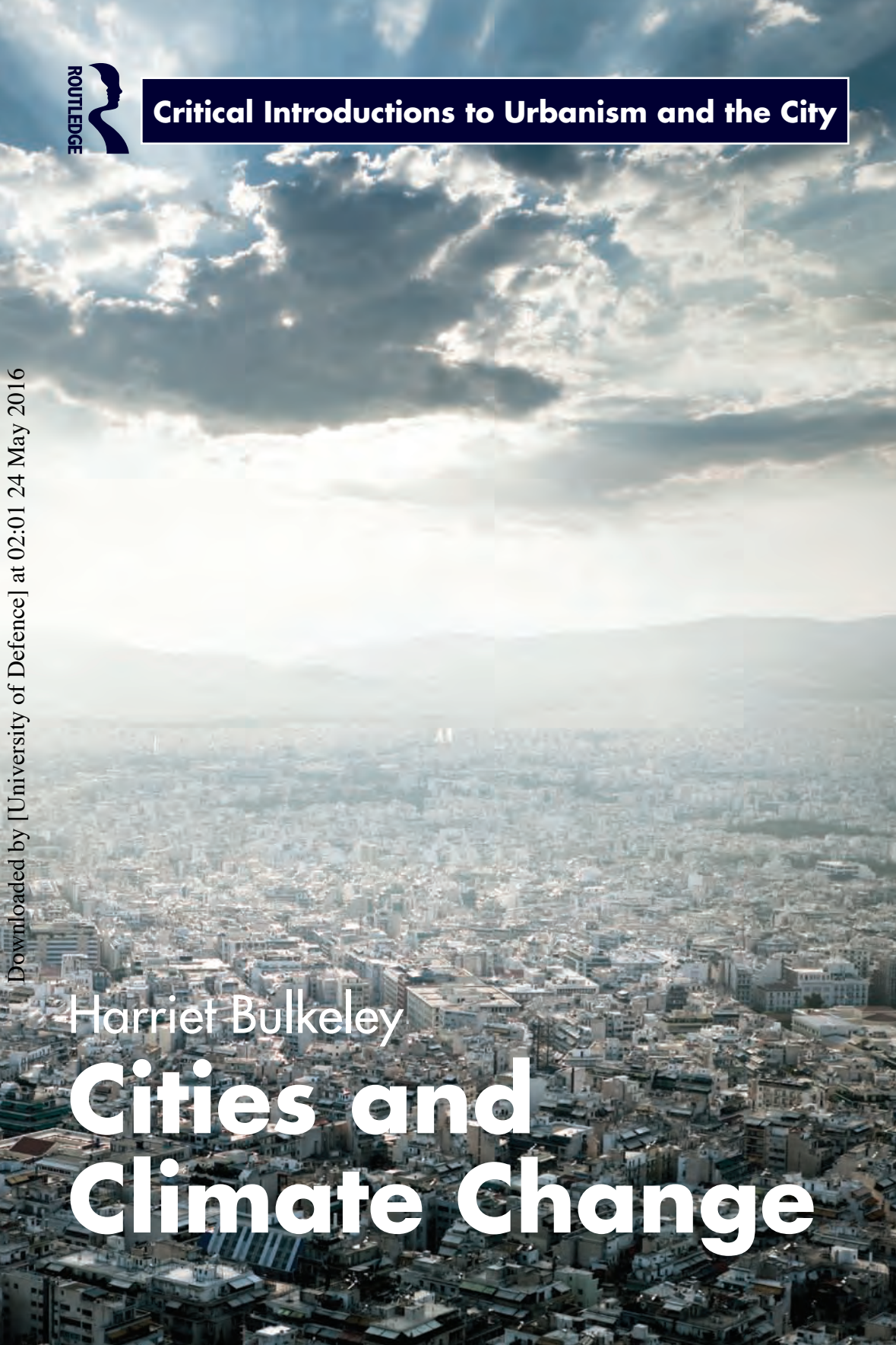


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Cities and Climate Change

Climate change is one of the most significant global challenges facing the world today. It is also a critical issue for the world's cities. Now home to over half the world's population, urban areas are significant sources of greenhouse-gas emissions and are vulnerable to the impacts of climate change.

Responding to climate change is a profound challenge. A variety of actors are involved in urban climate governance, with municipal governments, international organizations and funding bodies pointing to cities as key arenas for response. This book provides the first critical introduction to these challenges, giving an overview of the science and policy of climate change at the global level and the emergence of climate change as an urban policy issue. It considers the challenges of governing climate change in the city in the context of the changing nature of urban politics, economics, society and infrastructures. It looks at how responses for mitigation and adaptation have emerged within the city, and the implications of climate change for social and environmental justice.

Drawing on examples from cities in the north and south, and richly illustrated with detailed case studies, this book will enable students to understand the potential and limits of addressing climate change at the urban level and to explore the consequences for our future cities. It will be essential reading for undergraduate students across the disciplines of geography, politics, sociology, urban studies, planning, and science and technology studies.

Harriet Bulkeley is Professor of Geography, Energy and Environment in the Department of Geography, and Deputy Director of the Durham Energy Institute, Durham University, UK. Her research interests are in the nature and politics of environmental governance and focus on climate change and urban sustainability.

First published 2013
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

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British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data
A catalog record for this book has been requested

ISBN: 978-0-415-59704-3 (hbk)
ISBN: 978-0-415-59705-0 (pbk)
ISBN: 978-0-203-07720-7 (ebk)

Typeset in Times New Roman
by Florence Production Ltd, Stoodleigh, Devon

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1 Climate change – an urban problem?

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Introducing climate change

Over the past two decades, the term 'climate change' has for many acquired a well-worn familiarity. Whether on the pages of the national newspapers, through events such as the NDTV–Toyota's Greenathon in India, the WWF Earth Hour campaign, or the commitments of an ever-growing number of businesses to address the issue, climate change has entered into the popular vocabulary (Hulme 2009). Yet, at the same time, climate change remains a distant concern. In many parts of the world, and for many people, the extent and consequences of the ways in which human activities may be leading to long-term changes in the global atmosphere are obscured. This may be because of continued scientific controversy and political attempts to deny the significance or importance of the issue, or it may be because other, pressing, concerns dominate daily life. Elsewhere, climate change has a distant presence; it is an issue that rumbles on in the background to daily lives, surfacing at particular moments as, for example, international leaders seek agreement at the latest negotiations or another climate-related disaster strikes.

These qualities have made climate change one of the most taken-for-granted and most debated issues of the contemporary era. Although most agree that it is a serious issue that requires sustained attention and action, over two decades of international negotiation have yet to deliver a significant global response. The longevity of these debates, and the lack of resolution at the international level, could lead many to dismiss climate change as a lost cause. Given this context, it is worth reminding ourselves just what might be at stake. In their 2007 Fourth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) found that the weight of scientific evidence indicated that, 'warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level', and

that this was beginning to have an effect regionally on natural systems (IPCC 2007a). The IPCC found that, over the period from 1970 to 2004, there had been a 70 per cent increase in global emissions of greenhouse gases (GHGs) (Box 1.1) and concluded that, 'most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations' (IPCC 2007c). As a result of changing climatic conditions, the IPCC identified a series of potential impacts on different human and natural systems in different regions of the world, illustrated in Table 1.1.

Although the IPCC's language and its cautious calculation of the potential for global warming and the ensuing impacts have become an accepted part of society's understanding of climate change, for others it is precisely this language that has served to diminish society's engagement with the potentially far-reaching implications of a changing climate. From this perspective, what John Urry has termed the 'new catastrophism', climate change, is regarded as a symptom of the failures of industrial society, and, as such, 'there are no guarantees that the increasing prosperity, wealth, movement and connectivity of the industrial period will continue forever. A new and darker epoch may

BOX 1.1

What are GHG emissions?

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary GHGs in the Earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide and methane, the Kyoto Protocol deals with the GHGs sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons.

(IPCC 2007b)

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Table 1.1 Predicted regional impacts of climate change

Region	*Potential impacts of climate change*
Africa	By 2020, between 75 and 250 million people may be exposed to increased water stress.
	Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations.
Asia	By the 2050s, fresh-water availability, particularly in large river basins, is predicted to decrease.
	Coastal areas, especially heavily populated mega-delta regions, will be at risk from increased flooding.
	Climate change is projected to compound the pressures on natural resources associated with rapid urbanization and economic development.
Australia and New Zealand	By 2020, significant loss of biodiversity is projected to occur, including in the Great Barrier Reef and Queensland Wet Tropics.
	By 2030, water-security problems are projected to intensify in southern and eastern Australia.
	Coastal development and population growth will exacerbate risks from sea-level rise, storms and coastal flooding by 2050.
Europe	In southern Europe, climate change is projected to exacerbate high temperatures and drought, and reduce water availability.
	Climate change is also projected to increase the number of heatwaves and the frequency of wildfires.
Latin America	There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America.
	Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability.
North America	Warming in western mountains is projected to exacerbate competition for over-allocated water resources.
	Urban heatwaves are expected to increase in number, intensity and duration, with potential for adverse health impacts.
	Coastal communities and habitats will be increasingly stressed by climate-change impacts interacting with development and pollution.

Source: Adapted from IPCC 2007c

lie in the quite near future' (Urry 2011: 36). Critical thinkers such as Bill McKibben, James Lovelock and Mark Lynas have argued that the increased levels of GHG emissions in the atmosphere are likely to lead to a range of significant and catastrophic effects that would disrupt global markets, create flows of climate refugees, and challenge existing forms of political order (McKibben 2011; Lovelock 2009; Lynas 2004). In this sense, climate change

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is not a problem that can be managed through the application of new scientific knowledge and policy instruments, but rather requires fundamental shifts in the ways in which economies and societies are organized and operate.

Although they differ considerably in how the challenge of climate change is understood, both the 'scientific-manageralist' and 'new-catastrophist' views tend to assume that the issue is one of global proportions, with complex scientific and political dimensions. In this context, to consider climate change as an *urban* problem may seem counter-intuitive. As a matter of GHG emissions, atmospheric conditions, global disruption, extreme events, international negotiations, rapidly increasing populations and national economies, climate change may at first glance appear to have little to do with the city. However, as the rest of this book sets out in detail, it is increasingly recognized that cities are not merely a backdrop against which these global processes unfold, but are central to the ways in which the vulnerabilities and risks of climate change are produced, and to the possibilities and challenges of responding to these issues. Understanding the urban nature of climate change requires that we examine, not only the ways in which the issue is being produced, reconfigured and contested within cities, but also how climate change has come to feature in the imagination and creation of urban futures.

The rest of this introductory chapter is divided into three sections. The first considers in more detail how and why we might view the global challenge of climate change in relation to the city. In the second section, the ways in which our visions of the implications of climate change and of urban futures shape our response to these issues are explored. As is clear from the discussion above, thinking about climate change evokes some image of, and relation to, the future. More or less implicitly, cities loom large in the scientific, political and cultural imagination of a climate-changed world. Thinking through the diversity of urban climate-change futures that emerge in this manner is instructive in terms of understanding how the city is regarded as both the cause of, and solution to, the climate crisis. Moving beyond these utopian and dystopian caricatures, however, requires a considered and detailed examination of just how and why climate change comes to matter in the city. The third part of the chapter outlines the rest of the book and the ways in which it seeks to address this challenge.

Before turning to these matters, a few issues of terminology are worth considering. Throughout the book, the terms 'urban', 'city' and 'cities' are used interchangeably. Broadly speaking, 'city' is usually used to refer to a specific place or locale that has urban characteristics (e.g. of density of population, social/economic activities, forms of public culture), but, beyond the

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political jurisdiction of urban local authorities (here termed municipalities), its boundaries are difficult to define. It is also vitally important to recognize the significant differences in the ways in which cities are encountered and experienced by different social groups and individuals – such as women, children, the economically affluent and mobile, or those who are economically and socially disadvantaged. Using the term 'urban' or 'city' can too readily mask those differences, although in an introductory book of this nature the use of such shorthand terms is inevitable. Throughout the book, the intention is to explore and examine how the multiple dimensions of climate change are experienced differently within and between cities, and to consider the implications for issues of social and environmental justice.

What has climate change got to do with the city?

It was in the early 1980s that the issue of climate change began to feature prominently on scientific and political agendas. Although early scientific investigations had shown that particular gases, when present in the atmosphere, could have a warming effect on the atmosphere by trapping incoming solar radiation, it was not until the 1980s that the potential implications of this physical phenomenon began to be realized by the international political community (Paterson 1996). Following a series of scientific meetings and political summits, in 1992 the landmark international agreement to address climate change, the *United Nations Framework Convention on Climate Change* (UNFCCC) was agreed. At the heart of the UNFCCC is the intention to stabilize GHGs in the atmosphere at a level that would 'prevent dangerous anthropogenic (human induced) interference with the climate system', while recognizing the need to adapt to the potential effects of climate change (UNFCCC 1992). Throughout this process, climate change was regarded as a problem of common property – although individual nation-states might be contributing to the problem, through their GHG emissions, the effects would be felt by all countries, and particularly in the least developed economies, who had not contributed significantly to the problem.

Resolving climate change, therefore, required an approach that could foster collective action for reducing GHG emissions while recognizing the different responsibilities of economically developed and less economically developed countries. Seen in this way, attention focused on how to achieve an international agreement that would bind nation-states to 'common but differentiated' targets and timetables (UNFCCC 1992), and, in 1997 the Kyoto Protocol was established as a means towards this end. The Kyoto Protocol committed thirty-eight industrialized countries to reduce GHG emissions by

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an average of 5.2 per cent below 1990 levels during the period 2008–12, and established a set of flexible mechanisms through which individual national targets could be reached. These included the provisions for establishing carbon trading between economically developed countries and the Clean Development Mechanism (CDM), through which economically developed countries could undertake projects to reduce GHG emissions in less economically developed countries as part of reaching their national targets. Since Kyoto, negotiations have continued over just how these provisions should be implemented and have grown in complexity as the climate-change agenda has grown to include different areas of activity – notably, how we should adapt to the effects of climate change, and how we might reduce the impact of deforestation on the atmosphere. These negotiations have also reflected the changing position of different nation-states over the past two decades, including the reluctance of the US to participate in an international agreement and the recognition that major industrializing economies, such as Brazil, India, China and Mexico, should have a role to play in meeting international targets for reducing GHG emissions. In 2009, the international community, global media, non-governmental organizations and many businesses with interests in responding to climate change gathered in Copenhagen for one set of negotiations, believing that a breakthrough in the impasse might be possible. The tangible disappointment that followed the apparent failure of these talks is a sign of just how much has come to depend on addressing climate change, and the extent to which it is considered as a *global* problem requiring *global* solutions (Bulkeley and Newell 2010).

There are, however, other ways of viewing the climate problem and the ways in which it could be addressed. If we step back from the idea of the global commons of the atmosphere and consider instead how, why and where GHG emissions are produced and the risks of climate change may be felt, a different set of processes, actors and possibilities comes to mind. The GHG emissions that are contributing to the condition of climate change do not arise from some uniform and invisible source, but, rather, are the product of the ways in which energy is used in our homes and cars, is used to make the things we consume and the goods we use, as well as through our management of the land and forests. It is these processes, taking place in a highly uneven manner across different national contexts, that create both current atmospheric conditions and the common but differentiated responsibilities for acting on climate change. At the same time, the impacts of climate change are not spread evenly, but rather occur in particular locations – such as those prone to flooding or drought – and affect different groups of society in radically different ways, depending on their capacity to cope with, and adapt to, risks. These ways in

which climate change is closely intertwined with political economic structures and our daily lives is one of the reasons why it has proven so difficult an issue to address internationally. However, it also demonstrates that we can think about climate change differently – not as a *global* issue in the sense that it occurs in the same way across the world, but as one that has very different histories and geographies, varying across time and space and in its implications for economies and societies.

It is in this view of climate change, as shaped by diverse processes that vary not only between different nation-states but also within and across national boundaries, that the city comes into view (Table 1.2). Although the definition, nature and character of 'the city' as any singular entity are highly variable and contested, it can be shown that the twentieth century witnessed a rapid process of urbanization, particularly in the industrialized countries of Europe, North America and Australasia, and more recently in Asia, so that, by 2010, over half of the world's population lived within some form of urban context that is broadly understood as a 'city'. By 2030, it is predicted that almost 5 billion of the world's population of over 8 billion will live in cities, and this process of urbanization is likely to be most rapid in the least developed countries. Although large megacities will continue to grow rapidly, most urbanization is predicted to take place in smaller urban centres (UN-Habitat 2011: 2). As sites of rapidly growing population, cities have come to be seen as part of the climate-change problem. On the one hand, cities are now seen as potential sites of climate vulnerability. Because of the history of economic development, cities can occupy locations that are regarded as particularly vulnerable to climate change. The 2006 Stern Review, carried out for the UK government, finds, for example, that:

> Many of the world's major cities (22 of the top 50) are at risk of flooding from coastal surges, including Tokyo, Shanghai, Hong Kong, Mumbai, Calcutta, Karachi, Buenos Aires, St Petersburg, New York, Miami and London.
>
> Stern 2006: 76

At the same time, the rapid pace of urbanization is serving to produce its own forms of vulnerability within the city, as 'people arriving in already overstressed urban centres are forced to live in dangerous areas . . . many constructing their own homes in informal settlements on floodplains, in swamp areas and on unstable hillsides', in areas that lack necessary infrastructures and basic services (UN-Habitat 2011: 1).

On the other hand, cities are regarded as critical to the production of the GHG emissions that are creating the risks of climate change in the first place

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Table 1.2 Cities and climate change: part of the problem, part of the solution?

Cities as part of the climate problem?	*Cities as part of the climate solution?*
In 2010, more than half of the world's population lived in cities	Municipal authorities have responsibility for many processes that shape urban vulnerability and affect GHG emissions at the local level
By 2030, almost 5 billion of the world's 8.3 billion people will live in cities	Municipalities have a democratic mandate from local populations to address issues that affect the city
Cities have historically developed in locations that may be vulnerable to change, including in coastal areas and on rivers	Municipalities have a history of addressing issues of sustainable climate development
Rapid urbanization is creating significant urban challenges that will be exacerbated by climate change	Municipalities can act as a 'laboratory' for testing innovative approaches
Cities represent concentrations of economic and social activities that produce GHG emissions	Municipal authorities can act in partnership with private and civil-society sectors
Cities and towns produce over 70% of global energy-related CO_2 emissions	Cities represent high concentrations of private-sector actors with growing commitment to act on climate change
By 2030, over 80% of the increase in global annual energy demand above 2006 levels will come from cities in non-OECD countries	Cities provide arenas within which civil society is mobilizing to address climate change

Source: Adapted from UN-Habitat 2011: 91

(Bulkeley and Betsill 2003; UN-Habitat 2011: 91). The concentration of energy use within urban areas, in industry, transportation, and domestic and commercial buildings, means that cities are central to the ways in which GHG emissions, and particularly carbon dioxide, the most common GHG, are produced. The International Energy Agency (IEA) (2009: 21) has found that cities and towns currently consume over two-thirds of annual energy demand and 'produce over 70 per cent of global energy-related carbon dioxide emissions'. By 2030, their predictions are that, with 60 per cent of the world's population, cities and towns will consume over three-quarters of the world's energy demand, and that, 'over 80 per cent of the projected increase in demand above 2006 levels will come from cities in non-OECD countries' (International Energy Agency 2009: 21); that is, the vast majority of future increases in energy demand will come from those least developed and

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developing countries outside the Organisation for Economic Co-operation and Development (OECD).

As a resulting of the growing urban population and energy demand, cities are therefore seen as both the victim and culprit of climate change. Against this rather bleak picture, however, other views of the city as part of the *solution* to climate change are also emerging (Table 1.2; see also Bulkeley and Betsill 2003; UN-Habitat 2011: 91). Realizing the connection between climate change and existing forms of urban vulnerability, the nature of urban development and the daily use of energy requires recognition of the role that urban authorities – termed municipalities or municipal authorities in this book – have in shaping these processes. Municipalities have significant, although highly varied, roles in relation to urban planning, building codes, the provision of transportation and the supply of energy, water and waste services that shape existing patterns of vulnerability and the production of GHG emissions. Given these powers, and their democratic mandate as the local level of government, municipalities can therefore be seen as in a position to address the challenges of mitigating and adapting to climate change. Cities have a history of engaging with issues of sustainable development and can be centres for innovation, with the capacity to test new technologies and approaches, offering a means through which novel responses to climate change could be generated. Increasingly, cities are also home to a number of private and civil-society actors who are seeking to address climate change. In some cases, such actors are developing independent responses to climate-change mitigation and adaptation, but elsewhere municipalities can provide the basis for establishing partnerships with this diverse range of actors to approach these issues. It was this view, of cities acting on their ability to intervene in critical policy areas, democratic mandate, experience with sustainability planning and innovation, as well as their partnerships with other relevant actors, that led the mayors of some of the world's largest cities to call attention at Copenhagen to the importance of urban responses to climate change:

> We, the mayors and governors of the world's leading cities . . . ask you to recognise that the future of our globe will be won or lost in the cities of the world.
>
> (Copenhagen Climate Communiqué, December 2009)

Urban worlds and climate-change futures

For the group of the world's urban political leaders gathered at the 2009 Climate Summit for Mayors, taking place alongside the international Copenhagen climate talks, cities represented a battleground for our collective

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global futures. At stake, it seems, are competing views of what the city is and what it might become. As climate change has become a matter for popular culture and has entered into different forms of political, social and artistic consciousness, so too has the matter of urban futures become tied to our visions of what the climate problem is and how we might respond.

One such set of discourses has focused on the potential for climate change to cause catastrophe and the collapse of existing forms of civilization. The city takes central stage in these visions. In the 2004 film *The Day After Tomorrow*, rapid and abrupt climate change wreaks global havoc, with climate-related disasters striking Los Angeles, New Dehli and Tokyo and, centrally for the film's plot, flooding New York. In *Postcards from the Future*, an exhibition held at the Museum of London from October 2010 to March 2011, artists Robert Graves and Didier Madoc-Jones illustrated multiple forms of climate future for London, showing the fragility of the city in relation to the impacts of sea-level rise, abrupt glaciation, drought and climate migration. Beyond these images of the city as the somewhat unwitting victim of a climate-changed world are other urban dystopias in which the culpability of cities for climate change is writ large. Here, discourses and images of the city echo the official statistics of ever-growing urban populations and energy demand articulated by the United Nations and IEA, but the city is transformed from an abstract set of calculations to be seen as a site of insatiable consumption, greed and desire. In the 2010 novel by Ian McEwan, *Solar*, the central character describes his ambivalence on viewing the city from the air:

> Whenever he came in over a big city he felt the same unease and fascination. The giant concrete wounds dressed with steel, these catheters of ceaseless traffic filing to and from the horizon – the remains of the natural world could only shrink before them. The pressure of numbers, the abundance of inventions, the blind forces of desires and needs looked unstoppable and were generating a heat, a modern kind of heat that had become, by clever shifts, his subject, his profession. The hot breath of civilisation. He felt it, everyone was feeling it, on the neck, in the face.
>
> (McEwan 2010: 109)

In their discussion of the opportunities for, and limits to, urban responses to renewable energy, the IEA tells a 'Tale of two cities' (International Energy Agency 2009: 27–37). One, 'Bleak House', in which the impacts of climate change combine with urban dysfunction, including energy shortages, urban congestion, limited supplies of potable water, to create a bleak view of urban futures, a dystopia of urban neglect and decay. A second, 'Great expectations',

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represents a vision of 'the transition to a new, decentralised, decarbonised energy world: "it was the best of times"' (International Energy Agency 2009: 31), in which a range of new technologies that offer low-carbon energy are integrated into a new urban Utopia of a clean, vibrant and connected set of communities. This vision of a high-tech, low-carbon Utopia is increasingly associated with cities: a vision of plenty, continued economic prosperity and access to affordable energy for all. This is a view in which the individual elements of the city need to be brought together in a planned, coherent manner in order to respond to climate change. For Arup, an urban-development company, the challenge of climate change requires a holistic, integrated view of the city: 'creating a resilient city requires technical understanding of many individual elements, as well as the policy and regulatory frameworks that integrate them. Arup is well placed to help with it all' (Arup 2011a). In this vision, urban systems are able to be marshalled in response to climate change, creating a systemic and integrated response to challenges of both adaptation and mitigation. Such technical, often managerial, Utopias are of course not new in the urban arena – from ideas of the Garden City to Le Corbusier's visions of modernist urban planning, the urban has been an arena in which such ideals have been configured and contested. They rely on a particular sense of the urban as a system that can be known and is amenable to intervention. In other words, viewing urban responses to climate change in this manner involves a preconception of the urban as a relatively organized system, in which interventions can be readily planned and implemented. Various organizations, from IBM to Greenpeace, energy companies to governments, have started to create platforms and interfaces through which these discourses can be put to work to test new forms of urban future (Box 1.2).

Other utopian visions of the urban response to climate change are somewhat different. They are based on the idea of the urban as a place in which responses are emergent, coming from the activities and self-organization of independent actors, and where there are radical possibilities for living different urban lives in reconfigured urban economies. Less well established in mainstream discourses, this is a vision that might be termed 'decentralised engagement' (Foresight 2008: 117), in which multiple actors seek to develop measures that provide low-carbon energy and transport, or address urban vulnerability and foster resilience 'from the bottom up'. For some, this is a story of 'disruptive forms of innovation – cheaper, easier-to-use alternatives to existing products or services often produced by non-traditional players that target previously ignored customers' (Willis *et al*. 2007: 4). In terms of supporting adaptation, this is often a form of response focused on communities and recognizing that, 'planning and intervention design should use people's

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BOX 1.2

Virtual urban responses to climate change: LogiCity

LogiCity is a fun interactive computer game with a difference. Aimed at young people under 25, it's a game set in a 3D virtual city with five main activities where players are set the task of reducing the carbon footprint of an average resident. As players work their way through the game they will pick up information about Climate Change and some of the main ways in which everyone is currently contributing to the emissions of the main greenhouse gas (CO_2) that causes Climate Change.

It places individuals in a virtual environment and lets them experiment and experience the potential effect that individual actions can have on the planet before it's too late. Users can travel to the future to see the direct results of their actions in real time by quickly fast forwarding to the year 2066.

The game is part of Defra's Climate Challenge programme to increase public awareness of Climate Change across the country. The National Energy Foundation, Logicom and British Gas are also providing some support to the game's development.

(LogiCity 2012)

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own ability and practice of experimentation and innovation as an entry point', while also working to overcome existing institutional and political constraints (Levine *et al*. 2011: ix). For others, the vision is of a more radical disconnect from existing norms of growth, consumption and urbanization, where, for example, new forms of food and energy provision are located in cities and managed through different kinds of collective action. While the Transition Towns movement (as discussed further in Chapter 7) is mobilized around the notion of community, this is increasingly being taken up in towns and cities:

> Transition Initiatives, community by community, are actively and cooperatively creating happier, fairer and stronger communities, places that

> work for the people living in them and are far better suited to dealing with the shocks that'll accompany our economic and energy challenges and a climate in chaos.
>
> (Transition Town Network 2012)

Although these different utopian views of urban responses to climate change differ significantly in how they view the role of technology, economy, government and community, they share a sense of the city as a space of possibility, potentially in the face of more far-reaching systemic change and collapse, and of the ways in which responding to climate change is not only a matter of addressing a seemingly global environmental challenge but also of reconfiguring urban systems and daily experiences.

More or less implicitly then, the city has come to figure in our political, economic and cultural imagination of climate change (Figure 1.1). Discourses of climate dystopias either play out across an urban landscape or place the city as central to unfolding catastrophe. The city is regarded as either the victim of the dangers emergent in the complexity of climate change, or as the culprit of the organized irresponsibility through which dangerous climate change is being produced. Utopian visions of the social and technical response to climate change are also conducted through different imaginations of the future city. One set of stories reveals different kinds of climate-controlled

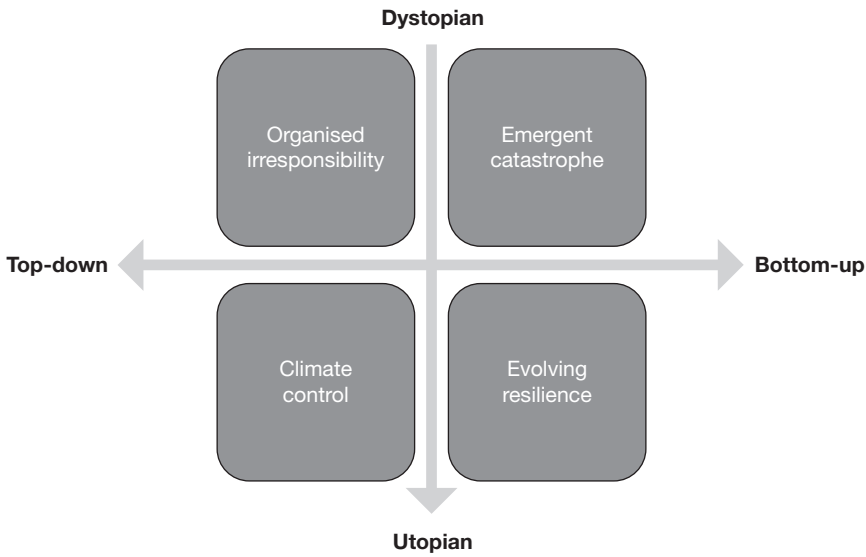


Figure 1.1 Imagining urban climate-change futures

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future, achieved primarily through combinations of managed change and technical innovation. Another discourse shows the urban landscape as more emergent and fragmented, where the complexity of climate change leads, not to catastrophe, but rather to evolving forms of innovation and grass-roots alternatives with radical potential.

Chapter outline

Cities are now firmly on the climate-change agenda. The ways in which the effects of climate change are produced through and by cities and the manner in which our understanding of the urban is being challenged and reshaped by climate change are the subject of the rest of this book. Throughout the book, examples from different cities and communities are used to illustrate and explore the issues and arguments raised. Given the scope and range of material covered, readers are encouraged to use the references and suggestions for further reading to explore individual cases in more depth. This is also a fast-moving field, including many more valuable studies and examples than are referred to only in these pages.

In Chapter 2, we consider the issue of the *impacts* of climate change and the challenge of *vulnerability* in more detail. The chapter examines the challenges of creating accurate and useful information about how climate change might affect cities, and how and why we might come to understand urban vulnerability in relation to climate change. An in-depth case study of the issue of climate-change vulnerability in Cape Town illustrates these issues. Chapter 3 assesses how we can account for urban GHG emissions and the common but differentiated *responsibilities* for producing climate change that are emerging at the urban level. Some of the challenges of creating reliable and accurate models of urban GHG emissions relate to technical matters, but others concern just how we should draw the boundaries around cities and their wider connections to the processes of economic production and consumption. As the case study of Amman shows, these are important issues, particularly as cities seek to gain international financial support for taking action on climate change.

In Chapter 4, we turn to exploring how we might understand urban responses to climate change. It focuses on those urban responses that can be described as *governing*: that is, those that can be regarded as involving some degree of intervention in order to direct or guide the actions of others. The chapter outlines the multilevel context within which the history of urban climate-change governance has evolved, the different modes of governance that have

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been deployed, and the drivers and barriers that have shaped urban responses to date. The case of Melbourne is used to illustrate these processes in depth.

While the realities of many urban contexts mean that it is difficult to separate climate-change mitigation from adaptation, international convention, national policy and financial support for responses to climate change maintain this divide. At the level of the city, to date, significant differences can also be identified in the histories of mitigation and adaptation response, and in terms of the actors involved and initiatives that are being undertaken. Chapter 5 focuses on *climate mitigation and low-carbon cities*, first setting out the core terms and issues, before detailing how urban mitigation policy has developed, examining the evidence of how mitigation is taking place in practice, and considering the drivers and barriers shaping mitigation responses. Using the case of São Paulo, the ways in which this process of addressing mitigation takes place are examined in further depth. In Chapter 6, the issue of *adaptation* is addressed through a discussion of definitions and key debates in the field, analysis of the emergence of adaptation policy, and an examination of the practice of adaptation at the urban level and the drivers and barriers that have been critical in shaping this response. The case study of Philadelphia shows how adaptation policy and measures have only recently emerged on urban agendas and illustrates the challenging issues of vulnerability that they are seeking to overcome.

Whereas Chapters 5 and 6 place municipalities at centre stage, focusing on formal processes of policy-making and the sorts of intervention and measure that municipal authorities have undertaken, Chapter 7 starts from a different basis and examines the *experiments and alternatives* that are emerging as part of the urban response to climate change across a wide range of state and non-state actors. Despite significant challenges facing the development and implementation of urban climate-change policy, there is evidence of an increasing number of projects and initiatives taking place in cities that are apparently concerned with climate change. The chapter explores the reasons for this growth of 'climate-change experiments' and how we might understand their role in urban climate-change responses and considers four different types of experiment – as policy innovation, eco-city development, technological innovation, and the transformation of everyday practices. At the same time, different forms of climate-change response, concerned with issues of social justice, with resilience and with radical alternatives, can also be found taking place in cities. The chapter examines why and how such alternatives are emerging, and what their implications might be for how we think about climate change and the city. Chapter 8, in conclusion, summarizes the main topics and debates discussed in the book and considers their implications for issues

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of social and environmental justice, as well as the future of urban responses to climate change.

Discussion points

- Why and how can climate change be thought of as an urban problem?
- For one or more work of climate-change fiction – book, film, poem or exhibition, for example – analyse the ways in which the relationship between climate change and the city is articulated. Working in small groups or a class, compare and contrast the differences between different texts and discuss how these might be explained.
- Taking the example of a city with which you are familiar – your home town, somewhere you have visited, perhaps where you are currently living – create alternative scenarios for urban development in 2020, 2030 and 2050 under the four different forms of climate-change future set out in Figure 1.1. Which do you think is most likely, and why? In small groups or with your class, role play a town meeting in which a decision has to be made to follow one of these scenarios – which argument wins, and why?

Further reading and resources

There are now a number of classic books and important reports on the topic of cities and climate change that provide additional references to this text:

This is an edited collection that contains a number of chapters that address questions of vulnerability and adaptation in different developing countries:

Bicknell, J., Dodman, D. and Satterthwaite, D. *et al*. (2009) *Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges*. Earthscan, London.

The first book to examine urban responses to climate change, this sets out the context for the emergence of urban approaches to mitigation and examines the processes of policy-making and implementation in six case-study cities:

Bulkeley, H. and Betsill, M. M. (2003) *Cities and Climate Change: Urban Sustainability and Global Environmental Governance*. Routledge, London.

This book examines how world cities are responding to climate change, providing an overview of the global situation and detailed examples from several major cities, including London, New York and Shanghai:

Hodson, M. and Marvin, S. (2010) *World Cities and Climate Change: Producing Urban Ecological Security*. Open University Press, Milton Keynes.

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This is a comprehensive analysis of urban climate-change challenges, illustrated with lots of cases and examples:

Rosenzweig, C., Solecki, B., Hammer, S. and Mehrota, S. (2011) *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press, Cambridge.

This is a comprehensive analysis of the relationship between cities and climate change, with a website that contains several background studies on individual cities, as well as links to other reports on urban sustainable development:

UN-Habitat (2011) *Global Report on Human Settlements: Cities and Climate Change*. UN-Habitat, Nairobi, Kenya. Online: www.unhabitat.org/content.asp?typeid=19&catid=555&cid=9272.

This is an important landmark report from the World Bank on the topic of cities and climate change:

World Bank (2010) *Cities and Climate Change: An Urgent Agenda*. World Bank, Washington DC. Further documents and analysis available online at: http://climatechange.worldbank.org/content/new-report-sees-cities-central-climate-action.

The following electronic resources provide different ways in which virtual cities are being created as a means through which to explore different ways of responding to climate change:

- www.greenpeace.org.uk/EfficienCity – virtual city used as an information portal on different energy technologies.
- www.electrocity.co.nz/Resources/ – New Zealand energy-company website designed for high-school students but useful for examining different kinds of alternative and the implications for decision-makers.
- www-01.ibm.com/software/solutions/soa/innov8/cityone/index.html – designed to simulate real-world decisions across different urban sectors and enable players to share their experience globally.

For one imagined view of the city and climate change, see *Postcards from the Future*: www.postcardsfromthefuture.co.uk/.

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