Cities and Low Carbon Transitions

Edited by
Harriet Bulkeley,
Vanesa Castán Broto,
Mike Hodson and **Simon Marvin**

Routledge Studies in Human Geography

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Current societies face unprecedented risks and challenges connected to climate change. Addressing them will require fundamental transformations in the infrastructures that sustain everyday life, such as those relating to energy, water, waste and mobility. A transition to a 'low carbon' future implies a large-scale reorganisation in the way societies produce and use energy. Cities are critical in this transition because they concentrate social and economic activities that produce climate change-related emissions. At the same time, cities are increasingly recognised as sources of opportunities for climate change mitigation. Whether, how and why low carbon transitions in urban systems take place in response to climate change will therefore be decisive for the success of global mitigation efforts. As a result, climate change increasingly features as a critical issue in the management of urban infrastructure and in urbanisation policies.

Cities and Low Carbon Transitions presents a ground-breaking analysis of the role of cities in low carbon socio-technical transitions. Insights from the fields of urban studies and technological transitions are combined to examine how, why and with what implications cities bring about low carbon transitions. The book outlines the key concepts underpinning theories of socio-technical transition and assesses their potential strengths and limits for understanding the social and technological responses to climate change that are emerging in cities. It draws on a diverse range of examples including world cities, ordinary cities and transition towns, from North America, Europe, South Africa and China, to provide evidence that expectations, aspirations and plans to undertake purposive socio-technical transitions are emerging in different urban contexts.

This collection adds to existing literature on cities and energy transitions and introduces critical questions about power and social interests, lock-in and development trajectories, social equity and economic development, and socio-technical change in cities. The book addresses academics, policy makers, practitioners and researchers interested in the development of systemic responses in cities to curb climate change.

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Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2011
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
270 Madison Avenue, New York, NY 10016

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

This edition published in the Taylor & Francis e-Library, 2011.

To purchase your own copy of this or any of Taylor & Francis or Routledge's collection of thousands of eBooks please go to www.eBookstore.tandf.co.uk.

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

Library of Congress Cataloguing in Publication Data
Cities and low carbon transitions / edited by Harriet Bulkeley ... [et al.].
p. cm.
Includes bibliographical references and index.
1. City planning–Environmental aspects. 2. Urban ecology (Biology)
3. Climatic changes. 4. Carbon dioxide–Environmental aspects.
I. Bulkeley, Harriet, 1972–
HT166.C466 2011
307.1'216—dc22
2010023424

ISBN 0-203-83924-2 Master e-book ISBN

ISBN: 978–0–415–58697–9 (hbk)
ISBN: 978–0–203–83924–9 (ebk)

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Acknowledgements

We would like to thank the publishing team at Routledge, and in particular Andrew Mould and Faye Leerink, for their support and help with the commissioning and production of this book.

Many of the book's chapters were first presented at the 'Urban Transitions/ Technological Transitions: Cities and Low Carbon Transitions' workshop hosted by SURF in May 2009. This workshop provided a stimulating, interdisciplinary and comparative context for starting to think critically about transitions in an urban context. We were extremely pleased and grateful for the collegiate yet critical style of both research and policy-maker participation in the workshop. Unfortunately, we were not able to publish in this collection all the excellent papers presented at the workshop, but we would like to thank all the participants for their papers and contributions to the debate. We would also like to acknowledge the support for the workshop from the University of Salford and from Harriet Bulkeley's ESRC Climate Change Leadership Fellowship 'Urban Transitions: climate change, global cities and the transformation of socio-technical networks' (Award no. RES-066-27-0002). We would also like to thank Victoria Simpson and Tori Milledge for their assistance in organising the workshop upon which this collection is based, and Tori Milledge for her work in managing the submission of draft chapters.

At SURF, Mike and Simon would also like to thank Tim May and Beth Perry for their continued support in the development of our intellectual interests and political priorities.

Finally, the production of this book has been the product of the editors coming together around a shared set of concerns about both the potential – and the limits – of low carbon transitions in an urban context. It has been a fun and enjoyable process!

Harriet Bulkeley
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1 Introduction

Harriet Bulkeley, Vanesa Castán Broto, Mike Hodson and Simon Marvin

> The transition to a low-carbon economy will be one of the defining issues of the 21st century.
>
> (Secretary of State for Energy and Climate Change, Foreword, *The UK Low Carbon Transition Plan*, 2009)

> We truly don't know if this will work. Transition is a social experiment on a massive scale.
>
> (Transition Network, April 2010)

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

Climate change is a 'wicked problem' (Rittel and Webber 1973). The nature of the climate change problem, in scientific, policy and political terms, is uncertain and there are multiple contested and conflicting discourses concerning how the issue should be addressed. In this context, it has become clear that conventional approaches to environmental management which address single parts of the climate change puzzle one at a time are inadequate. Instead, as the quotations above illustrate, proponents have begun to call for a wholesale *transition* to a low carbon future. In 2009, the UK government published *The UK Low Carbon Transition Plan*, which set out a 'route-map' for 'becoming a low carbon country: cutting emissions, maintaining secure energy supplies, maximising economic opportunities, and protecting the most vulnerable' (DECC 2009: 5). Using similar language but portraying significantly different ideas, the Transition Towns movement, founded in the United Kingdom in 2007 and by 2010 involving more than 250 communities globally, also argues that transition is needed in order to

> look Peak Oil and Climate Change squarely in the eye and address this BIG question: 'for all those aspects of life that this community needs in order to sustain itself and thrive, how do we significantly increase resilience . . . and drastically reduce carbon emissions?'
>
> (Transition Towns 2010)

Low carbon transitions are therefore gaining political salience and public currency. This book seeks to examine the emergence of low carbon transitions and explore their politics and possibilities in the urban arena. The role of cities in addressing climate change has increasingly been recognized over the past two decades (Betsill and Bulkeley 2007; Bulkeley 2010). From being acknowledged by a handful of pioneering municipal authorities in the early 1990s, climate change has risen on the agenda of urban governments and attracted the interest of private and third-sector organizations. Citing the growing proportion of the world's population living in cities in the twenty-first century and their contribution of over 70 per cent of energy-related carbon dioxide emissions (IEA 2008), the mayors of eighty world cities gathered in Copenhagen prior to the 2009 international climate negotiations and called for recognition of the critical role that cities will play in responding to climate change. During the past decade, membership of transnational networks such as the ICLEI Cities for Climate Protection and Climate Alliance has grown, and new networks, including the C40 Cities Climate Leadership Group and the Rockefeller Asian Cities Resilience Network, have been formed. In the United States, in 2005 the mayor of Seattle, Greg Nickels, challenged mayors across the nation to take action on the issue, and by 2009 over 900 mayors had signed up to the US Mayors' Climate Protection Agreement (Gore and Robinson 2009: 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 a thousand members. At the same time, private actors, including financial institutions, property development companies, utilities, foundations and non-governmental organizations, are increasingly involved in initiatives to address climate change. Further, new grassroots networks, including 'transition towns', are emerging which take the urban as an explicit arena within which to address climate change.

The conjunction of the growing prominence and plurality of urban climate change responses and the emergence of calls for a low carbon transition raises important questions about the future of cities, and in particular the infrastructures that sustain urban life. The provision and organization of urban infrastructures – including energy, water, waste, shelter and mobility – have largely been perceived as unproblematic and taken for granted as primarily engineering challenges and administrative issues (Graham and Marvin 2001). Recent analyses have called these assumptions into question, demonstrating the critical role played by infrastructures in urbanization and vice versa, and highlighting structural shifts taking place in the provision and use of urban networks. Recognizing the intimate connection between, on the one hand, cities and climate change and, on the other hand, urbanization and infrastructure systems, it is increasingly clear that addressing climate change will require fundamental transformations in the urban infrastructure networks that sustain daily life. In short, it is clear that urban infrastructure networks will be central to any effort to achieve a low carbon transition.

There is therefore a pressing need to consider how system transitions take place within the city. Such systems, we suggest, should be conceived as *socio-technical* – that is, they comprise, and are co-produced by, social and technical elements. For example, a photovoltaic energy system comprises a form of energy conversion

technology (photovoltaic cells), made from materials (e.g. silicon), installed through a particular configuration of technical artefacts (e.g. a building integrated system), in the context of political and legal institutions (e.g. planning requirements), processes of design (e.g. house building) and social practices (e.g. domestic use of electricity). The resulting system is considered socio-technical because it emerges through the conjunction and co-evolution of these 'technical' and 'social' entities and processes. While there are a variety of approaches to understanding socio-technical systems and their dynamics, the one which has to date engaged most explicitly with the challenges of sustainability and in particular energy systems is that based on the 'multilevel' analysis of systems in transition (Geels 2004; Elzen *et al.* 2004). However, while there is a growing scholarship on transitions in socio-technical systems, this work has to date paid little attention to the urban scale. In this book, we critically examine this underexplored relationship between the multilevel perspective (MLP) on socio-technical transitions and cities, where pressures to undertake low carbon transitions in infrastructure systems are, as we have outlined above, particularly pronounced. In so doing, we seek to answer the key question: how, why and with what implications are cities effecting low carbon transitions?

In order to address this question, the book is organized in two parts. Part I examines the key interconnections between cities and transitions by looking critically at the historical, theoretical, conceptual and methodological relations between the urban, infrastructural systems and socio-technical change. It outlines the key concepts underpinning theories of socio-technical transition, the emergence of the low carbon imperative within cities, and the extent to which such a phenomenon might be understood in terms of systemic change. Part II is more empirical in orientation. Through a series of case studies, contributors address how, and with what consequences, we understand the role of 'the city' in undertaking urban transitions in practice. In the remainder of this Introduction, we consider in turn these two related aspects of the book in more detail before introducing the contributions made by each of the following chapters.

Conceptualizing low carbon transitions and the urban

As the quotations at the beginning of this Introduction make clear, there are many different ways in which the concept of a 'transition' might be understood. In seeking to understand the nature and potential of urban low carbon transitions, Part I of this book draws on three sets of debates to outline some of the key issues concerning how we might theorize such processes. First, as we set out above, a primary concern of this volume is to consider the applicability to the urban arena of insights from the debates concerning socio-technical regimes and their transition (Geels 2002; Shove and Walker 2007; Smith *et al.* 2010; Hodson and Marvin 2009). As a field of study that has explicitly engaged with the ways in which Large Technical Systems, such as energy systems, remain stable and undergo change, this analytical framework holds significant promise for understanding the ways in which urban infrastructure networks may be transformed in response to climate change. Central to current

analyses of the historical and future transformation of socio-technical systems is the 'multilevel perspective', which suggests that such systems can be analysed in terms of a broad landscape of institutions and norms, distinct socio-technical regimes that structure the ways in which particular systems operate and their dynamics, and niches where innovation and experimentation take place (Geels and Kemp 2007; Geels and Schot 2007; Smith *et al.* 2010). Transformation in such systems can be both incremental and radical, and is dependent on the alignment of innovations at the niche level, with windows of opportunity created within incumbent regimes and through the dynamics of landscape change. The appeal of such an analytical framework lies both in its comprehensive nature and in its ability to explain long-term and far-reaching shifts in socio-technical systems. However, critics have cautioned that the politics of transitions receive limited attention in a framework more concerned with innovation and social learning (Shove and Walker 2007), and that the places within and through which transitions occur have largely been absent from analysis (Hodson and Marvin 2010). In Part I of this book, the authors consider the merits and limitations of the multilevel perspective and in particular seek to bring concepts of place and the urban into the analytical frame, while in Part II the contributors consider the analytical purchase of the multilevel perspective for explaining urban responses to the low carbon imperative.

A second set of debates with which this book directly engages considers urban low carbon futures in terms of policy, politics and governance. Within the growing literature on urban responses to climate change, analysis has predominantly focused on the processes of policy change which have or have not sustained shifts towards low carbon strategies and measures in the urban arena. The extent of policy transformation is explained in terms of issues of institutional capacity and urban politics, and conceived as structured within a 'multilevel governance' framework where decisions and actions at international, national and regional levels and emerging through governance networks serve to create the conditions of possibility within individual cities. While there are similarities here with the MLP on socio-technical systems transition, in terms of recognizing the different arenas through which transitions are simultaneously produced, in the multilevel governance approach these arenas are regarded not as separate entities but as continually structuring and reproducing one another. However, analyses of policy change have rarely taken into account the socio-technical, or explicitly addressed questions of transition. Chapters in this book take up these challenges, examining the growing imperative of 'carbon control' in urban governance and the emerging political economies of low carbon transitions (Bulkeley *et al.*, Chapter 3; Hodson and Marvin, Chapter 5; While, Chapter 4). In these accounts, cities are reproduced through, and at the same time actively reconfigure, structural social, economic and political processes. Cities become critical to 'state strategies' of carbon control, while urban actors respond to new low carbon imperatives in a variety of ways, from radical plans for localization to efforts to embed urban economies in low carbon technological futures, in turn reshaping what effective and legitimate state strategy might entail. In short, such analyses suggest that the urban is a fundamental part of low carbon transitions, whatever their spatial scale.

The third set of debates with which this collection engages problematizes the relation between the urban and infrastructure systems further through focusing on processes of 'urban metabolism', in which the city is described as a process of socio-ecological change (Swyngedouw and Heynen 2003). Rather than attending to the political economy of socio-technical systems, these debates are concerned with the ways in which infrastructure (and other) networks mediate socio-ecological flows in the city. The resulting political ecologies consider how uneven power relations orchestrate and are reproduced by the city, examining human and non-human agency in these processes. The flux and flow of urban metabolism suggests that transformation is a continual process, and, rather than being taken for granted, the fixity of urban socio-technical systems is a complex accomplishment. In this reading, transitions in urban systems are as likely to emerge from the co-incident actions of multiple agents and everyday actions as from purposive attempts to transform the city. Indeed, the success, or otherwise, of transitions may be located not in broader political and economic processes, or in terms of the processes of innovation, but through the ways in which they are mediated by everyday life and the myriad power relations that sustain and constrain such actions. Contributors in Part I of this book consider the implications of this alternative understanding of the urban, and of its transformation, suggesting that it may open up the analytical space for considering transitions in more diverse and plural forms while placing issues of social and environmental justice at the centre of the research agenda (Bulkeley *et al.*, Chapter 3).

Cities in transition?

If Part I is more conceptual in orientation, Part II of this book starts the significant and pressing task of understanding the processes of low carbon transition that are taking place in cities. Drawing from a range of urban places – from global cities to local communities, in the North and global South – the contributors focus on three sets of related issues. The first, and in some ways most fundamental, concerns whether we can identify processes of 'low carbon transition' taking place within urban arenas and, if so, what they entail. Contributors take diverse methodological approaches to this question, for example, considering the changing nature of energy use and demand (Dhakal, Chapter 6), providing an historical analysis of the emergence and implementation of low carbon strategies and measures (Späth and Rohracher, Chapter 7), or demonstrating the 'performance' of low carbon transitions in the Transition Town movement (Smith, Chapter 11). Nonetheless, across a range of cases the chapters in Part II suggest that the imperative of responding to climate change is firmly on the urban agenda. Evidence is found for the emergence of transitions – in energy use (Dhakal, Chapter 6), in low carbon urban planning and development (Evans and Karvonen, Chapter 9; Pickerill, Chapter 12; Späth and Rohracher, Chapter 7) and urban infrastructure systems (Aylett, Chapter 10; Coutard and Rutherford, Chapter 8) – but the picture is fragmented. While, following the multilevel perspective on transitions, this may be interpreted in terms of the emergence of low carbon urban niches, the contributors

also find theoretical insights from the literatures on urban infrastructures, political ecologies and policy useful in explaining their findings.

A second set of issues that Part II addresses concerns how transitions are taking place and who is involved in these processes. For many of the contributors, in contrast perhaps to the relatively comprehensive accounts of historical transitions presented in the literature on Large Technical Systems and socio-technical regimes, urban low carbon transitions appear to be fluid, contested and partial processes. The one exception may be the case of urban energy use in China, where the national government's policies for development and industrialization have steered urban energy trajectories towards greater energy consumption. In the other contributions, low carbon transitions are regarded as driven either through processes of urban governance, broadly defined, or through some form of social movement. First, contributors show how the fragmentation of urban infrastructure systems, the changing nature of urban governance, the creation of visions or shared discourses around urban futures, and the formation of coalitions across public/private boundaries and institutional structures have shaped the opportunities for reframing urban development processes in low carbon terms. Second, the chapters demonstrate that low carbon transitions are not necessarily the preserve of an urban elite; they are also being driven by social movements and individual actors. Here too, shared visions, creating coalitions and networks, and operating across the public/private divide are also seen as important. Cities are therefore involved in shaping and directing transitions, but the capacity to do so, the actors involved and the politics of these processes vary from place to place.

The third set of issues that the chapters in Part II raise is the extent to which urban places are shaping the conditions of possibility for low carbon transitions – or, in other words, what difference does the urban make? The chapters show how cities have provided both political opportunities – for example, coalition building – and openings for particular kinds of socio-technical intervention, such as combined heat and power plants and solar photovoltaic cells (Evans and Karvonen, Chapter 9; Coutard and Rutherford, Chapter 8; Späth and Rohracher, Chapter 7). At the same time, some contributors point to the ways in which making transitions in the urban arena is more challenging than in smaller communities or in rural settings, because of the challenges of developing in innovative ways within the existing urban fabric (Pickerill, Chapter 12; Smith, Chapter 11), and the limiting effects of existing institutional and political structures (Aylett, Chapter 10). Collectively, they suggest that the urban is critical in both enabling and constraining potential low carbon transitions, but at the same time point to the importance of regional and national government, transnational networks, private-sector actors operating locally and/or globally, and external events in shaping their trajectories.

Outline

Having outlined the main debates considered in this book, we turn here to the contributions of each chapter in turn. Following this Introduction, in Chapter 2 Geels provides an overview of the 'multilevel perspective' on socio-technical

transitions and discusses the relevance of different scales of social and political organization within this framework. While analyses using the multilevel perspective have focused on examples of transitions occurring at the national level, Geels suggests that transitions can also be studied at other levels (e.g. international, local/city), depending on the issues and audience in question. Focusing on the historical analyses of national transitions, Geels argues that a city can play three roles: as a primary actor leading the transition; as a seedbed of innovations which may gather pace through the creation of national infrastructure; or as having a limited role. The chapter provides a coherent analysis of the potential for the multilevel perspective in the urban context.

In Chapter 3, Bulkeley *et al.* outline how the city has come to prominence in the climate change debate. They argue that rather than regarding the urban climate change agenda in policy terms, there is a need to look to its socio-technical nature. Rather than regarding the city as either an actor or an arena within which transitions take root, they suggest that an engagement with the social studies of urban infrastructure systems shows the city as a complex web of social and ecological processes through which networks are sustained and contested. These perspectives, they argue, are particularly useful in revealing the ways in which obduracy and flux in urban systems are created, maintained and contested, and in enabling an analysis of the political implications of urban transitions. In Chapter 4, While also argues for the importance of theorizing the urban politics of transitions, making the case for an emerging 'carbon calculus' as critical to contemporary urban governance. In While's analysis, urban transitions take place at the intersections between the reconfiguration of state strategy around the political economy of carbon and the restructuring of urban infrastructure systems. By recasting the city as a space of carbon flows, new forms of intervention and practice become desirable, legitimate and even necessary. In this manner, the city is not separate from transitions, but fundamental to their emergence and development. In Chapter 5, Hodson and Marvin address two questions: Can cities shape socio-technical transitions? And how would we know if they were doing so? In addressing these questions, they set out emerging evidence that purposive and managed change in the socio-technical organization of infrastructure networks – characterized as 'systemic' transition – is unfolding in the context of world cities. Hodson and Marvin use these developments as an entry point to develop a conceptualization of the role of 'the city' in undertaking transitions and a review of the strengths and shortcomings of the MLP in addressing this. The chapter uses this engagement to identify what an urban transition would look like, and constructs a new framework to conceptualize and research urban transitions.

In Part II of the book, Dhakal in Chapter 6 provides an historical account of the emerging 'high carbon' transition taking place among Chinese cities in response to the drive for development and industrialization. Unpacking this phenomenon, the chapter demonstrates the place-specific nature of this transition, and the ways in which counter-currents towards low-carbon urban development are emerging in some of the largest Chinese cities, focusing on Shanghai as a case study. In Chapter 7, Späth and Rohracher also provide an historical analysis of energy transitions, although through a governance lens. They analyse the transition to sustainability

in Freiburg, Germany, and Graz, Austria, and show how new forms of discourse and governance are critical in shaping low carbon transitions. Their analysis demonstrates that different actors drive the transitions, whether led by politicians and administrators, as in Freiburg, or by entrepreneurs and knowledge makers, as in Graz, and that the potential for urban innovations to have a wider impact is conditioned by the 'multilevel' governance context within which they are situated.

In Chapter 8, Coutard and Rutherford examine the contemporary urban scene, arguing that the rise of new forms of experimentation with decentralized and localized urban infrastructure networks can be interpreted as part of the development of a 'post-networked city'. Drawing on the 'splintering urbanism' thesis and comparing its potential with theories of socio-technical transition, they argue for an approach that finds a middle ground between these alternatives. Identifying four different pathways through which the transition to a post-networked urban condition is emerging, and illustrating these with examples from across Europe, they use this framework to demonstrate the potential transformative power of urban experimentation but also the political ambivalence of the post-networked city. In Chapter 9, Evans and Karvonen point to the ways in which 'living laboratories' are becoming a means through which the development of, testing of and explicit self-reflection on 'niche' urban infrastructures are being undertaken. Often orchestrated through universities and with the explicit target of creating new forms of knowledge about what in Coutard and Rutherford's terms we might call the 'post-networked' city, they argue that living laboratories are an increasingly important vehicle through which knowledge of the city and plans for its future are being created. Drawing on examples from the Middle East, North America and the United Kingdom, they show how the living laboratory idea is being deployed and consider the potential implications for future urban development. In Chapter 10, Aylett focuses on the case of Durban, South Africa, a city that has experienced significant energy network shocks and lacks many of the advantages of the 'networked' city of the North. In his chapter, Aylett argues that the 'trained incapacity' created through organizational cultures and professional training can prevent experimentation even where opportunities may arise. In so doing, Aylett demonstrates the multiplicity of transitions taking place within one city, the ways in which agency is enabled and constrained by institutional structures, and the implications for how we consider the process and outcomes of transitions.

Chapter 11, by Smith, documents the emergence of the Transition Town movement, which emerged in the United Kingdom but has since spread to many countries of the OECD. Analysing the 'performative discourses' involved in Transition Towns, using Nottingham in the United Kingdom as an example, Smith examines the process of transition as a social one where different actors struggle to put forward their visions of what a transition entails and how it should be achieved. Although the movement has so far been successful in terms of developing the case for a transition, as this comes to be undertaken in practice, Smith questions the capacity of the movement to create momentum and catalyse a transition to a low carbon system. In Chapter 12, Pickerill also conceives of the process of transition through the lens of social movements. She explores the

opportunities for Low Impact Developments to act as innovations and catalyse change in the urban setting, drawing on examples from the United Kingdom and Germany, and documents cases of success and failure. Through this analysis, she argues that Low Impact Developments are innovations that seek to accomplish change from the 'margins'. This perspective opens up a critique of transitions as a 'blueprint', pointing instead at transitions occurring on a multitude of levels, and the complexity of 'engaging in radical social change'.

Individually and collectively, these chapters make a considerable contribution to how we can understand the emerging phenomenon of urban low carbon transitions. In Chapter 13, we revisit the key themes raised in this Introduction and throughout the contributions to the book to offer some conclusions about the state of the field to date and the directions for future research.

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