Chapter 1
Green Building as Urban Climate Change Strategy

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Abstract The building sector has been identified as one of the largest contributors to human-related greenhouse gas emissions but also as one holding great potential to lower its emissions. Due to the concentration of built structures in urban areas, green building has become a major part of urban climate change strategies, but approaches differ considerably. This book discusses local pathways to green building in four selected city regions: Freiburg in Germany, Vancouver in Canada, Brisbane in Australia and Luxembourg City in Luxembourg. The four case studies illustrate both similarities and differences through which green building is realised. The work presented identifies different forms of urban green building that range from experimental building designs and technologies and retrofitted building stock to newly designed neighbourhoods and from policies and regulatory tools to new institutional arrangements and actors. It captures not only endeavours to reduce the carbon footprint of buildings and their associated uses but also considers the wider context and social dimensions of sustainability such as ideas of liveability and affordability. It considers the conditions that foster and promote green building but also factors that inhibit its realisation and critically examines the success and changes over time within the four case studies in order to contribute to ongoing debates around urban sustainability transitions.

1.1 Introduction

In November 2017, shortly after the US government resigned from the Paris agreement, the United Nations Climate Change Conference (COP23) was held in Bonn, Germany. Despite the US government's withdrawal, the conference saw American delegations, but they did not represent the national government. The two initiatives *We are still in* and *America's Pledge* in particular drew a large number of subnational authorities and non-governmental organisations (NGOs) from the United

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States who demonstrated their strong commitments to the Paris goals. Not surprisingly, cities, city regions and city networks were central to these initiatives. These positions and initiatives are increasingly driven by the realisation that a reduction in carbon emissions requires fundamental change to our current socio-economic system. Cities have been identified as optimum scale to address climate change within policy and academic circles due to their high share of global greenhouse gas emissions but also in terms of the relatively close link between municipal governments and their constituencies, the relatively strong authority local governments have over a broad range of sectors as well as high(er) levels of civil mobilisation and activism (e.g. Bulkeley 2013). While these are all arguments favouring the urban scale, the extent to which cities have taken climate change action varies significantly within and across countries as does their success in promoting greening at the local scale.

Climate change actions by cities have been described and promoted as urban sustainability transitions to emphasise the extent of change needed to achieve green, sustainable and low-carbon futures (Bulkeley et al. 2011). Urban sustainability transitions help identify, conceptualise and categorise pathways to low-carbon and more sustainable societies within cities. Work has primarily focused on identifying drivers and barriers to regional and urban low-carbon transitions (Bulkeley et al. 2011; Rutherford and Coutard 2014) with a strong focus on the provision of infrastructure including transportation and energy (Rohracher and Späth 2014; Emelianoff 2014; McCauley and Stephens 2012). The building sector is one of the largest contributors to human-related greenhouse gas emissions but also one holding great potential to lower emissions due to the availability of technologies and opportunity for innovation related to new constructions, retrofitting of existing buildings and a more general shift to green energy supply and demand (UNEP 2011). The interest and literature on urban transitions and green building are growing quickly featuring work on green cities and eco-districts as well as on ecopreneurs and Eco-Homes (Gibbs and O'Neill 2014; Dixon et al. 2014; Frantzeskaki et al. 2017; Loorbach et al. 2016; van der Heijden 2014a, b; O'Neill and Gibbs 2014; Pickerill 2017).

One example of green building is the City of Freiburg in southwest Germany that has gained prominence during the 1990s through its Vauban neighbourhood development. In the early 1990s, the City of Freiburg decided to redevelop a former military barracks site located in the southern part of the city into the new eco-district of Vauban. Vauban was planned to provide homes to 5300 residents which were realised over a period of almost 15 years (Freytag et al. 2014). While the development was a response to growing population pressures on the residential market, the neighbourhood development was also guided by a number of sustainability principles including citizen participation, strict sustainable building standards enforced through Freiburg's very strict building codes and a transportation strategy based on alternative modes of transportation. These grew out of a local context of high levels of public participation and social mobilisation around environmental issues paired with a high demand for green energy. The most striking feature of Vauban is its solar settlement that consists of 59 housing units that were built as plus-energy neighbourhood that generates a surplus through the solar panels installed on the buildings' roofs (Fig. 1.1). Vauban also publicised the idea of building groups (Baugruppen) which have shaped parts of the neighbourhood not only through its

Fig. 1.1 The Solar Settlement in Vauban, Freiburg (Photo: Sebastian Fastenrath)

visual design but also providing strong social networks for residents. These building groups consist of individuals and families (self-builders) who form a collaborative to jointly design and develop plans for their building block usually with support of a hired architect and/or builder. Many of Vauban's building groups have voluntarily adopted passive house standards for their blocks going beyond legislated standards. Vauban as such is a green neighbourhood that has been shaped by the visions and actions of its residents not only through building groups but also through broader public consultation processes. Vauban was showcased as an example of best practice at the United Nations (UN) Habitat Conference in Istanbul in 1996 and has attracted international interest ever since making it one of the world's models for green eco-districts comparable to Hammarby Sjöstad in Stockholm and BedZED in London. It now serves as an example of success of green building and green neighbourhood development around the world attracting large numbers of professionals who visit the district for inspiration, learning and exchange.

Green building encompasses a vast array of activities related to the conception, planning and operation of buildings that make their construction and use more sustainable. This involves factors and measures leading to higher resource and energy efficiencies, to healthier work and living environments contributing to the well-being of users and residents as well as to a better functional integration into the built environment and its infrastructure, in particular regarding aspects of mobility and accessibility. Innovations and change in the building sector towards green building as covered in this book link to a number of discussions in the literature. Green building is probably mostly associated with physical buildings that feature green technologies and design options to reduce the ecological footprint. A lot of attention has

been paid to green and smart technologies including alternative building materials, energy saving and alternative energy sources including district energy, low-carbon or energy-plus houses, changes in conceptions of living space such as reduced unit sizes and shared facilities but also building design (e.g. through increased use of natural light) and urban design, i.e. the ways in which buildings interact with their environment and users. These innovations are frequently tested through building experiments such as the solar settlement in Vauban, Freiburg, or the BedZED building in London. The example of Vauban illustrates the opportunities to reduce carbon emissions through green building but also shows that green building is not restricted to green technologies such as alternative energy including solar panels and changes to building design but includes new organisational forms as illustrated by Freiburg's building groups and holistic approaches to neighbourhood development through integrated alternative transportation planning. Governance processes and policy analysis are central tools to understanding aspects of urban planning, design, regulation and stakeholder engagement and to identifying successful models and best practices. Green building also includes mechanisms that promote and support the implementation of green building innovations including green policies, regulations and standards (e.g. Freiburg's strict energy standards), support mechanisms providing know-how, financial tools and other relevant resources. These may take the form of new institutional organisations from certification bodies and neighbourhood organisations to research institutes as well as the restructuring of existing systems. Green building initiatives involve not only government stakeholders but also non-profit and private sector actors (e.g. BedZED, Bioregional, the Architecture 2030 programme). Finally, social and cultural norms, beliefs and habits shape expectations and standards of living (e.g. floor space, open living) and the way people interact and use the built environment. Despite green technologies and design, the success of a green building is ultimately defined by its users (e.g. Pickerill 2015). Similarly, performativity and the way people embody, envision and communicate green vision can impact the success of green innovations (Cidell 2015). This links to ideas of social innovations and organisational and institutional innovations (Seyfang and Smith 2007). Green building as it is discussed in this book encompasses all of these dimensions.

1.2 Cities, Climate Change and Green Building

Sustainable or green cities have become a common political objective and policy goal. Cities contribute a proportionally high share of greenhouse gas emissions compared to non-urban areas. They account for 60–80% of energy consumption and over 75% of natural resource consumption and emit 75% of global carbon emissions. And the numbers are expected to continue to rise. Estimates suggest that by 2030, over 80% of global annual energy demand will come from cities. Buildings are one of the biggest contributors to (urban) greenhouse gas emissions. Approximately 30–40% of final energy consumption is used by buildings

(Pérez-Lombard et al. 2008). But as much as buildings and cities contribute to greenhouse gas emissions, they are seen as a central part of the solution to our climate crisis (van der Heijden 2014a; Roaf et al. 2009).

Most cities are facing a number of challenges that force them to actively confront climate change including population growth that exerts pressures on already strained urban infrastructure and services as well as an increase in the total of carbon emissions. While cities are powerful in economic terms, they are also vulnerable places that are particularly hard hit by the implications of climate change. As a result, there has been a surge in urban climate change initiatives and leadership over the past few decades. While global and national positioning on climate change action has been relatively slow, decision-makers at the local scale have stepped up and taken on climate change leadership. An increasing number of cities have started to act as climate change leaders setting ambitious carbon emission reduction targets and developing a wide range of strategies to achieve these targets including low-carbon and green infrastructure and services. Some of them are now prominent examples of green leadership with cities like Copenhagen, Amsterdam, Singapore and Portland scoring high in global city rankings. Urban greening and climate change initiatives are frequently seen as bottom-up processes that are driven by local institutions and actors rather than expressions of top-down implementations of higher-scale regulations. This is, for example, illustrated by the position a number of American cities have taken in response to President Donald Trump's decision to withdraw the United States from the Paris accord. New York City, Miami and San Francisco amongst others have spoken up in support of the Paris accord commitments and are backed up internationally by cities through alliances such as the Global Covenant of Mayors. The growth of institutionalised networks from Local Governments for Sustainability (ICLEI) and the C40 Cities Climate Leadership Group to more recent initiative such as the Compact of Mayors, Covenant of Mayors and STAR Communities in the United States illustrates the surge in city initiatives. Cities can thus be understood as arenas for transition-oriented innovations that seek to transform urban systems fundamentally.

A significant amount of research depicts cities consisting of various governance arrangements involving municipal and higher-level governments, private sector organisations and civil society as key actors in addressing and mitigating climate change. This focus on cities is linked to the role of actors and scale. Municipal authorities have responsibility for many processes that shape urban vulnerabilities and affect greenhouse gas emissions at the local level including urban planning, building codes, provision of transportation and other infrastructures (e.g. energy, water, waste). But most of these processes are also governed or influenced by cross-municipal decision-making and regional, national and international frameworks and visions (e.g. EU regulations). Most municipalities in the Global North including the ones examined in this book hold a democratic mandate from the public to address issues that affect the city and hence are much more closely and directly linked to their constituency in contrast to regional or national governments (Bulkeley 2013). This is often linked to the idea of locally developed, endorsed and implemented solutions. Some cities have responded early to sustainability challenges and climate

change including the cities of Freiburg and Vancouver that now strongly promote their long experience.

Cities are also seen as *laboratories* for testing innovative approaches to mitigate climate change. They hold significant resources to drive transition processes, for example, through universities, research and development centres and cultural institutions (Evans 2011; König 2013; Evans and Karvonen 2014). As a result, innovation and entrepreneurship are much higher in cities than in less densely populated regions, and increased emphasis has been placed on the private sector providing climate change solutions whether this involves locally grown businesses or large external companies (Acs 2003; Carlino et al. 2007). Municipalities also act as partners for private and civil society actors who are often concentrated in cities and have shown growing commitment to taking climate change action. But change is also driven by public environmental concern, and cities provide effective arenas for civil society to mobilise support. The latter may profit from the fact that bigger cities often have a higher share of inhabitants sensible to these issues. Ultimately, buildings are only as sustainable and carbon intensive as their users. How green concepts, technologies and designs are put into practice and are lived out in the lives of ordinary citizens depends on how people use and interact with their work and living environments including single edifices, ensembles or neighbourhoods of residential and commercial buildings.

1.3 Green Building Transitions

Cities face their individual challenges, operate under different framework conditions and contexts, employ different strategies with varying degrees of success and have specific abilities and resources to do so. In order to identify and reconstruct urban trajectories of green building, these context conditions together with the actors as agents of change require careful consideration. The approach used in this book is informed by work on sustainability or low-carbon transitions (Bulkeley et al. 2011; Rohracher and Späth 2014; Rutherford and Coutard 2014; Wolfram 2016) that draws on transition studies thinking and more specifically a multi-level perspective. It also brings in work on policy mobility that raises questions of how ideas, knowledge and innovations travel and are transferred, adapted and adopted across space (Affolderbach and Schulz 2016).

The notion of *transition* highlights the process dimension under consideration, meaning a change that is happening over a longer time period. It also signals a change that is more radical and fundamental than those associated with other concepts as, for example, sustainable development. Work in transition studies and sustainability transitions focuses on the emergence and implementation of predominantly technological innovations that bring about far-reaching changes to existing production and consumption systems. While some earlier work in the field of transition studies has focused on historical examples of radical innovations, a dominant theme in transition studies relates to its application in respect to low-carbon

or sustainability transitions that seek to identify drivers behind (and to a much smaller extent barriers to) greening processes. Technological innovations are key to this conceptual approach, but they are understood as products of socio-technical dynamics. One approach to analyse and understand these socio-technical dynamics is the multi-level perspective (MLP) that differentiates the societal context of innovations into three different levels: the landscape, regime and niche level. The logic of the MLP relies on the realisation that change is often hard to implement and the different levels provide different barriers and contexts to change. The niche level is seen as the immediate nurturing environment that allows innovations to blossom. Niches may consist of legally or otherwise protected spaces that allow experimentations outside of the rules of the market or emerge where knowledge networks are particularly dense (e.g. collaboration between the higher education sector, other research institutions and the private sector). These niches never exist in isolation but are embedded in *socio-technical regimes* (Smith 2007) which are defined by predominant organisational standards (e.g. building regulations). The highest landscape level describes broader societal values, norms and standards that may include the predominant position on energy sources and environmental consciousness amongst the public. In order for green building innovations to have a wider impact, they need to spill over and promote change at these broader levels.

From a transition studies perspective, niches, regimes and landscapes do not correspond to specific spatial scales. In fact, transition studies do not engage with spatial conceptions and dimensions of niche development. But niches are spatial expressions that allow the emergence of green building as illustrated in this book for Freiburg, Vancouver, Brisbane and Luxembourg. City regions could be understood as niches that provide a test bed or laboratory for the development of green building experiments and innovations. At the same time, cities are not homogenous but may be rather uneven spaces that consist of a mosaic of different niches as illustrated by experimental green neighbourhood developments such as Vauban in Freiburg. Innovative approaches to green building through regulatory frameworks and governance provide further examples of niche initiatives including green policies and regulations such as Freiburg's green building codes, certification schemes such as Leadership in Energy and Environmental Design (LEED) in North America and Green Star in Australia or specific institutions dedicated to advance green building both in research and development and implementation.

While the MLP provides a structured heuristic to analyse green building transitions, it runs the risk to neglect or disregard important dimensions of urban transition processes (Affolderbach and Schulz 2016). Firstly, it is at least in its origin technocentric reducing green transitions to technology-driven processes that neglect very important policy, institutional, organisational and other social innovations. As such, it focuses on a narrow understanding of knowledge creation. Secondly, the idea of radical niche innovations simplifies complex processes of exchange and interaction between various actors which involve learning, adaptation and mutation of ideas. Thirdly, transition research is focused on the local, regional or national level but ignores connections and flows between these scales. Finally, transition studies understand innovations through institutional structures and actor networks

but neglect the role of individuals. A policy mobility perspective helps to address these limitations. Innovations result from processes of knowledge creation and learning. The policy mobility perspective focuses on these processes to understand how cities learn about urban policy innovations and how ideas, practices and models circulate, travel and become implemented in different places (McCann and Ward 2010, 2011). In particular, it involves analysis of those involved in policy mobility including key actors, how and what they learn and what happens to knowledge, ideas and practices when they travel. On the one hand, the (geographic) literature emphasises the relevance of the local context in respect to urban development consisting of context-specific, localised processes of putting green (building) strategies into practice. On the other hand, urban geography scholars argue that local strategies and practices are being *debordered* as models, knowledge, practices and successes as well as stories of failure are being transferred, circulated and shared internationally and globally (Peck and Theodore 2010) turning cities into assemblages of pieces, ideas and practices from elsewhere (McFarlane 2011). In this book, cities and city regions are understood as relational spaces that are as much shaped by their intrinsic natural environment, political climate and level of autonomy as by external influences and relations across space. They are not just local or urban. It is these connections and causalities that are being presented here using micro or niche case studies for each of the four cities.

1.4 Objectives of the Book

The central questions addressed in this book revolve around why some cities innovate and engage in broader transitions towards green building while others struggle, resist or fail. What are the context and circumstances that drive cities to take action? Where do innovations in green building come from and what are the conditions needed to foster their emergence and spread? The objectives of the book are twofold. First, the book aims at providing empirical evidence from in-depth case study research towards an increased understanding of how innovations towards low-carbon economies in the building sector come into being and have developed over time in different geographical contexts. Green building innovations include both newly developed as well as adapted and adopted strategies including technological, institutional, organisational and other dimensions as outlined above. The case studies consist of four city regions in Europe, Canada and Australia: Freiburg (Germany), Luxembourg City (Luxembourg), Vancouver (Canada) and Brisbane (Australia). Second, these insights are used to contribute to current scholarly debates and understandings of sustainability transitions and urban climate change mitigation policies. The main contribution relates to the international perspective that brings together insights from three continents. The four case studies provide a multisited and contextualised perspective of urban green building transitions. While some of the case studies present linear trajectories of greening and a high level of mobility of

concepts and ideas between cities, this is not the case for all of them as some are also marked by ruptures and roll back of greening initiatives. As such, the evidence presented here provides rich evidence to conceptualise trajectories from an international perspective even though they remain restricted to the Global North.

The case study research was conducted as part of a binational research project (GreenRegio or *Green building in regional strategies for sustainability: Multi-actor governance and innovative building technologies in Europe, Australia and Canada*) funded by the National Research Fund Luxembourg (FNR) and the German Research Foundation (DFG) from July 2013 to June 2016 (INTER_DFG/12-01/GreenRegio). The four case studies include the cities of Freiburg and Vancouver that have comparatively long histories of urban greening and feature recognised best practice examples and the cities of Luxembourg and Brisbane that present more recent approaches to green building. For reasons of practicability, the research presented here focused on the facets of green building related to climate change mitigation listed above. The analysis of green building transitions in the four case study city regions features micro case studies of (1) innovative green building policies and regulations, (2) leading institutional actors and new institutional and organisational arrangements (e.g. research and resource centres) and (3) the built environment represented by individual buildings (both residential and commercial) as well as neighbourhood developments including technological, socio-political (e.g. flagship buildings, social housing) and temporal dimensions. Though equally important, aspects of user well-being, health issues related to building materials as well as other social aspects (e.g. exclusive/inclusive forces of real estate market dynamics) were not explored with the same rigour. Nonetheless, these issues were taken into account where case study research suggested their strong influence on other dimensions of green building developments.

1.5 The Structure of This Book

The structure of this book is organised in three sections. The first section lays out the conceptual framework as well as the research design of the study. Part II presents the empirical results from Freiburg, Vancouver, Brisbane and Luxembourg. Part III is dedicated to the interpretation and discussion of findings bringing together the insights from the four city regions.

Part I first discusses the state of the art of scholarly debates around the notions of sustainability transitions (Chap. 2) and urban spaces as arenas for climate change mitigation (Chap. 3). An adoption of the transition studies approach to socio-technical innovations is discussed as a promising perspective for tackling ongoing changes in the building sector, including technological, organisational, institutional and social innovations. Debates about the role of cities in low-carbon policies help to conceptualise urban actors and institutional contexts. Both chapters thus try to distil the usefulness of the respective approach to green building and to derive detailed research questions for further investigation. Chapter 4 introduces the

research design and discusses opportunities and methodological challenges encountered.

Part II consists of four case study chapters each following a similar format. After a short introduction into the particularities of the respective region, the observed pathways to green building and ongoing transitions are reconstructed based on the findings obtained in the various micro case studies. Chapters 5 and 6 present the case studies of Freiburg and Vancouver which have both gained international recognition for their green building initiatives. Although their pathways have been quite different and their extant priorities vary in many regards, they currently are both positioning themselves as green cities at the global scale. Chapters 7 and 8 show the particularities of Brisbane and Luxembourg as rapidly growing city regions where more recently launched green building initiatives are driven primarily by economic imperatives. All four case study presentations discuss the main triggers for and barriers to successful green building endeavours.

Part III builds on the results presented for the four case studies and discusses the major findings regarding possible generalisations and theoretical impacts. Chapter 9 comes back to framings influenced by transition studies approaches and compares pathways and trajectories in the four cities focusing on local and regional framework conditions. More specifically, it discusses in how far and in what ways Freiburg, Vancouver, Brisbane and Luxembourg can be understood as seedbeds or niches that allow (or inhibit) green building innovations to be developed or adopted. Linking back to the discussed weaknesses of the transition studies literature on spatial dimensions of sustainability transitions, the discussion argues for a stronger relational perspective. Chapter 10 critically analyses aspects of green leadership, knowledge transfer and learning within and beyond city regions including critical reflections on environmental, economic and social implications of green building initiatives based on the four case studies. It hence responds to questions of comparability and transferability and argues for an open engagement with green initiatives that takes into account spatial and temporal relationality.

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