Bank, which hosted an Urban Research Symposium on the topic in 2009, and UN-HABITAT, whose 2011 Global Report on Human Settlements will address the issue—have begun to show an interest in the urban implications of climate change. Coupled with this increasing diversity has been a growing acknowledgment that issues of vulnerability and adaptation are as significant as mitigation. However, research suggests that issues of adaptation remain marginal:

> most urban governments in low- and middle-income nations have not considered adaptation seriously. For instance, in India, Chile, Argentina and Mexico, central government is beginning to take an interest in adaptation, but this interest has yet to engage the interests of the larger, more powerful national ministries or agencies or city and municipal governments (44, p. 14).

A recent analysis of the climate change strategies and actions of 10 cities in India, China, Mexico, Brazil, Australia, South Korea, Indonesia, and South Africa found that mitigation remains the focus of urban climate policy, despite the arguably more pressing adaptation issues facing cities in the global South (42).

In seeking to explain the emergence of urban climate governance, many scholars have drawn attention to the importance of individual politicians or officials—sometimes termed policy entrepreneurs—who champion the issue, set agendas, and establish the basis for policy responses. For example, in Baoding, Hebei Province, the development of a low-carbon city development initiative was facilitated by the Mayor, who realized "the need to develop institutions and policy for low-carbon city development and hopes that his pioneering efforts will set a role model for low-carbon city development in the country" (45, p. 386). Likewise, in both London and Los Angeles, it has been the influence of the Mayor that has been critical in mobilizing climate change policies (46, 47), and the emergence of the U.S. Mayors Climate Protection Agreement, discussed above, also points to the significant role that individual politicians are playing in catalyzing climate governance in the city (38). However, these studies also suggest that individuals can only take climate change action so far, for "while policy entrepreneurs are critical at the start of a policy process, in order to overcome the constraints of administrative structures, party politics and political timetables, and to survive the loss of particular individuals, a broader institutional capacity for climate protection is necessary (13, p. 2253). Policy entrepreneurs may then be a necessary, but not sufficient, ingredient in the development of urban climate governance. Researchers have also identified the transnational municipal networks, discussed above, as a key factor in generating urban responses to the issue. Networks have provided the resources and political space within which policy entrepreneurs can operate with some degree of protection from "politics as usual" (see below). Hoffman (48) suggests that the transnational urban governance of climate change is one of a suite of "governance experiments" that are emerging in response to the issue. Experiments are, he argues, emerging as a result of the fragmentation of authority to govern global environmental issues (discussed below) and of a growing dissatisfaction with the multilateral processes put in place to address climate change. Although some cities and networks started to address climate change before the Kyoto Protocol agreement, this movement has gathered pace significantly since the early 2000s because of a growing sense of the failure in international negotiations. Within this context, Hoffman (48) suggests that actors are motivated to devise and implement experiments on the basis of profit, out of a sense of urgency, through a desire to expand authority and their claims to resource, and as a form of ideological expression. In relation to the urban governance of climate change, these motivations are clearly visible as actors seek to develop the "win-win" potential of responding to climate change, make claims that cities can act more quickly on this issue than national governments, stake claims for resources based on their potential to mitigate or adapt to climate change, and use the issue as a basis for political contestation with other levels of government. In marrying broader structural processes affecting the governing of global environmental issues with the actions of policy entrepreneurs, Hoffman (48) provides a convincing framework within which to understand the basis of the phenomenon. At the same time, his analysis provokes a range of further questions for the research community concerning the extent to which

such experiments are taking place within as well as across cities and their implications in terms of the accountability and legitimacy of decision making in this critical policy area.

Assessing Urban Policies and Initiatives

In terms of documenting urban responses to the issue of climate change, a second core concern has been with the assessment of the strategies and initiatives that have been developed. On the one hand, researchers have sought to analyze and explain the nature of urban climate change policy. Even though many transnational municipal networks have sought to promote a systematic response to the issue, characterized by the assessment of GHG emissions, target setting, and performance monitoring, research has found that "numerous cities, which have adopted GHG reduction targets, have failed to pursue such a systematic and structured approach and, instead, prefer to implement no-regret measures on a case by case basis" (49, p. 4). Furthermore, research suggests that, in the main, municipal authorities have focused on implementing measures in their own estate rather than in the community and have concentrated effort in the energy sector (1, 13, 38). Reviewing the evidence of the sorts of schemes and measures that have been implemented, Schreurs (41, p. 353) finds that "the kind of climate change initiatives that local governments can most easily do appear to be such activities as climate change and renewable energy target setting, energy efficiency incentive programs, educational efforts, green local government procurement standards, public transportation policies, public-private partnership agreements with local businesses, and tree planting." That energy, and in particular energy efficiency, is at the heart of many urban climate change initiatives is perhaps not that surprising. Energy provision and management is a sector in which municipalities have had a long history of engagement in North America and Europe, albeit this influence is now waning (5, 13, 51). Furthermore, as Rutland & Aylett (52, p. 636) have argued in the analysis of the development of climate change policy in Portland, Oregon, energy efficiency is a particularly powerful mobilizing device as it can "advance diverse (and often divergent) goals in tandem," serving to translate various interests into those concerning climate change and effectively forging new alliances. Increasingly, issues of energy security and energy costs are serving to place the issue on urban policy agendas, and links to addressing climate change can therefore serve to justify a new politics of urban "ecological security" (39). However, as the issue of reducing GHG emissions has started to be addressed in a more geographically diverse range of cities, there is some evidence of a switch from a concern with reducing the domestic use of energy to commercial buildings and of the development of initiatives that target transportation issues, primarily to address congestion and air quality, but that also have side benefits in terms of mitigation (21, 42).

At the same time, a shift has been noted in the approaches taken to address climate change in cities. If the pioneering cities that took on the issue in the 1990s were mainly concerned with self-regulation—the reduction of emissions from their own estate and operations—and the development of enabling activities to promote the actions of communities and businesses (13), there is some evidence that, as climate change becomes an issue in a wider range of cities and gains political momentum, regulation and the direct provision of low-carbon services and infrastructures are being deployed by municipalities (42). Equally, the growing involvement of a wider range of partners in the urban governance of climate change and the growing number of ad hoc projects developed to respond to the issue mean that the governing of climate change now extends beyond municipal authorities. Nonetheless, within both local governments and other organizations, researchers find that climate change remains a marginal issue, usually confined to the environmental wing of local authorities and disjointed from other areas of policy making (49). Furthermore, to date

the literature has provided very little evidence of the extent to which the growing mass of urban policies and initiatives to address climate change are having an impact either in terms of reducing GHG emissions or through reducing vulnerability to climate risks. In part, this reflects the more general challenges of assessing the impacts of policy interventions, the relatively short timescales involved, and the fragmented nature of the data available, especially with regard to levels and reductions of GHG emissions across urban communities. Although studies explicitly examining the stocks and flows of GHG in cities have been conducted (see, for example, References 53 and 54), these analyses of "urban metabolism" are focused on understanding historical and future trends rather than any direct assessment of the impact of policies and measures that have been put in place. It would seem that there is significant scope for a productive engagement between those researchers examining the governing of climate change in the city and those whose primary focus has been detailing the factors that are shaping trends in GHG emissions.

Such an engagement may also be one means of responding to recent critique that the focus on cities' responses to climate change is misplaced. Dodman (28) and Satterthwaite (29) have powerfully argued that the rhetoric that attributes over 70% of anthropogenic emissions of carbon dioxide to cities could be regarded as one that blames cities for the problem without either acknowledging the possible benefits of urban living or the significant differences within and between cities in terms of where responsibilities for current and future climate change might lie. Citing evidence that shows that urban dwellers have lower per capita GHG emissions than their rural counterparts, Dodman argues that a perspective that sees cities as the root of the climate change problem "ignores the fact that many of the processes implicit in urbanization can actually have a positive overall effect on global environmental change, and fails to recognize that the spatially varied consequences of global environmental change are likely to affect different urban areas in a variety of different ways" (28, p. 186). While transnational networks and urban elites may seek to enroll cities in the global South into the politics of reducing GHG emissions, Satterthwaite (29, 55) and Dodman (28) express concern that this may be both inappropriate—given the low levels of emissions involved and the more pressing issues of climate adaptation—and unjust, shifting the blame from northern consumers who are driving much of the emissions growth in industrializing countries and missing the "very large differentials in per capita emissions between different city individuals and households" (29, p. 546). Both authors are, however, at pains to point out that such an analysis "is not intended to mask the scale of the problem or to disguise the need for substantial action at the city level to address greenhouse gas emissions" (28, p. 197). Rather, it suggests that more careful analysis than has been offered in most of the literature to date is required as to where and with whom responsibilities for addressing climate change in the city may lie.

GOVERNING CLIMATE CHANGE IN THE CITY AND BEYOND

A second broad area of investigation with which the literature on cities and climate change has been concerned is the multilevel governance of global environmental issues. Work on urban responses to climate change was among the first to challenge traditional approaches that regarded the international community, and the development of regimes, as the exclusive site of global environmental politics. Equally, scholars have recognized that the context within which urban actors are responding to the issue is critically shaped by the structures and processes of governing taking place at other scales and through multiple networks (30, 36, 43, 50, 56, 57). Such multilevel approaches have been used to analyze the nature of urban climate change governance and, more recently, to analyze its implications in terms of the reconfiguration of political authority within and beyond the state. Taking their cue from the original literature

on multilevel governance in Europe, scholars have situated the development of urban climate governance at the interface of horizontal networked forms of authority and vertical divisions of responsibilities among different parts of the state. These different spheres of authority have been found to have profound effects on the ways in which climate change is governed in the city, and each is considered below in turn. Such approaches have, however, primarily taken the processes of multilevel governance for granted and have regarded urban climate governance as the outcome of this complex politics. A new direction in the research field, considered in the last part of this section, argues instead that responding to climate change in the city has become a strategic arena for the development of the state and one in which the restructuring of authority is taking place.

Network Governance

As discussed above, many scholars have identified the development and growth of transnational and national networks as central to the history of urban climate change responses (19, 35–36, 40–41, 57). Determined as an important facet of the multilevel governance framework within which urban responses have emerged, the analysis of municipal networks has also sought to uncover how, and with what implications, such networks are able to govern their constituent members in the absence of any direct form of authority. One analysis suggests that it is the opportunities that networks confer on their members that provides both the incentives to join and the "glue" that keeps networks together. For example, Granberg & Elander (36, p. 545) find that

> participating in networks gives municipalities access to flows of opportunities, and allows the municipality itself to be a part of the flow. Cooperation also opens a possibility to create a positive image of a municipality as forerunners spearheading innovative ideas align with ecological modernisation, i.e., combining local economic development with reduction of GHG emissions. Thus, networks may strengthen their participants' ability to attract investments from the private sector and from public funding to bring about sustainable development.

Access to the resources offered through transnational networks has been regarded as especially critical for cities in the global South. In Mexico City, Romero Lankao (21) argues that the presence of influential scientists, together with the CCP network, was instrumental in establishing climate change on the policy agenda, though their presence could not overcome greater institutional barriers to action such as the availability of resources and the coordination within and between relevant government bodies. Another interesting example can be drawn from Holgate's study (19) of two cities in South Africa—Cape Town and Johannesburg. Although both cities have similar socioeconomic and institutional challenges, the implementation of GHG mitigation policies has differed greatly. Cape Town has successfully implemented GHG mitigation measures because of cooperation with external institutions, including ICLEI's CCP program, nongovernmental organizations, Eskom (the local utility), and academic institutions. In contrast, Johannesburg has been less successful owing to a lack of institutional capacity, a fragmented structure, and privatized utilities, all of which reduced the city's ability to implement climate change initiatives (19).

Municipal networks are found to be successful in enrolling and keeping members in so far as they can offer expertise, funding opportunities, and the ability to disseminate and learn from good or best practices, and these networks have developed a range of mechanisms and tools, such as target setting, benchmarking, and other forms of soft regulation, enabling them to govern through their networks (35). However, as Toly (40) argues, these practices represent a form of technical leadership in which fundamental issues concerning the nature of the problem to be governed and the implications of various solutions are rarely

discussed. As he goes on to suggest, the "CCP and its member cities most often frame the call to action in terms of cobenefits that primarily satisfy the demands of other competing first principles," which serve to legitimize "neoliberal ecopolitical principles" and dilute "the capacity for norm contestation" (40, p. 350). However, Toly also identifies the potential for networks to govern differently through "norm entrepreneurship"—providing a political space in which alternative understandings of the (urban) climate change problem might be pursued. He identifies the 2005 International Solar Cities Initiative as one such example, given that it both "affirms the goal of a sustainable and equitable per capita emissions target" and seeks to develop "a cadre of entrepreneurial, pioneer, or 'benchmark' cities, which commit to ambitious emission reduction goals. . .which meet 2050 IPCC-consistent targets" (40, pp. 350–51). The Transition Towns network might also be considered in this regard, as it promotes alternative discourses about the nature of the climate change problem as linked to the profligate use of fossil fuels and the need to localize economic production and social life (43). In pointing to the critical role of networks in both technical and normative terms, Toly (40) captures the essence of their role in the urban governance of climate change. However, whether these two roles are as distinct as his analysis suggests is perhaps moot. The technical leadership offered by the CCP program, and indeed many other networks, is a means through which norms concerning what governing climate change should be about are made concrete. Most urban networks currently have goals that go far beyond those agreed upon in international forums, suggesting perhaps that challenges to climate orthodoxies are being mounted through these means. Nonetheless, his analysis is that by tying into neoliberal and eco-modern approaches to environmental governance—based on the fundamental principle that in addressing climate change or any other issue economic growth need not be jeopardized—such networks limit their capacity to achieve their ambitions, and this anlysis is persuasive.

Vertical Autonomy

In addition to considering the "horizontal" means through which the urban climate governance is being conducted, many analysts have found that the relations between local, regional, and national state authorities have been critical in determining the scope for responses (6, 12, 20–21, 36, 50, 56–59). In the main, this analysis has focused on the competencies that municipal governments have—in terms of their powers and duties—and the extent to which they have autonomy in exercising these in key policy sectors, such as transport, land-use planning, infrastructure development, building standards, waste management, and so on. The role of municipalities in these areas is usually defined by central or regional governments and is delegated to local authorities. Research has found that municipalities that have specific competencies for the direct provision of waste, transport, or energy services, such as is the case in many northern European countries, can have significant capacity to address climate change that other local authorities lack (5, 13, 17). However, this is a relatively rare situation. Most analysts find that municipalities have limited powers and responsibilities with respect to key sectors related to GHG emissions, including energy policy, pricing, and supply; the development of urban infrastructures, such as transport systems; the use of economic instruments, such as taxes and charges; as well as energy efficiency standards for buildings and appliances, though there is more autonomy with regard to land-use planning, education, and voluntary programs (5, 37, 41, 60–62). A study of climate change responses in Helsinki, Finland, illustrates how the relations between different levels of governance changes significantly across sectors. Monni & Raes (50) found that energy consumption in the built environment was determined by European regulations, such as the Energy Performance of Buildings, national regulations, municipal regulatory oversight, and voluntary agreements between energy companies and government departments. In this policy area, "the different levels of governance are working well together in

this field: the city is implementing energy performance policies by implementing the building code and granting energy aid, and also by participating in the voluntary energy conservation agreement scheme" (50, p. 753). However, when it comes to the promotion of renewable energy, policy initiatives at the city level remain in contradiction with EU and national policies of increasing renewable energy generation because of the technical and financial implications of changing existing energy networks to accommodate biofuels (50, p. 749).

Furthermore, although most municipalities have been found to have at least a degree of partial autonomy over the governing of climate change locally, the extent to which national and regional governments have actively supported urban actions varies significantly from country to country. In Sweden, for example, "although climate policy is not mandatory, central government support to local climate-change mitigation is offered through environmental and climate investment programmes requiring cooperation between local actors from both the public and the private sectors" (58, p. 63). Elsewhere, researchers suggest that it has only been because of changes in policy at the national level that municipal action has been forthcoming. In China, changes in local government priorities are usually the result of requirements or incentives offered by the national government (45). However, such mandates do not automatically lead to local responses. Qi et al. (45) propose instead that "local governments operate according to motivation (M), power (P) and capacity (C). They are also affected by various incentives (I) and constraints (C)" (45, pp. 389–90). Although relations between local and central governments are critical in determining these different factors, they also find that international policy—in the shape of the availability of carbon finances—and personal motivations are also key in determining the nature of urban climate governance in China. However, the multilevel governance of urban responses to climate change is not only structured by the formal competencies, autonomy, and financial incentives offered to local government but also by the political conflicts involved. It is perhaps in the United States that this has been most evident. Research by Betsill found that in "Colorado the state's 1999 appropriations bill forbids the expenditure of any state funds to implement the Kyoto Protocol until the treaty has been ratified by the U.S. Senate" (cited in 17, p. 21). However, in the United States, as in Australia, the absence of national leadership on the issue of climate change has also served to create a policy vacuum into which city and state authorities have ventured, suggesting that coordination and support across vertical layers of government may not always be necessary in promoting urban responses to climate change. Nonetheless, in each case, (state and) municipal authorities were able to draw on federal funding to undertake various initiatives, albeit these were relatively small in scale, and have been able to exercise their autonomy in devising and implementing climate policy. Summing up the current situation, Gore & Robinson (38, p. 155) suggest that, although "federal institutions have not directly impeded municipal actions," they have "only provided limited and largely inconsistent support," and it is currently unclear as to whether they will support future municipal action.

Urban Climate Governance and the Restructuring of the State

Across a wide range of literature, then, multilevel governance—in terms of both the development of (transnational) networks and the relation between different levels of the state—has been found to be a critical factor shaping urban climate governance. In the main, authors have analyzed these processes in terms of (*a*) the divisions of responsibility and sharing of competencies between and across levels/spheres of governance; (*b*) the resources that are mobilized vertically and horizontally through these different sets of relations; and (*c*) the ways in which ideas and norms are learned, shared, and contested in these processes. In such accounts, multilevel governance is both regarded as the context within which

the urban governance of climate change has unfolded—providing opportunities for subnational actors and transnational networks as the authority of the nation-state is reduced and the governing of environmental issues takes place locally and globally—and as a set of processes that structure the opportunities for acting at the city scale. In effect, most authors have regarded multilevel governance as the stage upon which the drama of urban responses to climate change are played out. There has been considerably less attention given to the possibility that the urban governance of climate change may be a key site in the reconfiguration of (state-based) political authority. The absence of such consideration is perhaps all the more surprising given that such questions have been at the heart of urban and regional research for the past two decades (63). It is in part a reflection of the fundamental disconnect between scholars whose primary focus is on understanding the dynamics of urban governance, who have traditionally neglected the environmental sphere (64–66), and those whose first concern has been with understanding responses to climate change in the city, predominantly from an environmental or political science background. Some recent papers have, however, started to buck this trend. In their discussion of the climate policies developed by two cities in Sweden, Sundsvall and Växjö, Gustavsson et al. (58, p. 70) find a prevalence of networks ranging from the "very local network encompassing only local government actors to national and transnational networks, aiming at exchange of knowledge and experience between cities. There are also partnerships including actors both from the public and the private sectors in developing new technical solutions." They argue that this phenomenon is representative of what Brenner (63) has termed the rescaling of statehood, such that "climate networks and other networks are relatively self-governing, with collective actors challenging the territorially bounded, vertical, nature of central-local government relations" (58, p. 70) and that urban responses to climate change should be considered not only as an outcome of globalization but as fundamental to that contested set of processes (58, p. 72). What is less clear from their analysis is, however, the extent to which the state is being fundamentally reconfigured through this process or whether the governing of climate change in the city is taking place through an alternative geography of authority and resources that operates around (and some would say at the margins of) existing state practices.

In their recent paper, While et al. (66) make a stronger claim for the reworking of the state and the resulting implications for urban and regional governance through processes of "carbon control." They suggest that a continual (and contested) process, occurring over the past 40 years, of *eco-state restructuring* can be identified and defined it as "the ongoing reorganization of state powers, capacities, regulation and territorial structures around institutional pathways and strategic projects which are (at least from the vantage of state interests at a given moment in time) viewed as less environmentally damaging than previous trajectories" (66, p. 77). In practice, eco-state restructuring "includes organizing and mobilising strategic interests and actors to undertake specific projects and activities that the state. . .understands to be consistent with strategic environmental goals and outcomes set at international and national levels" (66, p. 80). Within this framework, they suggest that over the past four decades, three waves of environmental governance can be identified: the first, which dominated the 1970s and 1980s, focused on prevention and control of environmental pollution; a second was based on the concepts of sustainable development and ecological modernization in the 1990s; and a third, which occurred over the past decade, has had at its heart the notion of carbon control (66, pp. 80–82). They suggest that the current phase of eco-state restructuring, which is based on carbon control, is giving rise to a "distinctive political economy" given that discourses of mitigating climate change both "open up, and necessitate an extension of, state intervention in the spheres of production and consumption. Controlling carbon emissions might be seen as a problem

and an opportunity for advanced liberal states" (66, p. 82).

Other authors have, of course, drawn attention to the fundamental challenges that addressing climate change poses for the state, and in particular its relation with private authority (for a review, see Reference 2). However, While et al. (66) offer a perspective that deals directly with the potential implications for urban and regional governance. As they argue, to date less attention has been paid to how "international and national carbon control regimes *come to ground*" at the urban and regional scale. This, they argue, is critical for "the coming era of carbon control will alter the strategic context for urban and regional management in ways that go beyond the largely voluntaristic carbon reduction strategies so far pursued by activist authorities" (66, pp. 86–87) through, for example, the need to comply with new forms of legislation, pressure to invest in low-carbon infrastructures, the need to manage low-carbon budgets, and the opportunities offered by new carbon markets. In particular, they suggest that the restructuring of the state around carbon control may alter the "calculative practices of urban management" (66, p. 87) both in simple financial terms and in relation to the role of the state in relation to energy networks and infrastructures. This, in turn, may "open up alternative socioeconomic possibilities for localities and regions locked into the narrow growth pathways of the neoliberal competition state" (66, p. 87). Furthermore, they argue that, as practices of carbon control come into contact with existing patterns of uneven social and economic development, a distributional politics of the responsibilities, benefits, and consequences of addressing climate change may emerge. For example, this is witnessed in the growing debates in the United States about the impact of cap-and-trade schemes on different regions and the impacts of climate policies on the inner cities and suburbs (66, p. 88). In making the connection between the reworking of the state, processes of urban and regional governance, and efforts to address climate change in the city, While et al. (66) offer much food for thought and a significant set of questions for the research community. However, although traces of the sorts of processes that they identify can be seen [for example, as global cities start to engage with the issue (39, 67) and alternative discourses of economic development emerge (43)], there is limited evidence to date that they are becoming widespread, especially outside of the United Kingdom. In addition, for the most part, urban and regional responses to climate change remain voluntary, and despite the strong emphasis on carbon control in these discourses, whether "state strategies of carbon control. . .represent a harder edge to state environmental regulation" (66, p. 77) through the use of nonnegotiable targets is moot. Furthermore, as summarized above, research has found that, even though the state has had a critical role to play in orchestrating the possibilities for responding to climate change in the city, this has also been determined through a range of networks and the interweaving of public and private authority, raising questions as to how far the politics of carbon control is a state project.

Nonetheless, the argument that climate change is becoming a key strategic issue for cities around the world and that this process cannot be understood without recourse to the broader processes affecting urban and regional governance is well made. In another recent account, Hodson & Marvin (39) argue that global cities are now engaged in a project of urban ecological security in response to concerns over resource constraint and climate change. In a similar vein to While et al. (66), they suggest that issues of environmental governance are becoming a key strategic concern for urban authorities, provoked by discourses of the urban causes and consequences of environmental problems and facilitated through the restructuring of the state and the creation of "new state spaces"[1] (39, pp. 195–96). This they contend

[1]The term new state spaces describes novel arrangements for governing public affairs undertaken by the state, usually in partnership with private and third sector organizations, beyond traditional government mechanisms and institutions.

is leading "the world's largest cities" to begin "to translate their strategic concern about their ability to guarantee resources into strategies designed to reshape the city and their relations with resources and other spaces" (39, p. 200). They suggest that these strategies are manifest in three particular ways: the protection of the city against the potential impacts of climate change, the decoupling of urban infrastructures from national and regional systems "by building more 'self-sufficient' infrastructures of provision on a city scale" (39, p. 201), and the creation of new global urban agglomerations through the development of networks of world cities and the development of intercity technological networks. Together, they suggest, this amounts to the "metropolitization" of ecological resources, as urban authorities seek both to relocalize key infrastructure networks and to "glurbanize" through transnational collaboration, underpinned by a new logic for urban development of "Secure Urbanism and Resilient Infrastructure" (39, p. 204). In documenting the growing response among the world's major cities to climate change, Hodson & Marvin raise some significant issues concerning both how climate change is being interpreted and the consequent implications for these and other cities. As such cities make claims on national resources and enroll powerful private actors "to develop strategies, social relations and technologies that can attempt to guarantee the ecological security of infrastructure" (39, p. 201), there is a need to critically assess "the implications of this new logic in shaping the contours of the emblematic, exemplary and dominant sociotechnical-ecological fix for cities" (39, p. 210). In particular, they raise questions about the roles of elites and particular interest groups in establishing what counts as feasible and desirable responses to climate change and which cities and communities may be excluded through these processes. In drawing attention to the political economies of the processes of responding to climate change in the city, Hodson & Marvin (39) provide some crucial avenues for future research in this area. This is particularly important given that research in this field has to date failed to provide much insight into who gains and who loses from the new urban politics of climate change.

POLICY FAILURE AND POLITICAL STRUGGLE

The third key issue with which scholars in this field have been concerned is with examining why the political rhetoric of urban commitments to addressing climate change has so far failed to make a significant impression. Explanations are usually described either in terms of institutional capacity (for example, concerning the jurisdictional remit or resources of municipal authorities) or in terms of political factors (for example, the opportunities for political leadership or the degree to which addressing climate change fits with other social and economic concerns in the city). These different approaches are reviewed and critiqued below. New research in the field suggests that there is a need to critically address the basis for the lack of capacity and the political conflicts that have been encountered locally, and that this may require the deployment of alternative theoretical perspectives.

Institutional Capacity

Turning first to issues of institutional capacity, as discussed above, one factor that many authors have identified is the level of vertical autonomy between municipalities and other levels of government (17). This is further exacerbated by what has been termed the problem of "fit"—the lack of coincident boundaries between the scale of the issues that need to be addressed (e.g., commuting) and municipal authority. In Thailand, Lebel et al. (68, p. 117) suggest that the "jurisdictional areas of the current municipal boundary of Chiang Mai is way too small to be relevant to affectively govern the urbanization process" given the interplay between urban and rural processes in shaping urbanization. Similarly, in her study of climate responses in Mexico City, Romero Lankao (21, p. 529) finds

> the administrative structure of city's governance differs from its boundaries and carbon-relevant socioeconomic and ecological functioning. Administratively, the city is managed by diverse federal, state and local tiers of government. Yet, the city functions as a complex system; its core area and localities, activities and households are interlinked by economic interchanges and transportation activities, by fluxes of materials and energy.

In such cases, analysts usually suggest that more coordination between different levels of government is required. Other issues of capacity and resources are also considered significant. One is the degree to which municipal authorities and other urban actors have sufficient knowledge of the problem of climate change upon which to act. In terms of reducing GHG emissions, researchers have found that, despite the efforts of transnational municipal networks and a few examples of localized models, problems in assessing GHG emissions remain significant for most local authorities, particularly those in the global South because of a lack of data and the challenges of downscaling approaches designed for profiling emissions at regional and national spatial scales (9, 37, 68). Arguably, given the significant variations involved between and within cities and the uncertainty over the potential impacts of climate change, these issues are even more pressing when it comes to climate adaptation (25). A third set of institutional issues identified in the literature relates to the internal dynamics of municipal governments. Research has found that expertise on climate change remains concentrated in the environmental department (49). This potentially limits municipal capacity for two reasons. First, environmental departments are often marginalized within municipal (and other) authorities. Second, the "cross cutting nature of climate change governance means that environment departments or agencies are frequently not able to implement the policies (for transportation or finance for example) that are required to address the problem" (42, p. 23). In this context, it has been argued that "mainstreaming, coordination, and cooperation across government agencies is vital" (69, p. 24; see also 17, 49).

A final, and arguably the most important, institutional factor shaping urban capacity to respond to climate change identified in the literature is that of resources—both human and financial. Holgate's (19) study of climate change policy and action in Johannesburg and Cape Town demonstrates how limited human resources can make a significant difference to the extent and efficacy of the measures taken. In Cape Town, the comparatively well-resourced municipality was able, with the help of additional resources from outside the local authority, to make significant advances in tackling the issues, whereas in Johannesburg, one officer was responsible for addressing the range of environmental challenges facing the city, and, at least partly as a result, the response to climate change was minimal. Satterthwaite (44) draws attention to the problem of a lack of municipal finance for providing basic infrastructures and the consequent implications for adaptation. This lack of service provision, he goes on to argue, reflects

> local governments lacking the resources to meet their responsibilities—and often with very limited capacities to invest (as almost all local revenues go to recurrent expenditures or debt repayment). These inadequacies often reflect local governments that are unrepresentative, unaccountable and antipoor—as they regard the population living in informal settlements and working within the informal economy as 'the problem' (44, p. 11; see also 24, 55).

Although not as critical in life-and-death terms, similar findings concerning the lack of resources to implement measures that could address climate change have also been found in developed countries, where the ability to access external sources of funding has been a key factor in determining which municipalities have put some policies and measures into place (13, 36, 61).

Political Economies of Urban Climate Governance

Frequently, the prescription given for overcoming the institutional barriers discussed above is to generate more capacity through the development of more knowledge, the provision of more resources, the creation of new institutions, enhancing good governance, or through ceding more autonomy to municipalities (e.g., 9, 17, 19, 21, 42, 49, 56). However, as many researchers have pointed out, such institutional barriers do not operate within a political vacuum, and more often than not, it is the urban political economies of climate change that matter most in enabling and constraining effective action.

At the most fundamental level, struggles have emerged over whether cities should or should not be addressing climate change. Bai (17) suggests that the "not on my turf" and "not in my term" arguments are prevalent in many cities, particularly in the global South, where resources are limited and other concerns are more pressing (see also 24). Likewise, given the global politics of climate change, questions of responsibilities and of development priorities also arise. As Lasco et al. (70, p. 84) explain, "for many developing countries GHG mitigation has a negative connotation because of the perception that this will deny them of their basic right to growth in human services and economic activities; the prospects of 'reduced growth' or 'no growth' are not feasible." Such tensions are, however, also discernible in the politics of addressing climate change within cities in the North. In the United States, for example, Zahran et al. (71) observe that it is communities most likely to be affected by the impacts of climate change, and those with a liberal political constituency, in which climate change mitigation is likely to be prioritized. In their study of climate change mitigation and transport policy in Cambridgeshire, Bulkeley & Betsill (12) found that efforts to reduce the demand for travel and hence of GHG emissions locally had been confounded by the priority given to economic considerations within transport and land-use planning and the stress on the need for increasing travel demand in the county.

At the same time, research suggests that addressing the challenges of adaptation is also politically difficult, particularly in cities in the global South. As Satterthwaite (44) argues, those most vulnerable to the impacts of climate change are those in the more vulnerable and high-risk sites, which may lack competent, capable, and accountable government, and often lie outside the public provision of infrastructure and services, such as those living in squatter settlements. In these cases, it may be an absence of governance rather than any overt conflicts about how to address adaptation that is creating the biggest barriers to action. This is not to say that more explicit conflicts may not arise. As Huq et al. (23, p. 14) have argued, the "kinds of changes needed in urban planning and governance to 'climate proof' cities are often supportive of development goals. But. . .they could also do the opposite—as plans and investments to cope with storms and sea-level rise forcibly clear the settlements that are currently on floodplains, or the informal settlements that are close to the coast." To date, research on the urban politics of adaptation has received relatively little attention, but as these arguments make clear, there is a pressing need to understand how, and with what implications, adapting to climate change is taking place in the city.

Given the potential ambiguous or overtly hostile responses to urban climate change initiatives, researchers have found that two factors have been important in enabling cities to respond to the issue. One factor has been the presence of opportunities to demonstrate leadership (by politicians and businesses, or for the municipality), and these have provided a means of countering arguments against taking action (41). These opportunities have arisen through the development of transnational municipal networks, which offer "soft" rewards for pioneering actions and trigger events, such as the hosting of global conferences or sporting events (35, 36, 42). These findings do of course beg questions about the possibilities for ordinary cities to overcome opposition

to addressing climate change through these means, with the potential of a divide opening up between those cities that can deploy resources to act on climate change ahead of the pack, creating a positive spiral of reward and (economic) gain, and those who can not, for whom climate change will remain a marginal issue. Equally, research has found that adaptation measures often get adopted only in response to specific local or regional natural disasters, which may or may not be climate related. For example, in Mumbai, after the 2005 deluge flooding, the Greater Mumbai Disaster Management Plan was revised in 2007, strengthening the Municipal Corporation of Greater Mumbai's Disaster Management Committee and raising the disaster preparedness of the city (72). However, in general, although political leaders have been able to create significant political capital on the issue of mitigation, to date there is little evidence that this has been the case in terms of addressing adaptation because of the relatively mundane nature of such measures, and this lack of opportunity for leadership may provide one explanation as to why this issue remains on the back burner for many cities.

A second key factor identified by several authors has been the ability of municipal actors to reframe climate change as a local problem and/or one that will have significant additional benefits (10). For example, in Canada, "actions to reduce GHG emissions are also deeply connected to other goals and cobenefits such as human health improvements through improved air quality, cost savings, adaptability to real or potential vulnerabilities due to climate change, and overall improvements in short, medium and long-term urban sustainability" (73, p. 9). Equally, Bai (17, p. 26) argues that there are plenty of local hooks upon which responding to climate change might be hung within cities in the global South, including "air pollution control, solid waste management, urban development and growth management, transportation and other infrastructure development, to name a few." Other studies suggest that it is this process of reframing, localizing, or issue bundling (74, p. 61) that has been effective in mobilizing local action on climate change in cities in the global South and that this will remain an important aspect of building the local capacity to act (20, 70). Although the research community has tended to evaluate such political strategies positively, little analysis has been conducted about their potential implications. Arguably, a focus on the win-win potential of addressing climate change lends support to neoliberal discourses about the ways in which the problem should be defined, focusing attention on issues such as energy efficiency, where there are clear monetary gains, and avoiding more fundamental questions concerning, for example, how (and by whom) energy is provided, mobility demands satiated, and the production of wastes reduced. Furthermore, it is not clear that all aspects of the climate change problem can be successfully reframed locally. Research suggests to date that there is an "absence of issue framing that has linked adaptation to pressing urban social, economic and environmental issues with the result that adaptation has limited traction or support locally" (42, p. 78).

New Directions in Understanding Urban Climate Governance

Despite the emphasis in many studies on the political issues that are arising in response to addressing climate change locally, relatively few examine the basis for such conflicts. Recent writing suggests the need to examine three key areas: the relation between public and private authority; the ways in which the policy problem of climate change is constituted; and the material basis of policy interventions in the networked infrastructures, which mediate relations between society and nature.

As discussed above, studies of urban governance have drawn attention to the need to critically consider the dynamics of political authority, the restructuring of the state. and the consequent implications for reducing GHG emissions or adapting to climate change. A recent study of the responses of two cities in Sweden (58) suggests that this can be critical:

> contrasting business structures lead to different climate-policy strategies. The large and energy-consuming industries are crucial actors in the local climate strategy of Sundsvall. In addition, the domination of a few large industries tends to bring about large-scale projects and solutions. In Växjö, however, local industry is typically small scale and less problematic from an environmental point of view. The city's climate policy thus has initiated a variety of projects, often small scale and experimental in character, where local government and local firms interact as partners with mutual interests (58, p. 71).

The boundaries of the relations between public and private are also in flux, particularly in the wake of neoliberal reforms, which have led to the privatization or contracting out of what were previously municipal services (51). Research in Johannesburg suggests that a process of semiprivatization has occurred within the local authority that "creates a silo effect where communication between different agencies, utilities and the city administration are fragmented," reducing municipal capacity to address climate change (19). At the same time, there is evidence that private actors are increasingly seeing cities as places within which to act on climate change, for example, the HSBC Climate Partnership in Hong Kong, London, Mumbai, New York, and Shanghai. The ways in which public and private authority is being reconfigured and contested through urban responses to climate change is a critical area for future research.

Although several authors have analyzed the ways in which conflicts over addressing climate change in the city occur, Rutland & Aylett (52, p. 628) suggest that in the main the research in this field has failed to consider the ways in which the object to be governed—in their case, GHG emissions—comes to be determined and understood, and the "significant political work" involved in this process. Equally, they suggest, limited attention has so far been given to how municipalities (and other authoritative actors in the city) come to govern the conduct of others in line with these objectives (52, p. 628). Understanding the work of policy, they argue, requires a different conceptualization of power and of governance than is usually deployed in the study of urban environmental governance, one based on theories of governmentality and actor-network theory. Using this framework, Rutland & Aylett (52) provide a detailed and compelling account of the development of urban climate policy in Portland, Oregon, including the ways in which interests were aligned and a diverse collection of actors (human and nonhuman) were bought into an assemblage through which GHG emissions came to be governed locally. As they explain, in the process of the development of policy "targets and tactics were applied only to elements of energy consumption that could be influenced in an acceptable way by the municipal government. Energy used in flights to and from Portland International Airport, for instance, was excluded. Also excluded were the significant amounts of energy used in importing and exporting commodities, and the energy actually embodied in commodities" (52, p. 636). In effect, the process of making policy also constitutes what the object to be governed should be, with important implications in terms of how climate change is addressed, and whose interests are served. Rutland & Aylett (52) go on to demonstrate how, once energy efficiency became the central means through which to address GHG emissions locally, the municipal authority sought to govern the conduct of households through the deployment of various forms of facilitative power in the form of technical guidance, incentives, rewards. and so on. While several authors have documented the use of such instruments in the development of urban climate policy, Rutland & Aylett (52) offer a novel way of analyzing these processes, which gets to the heart of questions concerning how, given the voluntary nature of most urban climate governance, anything is achieved. By offering an alternative account of power and authority to most analyses of urban climate governance, their work opens up a series of questions for the research community concerning how, and why, the

governing of climate change comes to be authoritative and is successfully (or otherwise) conducted in the city. Engaging with such new theoretical perspectives is crucial if the research carried out in this field is to thrive and make an impact on broader debates concerning environmental governance.

Finally, recent work has also suggested that there is significant potential for the research community to engage not only with the political but also with the material basis of urban climate governance. To date, limited engagement has taken place with the infrastructure networks that produce GHG emissions and that shape vulnerabilities to climate change. This is a critical issue for the research community for these sociotechnical networks "structure a major part of the material metabolism in industrialized societies. They source, use, and transform huge amounts of natural resources. At the same time they are key catalysts of environmental problems like air, water, and soil pollution, and nuclear risks, and they make a major contribution to global warming" (75, p. 3). Monstadt (75, p. 9) argues that despite their critical importance in urbanization and their role in essentially shaping "the scope for urban governance, they have so far been a blind spot in contemporary governance studies." Research that has been conducted focuses on "the question of the extent to which" the liberalization, commercialization, and privatization of infrastructure systems, together with technical innovation and new forms of regulation, "induce a 'splintering urbanism' which means aggravating urban (social/spatial) inequalities by emerging patterns of network provision, access, and use" (75, p. 11; see also 76–78). However, as Monstadt (75, p. 12) goes on to argue, this literature has to date neglected the ways in which such infrastructures mediate the relations between nature and society, and the processes of splintering urbanism "have rarely been reflected on with regard to their impact on the environmental performance of these systems and their ecologically sustainable redesign and reregulation in the context of urban and sociotechnical renewal." To address these questions, Monstadt argues for the constructive engagement of approaches from science and technology studies, urban political ecology, and urban governance. Given the potential significance of these processes with respect to the potential for urban responses to climate change, scholars from this research community may do well to engage with this new agenda. One potential future area of research he suggests is the "study of 'urban infrastructure regimes' understood as stable urban configurations of institutions, techniques, and artifacts which determine 'normal' sociotechnical developments in a city and thus shape general urban processes and the urban metabolism" (75, p. 14). Such analyses would shed light on the social and technical dynamics shaping the development of urban responses to climate change while being attentive to the politics of these processes and, potentially, their implications in terms of social and environmental justice.

CONCLUSIONS

Studies of the urban governance of climate change have proliferated over the past decade, as cities across the world increasingly place the issue on their agendas, transnational networks multiply, national governments seek to implement policies, and private actors experiment with various responses. Although much of this research has been limited in terms of both the number and geographical locations of the cases examined, it has provided a good deal of insight into the development and nature of urban climate governance. Following a period of policy innovation among some pioneering municipal governments and the birth of transnational municipal climate change networks in the 1990s, the 2000s have witnessed a rapid expansion in terms of the number of cities involved, accompanied by a growing diversity in terms of their positions within the urban hierarchy (both global cities and small urban communities) and their geography (especially in the global South). Despite these trends, the research suggests that urban climate change governance remains focused on the mitigation

agenda, with issues of climate change adaptation only recently beginning to make their presence felt, and that policy interventions remain concentrated on those issues, e.g., energy efficiency, in which additional benefits can also be realized. The research community has provided several insights into why this has been the case. Urban climate governance has primarily been driven by policy entrepreneurs and transnational municipal networks, reliant on persuasion and soft forms of (self-) regulation through which an emphasis on the win-win potential of addressing climate change in the city has become orthodox. With highly variable degrees of vertical autonomy, with respect to regional and national governments, institutional fragmentation, scarce finances, and local conflicts between environmental and development goals, the extent to which municipalities have been able to put into place policies that constrain emissions of GHGs or insist that future vulnerabilities are taken into account has been limited.

Despite these valuable insights, this review has also demonstrated some significant gaps in our current understanding of urban climate governance, opening up several horizons for future research. The first, and perhaps most fundamental, is that of evaluating the impact of the policies and measures that have been put into place in terms of reducing GHG emissions and enhancing urban resilience. We simply do not know what the impact of many of the initiatives that have been undertaken over the past two decades has been or what these achievements might amount to collectively. The second, related issue is that to date the research base has been built primarily upon the basis of small numbers of cases concentrated in Europe and North America. As a growing number of cities across the world engages with climate change, the evidence base must also diversify. Equally, there is a need for further comparative research using significant numbers of cases. Third, despite some notable exceptions, research on responses to climate change in the city has been driven primarily from perspectives of environmental management and global environmental governance. This review has highlighted several areas where engagement with other fields of study is necessary in order to grasp the complex problem that is governing climate change in the city. In particular, there is a need to engage more thoroughly with the processes of urbanization, development and urban governance, as well as with debates over the reconfiguration of political authority to understand how and why urban climate governance is being defined and contested. Such approaches would enable the analysis of who is gaining and who is losing from addressing climate change in the city and of the implications of these findings for broader processes of (environmental) governance. Finally, mirroring its intellectual roots, research in the field has deployed relatively few theoretical approaches in seeking to understand the subject of cities and climate change. Again with some exceptions, questions of how policy is made and contested, how governance is practiced, and the politics of these processes have been neglected. This review has shown that there are several different frameworks that could be used, including multilevel governance, actor-network theory, governmentality, theories of the state, and so on, which can provide valuable insights into how urban climate governance is taking shape. This is not to suggest that any one of these frameworks might be better than another, but it is a call for more theoretical engagement in the field and for the need to unpack some of the fundamental categories of analysis. Rather than viewing the city as an actor responding to global processes of environmental change and political fragmentation, this review has suggested that the urban governance of climate change is constituted through a myriad of public and private actors (operating across different scales and through multiple networks) and mediated through sociotechnical infrastructure systems and, in the process, is creating an arena in which what it means to act in response to climate change is being defined and, with it, what it means to have authority to govern.

SUMMARY POINTS

1. Over the past two decades, two waves of urban responses to climate change have been identified. The first was characterized by pioneering municipal governments and focused on issues of energy efficiency. The second has been more political in nature, encompassing a broader set of climate-related concerns and a wider range of cities, including those in the global South.
2. The emergence of the urban governance of climate change is one of a growing number of governance experiments that are emerging as a result of dissatisfaction with progress at the international level and the fragmentation of political authority.
3. The policies and measures that have been put in place in cities across the world are diverse but tend to be concentrated on mitigation, rather than adaptation, and concentrated on eco-modern responses that have economic as well as environmental benefits. Although action at the city level is growing, evidence of the impact and effectiveness of these measures is to date limited.
4. Research suggests that urban climate governance does not take place in a vacuum but rather is structured through processes of multilevel governance. Networks and governments have been found to be critical in shaping the capacity and political space for municipal responses.
5. On the whole, multilevel governance is regarded by analysts as the stage upon which the drama of urban responses to climate change is played out. New research suggests that the urban governance of climate change may instead be a key site in the reconfiguration of (state-based) political authority through carbon control.
6. Despite over two decades of policy interventions at the city level to address issues of climate governance, there remains a stubborn gap between rhetoric and action. Explanations for this gap vary from case to case but focus on issues of institutional capacity and factors of political economy.
7. Consequently, recommendations for enhancing responses to climate change at the urban level revolve around the development of capacity (in technical, legal, and financial terms) and of ways to marry climate change policies with other initiatives. However, such analyses fail to examine the underlying reasons why capacity is limited and conflict rife.
8. Alternative analyses, which examine issues of power, public and private authority, and the material infrastructures that mediate policy interventions, offer several promising lines for future inquiry. Engagement with these approaches may deliver new insights into how climate change is being governed in the city and determine the implications for urban governance, socioenvironmental justice, and the reconfiguration of political authority.

FUTURE ISSUES

1. What have been the impacts, in terms of reducing GHG emissions and vulnerability, of policies and measures implemented at the city scale? How significant are these impacts collectively?

2. What are the differences and similarities between policies to address mitigation and adaptation? How and why do approaches to addressing climate change in cities in the global South differ from those in the North?
3. To what extent is the city becoming an arena for experimentation in response to climate change? What forms are these experiments taking, and what are their impacts and implications?
4. How, and why, is climate change becoming a key strategic issue for urban governance? Are new discourses concerning energy and environmental security emerging? What are the implications of how the governing of climate change is being conducted?
5. To what extent is a more radical urban politics of climate change emerging? What forms is it taking, and what is their potential?
6. What are the implications of urban climate governance for issues of social and environmental justice?

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Annual Review of
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Contents

III. Management, Guidance, and Governance of Resources and Environment

Indexes

Errata

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