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Urban debates for climate change after the Kyoto Protocol

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Abstract
From the catalogue of environment-related publications in *Urban Studies*, this paper identifies and reviews 12 thought-provoking articles that have addressed the issue of climate changes and cities from complementary perspectives. It argues that to advance a holistic understanding of urban environmental issues it is necessary to embrace a broad multi-disciplinary approach, particularly as moving towards low carbon urban living will require integrated social, political and technical adaptation processes. Ultimately, the paper advances a forward-looking research agenda that extends beyond consideration of how to improve urban environmental performance to include evaluation of how urban consumers, firms and local government endeavour to achieve sustainable urban development.

Keywords
development, environment, governance, sustainable, urban

摘要
本文从《城市研究》与环境相关的文章目录中找出并审视了 12 篇激发思考的文章，这些文章从互补的视角探讨了气候变化与城市的问题。文章指出，要推进对城市环境问题的整体性理解，就必须采用宽泛的多学科方式，尤其是因为转向低碳城市生活需要社会、政治和技术的综合调整过程。最后，本文提出了一个前瞻性的研究议程，将思考范围从如何改善城市环境表现扩展到包括评估城市消费者、公司和地方政府如何努力实现可持续城市发展上。

关键词
发展、环境、治理、可持续、城市

The Kyoto Protocol identified climate change as a global problem and in 1997 set internationally binding greenhouse gas emission reduction targets that took effect in 2005. A substantial number of economic or environmental journals have subsequently published environment-related articles that focus on aspects of global economic growth (e.g. Almer and Winkler, 2017; Antweiler et al., 2001; Cole and Elliott, 2003; Li and Tu, 2013). Cities as such were not mentioned in the Kyoto Protocol because international negotiations for the climate change issue often take place between national

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governments (Hebbert and Jankovic, 2013). Cities, however, are responsible for up to 70% of greenhouse gas (GHG) emissions, even though they occupy only 2% of all land (UN HABITAT, 2011). More encouragingly, the myriad links between cities and climate change have been carefully documented in the research reports of several world organisations (e.g. OECD, 2009; UN HABITAT, 2011) and have also been extensively explored in articles and journal special issues such as the recent collections edited by While and Whitehead (2013) and Rutherford and Coutard (2014) for *Urban Studies*, and the cross-disciplinary dialogue on future perspectives for a sustainable development of regional resources edited by Fürst et al. (2013) in the *Journal of Environmental Management*.

Based on available studies, the urban debates on climate change can be broadly classified into two domains: the causes and consequences of climate change at the urban level, and interventions to counteract urban environmental degradation. Both domains include a wide range of topics, such as the relationships between urban forms, planning and environment; urban energy consumption and the environment; urban waste disposal and water conservation; green urban development; citizens' participation in environmental conservation; sustainable economic growth; low carbon urban transitions and governance gaps in conducting climate change interventions. While not exhaustive, this list implies that understanding environmental issues require a broad multidisciplinary approach.

The first environment-related paper to be published in *Urban Studies* was in 1967. In the following 50 years, environment-related papers account for 1.7% (70 papers) of all papers published in the journal (4059 papers). If January 2012 is taken as a cut-off point, noting the sudden increase in the number of environment-related papers from that year onwards (see Figure 1), environment-related papers account for 0.9% (29 papers) of all publications since 1967 and 4.6% (41 papers) of all

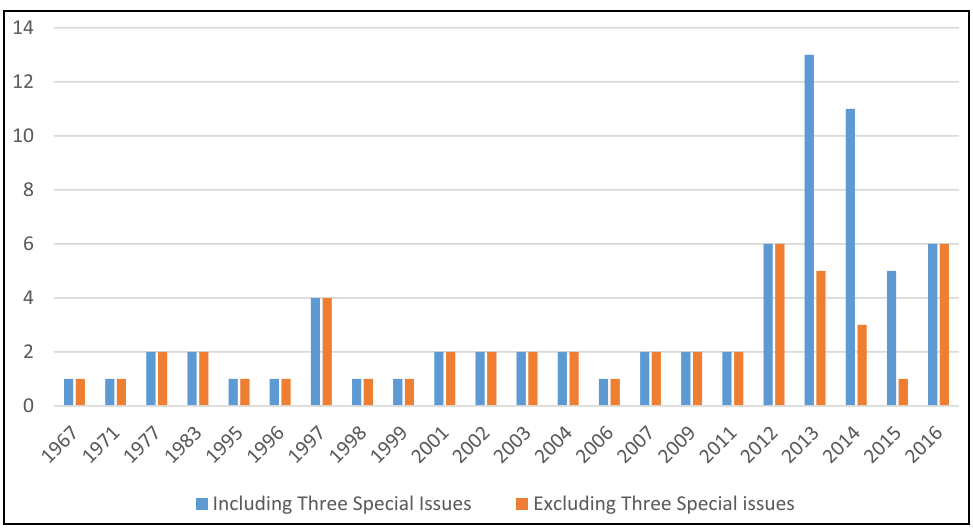

Figure 1. Urban environment-related publications by years in *Urban Studies* over 50 years
Note: in some years, there were no environment-related publications. These years are not indicated in the chart.

Table 1. 50 years of urban environment-related publications in *Urban Studies*.

Themes	January 1967–December 2011	January 2012–December 2016		January 1967–December 2016	
	All (no Special Issues)	All (including Special Issues)	Excluding three Special Issues	All (including Special Issues)	Excluding three Special Issues
Environment & urban development	8 (28%)	16 (39%)	9 (43%)	24 (34%)	17 (34%)
Urban climate governance	9 (31%)	23 (56%)	10 (48%)	32 (46%)	19 (38%)
Others: environment with health, urban economic growth, real estate, etc.	12 (41%)	2 (5%)	2 (9%)	14 (20%)	14 (28%)
Total	29 (100%)	41 (100%)	21 (100%)	70 (100%)	50 (100%)
	29 (41%)	41 (59%)		70 (100%)	

Notes: 1. the survey was undertaken using SCOPUS based on the combinations of the selected key words, such as, environment, sustainability, development, urban growth, urban form, eco-cities, green buildings, etc. We then checked the survey results for the publications after January 2012 by screening each individual issue. To our subjective identification and classifications, 70 publications in *Urban Studies* particularly focus on exploring the links between environment and urban changes. 2. There are three environment-related Special Issues in *Urban Studies*, which were published in the years of 2013, 2014 and 2015.

publications between January 2012 and December 2016. Based on my own subjective classification of environment-related papers since 1967, 34% (24 papers) are in the field of sustainable urban development, whilst 46% (32 papers) are related to urban climate governance (see Table 1, which also distinguishes between standard and Special Issue papers). Excluding the three environment-related Special Issues, there is a higher percentage of publications in the field of urban climate governance between 2012 and 2016 (see Table 1).

After a careful review, this VSI selects 12 thought-provoking articles (Anderson et al., 1996; Aylett, 2013; Bae and Feiock, 2013; Blowers, 1997; Bulkeley and Kern, 2006; Collins et al., 2007; Cugurullo, 2016; Dierwechter and Wessells, 2013; Jonas et al., 2011; Leck and Simon, 2013; Satterthwaite, 1997; Whitehead, 2003). Taken together, these articles address the central issue of climate change and cities from complementary perspectives. One important implication of this collection is that addressing urban environmental degradation and moving towards low carbon urban living requires joint social, political and technical adaptation processes which include the development of sustainable urban fixtures or infrastructures (such as green buildings, eco cities, etc.), climate protection governance and consequent adaptions of urban society and policy making. This should underpin the future research agenda for urban environmental studies in general.

The VSI is structured as follows. The first section reviews five studies (Anderson et al., 1996; Collins et al., 2007; Cugurullo, 2016; Satterthwaite, 1997; Whitehead, 2003) on sustainable urban development and considers their contributions to urban environment literature. The following section reviews a further seven selected papers (Aylett, 2013; Bae and Feiock, 2013; Blowers, 1997; Bulkeley and Kern, 2006; Dierwechter and

Wessells, 2013; Jonas et al., 2011; Leck and Simon, 2013) regarding the forms of urban climate governance and their implications for urban societies and policy-making. Building on these two blocks of knowledge, the next section suggests a research agenda geared to the promotion of deeper and broader debates regarding cities and the environment, path-breaking ways to support different areas of environment debate and possibilities for addressing traditional areas of concerns from alternative viewpoints. In this context, it is worth noting that the environment-related studies that have been published in *Urban Studies* are frequently cited in a variety of other urban or disciplinary-based journals (such as *Cities; Energy Policy; Journal of Environmental Policy and Planning*, etc.). However, a study of the citations of the 12 papers selected in this VSI (using SCOPUS) shows that few have been cited by primarily economic or environment-oriented journals (such as *The American Economic Review; The Quarterly Journal of Economics*; or *Journal of Environmental Economics and Management; Journal of Environmental Management; Resource and Energy Economics*, etc.). In terms of subject fields, the citations are mainly in the field of social science, followed by environmental science and energy studies. Only a small portion of total citations, are from journals in the fields of business management and economics. To promote wider engagement between urban scholars and those contributing to related fields of inquiry, such as behavioural and environmental studies, environmental management and public policy; economic growth and the environment – issues which the major economic or environmental oriented journals may be interested in – it is perhaps best to envisage a research agenda that speaks to the debates in these broader fields while maintaining an urban perspective. Thus, Satterthwaite (1997) suggests that urban environmental research should not only focus on how to improve the environmental performance of cities, but also should stress how urban consumers, firms and (local) governments work together to contribute to sustainable urban development.

Sustainable urban development

The first five selected studies (Anderson et al., 1996; Collins et al., 2007; Cugurullo, 2016; Satterthwaite, 1997; Whitehead, 2003) deliver an important message that minimising or reversing urban environmental degradation involves a transition to low carbon living. To facilitate that transition, a proper accounting of environmental costs and performances is essential, coupled with sustainable urban design, planning and advanced clean technologies.

In a city, people are both causal agents in climate change and vulnerable victims of climate degradation (Hebbert and Jankovic, 2013). Sustainable urban development is one important approach to reducing a city's impact on the environment and protecting cities from climate change. Urban research in this aspect may be traced back to earlier debates regarding sustainable urban forms. In a free market economy, urban form refers to the outcome of the locational decisions of households, firms and public authorities. At the same time, a variety of policies guide the evolution of urban form – primarily transport policies and land use policies – and thereby modify GHG emissions (Anderson et al., 1996).

In an early contribution, Owens (1986) identified urban form as a primary concern of efforts to move towards sustainable urban development because of its significant impact on urban energy consumption. He proposed a three-tiered energy efficient urban form that combined clusters of relatively small urban settlements at the regional level, compact settlements at the sub-

regional level in either linear or rectangle shapes, and medium to high residential density with well dispersed employment at the local level. Many subsequent scholars have argued for compact, higher-density urban forms, although others have questioned their efficacy (Hall, 1997; Haughton, 1999; Lariviere and Lafrance, 1999; Naess, 2001; Sorensen, 2000; Tjallingii, 1995). Breheny (1992) maintains that increasing urban densities is a laudable objective, but that extremely compact cities are neither realistic nor desirable. To achieve sustainable urban form, he argues cities should encourage mixed uses, and that zoning should be discouraged. Other scholars have repeated the suggestion that various forms of 'decentralised concentration' based around single cities or groups of towns may be appropriate. A relatively open urban structure is then recommended, where built-up areas, farmland and other green areas make up a mosaic-like pattern to provide a sustainable urban form for the promotion of economic growth, social equity and reversal of environmental degradation (Burton, 2002; Campbell, 1996; Holden and Norland, 2005; Huang et al., 2007; Jabareen, 2006; Naess, 2001).

Anderson et al. (1996) attempted to reconcile differing positions regarding the relationships between the spatial configuration of cities/urban environments and GHG emissions by arguing that a better understanding of the processes that generate GHG emissions is needed to help urban policy makers form effective policies to meet environmental targets. More specifically, these authors maintain that we do not yet fully understand how and which urban forms may be harmful or beneficial to the environment. At least two strands of literature have evolved from this argument. One focuses on investigating in detail the causes of environmental degradation from the perspective of urban form (Lariviere and Lafrance, 1999; Norman et al., 2006, etc.). A second strand attempts to find an effective urban form to reduce GHG emissions (Chatterton, 2013; Dhakal, 2009). In this, it is important to note that transitioning to a sustainable urban form does not necessarily imply that expensive green urban infrastructures will directly lead to energy conservation. For example, reducing commute times by improving public transportation systems may only be effective if residents are willing to change their consumption behaviour by switching from cars to public transit. Supplemental strategies are consequently needed to make environmental conservation possible (see additional discussion in the following section).

Green buildings and eco-cities have both been widely recognised as effective urban forms that reduce emissions and minimise environmental degradation. Regarding the first, although green buildings can be up to 50% more energy efficient than their 'non-green' counterparts, it is known that the installation of green technologies may significantly increase construction costs and ongoing property management costs. Construction of green building may cost 30–50% more than an 'ordinary' building (Pow and Neo, 2013). Eichholtz et al. (2010), in their seminal article on green office buildings, published in the *American Economic Review*, found the design and operation of real estate to play an important role in urban energy conservation; office buildings rated as green could command higher rents (7%) and up to 16% higher selling prices than otherwise similar buildings. Subsequent empirical research has advanced the topic by analysing whether achievable returns can cover incurred additional green costs (Deng and Wu, 2014; see also Brounen and Kok, 2011; Circo, 2007; Deng et al., 2012; Eichholtz et al., 2013; Fuerst and McAllister, 2011a, 2011b, 2011c; Gottfried, 2003; Zheng et al., 2012).

The development of eco-cities, meanwhile, has become a global trend – by 2011,

more than 170 were under construction globally (Cugurullo, 2016) A handful of these eco-cities are now fully functioning. Eco-cities feature environmentally friendly urban forms and planning as well as infrastructures that are equipped with advanced green technologies. Shwayri (2013) highlights Songdo, a Korean eco-city that was intended to be an exportable, high-tech model of city-making. Although eco-cities are designed to promote economic self-sufficiency and globalism (Chang and Sheppard, 2013), Hodson and Marvin (2010) have warned that they may become 'ecological enclaves' where protection is given to a small group of people and the burden of climate change becomes unevenly distributed. Building on earlier work (see, for example, Holden, 2000), Collins et al. (2007) offer an early example of efforts to measure such environmental impacts. These scholars demonstrated how two techniques (environmental input-output tables and ecological footprint analysis) provide different perspectives on the environmental effects of an event to help policymakers effectively meet their responsibilities and allow them to examine the trade-offs between commonly reported economic aggregates and environmental impacts (see also Babiak and Trendafilova, 2011; O'Brien, 2007). But, in general, the environmental aspects of development issues cannot be reduced to a technological and financial calculation or a technocratic process in town planning/urban design (Mega, 1996). Whitehead (2003), by innovatively integrating the concepts of sustainable urban development and urban governance, reminds us that a sustainable city is an object of political contestation. The complex discursive processes and sociopolitical struggles through which sustainable cities are produced must not be ignored (Haughton and Hunter, 2004). A broader regime and regulatory structure for the formation and constitution of sustainable cities is crucial (also see the citations in Bulkeley, 2005, 2006; Vallance et al., 2011). Urban governance must ensure political and social transitions to achieve environmental conservation objectives (Rohracher and Spath, 2014).

Climate change and urban governance

Aylett (2013) points out that the problem in urban sustainability is primarily a socio-institutional one. Although the past 20 years have witnessed a rapid expansion of municipal engagement in urban climate change, most actions taken remain shallow because climate policies fit uneasily into existing bureaucratic structures and practices. Effective urban climate governance requires adaptive, innovative, collective and complementary efforts among multiple agencies and government divisions through various forms of horizontal and vertical collaboration. It is also the case, of course, that urban climate change may have been hampered as it sits (potentially) in opposition to the goals of neoliberal urban agendas (Harvey, 1989; Peck, 2017a, 2017b). Governments of the world's wealthiest countries have supported sustainable development but often do not make enough effort in the reduction of resource use and waste generation among their consumers and enterprises. Most governments continue to perceive economic growth as the primary method by which to reduce unemployment rates and increase incomes. It is often difficult to combine these two methods with the use of renewable resources and reduction in GHG emissions, unless there is an explicit link of employment generation with such goals (Satterthwaite, 1997).

Two major debates persist in relation to climate change and urban governance. One debate focuses on the forms of urban climate governance that can effectively and efficiently facilitate climate protection or environmental conservation. The primary issues that arise in

this field are institutional barriers that may block integrated municipal responses to climate change in a transition to low carbon urban living, and difficulties in determining the necessary reforms to create bureaucracies capable of facilitating the transition. Four representative studies from *Urban Studies* (Aylett, 2013; Bae and Feiock, 2013; Bulkeley and Kern, 2006; Leck and Simon, 2013) speak to these issues. Bulkeley and Kern (2006) emphasise that climate change challenges urban governance internationally and locally, particularly in the way that climate protection policy is shaped. Leck and Simon (2013) argue that effective climate governance requires collaboration between different levels of government. Bae and Feiock (2013) explore how forms of urban climate governance and community factors together shape local government climate mitigation efforts. Finally, Aylett (2013) identifies the barriers that inhibit effective urban climate governance and suggests alternative approaches.

The second debate concerns the implications of climate change and environmental degradation for urban society and urban policy strategies. Blowers (1997), Jonas et al., (2011), and Dierwechter and Wessells, 2013) are relevant in this context. Blowers (1997) explores the relationships between environmental and societal changes. Jonas et al. (2011) examine how environmental policies can be harnessed into urban development politics, whilst the work of Dierwechter and Wessells (2013) highlights that climate protection policies are unevenly practiced across cities, which may inadvertently intensify disparities in public services and quality of life amenities.

Forms of urban climate governance

Climate changes pose new challenges to cities and require new, flexible forms of urban governance capable of dealing with the uncertainties and abruptness of change (Boyd and Juhola, 2015). From a narrow perspective, urban climate governance refers to specific channels through which public and private entities discuss climate issues and establish responses. Cities are experimenting with new institutional arrangements to address climate change. These encompass strategies utilised for both reducing GHG emissions and for adapting to the inevitable impacts of climate change within the urban context (Anguelovski and Carmin, 2011). More broadly, climate governance is the totality of mechanisms through which a multitude of actors become involved in climate protection decision making and includes a variety of socio-political processes operating at multiple scales (Hooghe and Marks, 2003). Bulkeley and Betsill (2005) note that the urban governance of climate protection is inevitably multilevel and involves the formation of new network structures that challenge traditional distinctions between local, national and global politics. Harvey's (1989) study of Cape Town illustrates urban energy policies emerging as multilevel issues and fuelling extensive interactions between national and local governments.

Leck and Simon's (2013) study insists that the relational dynamics between various levels of government, among neighbouring municipalities and between government and non-governmental networks, are central to the consideration of what constitutes effective governance in the context of urbanisation, environmental degradation and sustainability challenges. Weak relationships between governments, as illustrated by their case study in South Africa, may pose critical barriers to adaptation at all scales. For example, lack of information sharing, communication and reciprocal learning between similar municipalities represent obstacles to adopting and implementing effective climate adaptation programmes. Furthermore, effective action may be hampered by a plethora of economic, political, cultural and

developmental challenges for which consensus may be hard to achieve. Governance scholars have consequently concluded that effective adaptation to climate change requires new governance approaches that bridge or even transcend governmental levels and societal domains (Archer et al., 2014; Bauer and Steurer, 2014). Theorists have also stressed the importance of the relationship between urban governments and provincial governments to achieve resilience (Bahadur and Tanner, 2014).

The forms of governance adopted play a key role in shaping local climate protection policies. Bulkeley and Kern (2006) conducted a comparative analysis of local climate change policies in Germany and the UK, finding that actions were concentrated in the energy sphere and municipalities were increasingly deploying self-governing and enabling approaches to achieve emissions reductions. In Europe, the capacity of local governments to implement climate change policies and action plans tend to be closely linked with their governance modes, which in turn are influenced by EU policies, financial crises and the political challenges of implementing climate change policies (also see Corfee-Morlot et al., 2009 and Ostrom, 2010). Although the similarities in urban climate protection policies between Germany and the UK are discussed, Bulkeley and Kern (2006) imply that the challenge of reversing urban degradation can only be met through effective urban climate governance, with local authorities able to act as leaders in developing local climate change strategies (Kousky and Schneider, 2003). For example:

> Inducement is a powerful factor in the success of local climate schemes and primarily takes place through offering financial incentives, both to the municipality itself and to other actors. However, there is considerable uncertainty over the availability of the financial resources. (Bulkeley and Kern, 2006: 2251).

Bae and Feiock (2013) examined a unique data set of sustainability efforts by governments and communities, thereby demonstrating that government structure has a direct impact on the approach that a community takes to sustainability. These scholars showed energy and climate protection efforts to be an ideal policy arena to study the policy impacts of mayor-council versus council-manager government, because programmes of action can either be targeted to the promotion of energy efficiency in governmental operations, which aligns with the career incentives of professional managers, or they can be targeted to residences and businesses in a community, a strategy that aligns with the goals of elected mayors. The results of empirical tests demonstrated that council-manager government systems had a significant positive effect on efforts directed to governmental operations (see Svara et al., 2013), but a negative effect on community efforts. The study not only shows what may motivate communities to set targets and plans for climate change (see Baynham and Stevens, 2014) but also noted that the differences between the mayor-council (strong mayor) and council-manager (weak mayor platform) scenarios suggest fundamental differences in the motivations and incentives of local executives (also see Terman and Feiock, 2015).

Casting urban sustainability as primarily a social institutional problem, Aylett (2013) investigated two cities (Durban in South Africa and Portland in the USA) considered leaders in municipal climate policy (although they have not achieved goals of emission reduction to the scale believed needed). Aylett provides a list of organisational and conceptual approaches that may help break old bureaucratic routines and establish institutions that are more responsive, adaptive and collaborative in addressing climate change. These approaches include open

network structures to encourage new ideas and promote learning, experimentation and creative problem-solving. Both cities studied by Aylett had independent organisations that focused on environmental policies and that positioned themselves as hubs that facilitated communication and collaboration between multiple players in an urban climate protection decision-making process. In addition, both cities consciously changed their existing organisation cultures and developed structures that could promote skill acquisition on multiple levels, rewarding individuals who identify and pursue opportunities outside a department's 'business-as-usual' procedures. They aligned energy and climate issues with multiple other areas of interest and addressed the issue of achieving an appropriate organisational balance involving staff with the freedom to go beyond job scope and supportive senior management capable of maintaining sufficient control over project performance.

While the debate regarding the roles of municipalities in tackling environmental problems has received much attention (see Robinson and Gore, 2005; Simon, 2010), it has clearly been enriched by the above four studies in multiple ways, and in particular by virtue of their: addressing the issue of inter-municipal collaborations at both vertical and horizontal scales (Leck and Simon, 2013); highlighting the link between effective climate protection and having the 'right' form of urban climate governance for a city (Bulkeley and Kern, 2006); providing evidence regarding how a specific governing structure may influence the effectiveness of climate protection policies actually adopted (Aylett, 2013; Bae and Feiock, 2013).

Implications of climate changes for society and urban policy making

'It is conceivable that the challenge posed by the process of global environmental change heralds a defining moment of social change' (Blowers, 1997: 846). How far climate change and climate protection policy have progressed has become a central issue both in social scientific discourses and in political strategies. Another issue is whether climate change is capable of being absorbed by a society through adaptation or whether it provokes entirely different ways of organising, managing and living in society (Blowers, 1997). The debates regarding the relationship between the environment and society and the implications for urban policy making have not yet reached any consensus (Benton and Redclift, 2013; Lash et al., 1996).

Blowers (1997) outlined possible links between society and the environment from varying perspectives. Ecological modernisation theory (EMT) and risk society theory (RST) offer different and apparently irreconcilable insights for understanding the relationships between society and the environment (Guy and Farmer, 2001). The need for coordination across urban policy areas and the integration of environmental action into multiple sectors of an urban society requires that cities move beyond traditional short-term urban politics. At the political level, climate change requires a change in roles of the state in response to the rise of environmental social movements. One option is to involve the actors who are not bound by electoral constraints in the process of urban climate protection policy making, 'unconstrained by the necessity for electoral support and unconfined by territorial limitations, actors within this zone "of sub-politics" (or civil society) are relatively free to develop ideas and seek to influence the society at large as well as to mobilise support for particular issues and policies' (Blowers, 29917: 860). As such, climate change provokes new ways of organising and managing a city as well as new mechanisms for environmental policy decision-making (Van den Hove, 2000), which could lead to a

profound transition in cities towards a low carbon living. Environmental movements, as one set of interests in a civil society, contribute to the process of social and institutional learning, which is an important factor in incorporating the environment dimension into all levels of policy-making. This concept has motivated a major group of studies regarding energy and urban society change. Jonas et al. (2011) is one of the representative works within this group as indicated in Rutherford and Coutard (2014).

Jonas et al. (2011) perceived an energy saving infrastructure as an instrument of low carbon policy and cities as urban policy actors within a multilevel climate governance framework, through which socio-technical change takes effect to instigate a low carbon transition in cities. Specifically, the study explored the development of low-carbon urban policy and examined its potential ramifications for a new environmental politics of urban development (NEPUD) (an augmentation of Cox's (1993) concept of new urban politics that warned against a tendency to over-generalise about the entrepreneurial character of urban governance). NEPUD signals the growing centrality of carbon control in discourses and strategies around urban development and supported Blowers' (1997) argument. One of the features addressed in NEPUD is that city managers and politicians must recognise the political capital to be gained from being perceived as leaders of climate change governance (Bulkeley and Betsill, 2005); carbon control will likely influence how cities are governed and managing carbon emissions could represent a new measure of urban governance.

Political movements towards low carbon urban living have informed various types of urban governance at different scales. The Mayors' Climate Protection Agreement (MCPA) is one of the most significant networks for US climate action. Dierwechter and Wessells (2013) examined its implementation in Seattle and determined that global climate action in metropolitan Seattle appeared unevenly localised. For example, only 11–13% of all MPCA communities have conducted greenhouse gas inventories or developed standalone climate action plans. Many MCPA communities have executed global climate actions superficially, as evidenced by the limited fiscal resources devoted to, and the imprecise implementation plans of, these actions. The analysis indicated that unevenness was not due to varying commitment to climate action across a metropolitan area, but rather uneven structural economic conditions between locations, which in turn leads to different institutional capacities and resources.

In short, effective climate interventions require innovative, adaptive and spontaneous responses, while, in turn, successful responses to climate change demand an efficient and effective network of governance, itself likely to involve new ways of managing and organising urban society.

Research agenda

The discussions in the first two sections outline a framework with which to approach issues regarding cities and climate change. This framework includes four interrelated components. First, a proper accounting of environmental costs at urban level is essential before any environmental intervention can be designed and effectively implemented. To calculate the environmental costs that are generated by the production and consumption activities within a city, we need to estimate their impacts on societies both within and outside the city, particularly on neighbouring areas, and societies in the future. When justifying environmental costs, we should also consider that city-based enterprises and consumers may also generate benefits to the individuals and natural resources

outside the city's boundaries. Second, adopting sustainable urban design and planning is a critical response to urban environmental degradation. To ensure the success of sustainable development, improved environmental performance should be integrated into the social, economic and political goals of a city, as well as within national environmental plans and development strategies. Third, the forms of urban climate governance are important for successful implementation of climate protection policies. To determine an effective form of climate governance, analysis should encompass cooperation among municipalities and integration across all levels. Fourth, addressing climate change will have profound impacts on urban society and require profound societal transformation to ensure the success of environmental interventions.

Understandably, there is a tendency for disciplinary-based journals to be inclined to publish environment-related papers that focus on current debates from their own specific perspective. The effect, however, is for, disciplines and scholars to talk past each other, rather than to each other on environment-related matters. Clearly, resolving urban environmental problems requires multi-disciplinary engagement. In these terms, academic journals should actively encourage urban-centric, environment-related research to engage with the broadest possible range of environmental discourse. Similarly, scholars should frame their argumentation in such a way as to derive the broadest range of disciplinary and policy-related implications. For example, debate on the adoption of green urban transport facilities can be linked to debates on establishing social norms on urban conservation. The evidence of success here will be in growing volumes of cross citations between urban-specific journals such as *Urban Studies* and papers focusing on climate change in economic- or environment- oriented journals. Achievement here will depend on a research agenda able to reflect the following five perspectives.

First, a significant issue in need of further thought is how urban climate actions and policies may change the ways by which a society is operated and governed (Benton and Redclift, 2013; Chetty, 2015). For example, how will individuals need to adjust to meet environmental protection objectives? And, how does social marketing influence environmental behaviour? These questions have attracted the attention of the primarily environmental and economic-oriented journals in which researchers typically explore behavioural change based on 'nudging' approaches (Allcott, 2011a, 2011b). Although the findings of behavioural interventions are positive and consistent, their effects are often short lived because of a rebound effect as citizens revert to 'old habits' (Berkhout et al., 2000). Approaching the same question from an urban perspective inspires us to seek more permanent solutions that 'potentially' rest in governance strategies. But, what are the elements of such strategies that would make them durable? In overview, sustainable climate change requires an integrated approach inclusive of behavioural nudging and urban governance (as well as numerous other dimensions such as green technology). Yet, and despite the dramatically increased reliance on local governments to manage energy and climate issues, we know little about the channels through which a policy can pro-environmentally transform its citizen and societal behaviour.

Second, what constitutes effective urban climate governance? The primary achievement in the field of the environment and development has so far evolved around a central question about the relationships between non-market environmental resource consumption and economic development, as well as the institutional responses to the threats that arise. The theoretical foundation of the

question is primarily attributed to the Nobel Prize winning research on management of common property resources conducted by Professor Elinor Ostrom (Hartwick, 2014). High quality papers on the subject have been published in *Urban Studies* and in other journals, but the institutional barriers towards the most effective forms of urban climate governance are still not well identified. Furthermore, climate change displays geographical heterogeneity leading to most of the research in this area being of a case study form. Therefore, we lack theories to guide the design of urban climate governance.

Third, important non-urban journals have published widely on solving environmental problems that stem from global economic growth and international trade. Grossman and Krueger (1995), a seminal article published in the *Quarterly Journal of Economics*, explicitly raised a debate regarding the relationship between economic growth and environment degradation. Because most economic activities occur in an urban area, a central debate at the urban level is how to resolve the conflict between urban economic growth and climate protection. For example, would limiting the development of profitable but polluting industries such as steel or oil refineries force a city to suffer economically? If so, how can this conflict be resolved?

Fourth, what makes a sustainable city? What has been done to achieve urban sustainability? And, are these actions enough? These are the essential questions asked in The Worldwatch Institution Annual Report (2016). The report points out that although many technologies and successful policies are well known and some may be replicable too, no mature models of urban sustainability are available because cities differ in geography, climate, culture, and history etc., which make it impossible to have a one-size-fits-all approach. A wide spectrum of questions arises around sustainable urban development. For example, when green buildings and eco-cities have been widely accepted as technical fixes to reverse urban environmental degradation, what are the costs and benefits of developing green buildings? How can an eco-city be managed to reach its full potential in climate protection? The answers to these questions are important because buildings are amongst the biggest consumers of the energy and materials that contribute to urban greenhouse gas emissions and the world building floor area is continuing to rapid expansion. Multiple other questions surrounding urban sustainability, of course, exist such as what makes a people-centric sustainable urban development? How does urban density contribute to the carbon footprint? And, how can a city be developed into a place for nature whilst also accommodating a growing population?

Finally, a proper accounting of environmental costs at the urban level is essential before policy makers can make accountable decisions regarding urban climate protection. Bombardini and Li (2016), for example, provide strong evidence on how pollution caused by international trade has resulted in rising infant mortality. Such a topic should not only interest economics and environmental journals, but also urban journals. A substantial number of empirical studies at the urban level are needed before a technically workable framework can be established to more accurately measure urban environmental degradation. Urban-focused studies should seek to complement studies that have already been published on the question in non-urban journals.

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