UNIVERSITY OF BIRMINGHAM

NETWORK GOVERNANCE AND LOW-CARBON TRANSITIONS IN EUROPEAN CITIES

By

TIMEA NOCHTA

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ABSTRACT

The thesis investigates the role of governance networks in advancing sustainable energy transitions in the cities of Europe. By doing so, it aims to provide insights about the practical applicability of the Transition Management framework in different urban settings. Exploring this issue is timely as well as important due to parallel processes of the rising profile of cities in transition governance; and the perceived need in city authorities to develop new governance mechanisms to support low-carbon transitions on the urban scale.

The main contribution to knowledge is the empirical evidence provided for the context-dependency of the connections between technological change required for urban low-carbon energy transitions and organisational change in local governance arrangements. The findings' consequence for theory is that the implicit assumptions built into Transition Management about the functioning of collaborative governance networks limit its applicability in different cities. The evidence collected through the study also highlights problems with scaling down the Multi-Level Perspective to the urban scale. The findings are derived from a comparative study of three cities from across Europe with diverse characteristics in terms of historical sustainability agenda development, locally relevant rationales for transitions, and patterns of organisational fragmentation and power-distribution in local governance arrangements.

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

ASCEND	Across Scales in Energy Decision-Making
AWM	Advantage West Midlands
BCC	Birmingham City Council
BDK	Budapest Diszkivilágítása Kft (Budapest Public Lighting cPlc.), Budapest
BEIS	Department for Business, Energy and Industrial Strategy
BEP	Birmingham Environmental Partnership
BES	Birmingham Energy Savers
BFVT	Budapest Főváros Városépítési Tervező Kft. (Municipal City Planning Agency), Budapest
BGYH	Budapest Gyógyfürdői És Hévizei Zrt (Budapest Spas cPlc.)
BIS	Department for Business, Innovation and Skills
BMWi	Bundesministerium für Wirtschaft und Energie (Federal Ministry of Economic Affairs and Energy), Germany
BSC	Birmingham Science City
BSC LCWG	Birmingham Science City Innovative Low Carbon Working Group
BSP	Birmingham Strategic Partnership
BuCC	Budapest City Council
CAS	Complex Adaptive System
CCP	Cities for Climate Protection
CDU	Christian Democratic Union
CEB	Community Energy Birmingham
CHP	cogeneration of heat and power
Climate KIC	Climate Knowledge and Innovation Community
CO_2	carbon-dioxide
COICA	Coordinator of Indigenous Organizations of the Amazon River Basin
CoM	Covenant of Mayors
COP	Conference of the Parties (UNFCCC)

CSP	City Strategic Partnership
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DH	district heating
DNO	Distribution System Operator
EBRI	European Bioenergy Research Institute
EEG	Erneuerbare-Energien-Gesetz (Renewable Energies Act), Germany
EGOS	European Group for Organizational Studies
EIT	Energy Technologies Institute
EM Group	Energy Management Group, Frankfurt City Council
EnWG	Energiewirtschaftsgesetz (Energy Industry Act), Germany
ESCO	Energy Services Company
ESPRC	Engineering and Physical Sciences Research Council
EU	European Union
EZ	Enterprise Zone
FCC	Frankfurt City Council
FCSM	Fővárosi Csatornázási Művek (Budapest Sewage Works cPlc.)
FGG	Federal Government of Germany
FGSZ	Földgázszállító Zrt (Natural Gas Transmission Closed Company cPlc.), Hungary
FIDESZ	Federation of Young Democrats
FKF	Fővárosi Közterületfenntartó Nonprofit Zrt (Budapest Metropolitan Public Area Maintenance cPlc.)
FNA	Federal Network Agency ('Bundesnetzagentur'), Germany
FŐGÁZ	Fővárosi Gázművek Zrt (Natural Gas Distribution Closed Company cPlc.), Hungary
FOKETUSZ	Fővárosi Kéményseprőipari Kft. (Budapest Public Utility Contractor cPlc.)
FŐTÁV	Budapesti Távhőszolgáltató Zrt. (Budapest District Heating Company cPlc.)
GBS LEP	Greater Birmingham and Solihull Local Enterprise Partnership
GC	Green Commission
GDP	Gross Domestic Product

GEMA	Gas and Electricity Markets Authority
GHG	greenhouse gas
HM Government	Her Majesty's Government, UK
ICLEI	International Council for Local Environmental Initiatives
IEA	International Energy Agency
IMP	Industry Masterplan, Frankfurt
INLOGOV	Institute of Local Government Studies, University of Birmingham
INSNA	International Network for Social Network Analysis
IPCC	International Panel on Climate Change
ISCO	Innovative Services Company
IUDC	Integrated Urban Development Concept (‘Budapest Városfejlesztési Koncepció’)
KPI	Key Performance Indicator
KSB	Klimaschutzbeirat (M100CP Advisory Board, Frankfurt)
LA	Local Agenda
LA21	Local Agenda 21
LAA	Local Area Agreement
LEP	Local Enterprise Partnership
M100CP	Masterplan 100% Climate Protection, Frankfurt
MEKH	Magyar Energetikai és Közmű-szabályozási Hivatal (Hungarian Energy and Public Utility Regulatory Authority)
MLP	Multi-Level Perspective
MSZP	Hungarian Socialist Party
NFFT	Nemzeti Fenntartható Fejlődés Tanács (National Commission for Sustainable Development), Hungary
NGH	National Government of Hungary
NGO	Non-Governmental Organisation
NPG	New Public Governance
NPM	New Public Management
NRF	Neighbourhood Renewal Fund
Ofgem	Office of Gas and Electricity Markets
OPEC	Organization of the Petroleum Exporting Countries

PA	Public Administration
PC	Pioneer Cities
PPA	Public Policy and Administration
R & D	research & developnment
RDA	Regional Development Agency
RQ	research question
RSA	Regional Studies Association
SDGs	Sustainable Development Goals
SEAP	Sustainable Energy Action Plan
SET	sustainable energy transition
SNA	Social Network Analysis
SNM	Strategic Niche Management
SPD	Social Democratic Party of Germany
SWM	Sustainability West Midlands
SZDSZ	Alliance of Free Democrats
TC	Transition Cities
TIS	Technological Innovation Systems
TM	Transition Management
TMN	Transnational Municipal Network
TSO	Transmission Systems Operator
UK	United Kingdom
UKERC	UK Energy Research Centre
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency
USA	United States of America
UTL	Urban Transition Laboratory
WCED	World Commission on Environment and Development
WMCA	West Midlands Combined Authority

CHAPTER 1.

INTRODUCTION

1.1 RESEARCH OBJECTIVE

This research seeks to understand the role of collaborative, networked forms of governance in facilitating low-carbon transformations in cities across Europe. The aim of the study is to investigate the role of collaboration processes between local stakeholders in supporting urban sustainability transitions, with a special focus on the influence of local contextual factors, and impact in terms of advancing transitions. The importance of this issue lies in the apparent growing interest from the local level in adopting a more strategic approach to deliver on low-carbon ambitions using techniques of stakeholder involvement (i.e. setting up low-carbon decision-making arenas) and steering governance processes which arise from deliberation and negotiations among the parties involved.

In order to understand and describe how these collaborative processes emerge and operate in different places with dissimilar social, political, economic and physical material characteristics, the study draws on the concept of 'network governance' (Khan, 2013; Klijn et al., 2013; Skelcher et al., 2013; Torfing, 2005). It analyses and compares three cases using an original framework developed on the basis of previous studies from the fields of sustainability transitions, governance networks and urban climate change governance. The comparative analysis highlights similarities and differences between the individual cases and identifies the most important context-specific characteristics which influence the formulation and functioning of local governance networks in the energy transition domain. By doing so, the research contributes to the growing literature on governing sustainability transitions on the urban level by discussing the applicability of two central concepts including the Multi-Level Perspective (MLP) (Geels, 2002, 2012; Smith et al., 2005) and Transition Management (TM) (Frantzeskaki et al., 2012; Kemp et al., 2007; Loorbach, 2010; 2007). The research focuses on the particularities of cities in Europe. Due to the centrality of context-specific factors in the research design, it cannot be assumed that the findings automatically hold in other geographical locations. However, the research approach has been designed to be transferable to investigate cases outside of the European context.

1.2 PREVIOUS RESEARCH: THE PIONEER CITIES AND TRANSITION CITIES PROJECTS

The study was born out of the lessons emerging from two successive projects funded by EIT's (European Institute of Technology) Climate KIC (Knowledge and Innovation Community), Europe's largest public-private innovation partnership focused on social and technological innovation to mitigate and adapt to climate change (Climate KIC, n.d.) . The Pioneer Cities (PC) and Transition Cities (TC) projects provided space for a network of cities from across Europe to work together on developing and testing strategic approaches to support urban sustainability transitions.

Today, most European cities have carbon emissions reduction targets: for example, over 7500 cities and towns have signed up for the Covenant of Mayors initiative committing to reducing emissions by at least 20% by 2020 (CoM, n.d.). So far, municipal responses to low-carbon innovation were mostly formulated on the basis of 'voluntarism'

(Bulkeley and Betsill, 2013) and on enabling actors to take action within their own spheres (Bulkeley and Kern, 2006), resulting in collections of isolated, standalone initiatives (Nagorny-Koring and Nochta, 2017). This situation provided the starting point for the consortium of the PC and TC projects which aimed at developing a novel methodology to connect the ongoing and planned low-carbon innovation activities in the partner cities. The goal was to find ways to achieve 'more with less' by introducing a strategic perspective to planning local action, it was expected that city governments could increase emission reductions rates while making low-carbon experimentation more cost-effective and efficient. Eight cities from six European countries were involved in the projects: Birmingham (United Kingdom), Bologna and Modena (Italy), Budapest (Hungary), Frankfurt (Germany) and Valencia and Castellón (Spain). The cities were selected by the project lead to represent fairly mainstream, middle-sized to large cities, covering a wide geographic area within the European Union with diverging social, political, economic and physical material characteristics.

The work started in 2012 with setting up the Pioneer Cities project. PC first sought to unpack the meaning of the concept of 'systemic innovation' on the city scale in practice. The project was led and managed by the city authorities themselves, with the help of a steering group made up of experts from academia and Climate KIC. Pioneer Cities first proceeded to build an understanding of ongoing low-carbon initiatives in the partner cities: an inventory of ongoing and recent innovation projects was undertaken (Pioneer Cities, 2013a). In total, over 110 initiatives were identified, with an overall value of approximately €2 billion. The analysis of the collected data revealed that most of the identified initiatives were concentrated around three key themes: Built Environment, Energy Networks and Transport.

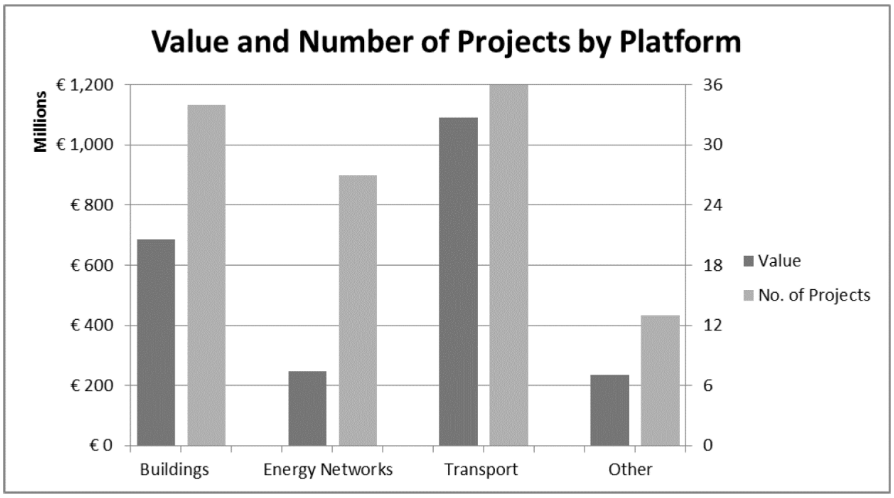


Figure 1.1 Value and Number of Projects by Platform (Pioneer Cities, 2013a)

Based on the results of the inventory, PC decided to focus on the three themes (Built Environment, Energy Networks and Transport) characterising them as urban innovation systems ('clusters'). In addition to the inventory of low-carbon projects, data have been collected about the stakeholders involved in co-ordination and project delivery. This provided the opportunity to represent the urban innovation systems as 'network maps' which showed the active projects in each city, the local stakeholders involved in project delivery and the connections between these. Thus, stakeholders and projects appeared on the network maps as 'nodes'. Stakeholders were connected to projects in which they participated creating network ties (in other words, edges). Examples of the network maps produced during this period are shown in Figures 1.2 – 1.4.

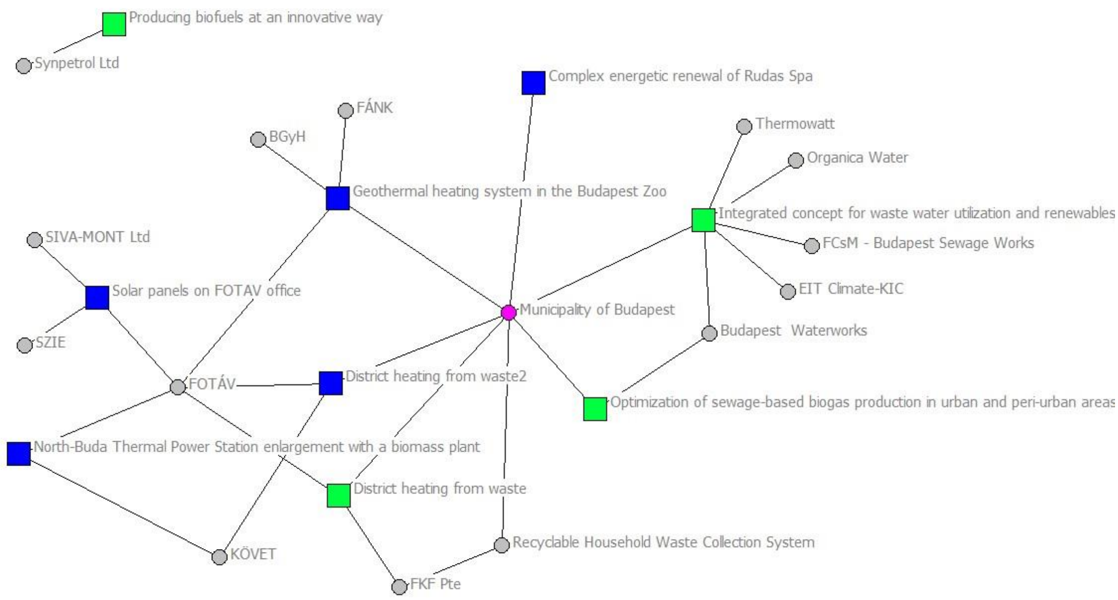


Figure 1.2 Network map of the energy networks innovation system in Budapest

(Pioneer Cities, 2013b)

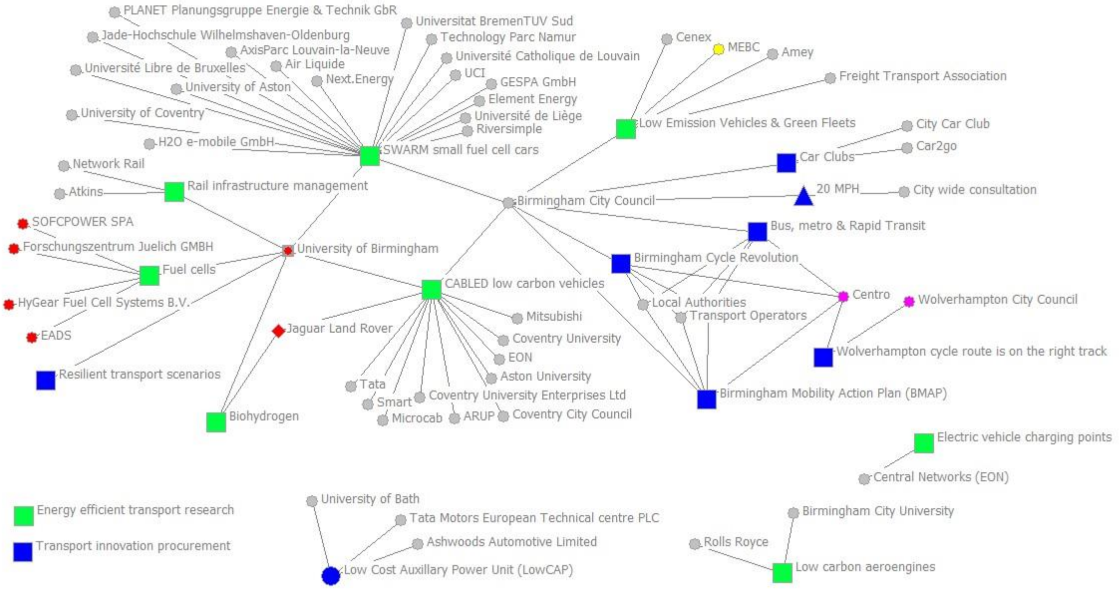


Figure 1.3 Network map of the transport innovation system in Birmingham (Pioneer Cities, 2013b)

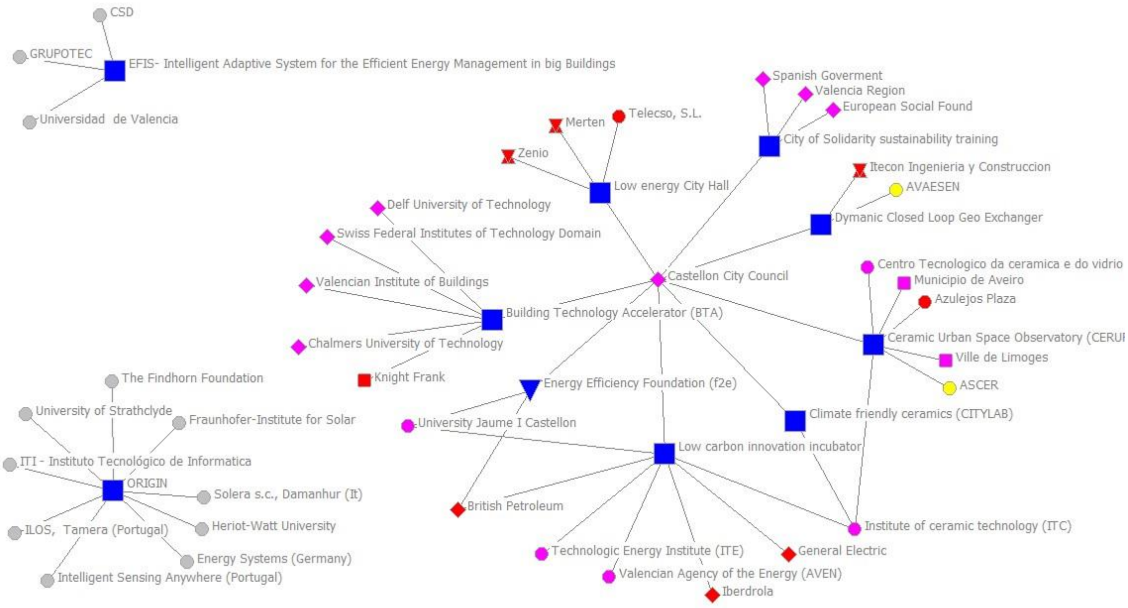


Figure 1.4 Network map of the built environment innovation system in Valencia & Castellon (Pioneer Cities, 2013b)

The network maps were envisaged to become tools for increasing the impact of ongoing low-carbon activities in each cluster (innovation system) through visualising the state of fragmentation and highlighting opportunities for better integration. Counteracting the negative effects of fragmentation, thus, was connected to increasing integration on the network maps through building connections between isolated initiatives where gaps were identified. Interpreting the information contained by the network maps was a participative activity in the cities, involving local stakeholders from the municipalities and beyond.

Based on the results and experience developed in the Pioneer Cities, a follow-up project named Transition Cities was set up in 2014 to further refine the methodology and test its potential to deliver the initial goal of enhancing the impact of low-carbon innovation in the partner cities. Activities related to the network mapping and stakeholder workshops continued, and various pilot projects were set up in each location informed by the PC/TC methodology (Transition Cities, 2015). Gap-filling pilot projects were supported financially by Climate KIC through a grant scheme. Knowledge and experience sharing between the partner cities was encouraged by an emphasis on replicating already successful projects from one city in other places. Case studies were developed on the basis of the experiences learnt during the PC and TC projects in order to try to outreach to new cities.

In a recent publication (Nagorny-Koring and Nochta, 2018) we argued that despite the theoretical framework and project design informed by the sustainability transitions literature (Nevens et al., 2013; Frantzeskaki et al., 2012; Loorbach and Rotmans, 2010; Kemp et al., 2001) the PC and TC projects had little impact in terms of implementing a more strategic approach to low-carbon innovation in cities. However, they highlighted a number of issues worthy of further investigation. First, that low-carbon innovation is not restricted anymore to a handful of frontrunner cities, as low-carbon innovation projects could be identified in each of the partner cities. Second, in line with the results of a previous large-scale survey conducted by other researchers (Castán Broto and Bulkeley, 2013), the projects confirmed that urban low-carbon innovation focuses mainly on infrastructures (energy, built environment and transport), and pilots emerge related to particular issues over which municipalities have some degree of authority. Third, despite these similarities, the information collected through the Pioneer Cities and Transition Cities revealed substantial differences with regard to stakeholder involvement in the delivery of low-carbon initiatives. Network maps showed high levels of variance in terms of integration between the local authority, business partners and companies in the arrangements tasked with policy making and/or implementation in the different cities. These conclusions provided the basis for the PhD research focusing on the role of stakeholder integration and collaboration (i.e. networked forms of governance) in supporting urban low-carbon development.

1.3 RESEARCH QUESTIONS

As discussed in the previous section, the Climate KIC research was aimed at enhancing integration between local actors in the innovation systems or ‘clusters’. It was expected that reducing fragmentation through connecting stakeholders in various ways (through new projects, through involvement in existing projects and by introducing new actors to the systems) would augment the impact of innovation systems in terms of cutting carbon-dioxide (CO_2) emissions. However, the data collected through the PC and TC projects, and the experience gained via working with municipalities from cities located in different countries within the European Union, showed that despite the similar options available to cities to intervene in urban infrastructures responsible for a high proportion of emissions, the organisational arrangements involved in the delivery of these were place-specific. The main differences were related to the number of actors involved, their background (public sector, market or civil society/community organisations) and the ways in which they were connected to each other through the initiatives identified. Thus, although stakeholder involvement may provide an opportunity for municipalities to expand their low-carbon portfolio, the nature and extent of collaboration seems to be influenced by the urban setting in which it takes place.

Previous studies have also highlighted the multi-actor and multi-scale challenges involved in managing urban low-carbon development (Bulkeley et al., 2015; Khan, 2013; Raven et al., 2012; Bulkeley, 2010). They emphasised that reducing CO_2 emissions in the urban setting is not possible without the low-carbon transformation of urban infrastructures which, in turn, requires joint action from multiple stakeholders operating on and between various geographical and organisational levels. Thus, initiatives based on stakeholder involvement, collaborative management, partnerships and so on might provide opportunities to tackle this issue. The conclusion that other studies reached resonates well with the PC and TC projects' focus on stakeholder integration.

However, due to a lack of empirical research focusing on comparing the potential of such collaborative ventures to support local low-carbon innovation in a variety of urban settings, there is little evidence available on how collaboration processes play out in different places in practice, and on the impact of any potential variation in terms of advancing low-carbon urban development. Consequently, the PhD research set out to investigate this issue through the following research questions:

RQ (1): What is the existing knowledge base regarding the potential and problems of network governance to support the transition to low-carbon cities?

A large body of literature has developed in recent years in public policy making and administration on the phenomenon of collaborative (or network) governance and its potential to govern processes where traditional hierarchical and market-style mechanisms tend to fail. The literature review presented in this thesis explores the ways in which the concept of network/collaborative governance appears in previous work on sustainability transitions and urban governance to identify the research gap and formulate a theoretical position on the role of collaboration among stakeholders to deliver emissions reduction commitments in cities across Europe. It concludes that the currently dominant discourse around analysing (MLP) and governing (TM) sustainability transitions has several shortcomings. The knowledge gap set out to be addressed in this thesis relates to the role of the context (i.e. the environment arising from issues related to scale, place, and politics and power) in influencing interaction in governance networks which, in turn, is expected to affect network impact. Impact is interpreted in terms of advancing local low-carbon transitions.

RQ (2): How can the form, extent, trajectory and impact of a city's low-carbon network governance be assessed?

The empirical part of this research focuses on developing a methodology to assess how collaborative initiatives appear, emerge and function in different urban settings. Thus, the investigation includes the effect of the local perspectives on collaboration (context) on the use of collaborative processes, and the impact these differences have on progress towards low-carbon development. The case studies demonstrate that different network processes emerge in dissimilar contextual settings which possess varying potential to produce and implement low-carbon transition strategies.

RQ (3): What is the comparative level of development, potential and constraint on the low-carbon network governance systems of the case study cities?

Comparing the results of the analyses of governance arrangements in individual cities was expected to either confirm or reject the initial assumption developed on the basis of the findings of the PC and TC projects which contends that collaborative initiatives develop in different ways in different places, influencing the impact in terms of advancing low-carbon transitions. Through the comparative analysis, specific contextual factors are identified, related to politico-administrative, economic and social pressures, which are particularly important in explaining the emergence of network processes. The findings based on empirical evidence contribute to addressing a gap in the critical literature, which so far has not been successful in explaining the role of contextual factors arising from differences in terms of scale, place, and politics and power. By doing so, they give indication on the applicability of the MLP and TM concepts.

RQ (4): In what ways can the potential of network governance be enhanced, and constraints reduced, in order to facilitate delivery of low-carbon ambitions?

Finally, the practical relevance of the PhD study needs to be explored through developing recommendations on how collaborative initiatives can potentially deliver better outcomes in different cities from across Europe. The practical recommendations point to the importance of truly cross-sectoral initiatives in advancing sustainability transitions via networked forms of governance. They are based on the literature stressing the difference between ‘policy networks’ as multi-actor decision-making contexts, and ‘network governance’ as a social coordination mechanism based on horizontal relationships (Blanco et al., 2011; Lewis, 2011).

1.4 THESIS OUTLINE

This dissertation is divided into three parts. Part I contains three chapters which discuss the contributions of various research strands to developing an understanding of the role of network governance in supporting low-carbon development in European cities. Chapter 1 defines the concept of low-carbon transitions, presents the literature on analysing transition processes and he different perspectives on facilitating transitions towards low-carbon societies. The emphasis is placed on one particular approach, TM, which recently became relatively influential on the urban level. TM explicitly addresses the issue of facilitating transitions through network governance. Chapter 2 presents the network governance literature. It starts with discussing the origins of the concept, the ways in which it fits into the broader public policy making and administration literature. In order to understand the potential shortcomings of TM's conceptualisation of network governance, different network-theoretical perspectives are introduced to highlight the variety of emerging network governance processes. Chapter 3 adds the spatial dimension to the discussions in the previous two chapters by assessing the literature on the urban governance of low-carbon development. It highlights that the different network-theoretical perspectives can be identified in the discussion on sustainable development in cities, even in the absence of explicitly referring to collaborative or network governance (excluding TM). Thus, the existing literature contains some evidence that local contextual settings may impact the ways in which governance networks are involved in low-carbon transitions in different cities. However, the comparative perspective represents a gap in the literature.

Part II of the dissertation contains the empirical part of the PhD research. Chapter 5 introduces the frameworks and methodology used in the case studies and the comparative analysis. A comparative research design with case study orientation is selected to address the research objective. Original conceptual and analytical frameworks are developed for this research based on previous studies. Chapter 6,7 and 8 present the case study analyses of the selected cases including the energy transition governance networks of Birmingham, Frankfurt and Budapest respectively. The aim of the case studies is to highlight the complex interactions between local contexts, governance networks and impact in terms of advancing low-carbon development.

The comparative analysis of the cases and the conclusions are presented in Part III. Chapter 9 contains the comparative analysis of the case studies and provides empirical evidence that governance networks develop and function in dissimilar ways in different places, and that this variance has an impact on the local authority's potential to steer network processes. Chapter 10 concludes the dissertation by systematically answering the research questions introduced in the previous section, followed by reflections on the strengths and weaknesses of the chosen research approach and methodology. On the basis of the research findings, theoretical contributions are developed related to the applicability of the Multi-Level Perspective and Transition Management in different urban settings.

Reflections on the approach to theory and methodology; further information related to sources of data used in the research (i.e. documents analysed, interview topic guides; lists of interviewees); and to the detailed results of the structural network analyses presented in the case study chapters are included as appendices.

1.5 RESEARCH OUTPUTS AND DISSEMINATION

Throughout the duration of the PhD, various outputs have been produced reflecting different stages of the research. These included conference papers and presentations, online publications in form of blog contributions as well as one journal article, as shown on Table 1.1.

TYPE	TITLE	PUBLISHED/ PRESENTED	DATE	NOTES
JOURNAL ARTICLE	Managing transitions in theory and practice – The case of the Pioneer Cities and Transition Cities projects	Journal of Cleaner Production[1], Volume 175, pp. 60-69	February 2018 (Available online November 2017.)	Co-authored with Nanja C. Nagorny-Koring (Goethe University, Frankfurt, Germany)
CONFERENCE PAPERS	Network governance and low-carbon transitions in European cities	33rd EGOS (*European Group for Organisational Studies*) Colloquium	6-8 July 2017	Held at Copenhagen Business School, Copenhagen, Denmark
	Managing Urban Transitions in Theory and Practice: The Case of Climate-KIC's Transition Cities Project'	RSA (*Regional Studies Association*) Winter Conference 2016	24-25 Nov. 2016	Held at Holiday Inn London Bloomsbury, London, United Kingdom
	Network governance and low-carbon transitions in European cities – preliminary results	RSA (*Regional Studies Association*) Student & Early Career Conference 2016	27-28 Oct. 2016	Held at Newcastle Business School, Northumbria University, United Kingdom
	Network governance and the low-carbon transition – Governing sustainable energy transition in the city of Birmingham, UK	INSNA (*International Network for Social Network Analysis*) XXXVI Sunbelt Conference	5-10 April 2016	Held at Marriott Hotel, Newport Beach, California, United States
ONLINE PUBLICATIONS	Sustainable urban development – are networks the key to success?	UKERC (UK Energy Research Centre) website[2]	14 Oct 2016	Guest blog
	Can network governance deliver energy transitions in the cities of Europe?	INLOGOV (Institute of Local Government Studies) blog[3]	10 April 2017	Guest blog

Table 1.1 Research outputs according to type (journal articles, conference papers and online publications)

Publications available from

[1] https://doi.org/10.1016/j.jclepro.2017.11.072

[2] http://www.ukerc.ac.uk/network/network-news/guest-blog-sustainable-urban-development-are-networks-the-key-to-success-.html

[3] https://inlogov.com/2017/04/10/can-network-governance-deliver-energy-transitions-in-the-cities-of-europe/

In addition to the aforementioned dissemination of the research findings at different stages of the PhD study, the specific methodology inspired by Social Network Analysis (SNA) to visualise and assess certain characteristics of networks of governance developed through this research has been adopted in an EPSRC-funded project entitled '*Across Scales in Energy Decision-making'* (ASCEND). ASCEND was a short scoping study running between June 2017 and January 2018, led by the University of Birmingham's Energy Institute in collaboration with the University of Edinburgh, University of Leeds and University College London (Energy Institute), in which I participated as part-time researcher. The study set out to investigate how whole energy system analysis and modelling is currently used in decision-making processes across scales and to identify ways in which the research – policy – decision-making relationship could be improved in the future. My responsibilities in ASCEND included conducting a literature review, a high-level organisational network mapping (based on the methodology developed through the PhD study) and preparing a related research brief on the options to use the network approach to visualise the structure of energy systems model use on different scales in the UK in a second project phase.

PART I.

THEORY

CHAPTER 2.

GOVERNING SUSTAINABILITY TRANSITIONS

2.1 OBJECTIVES AND STRUCTURE OF THE CHAPTER

This chapter provides an overview of the existing literature on sustainability transitions (elements of a shift away from the contemporary carbon-intensive economy to more sustainable carbon-neutral systems of production and consumption). First, Section 2.2 outlines the different but somewhat overlapping concepts of sustainable development, climate change and sustainability/low-carbon transitions. Second, in Section 2.3 I review the literature analysing the process of sustainability transitions through the concepts of 'socio-technical systems' and 'Multi-Level Perspective' (MLP). Third, building on the descriptive analytical frameworks, Section 2.4 introduces the various prescriptive approaches (governance models) which build on the socio-technical, multi-level understanding of transition processes. The main focus here is placed on the 'Transition Management' (TM) approach due to its increasing popularity and influence on local-level mitigation policy and strategy. Based on the critical reviews of the literature, Section 2.5 concludes by highlighting the critical shortcomings and weaknesses of the contemporary discourse on governing low-carbon transitions, providing the focus of the rest of the thesis.

2.2 SUSTAINABLE DEVELOPMENT, CLIMATE CHANGE AND LOW-CARBON TRANSITIONS

2.2.1 The concepts of ‘sustainability’ and ‘sustainable development’

The notion of 'sustainability' represents the idea of securing the future existence (‘sus-tenere’ - Latin for ‘up-hold’) of humanity on Earth. A closely related concept to sustainability is ‘sustainable development’, which refers to the process of achieving sustainability through integrating three central dimensions of human activities: economic, social and the ecological (see Figure 2.1; cf. Theis and Tomkin, 2015; WCED, 1987). The economic aspect of sustainable development relates to securing a continuing process of advancing productivity and pursuing economic growth with the aim of improving the quality of life globally. The social aspect is closely connected to the economic, encompassing concerns about global social and political equity (i.e. between developed and developing countries and between social classes). The ecological aspect recognises that the consequences of growth and development on the environment must be taken into account in order to avoid potentially catastrophic and irreversible environmental degradation. Thus, the concept of sustainable development concerns decisions and practices regarding the use of environmental resources to facilitate economic growth. In essence, it refers to a ‘*responsible behaviour directed toward the wise and efficient use of natural and human resources*’ (Theis and Tomkin, 2015, p. 11; c.f. Mebratu, 1998; Pezzoli, 1997).

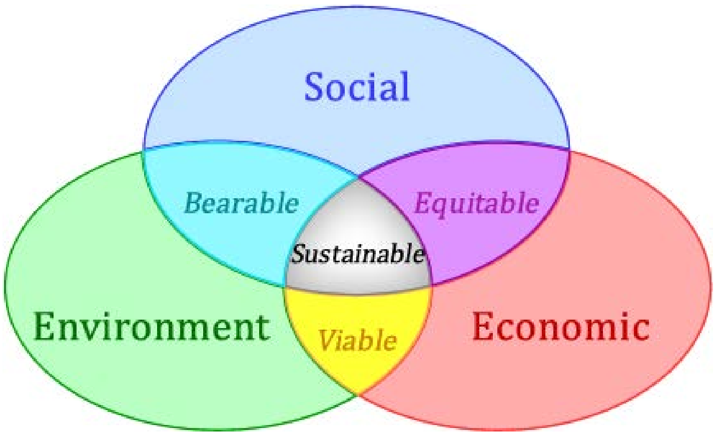


Figure 2.1 Overlapping dimensions of sustainable development

(Source: International Union for Conservation of Nature, 2006)

Albeit gradually, sustainable development has become a key concern for policy makers across the world, driven by growing evidence of the harmful effects of human activities on the global ecosystem. The understanding of the issue of ‘sustainability’ originates from the environmental movement of the 1960s, 1970s and 1980s which focused on the possibilities for preserving or conserving natural areas from the effects of rapid industrialisation (Robinson, 2004), including air, water and soil pollution. By the mid-1980s, the sustainable development issue succeeded in climbing high on the global political agenda, resulting in the establishment of the United Nations World Commission on Environment and Development (WCED). Led by former Norwegian Prime Minister Gro Harlem Brundtland, the WCED was operative between 1983 and 1987. It was tasked with publishing an overarching report on the options for moving towards sustainability through long-term environmental strategies by the millennium and beyond (Theis and Tomkin, 2015). The report, entitled ‘Our Common Future’, placed great emphasis on intragenerational (between developed and developing countries) and intergenerational equity (between the current and future generations; Holden et al., 2014). It defined ‘sustainable development’ as ‘*development that meets the needs of the present without* *compromising the ability of future generations to meet their own needs*' (WCED, 1987, p. 43), which is still the most widely accepted interpretation of the expression. Nevertheless, the way in which the notion of sustainable development was treated by the WCED report made it a widely contested concept due to its acknowledgment of the role of economic growth in the process of environmental degradation and its simultaneous conceptualisation of the solution as further development (growth) to counteract that process (Robinson, 2004).

In recent decades, both sustainability and sustainable development have become slippery terms used in a variety of ways in different contexts holding distinct meanings for different individuals or organisations. Despite the resulting confusion, Robinson has argued that such ambiguity is not necessarily negative, noting that: '*the lack of definitional precision of the term sustainable development may represent an important political opportunity'* (2004, p. 374). Ultimately, this is the natural way to explore the concept and its implications in a relatively new, messy and unstructured policy environment.

2.2.2 Climate change in the context of sustainable development

As mentioned above, the problematic definition of sustainable development originates from the acknowledgement of the negative impact of industrialisation on environmental systems. One particular aspect of such impact which has become particularly relevant to the sustainable development agenda in recent years is the emission of greenhouse gases from human activities, resulting in changes in the composition of the planet's atmosphere (Theis and Tomkin, 2015). Climatic changes caused by emitting particular greenhouse gases into the atmosphere have been connected to a consistent warming of global annual average temperatures (IPCC, 2014). Greenhouse gases include carbon-dioxide, methane, nitrous oxide and fluorinated gases, all of which possess the ability to trap heat within the Earth's atmosphere (US EPA, 2015). Due to industrialisation, emissions have increased significantly in the period between 1900 and 2011, showing a sixteen-fold rise (IPCC, 2014). In parallel, research suggests that the globally averaged combined land and ocean surface temperature has warmed 0.85°C in approximately the same period (1880 to 2012; IPCC, 2014). Moreover, the growing concentration of greenhouse gases in the atmosphere has been linked to air pollution causing health issues; changed weather patterns and to the increasing likelihood of extreme weather events such as droughts and storms; rising sea levels; extensive floods; and the shrinking of arctic sea ice and glaciers worldwide threating the clean drinking water supply of millions (Pidcock and Pearce, 2017; National Snow and Ice Data Center, n.d.).

Consequently, since the 1980s a near-universal scientific consensus has emerged that the stabilisation of the atmospheric concentration of GHGs (CO_2 in particular due to accounting for over 65% of the total GHG emissions) is crucial to minimise the adverse and potentially irreversible effects of climate change. This is only possible through a significant reduction in emissions (mitigation) in a relatively short period of time. Estimates and future scenario analyses conducted by the International Panel on Climate Change (IPCC) – the scientific advisory body to the UN on climate change – demonstrates that a reduction of 50-80% by 2050 (compared to a 1990 emissions baseline) is required to keep global warming below 2°C above pre-industrial levels. This is considered to be the limit within which climate change effects may still be manageable (IPCC, 2014; Knopf et al., 2010).

2.2.3 Mitigating greenhouse gas emissions via low-carbon transitions

The recently adopted Paris Agreement, signed by 195 countries responsible for the overwhelming majority of greenhouse gas emissions on the 21st Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), expressed the commitment of signatories to keep global warming 'well below 2°C' above pre-industrial levels (United Nations, 2015b). In spite of the growing evidence for the need to move towards a low-carbon economy in order to keep this objective within reach, global emissions are still on the rise (albeit carbon intensity, i.e. the amount of carbon emitted per unit of energy produced, shows a slow but consistent decline since the 1990s; Knopf et al., 2010). This means that, in practice, mitigating carbon emissions and stabilising the atmospheric concentration of greenhouse gases is far from being straightforward.

The vision of fast economic growth offered by high-carbon technologies, the availability of relatively cheap fossil-fuel based energy, together with increasing demand and competition resulted in a lock-in to carbon- and energy-intensive development paths in contemporary societies, preventing the development and take-up of alternative low-carbon technologies (Bulkeley and Betsill, 2013; Nill and Kemp, 2009; Unruh, 2000; 2002). This implies that large-scale emissions reduction can only be achieved if technological innovation (the roll-out of carbon neutral technologies) is supported by changes in '*markets, user practices, infrastructures, cultural discourses, policies and governing institutions*' (Nevens et al., 2013, p. 112). Such radical systemic transformations have been labelled as 'sustainability transitions' in the emerging transition studies literature, defined as '*fundamental transformation[s] towards more sustainable modes of production and consumption*' (Markard et al., 2012, p. 955). It has been long argued by transition scholars that the systemic reorganisation of the ways in which contemporary societies function involves radical social as well as technical change in terms of structure (e.g. organisations, institutions), culture (e.g. norms and behaviour) and practices (e.g. routines, skills) (Loorbach and Rotmans, 2010; Nevens et al., 2013).

In academic circles, low-carbon transitions (i.e. shifts from carbon intensive to effectively carbon-neutral economies) and the ways in which they can be accelerated through strategic processes on various scales and in different sectors and places, constitutes a salient research agenda. In practice, policy makers, private sector bodies and non-governmental organisations increasingly advocate the need for low-carbon transitions across a range of sectors including energy provision, mobility, food production as well as everyday spheres of consumption (Markard et al., 2012). In what follows, this chapter provides an overview of the most relevant transition theories focusing explicitly on low-carbon transitions.

2.3 RESEARCHING TRANSITIONS: THE SOCIO-TECHNICAL PERSPECTIVE

2.3.1 Socio-technical transitions towards sustainability

The transition studies perspective understands sustainable development as a process of continuous change, rather than a definitive end-state to work towards (Kemp et al., 2007). It builds on a punctuated equilibrium model of change borrowed from innovation studies and, indirectly, evolutionary biology (Geels, 2002; Rip and Kemp, 1998; Schot, 1998), characterised by periods of systemic transition (radical change) and relative stagnation (incremental innovation) (Geels et al., 2008; Hekkert et al., 2007;

Rotmans et al., 2001). Transitions occur when developments in various domains, such as the economy, technology, social behaviour, culture etc., result in a self-reinforcing loop and reconfiguration of entire systems (Rotmans et al., 2001, p. 20). The concept of 'socio-technical systems' and their patterns of development are central to the approaches analysing sustainability transitions. Interpreting human activities as socio-technical systems made up of social as well as technological elements (Berkhout et al., 2004; Geels, 2010; Geels and Schot, 2010) allows for an understanding of change as the consequence of co-evolution between technological innovation and societal advancement. This, in turn, determines the direction of the overall development of societies (Kemp, 2010a). Examples of socio-technical systems include energy and water supply, transportation and agriculture/food supply. These systems are composed of a number of components such as networks of stakeholders (individuals, companies or other organisations) involved in the supply chain, institutions (frameworks such as technological and social norms, regulations, standards), artefacts (material elements, e.g. pipes, wires, roads) and knowledge (Geels, 2004; Markard et al., 2012; Smith et al., 2005).

Transitions are conceptualised as processes of system innovation resulting in potentially irreversible shifts from one state of system equilibrium to another. This is a non-linear multi-phase process. It consists of four phases which together form an 'S-curved' pathway, a model borrowed from demographic transitions (see Figure 2.2; Rotmans et al., 2001). Experimentation, i.e. the early testing of new ideas, is the main process in the *pre-development* phase, when successful experiments begin to build momentum by reinforcing each other. As a result, the system starts to shift in the *take-off* phase (Loorbach and Rotmans, 2006; Rotmans et al., 2001). The slow change initiated in the *take-off* phase becomes a major force in the *acceleration* phase, in which fundamental structural change occurs. Subsequently, the new configuration becomes crystallised in the *stabilisation* phase before the system reaches the new equilibrium.

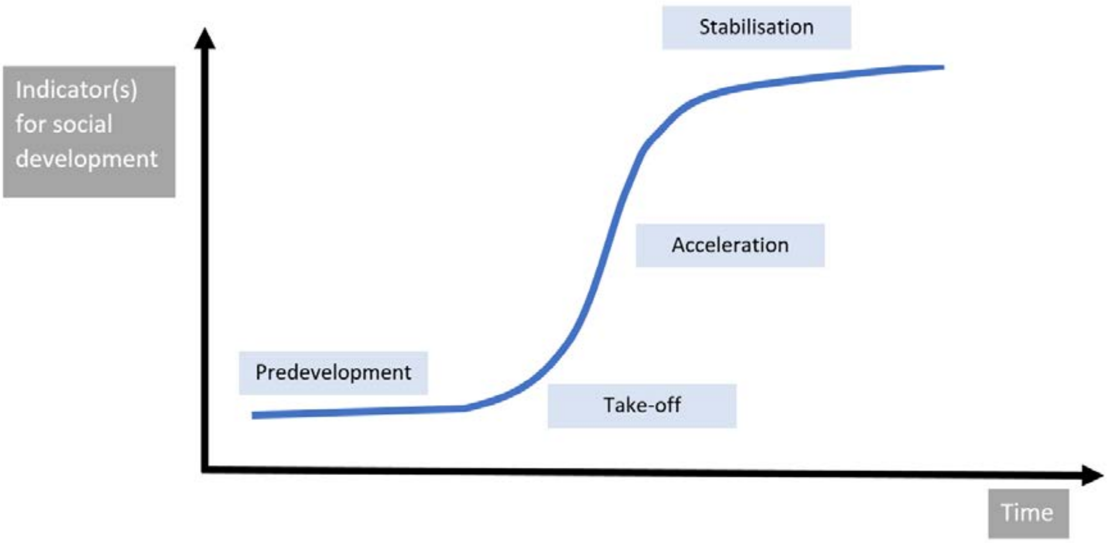


Figure 2.2. Phases of transitions (adapted from Rotmans et al, 2001)

In equilibrium states, established socio-technical systems show resistance to change due to interdependence between system elements, resulting in incremental innovation (Markard et al., 2012) and ultimately leading to path-dependency. Path-dependent incremental innovation stems from the existence of 'socio-technical regimes' (Geels, 2010; Monstadt, 2009) which represent dominant constellations of system components. Smith et al. describe socio-technical regimes as products of alignment between various system elements, or

> *'relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies'.* (Smith et al., 2005, p. 1493)

Thus, transitions are conceptualised as 'regime shifts', i.e. the substitution of the dominant regime by a new one. Historical examples of system-wide transitions include the introduction of pipe-based water supply (Geels, 2005a), the shift from cesspools to sewer systems (Geels, 2006), the shift from carriages to automobiles (Geels, 2005b) and the transition from sailing ships to steamships (Geels, 2002). Moreover, several enquiries have been conducted into changes in the energy sector using a socio-technical systems perspective, mainly in relation to energy transitions in The Netherlands (e.g. Kern and Smith, 2008; Verbong and Geels, 2007, 2010), the United Kingdom (e.g. Bolton and Foxon, 2015; Foxon, 2011; Winskel, 2007), Germany (e.g. Geels et al., 2016; Späth and Rohracher, 2010; Strunz, 2014) and the United States (e.g. McCauley and Stephens, 2012; Sovacool, 2009; Stephens and Jiusto, 2010).

2.3.2 The Multi-Level Perspective on sustainability transitions

Geels (2004; 2002), based on previous research on technological systems (e.g. Kemp, 1994; Rip and Kemp, 1998; Rotmans et al., 2001), introduced a descriptive framework to analyse socio-technical transitions defined as system innovation whereby the dominant socio-technical regime is replaced by a new one. The Multi-Level Perspective (MLP) places the socio-technical regime in a multilevel context, where the regime situated at the 'meso' level is maintained and/or challenged by development at the macro (landscape) and micro (niche) levels (see Figure 2.3). Transitions, according to the MLP, result from interaction processes between the three levels (Geels, 2010; Kern, 2012).

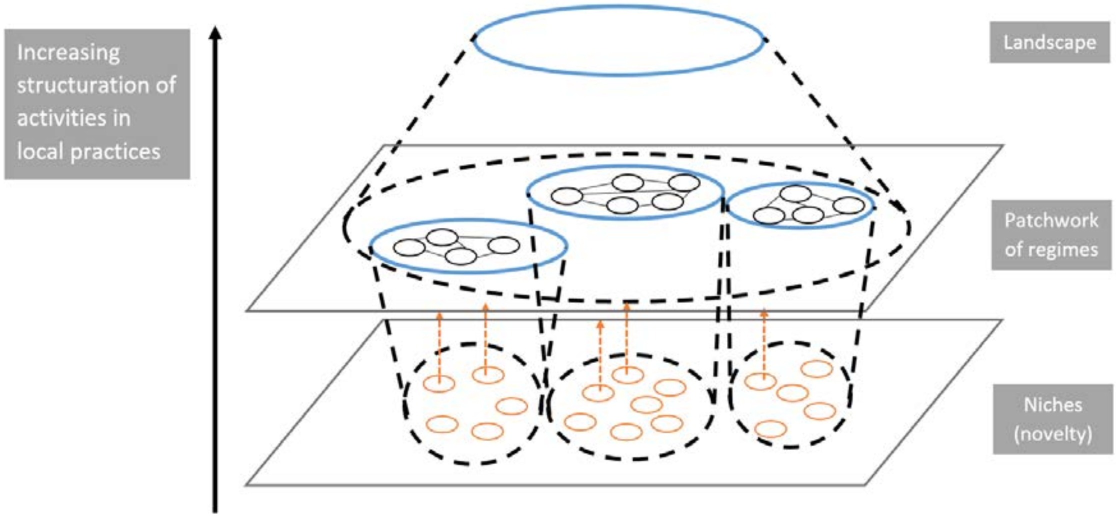


Figure 2.3. The multilevel context of the MLP (adapted from Geels, 2004)

The landscape is the exogenous environment which includes large-scale structural processes and trends outside of the reach of the regime, while niches are protected spaces where novel technologies and radical innovation may emerge without being exposed to dominant selection processes determined by the regime (Geels, 2010; Geels, 2004; 2002; Kemp et al., 1998). Thus, the regime (and to some extent, the landscape) acts as a so called 'selection environment' reinforcing path dependency. Here, path dependency is understood as an *'interpretive, negotiated and contested process of institutionalization'* (Geels, 2010, p. 504). System stability (retention) as well as system change (transition) is produced (and reproduced) by interpretive agents whose actions are influenced, but not determined, by their environment and the resulting (inter)actions within and between the different levels (Geels, 2010; Geels and Kemp, 2007; Geels, 2004).

Interplay between the macro, meso and micro levels may result in distinct change processes based on possible variation in relation to the timing, order and the nature of interactions. With the acknowledgement that these are not likely to occur in pure form in reality, ideal process types were described by Geels and Schot (2007). A distinction was made between: (1) ‘reproduction process’; (2) ‘transformation path’; (3) ‘de-alignment and re-alignment’; (4) ‘(technological) substitution’; (5) ‘reconfiguration pathway’; and (6) ‘sequence of transition pathways’.

When the socio-technical regime remains stable and resists contestation from niche developments, a (1) reproduction process (of the regime) takes place. In this case, due to continuing alignment between the regime and the landscape, the socio-technical system stays in its original equilibrium state despite pressure from the niche level. A different process develops if the regime remains powerful but must adjust using its adaptive capability in the face of new niche developments. First, in the case of a (2) ‘transformation path’, the capacity of the regime to remain stable is decreased by minor misalignments between the regime and landscape levels. However, at the same time, no mature niche innovation emerges which could instantly overthrow the dominant system constellation. Consequently, the regime has time and resources to reorient its development path in response to moderate pressure both from the landscape and the niche level. A second option for facilitating change through regime adjustment is the (5) ‘reconfiguration pathway’. Here, symbiotic niche innovations are initially utilised to improve or optimise the functioning of the regime. Over time, these adjustments trigger further changes in the basic structure of the regime, gradually leading to a major shift. Thus, the time component is key both in the case of system transformations and reconfigurations. Two types of complete, radical regime shifts are described by the ideal pathways formulated by Geels and Schot (2007), including (3) ‘de-alignment and re-alignment’ and (4) ‘technological substitution’. In both cases regime actors perceive significant pressure from the exogenous landscape; however, ‘de-alignment and re-alignment’ happens if no dominant niche development emerges and, therefore, multiple niche innovations must first compete with each other to constitute the new regime. In other instances, when one particular niche development is mature and dominant, it can simply overthrow the regime through a (4) 'technological substitution' process. A special 'mixed' pathway develops from the combination of previously mentioned processes if disruptive change develops on the landscape level over a long time period. Initially, regime actors are likely to understand this as moderate change due to long time frames. As a result, a (6) 'sequence of transition pathways' develops as actors continually change their perspectives due to the growing pressure, beginning with transformation, leading to reconfiguration, possibly followed by substitution or de-alignment and re-alignment' (Geels and Schot, 2007, p. 413).

The above description of possible system dynamics suggests that, in order to be able to apply the MLP empirically, the transitions analysed must be large-scale (for example, global) and historical in nature. This follows from the observation that transition processes develop over relatively long time periods, and that development pathways are more precisely distinguishable from a distance (both with regard to time and place). Despite such limitations, the MLP became a successful analytical concept and a foundation for further advancement in sustainability transition studies.

2.3.3 Main debates and criticisms of the MLP

The MLP has been accepted by the scientific community as a useful heuristic framework to describe large-scale historical transition processes. However, critical reviews have suggested that a number of issues remain unaddressed with regard to the practical applicability of the concept. Smith et al. (2010) argue that tackling specific challenges at the conceptual, analytical and practical levels could lead to a better understanding of the MLP's applicability with regard to the currently unfolding low-carbon transition process (Smith et al., 2010).

This conceptual challenge points to a frequent observation in empirical studies that, in real life situations, niche-regime interactions may be more diverse than the MLP suggests (Raven et al., 2012; Walker and Shove, 2007). Conceptual separation between niche and regime is central to the MLP. However, empirical research demonstrates that identifying boundaries between niche and regime levels is often rather challenging. It is suggested that the concept of a clear regime-shift from one dominant regime to another as a result of upscaling niche innovation is an oversimplification of real-life processes of transition (Bulkeley et al., 2014). Instead, niches may occupy a diversity of positions in relation to regimes, influencing the nature and effects of their interactions with the regime (Smith et al., 2010). Others point to the process of contestation between various niches in influencing the dominant development paths, stressing the existence of both sustainable and unsustainable niche practices. In this vein, niche innovation does not necessarily lead to more sustainable outcomes (Walker and Shove, 2007). At this point the conceptual meets the analytical challenge: looking at innovative experimentation as a contestation process highlights the role of structural power, agency and geographical context (Smith et al., 2010) in influencing the pathways of change, potentially leading to distinct types of transitions in different places.

Finally, the practical challenge relates to the governability of transitions: how can current transition processes be organised to ensure that they result in more sustainable societies? Smith and Stirling (2007) argue that the success and/or failure of transitions is, at least partially, determined by the perceptions of those in charge about the functioning of the socio-technical regime and the way in which these perceptions play out in the context of diverse responses in complex societies. This is inevitably unpredictable. Scholars researching the governability of transitions therefore propose that

> *'[g]overnance schemes that take socio-technical complexities into account, and yet retain a sense of which niche-regime-landscape reproduction processes are significant for transitions, and that target their policy attention on the key players accordingly, are more likely to generate effective transition policy'* (Smith et al., 2010, p. 445).

This discussion demonstrates that debates surrounding the MLP are yet to arrive at a decision regarding whether it can only be used as a 'heuristic' concept to describe large-scale historical transitions or it can become a useful analytical framework applicable to the on-going unfolding transitions 'on the ground'. Moreover, it is still to be understood what its contribution (or limitations) might be with regard to change processes (1) on various organisational or political levels, such as the urban or regional (Bridge et al., 2013; Coenen et al., 2012; Coenen and Truffer, 2012; Genus and Coles, 2008; Hansen and Coenen, 2015) and (2) in different places, for example, outside the context of 'classic' western democracies (Bulkeley et al., 2014; Mah et al., 2014; Meadowcroft, 2011; Tyfield, 2014). Thus, the issues listed by Smith et al. (2010) discussed above point to the necessity to investigate the role of the 'context' (both in terms of organisational scale as well as geographical location) in relation to the MLP's potential to describe socio-technical transitions in real-world settings. Consequently, this PhD thesis, by focusing on the similarities and differences of unfolding transition governance processes in different urban settings, will contribute to addressing this question.

2.4 GOVERNING TRANSITIONS

2.4.1 The Multi-Level Perspective and the governance of transitions

In recent decades, the public sector has taken an interest in moving towards a more strategic approach to sustainable development and low-carbon transitions, assuming an active role in the process in many countries. Scientific advancement with regard to climate change models and scenarios, both in terms of accuracy and credibility, provided the motivation for this shift. Scenarios prepared by the IPCC (2014) showed that business-as-usual (i.e. market mechanisms based on free competition) would likely not deliver the scale of innovation necessary to keep global warming within the critical 2°C target. The economic case for taking a strategic approach was made by Sir Nicholas Stern in his Review Report on the Economics of Climate Change. Stern, on the basis of available information about potential climate change effects, concluded that '*the benefits of strong and early action far outweigh the economic costs of not acting*' (Stern, 2006, p. vi). More recently, an overwhelming majority of countries expressed their commitment to reduce their carbon emissions with the overall aim of limiting the scale of average global warming to 1.5 to 2°C (United Nations, 2015b). The combined effects of developments from science, economics and politics encouraged research into devising new ways to take a more strategic 'management' approach and, by doing so, speed up sustainability transitions.

Consequently, the MLP has been used in various strands of research as a backdrop for developing new governance models which are aimed at generating knowledge about the options for governments to support innovation processes on various scales and in different sectors. Notable contributions came from research on Technological Innovation

Systems (TIS), Strategic Niche Management (SNM) and Transition Management (TM) (Lachman, 2013; Markard et al., 2012). All three approaches are intended to be used as tools and guidance for policy making. They concentrate on developing methodologies for allowing novelties (niche innovations) to be born, tested and adopted, with the ultimate goal of triggering system-wide change. In this section I discuss the TIS and SNM frameworks which preceded the development of TM. TM is introduced in more detail in Section 2.4.2, due to its growing popularity especially on the sub-national level, and its relevance to the Climate KIC research (the Pioneer Cities and Transition Cities projects; see Chapter 1, Section 1.2).

The TIS framework focuses on the issue of creating favourable conditions for particular innovative technologies to spread and facilitate technology regime shift. It attempts to provide a tool for innovation policy '*which supports the stabilization or even break-through of new socio-technical configurations*' (Weber and Rohracher, 2012, p. 1038). Links between policy and the structural components of the innovation systems (actors, networks and institutions) is established through the concept of functions, such as knowledge development, entrepreneurial experimentation, resource mobilization, market formation, legitimation, development of positive external economies and influence on the direction of search (Bergek et al., 2008; Hekkert et al., 2011). Policy advice is subsequently developed on the basis of the evaluation of how well the system elements fulfil their intended functions. The underlying assumption of the TIS approach is that sub-optimally performing components inhibit the evolution of the particular system as a whole (Lachman, 2013). However, due to a sectoral, technology-specific focus, TIS does not adequately engage with the process of triggering broader socio-technical regime change (Weber and Rohracher, 2012). Further criticisms of the TIS approach include the relative neglect of cultural and demand side aspects; the focus on identifying weaknesses but not providing sufficient solutions on how to overcome them; and the preference for large actors opposed to grass roots initiatives or individuals (Hekkert et al., 2011; Lachman, 2013). Moreover, TIS aims to aid the advancement of already functioning but underperforming systems as opposed to facilitating radical change (Lachman, 2013).

The SNM approach builds more directly on the MLP than TIS. In contrast to TIS, SNM takes into account both supply and demand side factors and understands transition as a systemic process as described by the MLP. Taking a bottom-up perspective, SNM focuses on the interaction between niches and regimes with the aim of developing knowledge about how niches can be actively managed and supported in order to build momentum for break-through and, ultimately, regime change (Hoogma, et al., 2002; Raven et al., 2010; Schot and Geels, 2008). Therefore, central to the SNM approach is the notion that transition can be brought about by modulating niche innovation through steering and harnessing existing system dynamics as opposed to understanding niche-creation as a top-down process exercised by the government (Schot and Geels, 2008). Niches emerge in response to favourable conditions, but government is expected to oversee and influence their advancement. Therefore, much research went into the issue of determining which conditions matter for niches to develop, transform from technological to market niche, and ultimately change the regime (Schot and Geels, 2008).

First, the process of SNM starts with selecting the technology eligible for support, which sits outside the regime and can be regarded as ‘radical’. However, it also responds to an existing societal problem in order to be able to become marketable in the future. Second, an appropriate experiment is selected using the chosen technology, in a setting where the disadvantages of the new technology are minimised, and benefits maximised, in order to remove barriers to diffusion. Third, the experiment is set up by creating favourable conditions for the technology to be taken up in the previously identified setting. Fourth, the subsequent scaling up process of a successful experiment requires continued support for the technology until a market niche develops which allows it to diffuse to other settings. Finally, the breakdown of the protective environment is possible when the technology becomes self-sufficient or the experiment proves to be unsuccessful (Kemp et al., 1998). As these steps suggest, the concepts of experimentation, learning-by-doing and doing-by-learning (trial-and-error) are central to the SNM approach (Markard et al., 2012). Building on the MLP, SNM has similarly been criticised for the conceptual divide between regimes and niches which, in practice, is likely to be complicated or even impossible, hindering the applicability of the frameworks in 'real life' situations (Bulkeley et al., 2014; Smith, 2007). Furthermore, the SNM provides little practical information about the time frame necessary for different steps of the experimentation process and about who should be in charge of setting up experiments (Smith, 2007). Due to SNM's sectoral focus, issues related to the consequences of regime change in one sector for other sectors (for example, the implications of the electrification of mobility for the electricity sector) are not considered. Most importantly, the approach is not explicitly interested in developing paths to sustainable development or low-carbon transitions. Despite such limitations, both SNM and TIS had a significant influence on the development of the TM approach which has been subject to growing interest from the local level in recent years (Nagorny-Koring and Nochta, 2018).

2.4.2 The Transition Management (TM) framework

Transition Management (Loorbach and Rotmans, 2010; Loorbach, 2007; Kemp et al., 2007) is an innovative governance model which aims to address the policy challenges of ‘making transitions happen’. TM keeps the MLP’s understanding of transition dynamics as an interplay between micro, meso and macro levels, and it builds on previous work on governance approaches to innovation, SNM in particular. As with SNM, TM also emphasises the role of niche developments in facilitating regime change; the importance of the experimentation process; and the ‘steering’ conceptualisation of governing transitions (i.e. governing from a distance). However, the explicit focus is on managing transformative change through reflexive and participative governance (Lachman, 2013). In terms of process, the aim is to create the conditions for gradual change which, over a sufficiently long time period, is expected to lead to large-scale structural transition. According to TM scholars, taking such an approach is necessary to avoid ‘*too much destructive friction in the form of social resistance*’ (Rotmans et al., 2001, p. 25). Consequently, the framework is designed to complement traditional policy making rather than attempting to replace it. Its role is to provide space for system innovation alongside traditional processes of incremental system improvement (Frantzeskaki, 2011; Rotmans et al., 2001).

TM combines insights from transition studies, complex systems theory and governance approaches, particularly in relation to managing Complex Adaptive Systems (CAS; Rotmans and Loorbach, 2009). CASs consist of agents following certain ‘behavioural schemata’, who, in the absence of central control, self-organise on the basis of available information about other agents’ behaviour, and through this co-evolutionary process, produce temporary system equilibria (Duit and Galaz, 2008). As system stability is continually contested, system dynamics show limited predictability. It is characterised by threshold effects (points of abrupt change), surprises (unexpected system behaviour) and cascading effects across scale, time and sub-systems as a result of interconnectedness

(Duit and Galaz, 2008). Drawing on CAS analysis, TM acknowledges the complexity of interaction patterns between various societal systems or sub-systems, where the effects of developments in one system act as cause of change in others, creating unpredictable cause-effect-cause loops (Kemp et al., 2007). Consequently, TM scholars argue that traditional planning processes are inadequate to tackle problems in the context of CASs. Problems 'persist' because they result from structural system failures of contemporary societies (Rotmans and Loorbach, 2009; Loorbach, 2007). As an alternative, greater attention is provided to harnessing the potential benefits of self-organisation within and between societal systems and subsystems, whereby problem solving (i.e. the management of transitions) becomes a 'strategic steering' process rather than 'top-down governing':

> *The model of transition management tries to utilize innovative bottom-up developments in a more strategic way by coordinating different levels of governance and fostering self-organization through new types of interaction and cycles of learning and action for radical innovations offering sustainability benefits. Transition management views societal change as a result of the interaction between all relevant actors on different societal levels within the context of a changing societal landscape. It is thus concerned with the use and coordination of interaction and coevolutionary processes* (Kemp et al., 2007, p. 80).

One of the central issues of managing sustainability transitions is that of introducing long-term thinking into the decision-making process by connecting governance activities on various levels of decision-making, including strategic (long-term), tactical (mid-term) and operational (short-term) (Loorbach, 2007; Loorbach and Rotmans, 2010; Nagorny-Koring and Nochta, 2018). In TM, long-term goals are expressed through strategic 'visions' which act as frameworks for short-term policy. In order to find ways through which a vision can be realised, 'transition pathways' are developed. This is done by setting interim targets via back-casting from the long-term vision (Loorbach, 2007; Rotmans et al., 2001). Pathways provide guidelines for the selection of short-term actions, or 'experiments'. Thus, experiments are selected on the basis of their potential to contribute to overall strategic goals and their fit with identified pathways. They are expected to either confirm or alter the vision and the selection process for new experiments, resulting in a process of social learning (learning-by-doing and doing-by-learning; Loorbach, 2007; Rotmans et al., 2001). The feedback loops created this way introduce reflexivity into the decision-making system (Loorbach, 2010; Voss et al., 2006; Voß and Kemp, 2015) by providing mechanisms to incorporate newly discovered knowledge and experience into the overall strategic (goals and visions) and tactical (pathways) frameworks. Thus, continuous evaluation, monitoring and adjustment are at the core of the TM concept, both with regard to the process and the content of experimentation (Kemp et al., 2007). The TM cycle is illustrated in Figure 2.4.

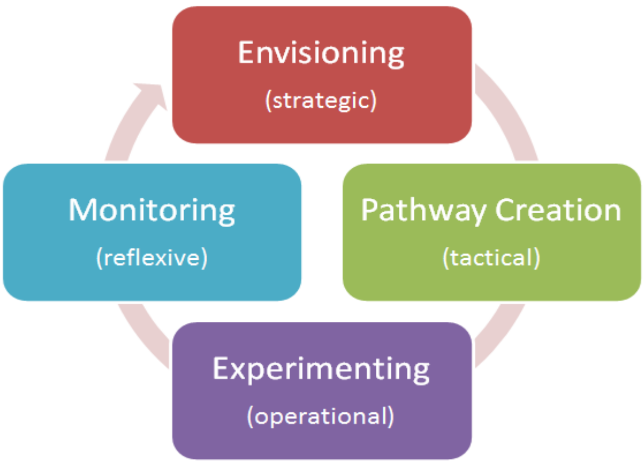


Figure 2.4 The Transition Management Cycle (adapted from Nagorny-Koring and Nochta, 2018)

TM recognises that social transitions take place in a multi-actor, multi-domain and multi-scale environment as a result of distributed control in modern societies. It contends that stakeholder involvement is crucial to the success of the transition process:

> *'Transition management can be considered as a specific form of multi-level governance (Scharpf, 1999; 1994; Hooghe and Marks, 2001) whereby state and non state [sic] actors are brought together to co-produce and coordinate policies in an iterative and evolutionary manner on different policy levels […]'* (Kemp et al., 2007, p. 82).

In order to enable participatory governance to emerge, TM calls for the establishment of networks of 'frontrunners' (champions) to steer the experimentation processes (Loorbach, 2010, 2007; Kemp et al., 2007). Such 'transition managers' are responsible for setting up transition 'arenas' (collaborative spaces) around specific sustainability issues or regimes. It is also their role to select arena participants (stakeholders) and to 'steer' (i.e. co-ordinate in a hands-off manner) self-organising processes in the transition arenas.

There is an attempt in the TM framework to address the challenge of avoiding lock-in situations similar to that of the current high-carbon, fossil-fuel based economy. During the selection of experiments, TM recommends working with 'portfolios of approaches' to ensure that a '*wide playing field'* is being kept (Rotmans et al., 2001, p. 22) at the beginning of the transition process. However, when investments are allocated at the stage of implementing experiments, a market approach based on competition is expected to narrow options down (Nill and Kemp, 2009). Thus, as Kemp et al. (2007, p. 87) argue, TM is a hybrid approach combining coordination mechanisms based on markets, network management and institutionalisation, echoing some of the recommendations of SNM.

Despite being a relatively new research field, TM has made a significant contribution to academic research into the governance of sustainability transitions. It also impacted government policies and strategies on the supra-national (European Union), national (for example in the Netherlands; Kern and Smith, 2008) and sub-national (urban and regional, both in- and outside of Europe; see ongoing research at DRIFT, www.drift.eur.nl) levels. However, critics of the approach perceive a gap between TM theory and real-world transitions (e.g. Kemp, 2010b, p. 2010; Kern, 2012; Kern and Smith, 2008; Kuzemko, 2013; Meadowcroft, 2011, 2009; Stirling, 2011; Voß and Bornemann, 2011). These critical comments became sources of extending and refining the TM approach. Nevertheless, to date many issues identified remain inadequately addressed. Section 2.4.3 provides an overview of the critical literature and situates this thesis within it.

2.4.3 Critical review of the TM approach

TM emerged as a conceptual framework in the early 2000s (Rotmans et al., 2001). Since then, major efforts went into further developing and adjusting the approach, mainly through action research and related policy experiments (Voß et al., 2009). The drive to test the concepts in ‘real life situations’ was (at least partially) driven by the simultaneously emerging critical literature. Nevertheless, some of the points made still remain unanswered. Foundationally, TM draws on insights from the MLP by attempting to give practical recommendations on the options to set up transition experiments with the purpose of enabling niche innovations to develop, gradually change and ultimately transform the dominant regime. Consequently, critical comments made in relation to the MLP, including conceptual (i.e. the difficulties with defining the unit of analysis in the niche-regime-landscape context), analytical (i.e. lack of consideration for structural power, agency, and geography) and practical (i.e. the real life viability of managed approaches to socio-technical transitions) challenges (Smith et al., 2010; Voß et al., 2009) are also sources of controversy in TM. The critical literature explicitly addressing the TM approach can be organised around issues related to the theory versus practice divide, the problems of place and scale and the resulting difficulties with implementation.

First, with regard to the perceived gap between TM *theory* and *practice*, critics pointed out that TM seemed to degrade transition into a managerial task, largely neglecting factors such as politics, power, stakeholders' self-interest and belief systems (Kuzemko, 2013; Meadowcroft, 2011, 2009; Voß et al., 2009; Walker and Shove, 2007); and the influence these might have on the nature and quality of collaboration in transition arenas. Meadowcroft (2011) acknowledged the value of transition thinking in the policy domain, arguing that it facilitated discussion about long-term structural change in social systems, provided a framework for exploring change processes based on historical evidence and offered a practical toolbox to encourage collaboration and to build coalitions of action for sustainability. However, he also warned that the management of transitions was an inherently political process and emphasised the messy and conflicted character of such long-term change. This contradicts the basic assumption of TM that governing transitions with a strategic approach was possible (Meadowcroft, 2009). The managerial perspective was also criticised by Kuzemko (2013, p. 12) who argues that it depicted transition processes as a '*monolithic process dominated by rational action*'. Consequently, the TM logic is likely to lead to an oversimplification of consensus building through the collaborative processes in transition arenas (e.g. problem definition, vision and agenda development), underplaying the effects of politics and power (Kuzemko, 2013).

A second, related issue which appears in the critical agenda revolves around the potential under-conceptualisation of '*place*' and '*scale*' in TM. In fact, in most of the early theoretical work both concepts only appeared indirectly and implicitly. The empirical work underpinning the conceptual model mainly focused on transitions at the national level, implying that the natural scale for transitions to occur is the nation state (Bridge et al., 2013; Markard et al., 2012; Truffer et al., 2015; Truffer and Coenen, 2012). Even in publications where processes on different levels were considered (i.e. supra- or sub-national), the emphasis still remained at the national level (Geels, 2011; Raven et al., 2012; Wieczorek et al., 2015). Only in recent years have TM scholars started to engage with transitions beyond the nation state, in part a reflection of growing interest from the local level (Frantzeskaki et al., 2014; Loorbach et al., 2016; Nevens and Roorda, 2014; Porter et al., 2015; Roorda and Wittmayer, 2014; Voytenko et al., 2016) in the potential of TM techniques to drive local low-carbon development. Issues related to place (i.e. geographical location) started emerging in parallel with attempts to apply TM in different countries. After initial development through case studies mostly from the Netherlands (Kemp, 2010b, p. 2010; Kemp et al., 2007, p. 2007; Kern and Smith, 2008; Loorbach and Rotmans, 2010, 2006), many commentators were concerned about the potential of the framework to travel cross-nationally, arguing for the need to develop an understanding of the (local) conditions which must be met for successful application of a TM approach (Heiskanen et al., 2009; Kuzemko, 2013; Nagorny-Koring and Nochta, 2018). For example, Heiskanen et al.'s (2009) case studies from Finland highlighted the specific problem that in many places there was very little or no capacity in practice for the kind of reflexive governance that TM required.

A third strand of critics stressed the possible complications during the implementation phase of managed approaches to transitions, emerging as a consequence of shortcomings related to underplaying the impact of scale, place and politics. The implementation process, according to the TM literature, starts with deciding about the transition manager, the content of transition arenas and the selection of participants for the arenas (Nevens et al., 2013; Loorbach and Rotmans, 2010; Loorbach, 2010; 2007). Clearly, these initial decisions have considerable impact on the manner in which subsequent transition processes unfold, including their success or failure (Loorbach and Rotmans, 2010; Kern and Smith, 2008; Kemp and Loorbach, 2006). However, so far very few concrete recommendations or guidelines were developed to ease the initial stages. Consequently, critics questioned whether the TM toolbox, in its current state, was sufficiently worked out or still too generic to become useful for addressing the problem of governing transition processes and whether this issue can be overcome in practice (Lachman, 2013; Kern and Smith, 2008).

The above discussion suggests that the TM approach is still a 'work-in-progress' and points towards critical issues to be addressed in order to improve successful implementation. The critical discourse around place, scale and politics provides a useful starting point to address the problems arising during the implementation phase which seem to emerge from the universalist perspective dominant in the TM approach. This underplays the role of context-specific factors which enable certain outcomes while acting as barriers to others, influencing the overall trajectory of transition processes.

2.5 CONCLUSIONS: GOVERNING LOW-CARBON TRANSITIONS IN THEORY AND IN PRACTICE

This chapter provides an overview of the existing literature on low-carbon transitions. Low-carbon transitions are defined as overarching change processes which facilitate a paradigm shift in the organisation of socio-economic systems from carbon-intensive to carbon-neutral systems of production and consumption. I argue for the necessity for transitions by discussing the adverse effects of climate change and their connection to the ever-increasing anthropogenic (human-induced) greenhouse gas emissions. By doing so, the chapter provides an account of the links between the notions of sustainable development, climate change and low-carbon transitions.

The existing literature on sustainability transition studies demonstrates that the analysis of low-carbon transitions builds on a co-evolutionary framework emphasising the interconnections between the various domains of society and technology in an attempt to explain path-dependence and change. Thus, low-carbon transitions are conceptualised as socio-technical transformations which take place in a multi-level, multi-actor context. The most prominent analytical framework in sustainability studies, the MLP, explains transition processes as results of interactions between the levels of landscape (macro), regime (meso) and niche (micro). It contends that path dependence is created and maintained by the existence of socio-technical regimes, i.e. dominant constellations of actors, rationales (rules and norms), techniques (practices) and material elements (artefacts). Change in the multi-level context can be brought about by exerting pressure on the regime either through developments on the landscape or on the niche level. In particular, the role of niche innovation is emphasised throughout the literature in facilitating regime change.

Drawing on the systemic perspective of the MLP, a range of social coordination models have been developed which take a prescriptive approach and aim to provide tools and methods to accelerate regime change through supporting and structuring niche innovations. These models (TIS, SNM and TM) share the assumption that innovative niche developments may be rendered 'governable' through various management techniques and, consequently, directed towards sustainable development paths. This central assumption is the main concern for critical commentators who stress the importance of building a better understanding of whether low-carbon transitions can indeed be rendered possible to govern. They question the real-life feasibility of managed approaches and argue that the socio-technical perspective, as well as the transition management framework, potentially present an oversimplified view on the process of sustainability transitions due to having an insufficient conceptualisation of scale, place, politics and power. In fact, the lack of appreciation of such contextual opportunities and constraints results in difficulties with implementation in contexts where conditions are different from what the frameworks assume.

Informed by the critical literature, the present study contributes a response to the aforementioned challenges by unpacking the concepts of self-organisation in transition arenas and of the steering of arena processes. This contribution builds on the network governance literature discussed in Chapter 3. The strand of the existing literature paying specific attention to the patterns of interactions between actors, and the ways in which these influence the outcomes of policy 'games', is used to analyse and evaluate the practical applicability of the MLP and TM in different urban settings. Urban settings are interpreted as specific combinations of factors related to issues of scale, place, and politics and power. By doing so, conclusions related to the role of networked-forms of governance (resulting from self-organisation processes and the steering of these) can be drawn in the context of low-carbon transitions.

CHAPTER 3.

THE NETWORK PERSPECTIVE ON GOVERNANCE

3.1 OBJECTIVES AND STRUCTURE OF THE CHAPTER

The purpose of this chapter is to give an overview of the burgeoning literature on collaborative, interactive or networked forms of governance in the field of public administration and politics. Following on from the conclusions of Chapter 2, the network governance perspective introduced in this chapter serves to build a better understanding of the effects that specific contextual factors have on the self-organisation processes in transition arenas, and the steering of these. This is important not only to assess the impact of this form of collaborative (or network) governance on advancing sustainability transitions, but also to evaluate the usefulness and applicability of the Multi-Level Perspective and the Transition Management approach in different settings in Europe.

This chapter is structured as follows. First, I present the emergence of the network concept from a historical perspective, including its relations with other governing modes; its origins and different traditions in academic research; and finally, I define the terms used throughout the thesis, such as ‘governance’, ‘governance networks’ and ‘network governance’ (Section 3.2). Second, I present the theoretical perspectives which inform the research on governance networks and provide a discussion on processes convergence and divergence within the literature (Section 3.3). Third, I review the different approaches to governing within (self-organisation) and via (steering) governance networks (Section

3.4). Fourth, the most important currently ongoing debates in the field are presented in Section 3.5. Fifth, a short summary is given of the issues discussed throughout the chapter to highlight their relevance to the PhD study on low-carbon transitions (Section 3.6).

3.2 THE NETWORK GOVERNANCE CONCEPT AND ITS ORIGINS

3.2.1 Public sector reforms: from hierarchies and markets to networks

Politics and public administration research has traditionally been focusing on the 'state' as a sovereign authority in the context of Weberian bureaucratic hierarchical systems in Western democracies (Bevir and Rhodes, 2016; Klijn, 2008a; Meuleman, 2008; Pierre and Peters, 2000). This state-centric view was particularly dominant until the 1970's, when parallel developments in various domains (including academic research, technological advancement and the economy; Bevir, 2011) contributed to the popularity of the emerging view among academics and practitioners alike that the welfare state has become overloaded, unaffordable and ineffective. Therefore, in order to be able to respond to the new challenges of the era, the public sector was to be 'modernised' through the adoption of techniques borrowed from the market sector which were expected to make it more (cost) effective, efficient and responsive to citizens' needs (Pollitt, 2009; 1996; Pollitt and Bouckaert, 2011; 2004). This first wave of reforms was characterised by an intra-organisational focus; the separation of politics (strategy) and administration (execution); the introduction of a managerial approach to public administration; and the specialisation of organisational tasks (Christensen, 2012; Klijn et al., 2013; Lynn, 2011; Osborne, 2010). Termed collectively as 'New Public Management' (NPM; Hood, 1995;

Lane, 2000), the concepts and principles were translated into a toolbox of techniques on the practical level including

- the performance-oriented evaluation of service provision through output measurement and KPIs;
- the internal restructuration of organisations into compact, specialised units;
- contracting out public services to re-orientate the focus of the public sector to a smaller number of core functions;
- the introduction of market-type mechanisms to the public sector (e.g. competitive tendering, league tables, quality management and performance-related salaries for public officers);
- and the reconceptualization of service users / citizens as 'customers' (Pollitt, 2009; 1996; Pollitt and Bouckaert, 2011; 2004).

By the millennium it became apparent that the NPM, which was aimed at rationalising public policy making and implementation in order to enhance efficiency and effectiveness, resulted in large-scale organisational fragmentation and the dispersion of resources and authority among a variety of actors both from the public and private sphere (Rhodes, 2007). Fragmentation arising from specialisation within public sector organisations; the wide-spread contracting out of public services to arm's length bodies or agencies; the demolition of public monopolies and opening up the playing field to market competition; and the privatisation of public assets led to coordination problems (Pollitt and Bouckaert, 2011; Skelcher, 2000), as well as issues related to accountability (Aars and Fimreite, 2005; Kersbergen and Waarden, 2004) and democratic quality (Drechsler, 2005; Hirst, 2000).

Although NPM-style interventions are still under way in a number of countries and sectors, a second wave of reforms started emerging from the late 1990's (Osborne, 2010; Pollitt and Bouckaert, 2011; Skelcher et al., 2013). Several parallel processes have contributed to the search for new coordination mechanisms to supplement hierarchical and market-style arrangements, such as the desire to mitigate some of the failures or unintended consequences of the NPM; globalisation and the resulting increased collaboration and exchange between nation states; an increased interest in, and acknowledgement of, the complexity of certain social coordination processes; as well as the changing societal perceptions about the role of public and private actors in public policy making and implementation (Klijn and Koppenjan, 2012; Meuleman, 2008; O'Toole Jr and Meier, 2011; Skelcher, 2000; Torfing, 2005). This post-NPM wave was termed New Public Governance (NPG) by Osborne (2010; 2006). NPG presents a pluralist alternative to the models traditional Public Administration (PA) and NPM. It became associated with a range of ideas around governance, participation, networks, partnerships, transparency and trust (Pollitt and Bouckaert, 2011, p. 11), and with the emerging complex coordination processes resulting from the (perceived) increased need for collaboration (Klijn and Koppenjan, 2012). Such developments led Rhodes (1996) to conclude that hierarchies (associated with classic PA), markets (NPM) and networks (NPG) constitute three ideal types of governing modes, from which governments can choose according to the particular task or problem at hand. Table 3.1 presents the distinctive characteristics of each perspective (mode of governing).

PARADIGM / KEY ELEMENTS	TRADITIONAL PUBLIC ADMINISTRATION (PA)	NEW PUBLIC MANAGEMENT (NPM)	NEW PUBLIC GOVERNANCE (NPG)
THEORETICAL FOUNDATIONS	Political science and public policy	Rational choice theory and management studies	Institutional and network theory
ASSOCIATED MODE OF GOVERNING	Hierarchy	Market	Networks
RELATIONSHIP BETWEEN ACTORS	Unicentric system, with powers retained by the state	Multicentric system of autonomous, rationally acting actors	Pluricentric system of operationally autonomous but interdependent actors
RATIONALITY OF DECISION-MAKING	Substantive, based on political values of elected officials and implemented by the executive branch of government	Procedural, relying on the 'invisible hand' of market forces	Reflexive, through interaction and negotiations with relevant stakeholders/actors
ROLE OF THE STATE	Command-and-control	Regulation aimed at ensuring free market competition	Steering and managing networks of collaboration

Table 3.1 Comparing the three dominant modes of governing

(Sources: Klijn and Koppenjan, 2016; Politt and Bouckaert, 2011; Osborne, 2010; Torfing, 2005)

While much of the academic literature often seems to suggest a linear development path along which clear shifts from hierarchies to markets and latterly, to networks took place (Skelcher et al., 2013), empirical evidence shows that, to a varying extent and in place-specific combinations, all three approaches remain in use. In practice, networks are emerging *alongside* the already functioning hierarchical and market-style arrangements (Considine and Lewis, 2003; Klijn and Koppenjan, 2012), creating place-specific (and temporary) 'hybrid' arrangements (Christensen and Lægreid, 2011; Skelcher, 2012; Skelcher et al., 2013). Despite the growing academic literature on governance, public management, networks and hybrids, no consensus emerged yet on to what extent the aforementioned reforms actually transformed the public sector. Politt and Bouckaert (2011) argued that the degree to which NPM substituted traditional hierarchies was heavily exaggerated. Lynn (2011) demonstrated that, in spite of the reported changes, hierarchical arrangements persisted in a variety of places, scales and domains even in the most enthusiastic NPM-adopter countries. Denters (2011) pointed out that in the era when reforms took place in the Western world several countries in Europe belonged to the Eastern communist bloc and, thus, had a distinctly different experience in trying to implement similar changes decades later, simultaneously to one another. Even advocates of the network approach warn against assuming that *'[network] governance is everywhere'* (Klijn, 2008b, p. 509), i.e. that it substituted more traditional ways of decision-making (i.e. hierarchies and markets).

3.2.2 Origins of the network concept

Although the way in which the concept of 'governance networks' is applied in the European context today is relatively new (Klijn and Koppenjan, 2012), it builds on various streams of research investigating patterns of power, authority and influence within and between the public and private sector in relation to collaboration, conflict and coordination. Broadly interpreted, 'governance networks' refer to a set of actors (public or private) involved in public policy making and/or implementation (Torfing, 2005). Klijn and Koppenjan (2015; c.f. Koppenjan and Klijn, 2004) argue that the strands of academic work that paved the way towards network governance theory fit broadly into three categories, based on the types of networks at their focus, including policy networks, inter-organisational service delivery networks and collaborative inter-governmental networks

(Bevir and Richards, 2009; Klijn and Koppenjan, 2015; 2000; Koppenjan and Klijn, 2004). The main characteristics of the three research fields are presented in Table 3.2.

	POLICY NETWORKS	INTER-ORGANISATIONAL SERVICE DELIVERY NETWORKS	COLLABORATIVE (INTER-GOVERNMENTAL) GOVERNANCE
FIELD OF ORIGIN	Political science (state-industry relations)	Organisational science (inter-organisational relations)	Public administration; (inter-governmental relations)
CONCEPTUALISATION OF THE 'NETWORK'	Metaphorical (discourse-oriented)	Instrumental (strong emphasis on network structure)	Initially metaphorical, nowadays more mixed
GEOGRAPHICAL FOCUS	Starts from the USA, spreading to UK and later to Western Europe	Mainly USA	Starts Western Europe, spreading to the UK and the US
NETWORKS OF FOCUS	Networks of actors influencing policy making in certain sectors or in the case of specific policies	Policy implementation and integrated service delivery networks	Networks of actors (e.g. governments) in decision-making situations where no (functioning) hierarchical order exists
NETWORK PROCESS AND FORMULATION	Access to policy making based on mobilisation, power and influence; power struggles	Interdependency among organisations resulting from the fragmentation of resources, responsibilities and tasks	Mixed (interdependency both in terms of power and resources)
NETWORK RELATIONSHIPS	Strong vertical links	Both horizontal and vertical links	Mainly horizontal links

Table 3.2 Diverging origins of the network governance concept

(Sources: Bevir and Richards, 2009; Klijn and Koppenjan, 2015; 2000; Koppenjan and Klijn, 2004)

As Table 3.2 demonstrates, the various traditions differ from each other substantially depending on the type of network they aim to analyse. However, they share the assumption that, in practice, processes of public policy making, implementation and/or service delivery can't be (and indeed, aren't) controlled by the state as a monolithic entity. Instead, such processes involve multiple actors, usually both from the public and private sector: organisations, including governments, in many situations cannot achieve their goals or complete their tasks without interacting with other organisations. Over time, the sum of relationships (interaction patterns) between organisations results in networks.

Both horizontal and vertical links may exist between network participants depending on the type of network in question. In this regard, a more evident connection can be observed between the inter-organisational service delivery and the collaborative governance traditions: both study networks which operate in 'institutional voids' (Hajer, 2003) resulting from the absence of functional hierarchical systems due the cross-cutting nature of the issue they aim to tackle. In contrast, policy networks are usually organised within established sectors and domains, broadly corresponding to government departmental silos and organised interests (Blanco et al., 2011). Therefore, hierarchical relationships and vertical links exist between network actors, and power-relationships and their impact on outcomes are central questions in the policy network approach. Such issues receive less attention in the other two research traditions. Instead, they tend to focus on the complex processes resulting from the mainly horizontal relationships between network participants. Therefore, if horizontal coordination is the distinguishing feature of the network mode of governance (see Section 3.2.1), the claim that '*policy networks [inevitably] result in network governance'* must be challenged (Lewis, 2011, p. 1222). In fact, the policy network concept highlights the importance of considering power differences between actors, as well as issues of inclusion and exclusion of certain actors and interests. Considering such problems may help to identify factors that contribute to analysing the evolution of the framing of problems and solutions in networks of collaboration (Klijn and Koppenjan, 2015, p. 37). This is because although horizontal relationships may prevail within inter-organisational service delivery and collaborative networks, neither of these exist in a vacuum (Koppenjan and Klijn, 2004): horizontal coordination between network actors remains, to a certain extent, obscured by existing power relationships embedded in the surrounding hierarchical system.

3.2.3 Key concepts and definitions

In order to be able to analyse emerging networks in various cities from different countries across Europe, I use broad definitions of ‘governance’, ‘governance network’ and ‘network governance’ in this study. The term ‘governance’ is used here to describe the sum of social coordination mechanisms which develops as a result of interactions and interventions (including hierarchical, market-style and network) between multiple actors from the public and private sector (Kooiman, 1993; Meuleman, 2008; Rhodes, 1996; Torfing, 2012). Thus, all three modes of governing are included which aim at solving a particular societal problem. ‘Governance network’ is interpreted a set of interacting actors (public or private) involved in public policy making and/or implementation (Torfing, 2005). Finally, I refer to ‘network governance’ as a social coordination mechanism in which network relationships (collaboration patterns) matter, at least to some extent, in the formulation of outcomes (Klijn and Skelcher, 2007).

3.3 DESCRIBING GOVERNANCE NETWORKS

3.3.1 Introduction: relevant theoretical approaches

The discussion in Section 3.2 demonstrated that a unified theory of network governance does not exist, rather, the field is still characterised by different research strands. However, the theoretical underpinnings of much of the literature on governance networks (including all three research strands mentioned in Section 3.2.2, especially in the European research) emerge from different approaches to institutionalism (Skelcher and Sullivan, 2008; Torfing, 2012; Torfing and Sørensen, 2014). Torfing (2005) developed a classification system to map the network-theoretical perspectives, making analytical distinctions between features distributed along two axes; (1) the conceptualisation of the driving force of human action (rational calculation versus culture-bound rule following), and (2) the perceived defining characteristic of the governance of societies (persistent conflicts or coordination). Separation can be made on the basis of the dominant views the different approaches emphasise, while also acknowledging that overlaps may exist between them. Table 3.3 introduces the theoretical concepts which are relevant for studies of governance networks, paired with the related institutionalist approaches.

	CALCULATION	**CULTURE**
CONFLICT	Interdependence theory (Historical institutionalism)	Governmentality theory (Poststructuralist institutionalism)
COORDINATION	Governability theory (Rational choice institutionalism)	Integration theory (Constructivist / normative institutionalism)

Table 3.3 Theoretical perspectives influencing the research on governance networks

(Sources: Sørensen and Torfing, 2007a; Torfing, 2005)

Despite the apparent differences, all institutionalist perspectives share the central assumption that institutions, understood as particular combinations of formal (e.g. written rules and regulations) and/or informal (e.g. norms, customs and practices) social organisational forms, informed and supported by knowledge, values, codes and conceptions (March and Olsen, 2010; Sørensen and Torfing, 2007a a), matter in the analysis and functioning of politico-administrative systems (Lowndes and Roberts, 2013; Peters, 2011).

'Interdependence theory' (Bevir, 2008; O'Toole, 1997; Rhodes, 2000) conceptualises actors as making decisions based on rational calculation with the aim of benefit maximising, and highlights the conflictual nature of collaborative processes which inevitably arises from diverging interests among the parties involved (Sørensen and Torfing, 2007b). It sides with historical institutionalism in emphasising path-dependency and the resistance to change of established social organisational forms which impact the behaviour of actors (Lowndes and Roberts, 2013; Torfing and Sørensen, 2014).

'Governability theory' (Bevir, 2008; Kooiman and Bavinck, 2013) shares the assumption with interdependence theory that actors' actions and interactions are driven by calculation and self-interest. It builds on rational choice institutionalism and interprets institutions as external constraints which, to a certain degree, regulate the self-organisation of the actors involved (Lowndes and Roberts, 2013; Sørensen and Torfing, 2007b). In terms of process, governability theory focuses on coordination: the options to render self-organisation processes 'governable' (controllable).

In contrary to the first two approaches, theories of 'governmentality' and 'integration' contend that the benefit maximising behaviour of actors is culture-bound: both their perceptions of the desirability and viability of possible options, as well as their understanding of what constitutes a 'benefit,' are shaped and informed by the institutional context in which they operate. 'Governmentality theory' (Bevir, 2008; Dean, 1999; Foucault, 1991) focuses on conflict and power struggles in the collaborative process.

Taking a poststructuralist perspective, it interprets institutions through the lenses of the contextually relevant 'governmentality' paradigm (Dean, 1999; Torfing, 2012) which acts as a framework to '*construct political subjectivities and identities*' (Lowndes and Roberts, 2013, p. 31) for the actors involved which may contribute to conflict resolution. In a somewhat different vein, 'integration theory' (Bevir, 2008; March, 1999; March and Olsen, 1998) sees institutions as vehicles for social coordination through shared values, norms and frames of reference (Torfing and Sørensen, 2014).

In this section, I provided a discussion on the theoretical underpinnings of different approaches to governance networks based on the distinct types of institutionalist accounts they tend to emphasise before proceeding with highlighting the different options for defining and analysing governance networks, and for explaining the reasons of the proliferation and formation of networks as well as of the processes that sustain them. The following sections present how the four theoretical lenses describe different building blocks of the network phenomena. This is important for the PhD research in order to expose the universalist nature of the dominant transition theories of the Multi-Level Perspective (MLP) and Transition Management (TM) with regard to the conceptualisation of collaborative network-type processes (i.e. self-organisation in transition arenas and steering from transition managers).

3.3.2 Emergence of networks and definitions

Network governance has traditionally been analysed mainly through the lenses of interdependence and governability (Torfing, 2012; Torfing and Sørensen, 2014), including all three types of network research in public policy and administration presented in Section 3.2.2. However, at least implicit assumptions about the network phenomena can also be derived from the more interpretative theories of integration and governmentality which stress the role of institutions (context) in shaping actors' perceptions and preferences, opposed to the other two perspectives which draw on the rational calculation model (Torfing, 2005). Therefore, they may contribute to providing a more complete overview on variation in networked forms of governance.

Interdependence theory takes the legacy of NPM as a starting point: the emergence of governance networks, according to this perspective, is an inevitable consequence of institutional fragmentation and resource scarcity (Sørensen and Torfing, 2007b) created by the introduction of specialisation and market competition to the public sector. Network governance is seen as developing organically rather than through a top-down process, with the aim of counteracting fragmentation which restrains actors' possibilities for resource pooling and exchange (Torfing and Sørensen, 2014). Therefore, governance networks are defined as

> *'interorganizational medium for interest mediation between* interdependent, but *conflicting actors each of whom has a rule and resource base on their own'* (Sørensen and Torfing, 2007a, p. 18).

Thus, according to interdependence theory, investigations into mutual resource dependency patterns provide the most valuable insights into the formation and functioning of governance networks.

Governability theory shares the concerns about the potentially negative consequences of organisational fragmentation with interdependency theory, albeit it sees fragmentation as part of a range of issues characteristic of contemporary societies, alongside increasing complexity and new societal dynamics (Torfing and Sørensen, 2014). It argues that traditional hierarchical and market-style modes of governing are unable to efficiently deal with coordination problems which arise from the perceived changed in conditions for coordination (Torfing, 2005). Thus, network governance is seen as a new, third option for social coordination and an alternative to hierarchies and markets. Networks are conceptualised as means for decision-making through interaction and horizontal coordination between autonomous actors (Sørensen and Torfing, 2007b). Therefore, from a governability perspective, studies on governance networks must uncover the complexities and uncertainties involved in particular decision-making situations or processes (Kickert et al., 1997).

Governmentality theory emerged to offer an alternative to achieve the neo-liberal ideal of the minimal state, in the light of NPM's failure to deliver it (De Vries and Nemec, 2013; Rhodes, 1996). Despite its promise to shrink the public sector to only include a few core state functions and to ensure free market competition, the introduction of market-style governance and service delivery did not reduce the size of the public sector substantially (Torfing and Sørensen, 2014). The main discourse is, therefore, focused on the advanced liberal government (Sørensen and Torfing, 2007b; Rose, 1993) which relies on a reflexive way of governing at a distance (Torfing, 2005, p. 306), enabling societal actors to regulate themselves (albeit within certain limits). Interactive policy arenas established by state bodies provide space to '*mobilize and shape the free actions of self-governing actors*' through intermediation (Sørensen and Torfing, 2007a, p. 19). Shared frameworks and conceptualisations arising from processes of institutionalisation within policy arenas hold actors together in (relatively) stable coalitions, potentially resulting in governance networks (Torfing, 2012; Torfing and Sørensen, 2014).

Integration theory shares the conceptualisation of network governance with the theories of governability as a third, distinct mode of social coordination alongside hierarchies and markets. It focuses on the potential of network governance as an intermediate option between totalitarian over-integration (bureaucratic hierarchy) and individualistic under-integration (market-style arrangements) to solve societal problems (Sørensen and Torfing, 2007b). Governance networks thus are defined as relatively institutionalised organisational structures which provide space for interaction for the relevant actors (Torfing and Sørensen, 2014). Processes of integration are affected by patterns of interdependence among actors as perceived by themselves driven by a 'logic of appropriate action' (March and Olsen, 2004). Actors' logics of appropriateness thereby are constructed through their interpretation of the institutional context in which they operate, and may change over time as a result of networking processes.

3.3.3 Network formation

The different theoretical perspectives highlight a variety of processes which can contribute to the formation of governance networks. Interdependency theory explains the emergence of governance networks with mutual interdependency relations between actors who interact because they benefit from joint solutions to shared problems (Torfing and Sørensen, 2014). Therefore, networks are formed through incremental bottom-up processes rather than being initiated by government bodies to 'get things done'. However, public authorities often choose to engage existing networks as '*vehicles for public policy making*' (Torfing, 2005, p. 312). According to governability theory, networks develop through game-like situations played in the various arenas of decision-making, facilitating horizontal coordination this way among actors from different sectoral and organisational systems (Torfing, 2012; Torfing and Sørensen, 2014). From this perspective, increasing trust between actors, established through the game-like interactions, is a key process in network formation (Kickert et al., 1997). Although networks are seen as developing in a bottom-up way, public authorities may play an important role in network creation by determining the content and membership of decision-making arenas (Koppenjan and Klijn, 2004).

A similar gradual, bottom-up process is described in integration theory, where actors proactively seek relations with other actors. Networks are formed through extending and deepening these contacts on the basis of actors' evaluation of the options, potential and benefits of collaboration (Börzel, 1998; Sørensen and Torfing, 2007b; Torfing, 2012). Collaborative processes may be aided or enhanced by governments in a hands-off manner through working to create a favourable institutional context. In contrary to the integration perspective, governmentality theory explicitly aims at understanding the ways in which particular institutional contexts can be created (for example, through narratives and storylines) which facilitate the formation of 'appropriate' (either collaborative or not) governance arrangements for transferring a certain responsibility or task from the state to social and political actors (Torfing, 2012).

In conclusion, all different strands emphasise the role of bottom-up processes in the formation of governance networks; members join on a voluntary basis and are relatively free to enter or leave the network at any point. However, their actions to some extent are conditioned by interdependency relations, as perceived by themselves or (higher levels of) public authorities, previous collaboration experiences and trust, as well as the 'logics of appropriateness' informed by the relevant institutional context. Difference can be found in the conceptualisation of the state-network interaction: while the theories of governability and governmentality more clearly express public authorities' potential to actively influence the network processes in direct or indirect ways, the other two perspectives place more emphasis on the 'organic' character of network formation and less scope or potential for the state to affect it.

3.3.4 Sustaining networks: the network governance process

Sustaining governance networks is only possible if actors actively seek to maintain their relationships with other network participants through interaction. However, their motivation to do so may be explained in several different ways. Each of the previously mentioned four theoretical perspectives emphasise distinct rationales which hold the networks together and, ultimately, result in distinct network processes.

According to interdependence theory, the main cause of the existence and continuing operation of networks is the mutual resource dependence between actors which keeps them together despite internal power struggles resulting from conflicting interests (Bevir, 2008; Torfing, 2012). Therefore, the process of achieving outcomes is characterised by negotiation and compromise (Ansell and Gash, 2008). Despite the primary role of interdependency in organising network processes (at least initially), it is also acknowledged that interactions between network actors may contribute to the development of common frameworks, rules and norms which, in turn, make it easier to achieve outcomes.

Governability theory highlights the role of mutual benefit from resource pooling and collective action in keeping networks intact. Network interactions serve for developing trust between actors. Increasing trust is seen as a major contributor in facilitating joint action (Edelenbos and Klijn, 2007). Network processes in this context may lead to outcomes in two different ways, termed as 'negative' or 'positive' coordination by Scharpf (1994). Negative coordination develops if the process is characterised by avoiding conflicts; in this case, the outcome is a 'lowest common denominator' type (Torfing, 2012) which is acceptable to all parties involved without having to significantly alter their perceptions and/or goals (Scharpf, 1994). If actors behave in a more open an engaged way, 'positive coordination' may develop through which joint problem definitions and joint solutions can be achieved that contribute to welfare-maximising (Torfing, 2012).

As mentioned previously, integration theory places emphasis on the role of institutions which provide actors with particular logics of appropriate action through the definition of common rules, norms and perceptions. Shared frames of meaning, in turn, contribute to developing solidarity and common identities among network actors. It is this context that sustains governance networks, according to theories of normative integration (March and Olsen, 1998; Torfing and Sørensen, 2014). Conflicts of interest may arise, but these are dealt with via democratic processes supported by the established 'community sense' (Torfing, 2012). Outcomes are, therefore, achieved through consensus-seeking rather than compromise.

In a similar vein to integration theory, governmentality theory also focuses on the role of cultural rules and norms in relation to social coordination. However, taking an instrumental perspective, it aims to facilitate the adoption of particular frames of reference by actors through specific governmental technologies and rationalities (Triantafillou, 2004). In addition to the recruitment of 'appropriate' actors, these frameworks may also contribute to developing an institutional context which eases collaboration and holds networks together (even though this is not explicitly claimed by the literature; Sørensen and Torfing, 2007b).

The overview of the theoretical approaches highlighted different perspectives on the operation of governance networks; the maintenance of network relationships; and the processes and types of outcomes of network interactions. In terms of network operation, one strand focuses on the existence of interdependence among actors (as perceived by themselves) as a starting point for developing network interactions. Here, the institutional setting in focus develops internally, as a result of networking processes. Depending on the success or failure of this process, outcomes may be based on simply avoiding conflict (lowest common denominator), on compromise or even on consensus. However, the institutionalisation process is seen to be progressing organically in a step-by-step way, without being directed towards achieving consensus. The second strand aims to uncover how actors' perceptions about their interdependencies with others are influenced by the distinct logics of appropriateness created by the wider institutional context in which they operate. Their focus is, therefore, on the ways in which the institutional setting can be organised to facilitate networked governance forms. Consequently, due to higher levels of convergence in terms of actor perceptions in these networks, interactions tend to aim at producing consensus-type outcomes.

3.3.5 Summary and conclusions

Despite the different theoretical lenses through which governance networks are analysed, a few common elements can be found between the approaches which, together, constitute a 'baseline' definition of governance networks. According to Torfing's description (2005, p. 307), governance networks are

> *'relatively stable horizontal articulations of interdependent, but operationally autonomous actors who interact with one another through negotiations which*

take place within a regulative, normative, cognitive and imaginary framework that is self-regulating within limits set by external forces and which contributes to the production of public purpose'.

This definition gives an indicative 'threshold' of what empirical phenomena can be referred to as governance network. Thereby, it provides means through which the concept can be applied in different contexts.

A few recent contributions take a similar approach in emphasising convergence with regard to certain elements of different theoretical and empirical perspectives on collaborative, interactive or networked governance. For example in an overview of the literature, Klijn and Koppenjan (2012, p. 591; c.f Lewis, 2011) identified four core concepts and related assumptions which appear in most studies on different types of networks. First, there seems to be a near-consensus on the significance of a recent move towards policy making and implementation which takes place in multi-actor settings. Networks develop because actors perceive collaboration as necessary to achieve their goals or deliver certain tasks. Nevertheless, conflicts are seen as inherent to networked decision-making due to actors' dissimilar perceptions, interests and strategies. Second, many commentators stress that interaction processes in networks show a high degree of complexity. However, outcomes (e.g. policies, strategies, projects, etc.) are, at least partially, results of these interactions. Third, the emerging pattern of interactions is often considered as an institutionalisation process, and rather than focusing only on the structural characteristics of networks, it can also be understood in relation to developing network-internal rules, practices and narratives (Lowndes and Roberts, 2013). Fourth, most of recent work tend to agree that due to the complexity of governance processes in networks, some form of steering, either via participation or from a distance, is required to make collaboration work 'well' (Lewis, 2011).

However, scholars also seem to agree that although some commonalities can be found within the literature, the tendency to emphasise divergence prevails. This can be attributed to the fact that both the notion of 'governance' as well as the notion of 'network' may be understood in a variety of different ways. Thus, analyses of governance networks encompass a wide range of phenomena with different functions, forms and labels (Bingham, 2011; Torfing and Sørensen, 2014). Such diversity is seen as a strength by many scholars of network governance (Blanco et al., 2011; Lewis, 2011) who stress that convergence is neither necessary nor possible in many cases. They point to the advantages that different conceptualisations and approaches possess on the basis of the empirical phenomena which they aim to study, and that of combining different perspectives in order to generate richer data (Blanco et al., 2011). In the case of this study, addressing the research questions set out in Chapter 1, Section 1.3 requires the acknowledgement of the potential of combining different theoretical perspectives to be able to build a better understanding of the place and scale-specific collaboration processes influenced by locally relevant patterns of politics and power distribution. It is expected that combining insights that can be gained though analyses informed by different theoretical lenses will contribute to constructing links between governance networks and their impact.

3.4 GOVERNING WITHIN AND THROUGH NETWORKS: NETWORK MANAGEMENT AND META-GOVERNANCE

3.4.1 Governing governance: options to steer network processes

There has been a longstanding interest in the issue of enhancing the efficiency and effectiveness self-organising networks in the literature on network governance (Gage et al., 1990; Kooiman, 2003; Koppenjan and Klijn, 2004; Rhodes, 1997; Scharpf, 1994; Sørensen and Torfing, 2009; Whitehead, 2003). This work into 'governing governance' (Jessop, 2002) resulted in the development of somewhat overlapping concepts of meta-governance (Jessop, 2011a; Meuleman, 2008; Sørensen, 2006) and network management (Klijn, 2005; Klijn and Koppenjan, 2015; 2012; 2000; Koppenjan and Klijn, 2004), in addition to the less governing-oriented intermediation (Bevir and Rhodes, 2003; Börzel, 2011; Rhodes, 2006) perspective. In the following I introduce the concepts and ways in which they interpret the task of steering network governance processes.

3.4.2 Intermediation

The (predominantly) British policy network research refers to 'interest intermediation' as the process of governance which arises within policy networks (Börzel, 2011; Rhodes, 1997, 1996). In contrast, the term 'intermediation' is used as a deliberate attempt to influence networking processes in a direct form through network participation in much of the continental European literature (Sørensen and Torfing, 2007b). In the absence of either capability or willingness to assume a more hierarchical mode of governing based on some form of authority, the only available option organisations are left with to shape network processes and outcomes is to become a member of the self-organising network. Therefore, intermediation can be carried out by whoever has the resources to do so, either in legal, institutional and financial (Kickert et al., 1997) or relational (Mandell, 1988; McGuire, 2006; Prell et al., 2009) terms. Though participation, the organisation may gain influence over the content as well as the structure of network governance, albeit at the expense of having to accept the horizontal coordination mechanisms inherent to the network (Sørensen and Torfing, 2007b). More discursive strands of the network governance literature, in which the network concept appears predominantly as a metaphor, focus on content-related intermediation as a process of conflict resolution (Kenis and Schneider, 1991; Rhodes, 2006; Rhodes and Marsh, 1992). However, intermediation as ‘brokerage’ or ‘boundary management’ between scarcely connected groups of actors is a central concept in studies explicitly interested in the structural features of network and the relations between structure, process and impact (Cash et al., 2006; Lewis et al., 2008; Midttun, 2005; Provan and Kenis, 2008; Williams, 2002). In the absence of attempts to steer networking processes through any form of hierarchical coordination, steering through intermediation leaves governance networks with a degree of capacity for ‘self-steering’ (Rhodes, 1997).

3.4.3 Network management

Expanding on the exclusively hands-on mode of influencing governance networks via intermediation, ‘network management’ (Klijn, 2005; Klijn et al., 2010; Klijn and Koppenjan, 2015, 2012, 2000; Koppenjan and Klijn, 2004) combines both hands-on (direct) and hands-off (indirect) techniques to enhance network success. Network management may be aimed at improving the quality of interaction between actors (Gage et al., 1990; Klijn and Koppenjan, 2012); introducing changes to the network structure for better coordination (Klijn and Koppenjan, 2015; Koppenjan and Klijn, 2004); or influencing the content of discussions within the network (Klijn and Koppenjan, 2012; Koppenjan and Klijn, 2004). According to the literature on network management, both the network process, structure as well as the content of deliberation taking place in the network can be influenced either directly (process management with or without network participation) or indirectly (institutional design) (Klijn, 2005; Sørensen and Torfing, 2007c). Process management involves direct interventions related to the activation of specific actors or resources; the formation of goal-achieving strategies; the creation of organisational arrangements; and the guidance of interactions via intermediation and brokerage (Gage et al., 1990; Kickert et al., 1997; Klijn, 2005; Koppenjan and Klijn, 2004). Institutional design strategies are considered indirect because, instead of focusing on directly affecting the network structure, process or content, they intend to change the formal and informal 'rules of the game' which in turn have an impact on the characteristics and functioning of the governance network (Klijn and Edelenbos, 2007; Klijn and Koppenjan, 2015; Sørensen and Torfing, 2007c). Thus, institutional design is aimed at changing the '*sets of rules which influence, guide and limit the behaviour of actors'* (Klijn and Edelenbos, 2007, p. 206). This can be achieved, for example, via changing the rules of network access which will result in the transformation of network structure; the conditions which determine actors' strategies and perceptions and, by doing so, influence the outcomes of network processes; or introducing procedures and mechanisms which have the potential to regulate network interactions (Klijn and Edelenbos, 2007; Klijn and Koppenjan, 2015). This perspective emphasises the complexity involved in steering network governance processes and, consequently, highlights the range of resources (including skills, competence, but also powers and authority) that network managers (organisations or individuals) need to possess (Koliba and Koppenjan, 2016). Consequently, the approach assumes some form of hierarchical relationship within the network between the network manager and the other participants. Governance networks in this interpretation are, therefore, described as self-regulating within certain limits (Klijn and Koppenjan, 2015) rather than being considered self-steering.

3.4.4 Meta-governance

The notion of meta-governance refers to the 'governance of governance' (Jessop, 2003; 2002). As the rather vague definition suggests, different interpretations exist with regard to the meaning of the concept of meta-governance and its relationship with network management. The variation can be explained by different understandings of the phenomena of governance. Originally, meta-governance was introduced to capture the changing possibilities and potential of governmental actors for social coordination. Thus, from this perspective, meta-governance represents a shift from direct coordination to 'steering from a distance' by setting limits and providing direction for self-organisation either through market or network mechanisms (Sørensen, 2006). For others, the concept of governance is inseparable from the concept of networks; rather, they contend that 'governance' is the process which takes place in governance networks (Klijn, 2008b; Klijn and Koppenjan, 2000; Koppenjan and Klijn, 2004). Thus, meta-governance in this case is analogous to network management (Klijn, 2008b; Klijn and Koppenjan, 2015). Finally, in its broadest sense the notion of meta-governance is used as the process of '*designing and managing mixtures of hierarchies, networks and markets'* (Jessop, 2011b, p. 107) in studies where governance is interpreted as the sum of social coordination mechanisms which results from interactions and interventions (including hierarchical, market-style and network) between multiple actors from the public and private sector

(Kooiman, 1993; Meuleman, 2008; Rhodes, 1996; Torfing, 2012). Sørensen (2006) identifies four distinct ways through which meta-governance can be exercised, including hands-off policy or resource framing; hands-off institutional design; hands-on facilitation of network cooperation; and hands-on network participation. Thus, according to this account, meta-governance differs from network management in two ways: first, it emphasises that process management and network participation are two separate mechanisms; and second, it highlights the potential for indirectly influencing network processes through '*the strategic design of the institutional conditions under which networks govern themselves*' (Sørensen, 2007, p. 92).

3.4.5 Summary and conclusions

The discussion provided in this section demonstrated that intermediation, network management and meta-governance can be understood as three distinct types of coordination mechanisms which provide different opportunities for 'steering' network governance processes. Organisations which have an interest in steering network processes may opt for any one of these, based on the resources available to them. Such resources may either be exogenous (legal, financial, or institutional) or endogenous (relational, based on the organisations' position within the network) to the governance network. The existing literature based on the comparative analysis of the operation of governance networks in different contexts (places or domains) suggests that organisations' options to choose between intermediation, network management or meta-governance are largely conditioned by the context in which they operate (Kriesi et al., 2006; Skelcher, 2007; Skelcher et al., 2013).

3.5 Main debates and critical reviews

3.5.1 Place: context and cross-national applicability

Section 3.2, 3.3 and 3.4 highlighted that a single, unified theory of network governance does not exist. Instead, parallel network-related concepts have been developed in different places (i.e. in the USA, the UK and continental Europe) which emphasise divergent characteristics of networked forms of governance (see Section 3.2). Although some claim that significant convergence took place between the different research traditions, particularly in the last decade (Klijn and Koppenjan, 2015; 2012), others point to the persistence of divergence and emphasise the distinctive interpretations that the research strands offer (Blanco et al., 2011; Lewis, 2011). Subsequently, it has been discussed that differences and similarities between the research strands can be understood with regard to their emphasis of one of the four distinct but overlapping theoretical perspectives which underpin the network research (see Section 3.3). Based on such overlaps, Torfing (2005) offered a comprehensive, albeit generic, definition for governance networks. However, subsequent empirical research demonstrated that, in practice, governance networks show divergence from this ideal-type account due to differences related to place-specific contextual factors (Skelcher, 2007; Skelcher et al., 2013; Torfing and Sørensen, 2014). Finally, it has also been shown that different types of networks provide distinct opportunities for coordination (or steering) within and through network governance and vice versa (see Section 3.4). Consequently, a number of recent reviews suggest that there is still a lack of understanding of the ways in which contextual factors, network structures, processes and outcomes influence each other; thus, they call for further empirical research in the form of comparative, cross-national studies which combine qualitative and quantitative approaches (Lewis, 2011; Torfing and Sørensen, 2014).

3.5.2 Scale: networks within and between societal organisational levels

So far, issues related to ‘scale’ and ‘scaling’ received less attention in studies of network governance (Ansell and Torfing, 2015) even considering the large number of empirical analyses of governance networks operating within certain organisational scales (i.e. local, subnational, national, supranational or global; Torfing and Marcussen, 2007), and the studies into scale-crossing collaborative arrangements (Bache and Flinders, 2004; Hooghe and Marks, 2001). Thus, a lack of evidence is apparent regarding the impact of scale on governance networks (and vice versa; Ansell and Torfing, 2015). It has been suggested by Torfing and Sørensen (2014), on the basis of the available empirical research, that governance networks are on the rise on the local, regional and transnational levels, but are less relevant for national level decision-making and coordination processes. They claim that, among other reasons, decision-making on the local level is likely to involve a variety of actors from different spheres of the public, market and civil sector due to a context characterised by ‘*many public agencies with overlapping jurisdictions, a high degree of institutional fragmentation and a large number of competent organisations and user groups*’ (Torfing and Sørensen, 2014, p. 336). Others explain the necessity for local authorities to get involved in networked forms of governance by parallel processes of urbanisation, globalisation and Europeanisation (Bulkeley, 2010; Castells, 2002; Denters and Rose, 2005; Sørensen and Torfing, 2009). Such processes have been triggered by global socio-economic changes and resulted in ‘authority migration’ (Gerber and Kollman, 2004) from the national to supra- and sub-national levels and to private sector bodies (Jessop, 1999; Kersbergen and Waarden, 2004; Marks and Hooghe, 2003). These parallel developments have been shown to potentially strengthen the position of local authorities within the vertical power distribution between levels of government while, simultaneously, the blurring of boundaries between the public and private sector may have diminished its authority in certain domains. Thus, it is unclear how the still currently unfolding processes of power re-distribution impact the potential for network governance within and between organisational and geographical scales (Denters, 2011).

3.5.3 Impact: does network governance deliver and how would we know if it did?

Although some commentators perceive network governance as *de facto* superior to hierarchical or market-style coordination mechanisms, the majority of the literature agrees that networks are no panacea (Börzel, 2011; Lewis, 2011; O'Flynn, 2009) and that their potential is only realised if they function 'well' (Lewis, 2011; Robins et al., 2011). Networks have been praised for creating space for interaction and multi-sectoral co-operation between various organisations; for facilitating informed decision-making based on knowledge exchange and deliberation between stakeholders; and for building engagement to achieve the negotiated goals (Agranoff and McGuire, 2003; Duit and Galaz, 2008; Klijn and Koppenjan, 2015; Torfing, 2005). However, governance networks regularly fail to live up to these expectations. First, a large body of literature points to possible shortcomings related to the quality of network processes in relation to problems of: democratic quality (Hendriks, 2008; Sørensen, 2002); accountability (Esmark, 2007; Newman, 2004); legitimacy (Aars and Fimreite, 2005; Börzel and Panke, 2007); and equity (Bingham, 2006; Fischer, 2006). These issues may also contribute to operational difficulties: it can be difficult, time and resource consuming to achieve outcomes through network governance due to the existence of, or potential for, conflicts of interests between actors (Klijn and Koppenjan, 2015; Koppenjan and Klijn, 2004). Unsuccessful attempts to resolve conflicts may result in impasse, or in more extreme cases, the termination of interactions (Klijn and Koppenjan, 2015). Moreover, even if governance networks achieve an outcome, the evaluation of such outcome is not straightforward: as actors often possess dissimilar problem definitions and frames of reference in the beginning of the network process (which may also change over time as a result of network interactions), the classic evaluation method of ‘goal attainment’ cannot be applied (Klijn and Koppenjan, 2000). Besides issues internal to the network processes in achieving outcomes, governance networks may also face difficulties in terms of making an impact, i.e. converting outcomes into policy, strategy or else (McGuire and Agranoff, 2011; McGuire and Fyall, 2014) due to operating in ‘the shadow of hierarchy’ (Börzel, 2010; Sørensen and Torfing, 2009). Determining the success or failure of governance networks in terms of impact, thus, is an empirical question such as assessing the conditions which shape the results.

3.6 CONCLUSIONS: NETWORK GOVERNANCE IN LOW-CARBON TRANSITIONS

This chapter provided an overview on the existing literature on the governance network perspective in the context of public policy making and delivery. In the first part of the chapter I argued that there is compelling evidence that networks can legitimately be considered as a distinct, third mode of governing besides the traditional hierarchical and the neoliberal market-style mechanisms. However, from a historical perspective, the extent to which networked forms replace hierarchies and markets may be questioned. Most scholars agree that instead of clear shifts from hierarchies as the dominant mode of governance to markets and latterly, to networks, public sector reforms resulted in a complex layering of the different models. In most cases, markets and networks appear alongside of hierarchies in the various domains of policy making and implementation on different scales and in different places and sectors.

Governance networks, thus, may have different functions, take different forms and may be labelled in a variety of ways; consequently, a wide range of empirical governance phenomena can be considered in network terms. As a result of such a wide empirical focus, different research strands can be identified within the network literature, informed by a variety of theoretical assumptions. The theoretical perspectives relevant to the network research, drawing on different institutionalist accounts, have been shown to emphasise diverging views on the definition of governance networks, on the reasons for their emergence and on processes of network formulation and operation. The conclusion that could be drawn from the discussion on the different approaches to analysing governance networks was that commonalities among the divergent perspectives are adequate only to give a descriptive 'threshold' account of what phenomena can and cannot be considered as 'governance networks'. Thus, divergence within the network scholarship could be considered as a strength rather than an obstacle which ought to be bridged. Different research strands and theoretical perspectives may be better suited to be able to assess particular empirical phenomena in 'real world' situations. Similarly, they may also produce richer insights on the potential for steering network governance processes operating within and between different places, scales and domains or sectors.

Such focus on divergence is currently still missing from the literature on sustainability transitions. Rather, dominant approaches to analyse and support transition processes are mainly based on assumptions congruent with theories governability (e.g. MLP and TM), and to a lesser extent interdependence, both of which emphasise rational calculation as the driving force of human action. However, the existing research on network governance shows that the emergence, formulation and operation of governance networks cannot exclusively be explained through these theoretical perspectives. Thus, research informed by perspectives emphasising the role of culture-bound rule following (as well as rational choice theories) may provide fresh insights into the role of context in the emerging patterns of collaboration in transition arenas and on the options to steer these towards low-carbon development. 'Context' has been defined in Chapter 2 as a combination of factors related to place, scale, and politics and power. This PhD study set out to analyse the governance of transitions on a particular organisational level, where a lack of empirical evidence is still apparent: the urban scale. The existing literature on the specificities of urban transitions, with an emphasis on network-theoretical perspectives, are introduced in the next chapter (Chapter 4).

CHAPTER 4.

NETWORK GOVERNANCE AND LOW-CARBON TRANSITIONS IN CITIES

4.1 OBJECTIVES AND STRUCTURE OF THE CHAPTER

This chapter provides an overview on the ways in which low-carbon transitions and governance networks appear in the literature focusing on urban governance and the particular scale of cities (i.e. settlements with a 'city' status in their respective countries). First, I discuss the opportunities and barriers to addressing the transition to low-carbon societies in the urban context; the options for cities to respond to challenges posed by transitions on different scales (i.e. national or global); and the dominant debates on what low-carbon urban transitions might entail, according to the existing literature (Section 4.2). In the second part of the chapter, I present an overview of the prevailing discourses in academic research on the governance of low-carbon transitions in cities (Section 4.3). This is done by connecting the different strands of literature to the theoretical perspectives on governance networks introduced in Chapter 3, (Section 3.3). In Section 4.4, I outline the theoretical position which informs the empirical research presented in Part II of the thesis.

4.2 THE ROLE OF CITIES IN SUSTAINABILITY TRANSITIONS

4.2.1 Cities as sites for low-carbon transitions

'Our Common Future' (WCED, 1987), the report published by the United Nations' World Commission on Environment and Development, has been the first official UN document to emphasise the trend of urbanisation as one of the core issues to be dealt with as part of the solution to environmental issues. Today, solving challenges related to urbanisation is more timely than ever: statistical data collected by the Eurostat Urban Audit (Eurostat, 2016) reveals that over 75% of the population of Europe lives in cities or their agglomerations at the present day, estimated to rise to above 80% by 2050. Simultaneously, the size of urban settlements is expected to grow (both with regard to the space they occupy as well as the number of inhabitants they house), and one in every three people globally will live in cities with over a population of over half a million by 2030 (United Nations, 2016). Therefore, it doesn't come as a surprise that the sustainable transformation of cities has been included among the UN's 17 'Sustainable Development Goals' (SDGs) which are the building blocks of the '2030 Agenda for Sustainable Development' (United Nations, 2015a).

Despite housing the majority of the world's population, urban areas (in spatial terms) occupy less than 2% of the land available globally (excluding Antarctica; Cox, 2010), resulting in an extensive concentration of human activities. On the one hand, such activities require extensive resources which have to be imported into the city; on the other, they generate processes which have a negative effect not only on the climate, but also on citizens' well-being (e.g. urban heat-island effect, air pollution, flooding, little or no access to green spaces). Thus, governing climate change in cities takes place in a context characterised by ambivalence on multiple levels: first, while cities are claimed to be responsible for up to 70% of global carbon emissions (Satterthwaite, 2010; Stern, 2006; United Nations, 2011), they are also among the most vulnerable sites when it comes to adverse effects of climate change (Lo, 2014). For example, because of their location based on particular historical development trends (i.e. in the proximity of waterways), many cities are prone to extensive flooding due to sea level rise or extreme weather events as a direct outcome of climate change. Second, although they represent significant opportunities to curb emissions, attention must also be paid to adaptation to the consequences of climate change (Anguelovski and Carmin, 2011). Clearly, this is not a straightforward process: despite being considered to be hotbeds for innovation (Kronsell, 2013), city systems exhibit significant obduracy (i.e. resistance to change) due to the inflexible nature of urban infrastructures on which often millions of people depend (Bulkeley and Betsill, 2005; Bulkeley and Castán Broto, 2013). Third, as a result of the contemporary economic environment, direct competition between urban regions on the global marketplace means that no-growth or de-growth policies are rarely or not at all considered (Bai, 2007). Nevertheless, entrepreneurialism requires cities to engage with self-marketing to attract capital, people, and ideas (Castells, 2000).

Considering the complexities involved in sustainable urban transformations, it is rather unsurprising that initial action related to both emissions mitigation and adaptation to the changed environment was confined to a number of pioneer cities in North America and in Europe (Bulkeley and Betsill, 2005). However, recent studies found that the number of initiatives aimed at responding to climate change is growing continuously, as more and more cities from across the world engage in mitigation and/or adaptation initiatives (Castán Broto and Bulkeley, 2013). Such growing interest may be (at least partially) attributed to the benefits of making cities more sustainable: on the one hand, the mitigation of greenhouse gas emissions can provide a higher standard of living in terms of reducing health risks from pollution, and by doing so, improving citizens' well-being; and on the other, transition initiatives have been proven to be effective means of attracting funding from national and international (for example EU) governments, contributing to urban development and offering opportunities for cities to strengthen their position on the global marketplace (Nagorny-Koring and Nochta, 2018). Thus, in spite of a significant variation with regard to the nature and extent of engagement between different urban localities, climate change mitigation and adaptation are now considered to be legitimate concerns for cities and local authorities (Bulkeley, 2010; Bulkeley and Betsill, 2013).

4.2.2 The role of cities in the multilevel context of transitions

There has been a long-standing acknowledgement in urban governance and climate change studies that governance related to addressing climate change impacts takes place in multilevel context (Betsill and Bulkeley, 2006), including international negotiations, national as well as urban level policy making and implementation. Furthermore, climate change action cannot be divided into a set of parallel, isolated processes. Instead, it is characterised by a high degree of interconnectedness between places, scales and domains (Bulkeley, 2010; Bulkeley and Betsill, 2005, 2013).

Considering the multilevel nature of climate change responses, Geels (2011) attempted to provide a comprehensive account of the potential for governing low-carbon transitions in cities, informed by the Multi-Level Perspective (MLP; see Section 2.3.2). He argued that the focus on the national level in socio-technical transitions can be attributed to the generally nationally organised infrastructure systems which critical to the shift to a low-carbon economy, as well as the relevant regulative frameworks and governing organisations (cf. Raven et al., 2012). According to Geels (2011), cities can play three distinct types of roles in transition processes, including acting as primary actors leading transitions; providing space for experimentation which may trigger national-level systemic change; and having a limited role in transitions of nationally or internationally organised socio-technical systems.

First, with regard to transitions in locally organised systems, such as waste, water and sewer infrastructure, cities may play the role of primary actors (Geels, 2005). The reason for this is that although these infrastructures may be regulated at the national level and may contribute to and be influenced by national level knowledge base (e.g. in terms of engineering practices), their operation is often assigned to actors on the local level who, in many cases, have an affiliation with the local authority. The up-scaling of innovation in these domains develops through replication, whereby successful initiatives in one city get transferred other places. Thus, the transformation of the national (or supra-national) infrastructure emerges as a result of a collection of parallel local innovations (Geels, 2011).

Secondly, cities may be viewed as testbeds for innovative experiments (‘living laboratories’; Evans and Karvonen, 2011; Karvonen and Heur, 2014; Voytenko et al., 2016) in nationally organised systems which have a territorial anchor, such as public transport, electricity or gas infrastructure. Subsequently, successful experiments can be up-scaled and taken up by national level actors who facilitate change processes in the operation of national infrastructure (McCormick et al., 2013). Thus, although transition initiatives start in cities, breakthrough is achieved via a hierarchical process and, consequently, the importance of local actors and city authorities diminishes over time when national level actors overtake the leading role in the expansion (scaling-up) phase (Geels, 2011).

Thirdly, city governments may have a limited role to play in transitions of nationally (or internationally) operating systems with a weaker local territorial anchor, such as food supply (Marsden, 2013) or electric infrastructure transition via the direct replacement of high-carbon power plants by low-carbon options (Bolton and Foxon, 2011). In the absence of territorial embeddedness, market dynamics (demand and supply), and national and international regulations drive and control change processes in these domains.

Geels (2011) thus considers cities as part of the national context where they are located, and contends that their role in transitions is determined by the nature and extent of the overlap between the national sectoral 'regime' and the local territorial governance (c.f. Jonas et al., 2010; McGuirk et al., 2014). Therefore, the emphasis on the national as the natural scale for sustainability transitions has not been abandoned; rather, simply the unit of analysis changed. Taking such a perspective may be beneficial for analysing how local transition initiatives facilitate change on the national scale (Hodson and Marvin, 2013) or the other way around (Hodson and Marvin, 2007) but it may be less helpful and/or insufficient to answer questions related to (1) how local transitions, which often transcend sectoral boundaries, unfold in different places or (2) the ways in which these can be supported by city authorities or other local actors (Bulkeley et al., 2011; Quitzau et al., 2013; Raven et al., 2012). Consequently, it is not surprising that research in the urban studies literature (mostly informed by human geography in contrast to the innovation studies inspired socio-technical transitions perspective) paints a rather different (and potentially more nuanced) picture of governing sustainability transitions in cities both in terms of focus, approach as well as methodology.

4.2.3 Urban infrastructures and the low-carbon transitions

Due to the critical role played by the development and technological advancement of infrastructure systems in processes of urbanisation and, consequently, of the sustainable future of cities, both academic research (Bulkeley et al., 2014; Eames et al., 2013; Monstadt, 2009, 2007; Rutherford and Coutard, 2014; Swilling et al., 2013) as well as urban climate change action 'on the ground' (Castán Broto and Bulkeley, 2013) focuses mainly on the sustainable transformation of urban infrastructures. Influenced by historical studies of technology and research on large technical systems (LTS; (Coutard et al., 2004; Hughes, 1987; Mayntz and Hughes, 1988), an overwhelming majority of this body of work takes a socio-technical perspective and argues that the obduracy of these systems stems from the existence of socio-technical regimes (Bulkeley et al., 2011; Monstadt, 2009). Infrastructure regimes have been defined as

> *'relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies'* (Smith et al., 2005, p. 1493).

This conceptualisation of infrastructure change over time, in line with the socio-technical transitions studies and the multi-level perspective, emphasises the punctuated equilibrium model of transitions. In contrast, studies influenced by the concept of 'urban metabolism' (Kennedy et al., 2011; Kennedy and Hoornweg, 2012; Swyngedouw and

Heynen, 2003) see urban infrastructures as vehicles for the mediation of socio-ecological flows in the city. Due to such a focus on the dynamics of continuous in-and-out flows of capital, energy, materials, people, waste and so on, this strand of research interprets the transformation as a continuous and cyclical process (Hodson et al., 2012). It stresses that apparent periods of equilibrium are, in reality, results of cyclical reproduction and, thus, are open to contestation. According to this perspective:

> *'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'* (Bulkeley et al., 2011, p. 5).

This perspective opened up a research field on urban infrastructure transitions which questions the linear model of change occurring through a shift from one state of equilibrium to another. Instead, this interpretation acknowledges that in the context of complex and interconnected urban systems, transitions may be more fluid, contested and partial than what the more technology-oriented accounts assume (Bulkeley et al., 2011; Monstadt, 2009). Consequently, it allows for a richer understanding of the causes, processes and outcomes of urban transformation processes, as well as the means through which these are or can be achieved. By doing so, studies informed by this perspective aim to build a conceptualisation of

> *'cities and infrastructure that recognizes their mutual constitution and the inherently political nature of networked urban infrastructure'* (McFarlane and Rutherford, 2008, p. 363).

This development in the literature is important, because it signals a tendency to move away from the traditional, technology-focused interpretation of transitions and provides opportunity for enquiry into the role of social and institutional stability and change in sustainability transitions in cities, and the ways in which these are influenced by context-dependent factors.

4.3 GOVERNING LOW-CARBON TRANSITIONS IN CITIES

Discussions about the role of cities in mitigating the causes and adapting to the effects of global climate change started emerging from the 1990's, mostly in response to the Bruntland Report prepared by the WCED (see Section 4.2.1). This prompted a large body of empirical work which aimed at developing knowledge about the ongoing efforts to respond to climate change in various geographical locations (Betsill, 2001; Bulkeley, 2010; Bulkeley and Betsill, 2005, 2013; Castán Broto and Bulkeley, 2013; Smith and Lenhart, 1996); the options for the sustainable development of cities and the tensions between urbanisation and its environmental consequences (Campbell, 1996; Hopwood et al., 2005; McGranahan and Satterthwaite, 2014; Pugh, 2013; Satterthwaite, 1997; Williams, 2010); and more recently, the sustainable, low-carbon transformation of urban socio-technical systems (Bulkeley et al., 2011, 2015; Hodson and Marvin, 2010; Nevens et al., 2013; Quitzau et al., 2013; Rutherford and Coutard, 2014). The majority of this work shares the assumption that the interrelated and overlapping issues of climate change, sustainable development and low-carbon transitions represent a complex set of problems characterised by uncertainties related to lack of universally accepted knowledge about the nature of the problem, the possible solutions and consequently, the actions to be taken. Moreover, the literature also recognises that the related coordination processes take place in a multi-level context through processes and institutions operating at and between a variety of geographical and organisational scales (Bulkeley and Betsill, 2013; 2005), involving a wide range of actors with different levels and forms of authority, responsibility and potential (Bulkeley et al., 2015). Nevertheless, different research strands emphasise distinct ways of acting upon the difficulties posed by climate change, sustainable development and low-carbon transitions in the context urban governance. These diverging approaches can be mapped through the theoretical lenses used to discuss the different perspectives on governance networks in Chapter 3. The following sections will link the theoretical perspectives to currently unfolding network governance processes in the context of the urban governance of sustainability, including governing via transnational municipal networks (integration theory; Section 4.3.2); governing by experiments (governmentality theory; Section 4.3.3); mediating urban sustainability transitions (interdependence theory; Section 4.3.4); and managing transitions (governability theory; Section 4.3.5).

4.3.1 Governing via Transnational Municipal Networks (TMNs) – The integration perspective

Efforts aimed at developing collective solutions to the challenges posed by climate change have primarily focused on international negotiations between nation states in the context of the 'Conferences of the Parties' (COPs) to the United Nations Framework Convention on Climate Change (UNFCCC) held yearly since the mid 1990's. Despite the dominance of the COPs in negotiating climate change action, the potential for coordinating reforms on the local level has already been recognised in 1992 at the Rio Earth Summit (or UN Conference on Environment and Development), the 'birthplace' of the UNFCCC itself. Chapter 28 of the Agenda 21 (United Nations, 1992), developed through the negotiations on the Conference, called for the formation of '*processes to* *increase the exchange of information, experience and mutual technical assistance among local authorities*' (Objective 28.5), and for the creation of local agendas (LAs) to build an understanding of how sustainable development can be achieved locally (Betsill and Bulkeley, 2006). Nevertheless, local action was pushed to the background until the 2009 COP held in Copenhagen, where the parties (nation states) failed to negotiate a successor for the Kyoto Protocol expiring in 2012 which was the first legally binding emissions reduction framework adopted in 1997. The consistent failures of annual meetings of the parties to negotiate a new scheme up until 2015 contributed to the development of widespread local commitments and action, as well as the growing acknowledgement of the key role of the sub-national level in the multilevel context of sustainability governance. Subsequently, at the 16th session of the Conference of the Parties (COP 16) in Cancun, Mexico, local authorities were recognised as governmental stakeholders in global climate action (ICLEI, 2012). The 2015 Paris Agreement (adopted by COP 21 in Paris) reaffirmed the role of cities and regions in climate change mitigation as well as adaptation by pointing to the importance of scaling up local (urban or neighbourhood) initiatives; maintaining and promoting cooperation between local level actors to mitigate emissions; and that of building resilience and reducing vulnerability by adapting to the adverse effects of climate change (United Nations, 2015b).

Parallel to the growing consensus of the potential benefits as well as the necessity to take action locally, a number of pioneering cities located mostly in North America and in Europe started initiating local climate change responses from the early 1990's. Recognising the limitations of local authorities in governing climate change through isolated initiatives, pioneers on the climate change issue began forming transnational municipal networks (TMNs) from the early 1990's (Andonova et al., 2009; Bulkeley et al., 2003; Bulkeley, 2010; Kern and Bulkeley, 2009; Toly, 2008). Such networks served to share knowledge and experience; to develop new initiatives through collaboration; and to better represent local interests in global international negotiations (Hakelberg, 2014). TMNs (1) are collaborative arrangements of member cities which are autonomous and free to join or leave the network at any time; (2) represent a form of self-governance as they are organised internally in a non-hierarchical and polycentric way based on horizontal relations; (3) directly affect local decision-making through the implementation of decisions agreed upon within the network (Kern and Bulkeley, 2009).

The first wave of transnational municipal networks includes such well-established organisations as the "Cities for Climate Protection" (CCP; within the frames of the International Council for Local Environmental Initiatives, ICLEI); “Climate Alliance”; “Energy Cities”; and Eurocities. These pioneer TMNs helped to raise awareness, to gather information and knowledge, to identify common goals and to provide space for sharing experience (Bulkeley, 2010; Bulkeley et al., 2012; Bulkeley and Betsill, 2005). More recently, a second generation of TMNs started emerging from the early 2000's. Bulkeley (2010; c.f. Kern and Alber, 2009) argues that there are three major differences between the approach and structure of the first- and second-generation networks, including

1. *the changing relationship with national governments:* many of the new networks are now nationally organised or have country-specific sublevels (e.g. CCP), and engage in discussion with the state governments;
2. *the mobilisation of new actors:* collaboration between public and private actors within the frames of TMNs became a wide-spread practice (for example, the C40 Cities Climate Leadership Group's co-operated with Microsoft to find a solution for the problem of GHG emissions accounting at the urban scale);

3. *and the emergence of new grassroots initiatives:* increasing citizen participation in climate change responses contributed to a shift towards a more bottom-up approach (e.g. Transition Towns network, local smart city initiatives).

Such developments, together with a broader participation of cities on the global level in TMNs (most initiatives now have thousands of members from across the world), and the increasing number of networks signal a growing importance of the local (urban and regional) level within the multilevel governance of sustainability (Betsill and Bulkeley, 2006; Hakelberg, 2014; Keiner and Kim, 2007). TMNs have been found to make a significant impact on local climate change policy formulation and implementation (Bulkeley et al., 2003; Kern and Bulkeley, 2009), albeit their degree of influence shows considerable variation between different regions and between smaller towns and world cities (Toly, 2008).

The emergence and spread of transnational municipal networks represent examples of processes which are best described through the lenses of integration theory (March and Olsen, 1995). An overwhelming majority of them started to develop in a bottom-up way through municipal actors realising their interdependencies rendered visible by the desire to realise common goals (through knowledge and experience sharing, setting up and delivering common initiatives as well as lobbying). Patterns of interdependence and collaboration were not ‘given’ (established exogenously) at the start of the process. Actors joined (and keep joining) TMNs on a voluntary basis because they perceived it to be beneficial to take part in order to deliver on their own ambitions and goals. Moreover, the institutional context which emerged through the international negotiations between nation states also encouraged cities to participate (Anguelovski and Carmin, 2011).

4.3.2 Governing by experiments – The governmentality perspective

A substantial body of literature developed since the early 2000's which investigates urban responses to climate change based on work done mainly by British geographers (Bulkeley, 2010; Bulkeley et al., 2011; Bulkeley and Betsill, 2013; Bulkeley et al., 2015; Kern and Bulkeley, 2009). This strand of research takes a bottom-up perspective through exploring and describing emerging empirical phenomena in cities. Thus, the core interest of scholars has been to build a knowledge base of climate change policies and action being undertaken in cities in practice; to seek explanations for the development of certain responses through analysing the global and local conditions; and to uncover the underlying issues of why urban initiatives have often failed to live up to the ambitions expressed initially (Bulkeley, 2010; Bulkeley et al., 2015).

Empirical investigations of governing the sustainable development of cities in the context of climate change and carbon control found that local authorities employ a range of strategies and methods to mitigate carbon emissions from various sectors, including self-governing (cutting emissions directly caused by the municipality); provision (shaping local practices through providing or supplying particular services or resources); regulation (based on traditional local state authority); enabling (facilitating and encouraging action in the private sphere); and partnerships (co-producing initiatives with other stakeholders) (Betsill and Bulkeley, 2007; Bulkeley et al., 2011; Bulkeley and Kern, 2006). Studies have found that despite such wide-ranging options to intervene, a systematic approach to implementation was often lacking. In practice, urban climate change responses tended to develop on an ad-hoc basis when windows of opportunities emerged, opposed to strategic and planned approaches integrated across relevant spheres of action (Castán Broto and Bulkeley, 2013; Nagorny-Koring and Nochta, 2018).

Consequently, empirical observations led scholars to acknowledge the role of such 'piecemeal' responses ('experiments') in the process of urban climate change governance, and this project-based approach was conceptualised as a specific mode of governing through an ongoing, unfolding and heterogeneous set of processes described as 'governing by experiments' (Bulkeley et al., 2015; Evans et al., 2016; Nagorny-Koring and Nochta, 2018; While et al., 2004).

The proliferation of the voluntarist, largely piecemeal approach to govern climate change in cities can be explained by a variety of reasons. First, it is extremely difficult to predict what effects the global phenomenon of climate change will have locally and, therefore, considerable uncertainty exists around the pace and form of necessary transformations (Bulkeley, 2013; Bulkeley et al., 2015). This situation is further complicated by several issues with regard to measuring actual local carbon emissions (Khan, 2013). Second, increasing fragmentation in the multilevel governance context results in the multiplication of policy vacuums which provide space for the emergence of governing experiments that are driven by the '*opportunities for developing new sources of legitimacy, finance and moral authority'* (Bulkeley et al., 2015, p. 18). Third, budgetary and personnel constraints in the current era of austerity politics contribute to the emergence of an opportunistic case-by-case approach (Bulkeley and Castán Broto, 2013). Fourth, municipalities' capability to facilitate integrated and planned approaches is limited due to lack of authority and weak institutional and financial capacity (Khan, 2013). Fifth, in today's globalised economy, principles of economic growth and attracting investments often override low carbon priorities (Bulkeley, 2010).

Bulkeley et al. (2014) argue that this fragmented urban response to climate change does not mean the lack of 'governing'; rather, experimentation as a mode of governing is considered an appropriate and legitimate answer due to having the highest potential to bring about change in the social and material reality of the city in an organic, messy way in response to the unstructured and complex problems of sustainable urban transformations:

> *'the transformative potential of experiments relates to the enfolding of socio-spatial relations of power within experiments, the ways in which they reconfigure existing assemblages to entrain different socio-materialities and ecologies, their circulatory capacities in relation to wider circuits of urban metabolism, the extent to which they give rise to new forms of practice and its reproduction, and the ways in which they establish new norms in relation to climate governmentalities'* (Bulkeley et al., 2015, p. 246).

Here, experimentation must be considered as a strategic and purposive mode of governing (Broto and Bulkeley, 2013; Bulkeley et al., 2014) which serves to develop new socio-technical configurations with new sources of legitimacy and authority (Hoffmann, 2011) as opposed to being ad hoc, improvised or simply coincidental (Bulkeley et al., 2015; Nagorny-Koring and Nochta, 2018). From a governmentality perspective (Foucault, 2009; 1991), experiments provide space both for the assembling and trialling of new governmental rationalities and for the development of techniques and practices through which the novel rationality is produced, made visible and sustained (Bulkeley et al., 2015; Murdoch, 2000). A governmentality theory-informed approach thus acknowledges that issues of defining what the notion of 'sustainability transition' means in any given city, constructing appropriate solutions and acting upon them constitute a set of interconnected processes (Bulkeley et al., 2015). Issues requiring intervention (i.e. the 'objects' to be governed)

> *'are identified [...] through processes that constitute the object itself – how it is understood, delineated and related to other objects'* (Lockwood and Davidson, 2010, p. 391).

Consequently, the approach sees little or no potential for 'governing' sustainability and low-carbon transitions in cities in the traditional sense of the word associated with strategic interventions in any specific site or scale. Rather, by accepting Foucault's (2009, p. 20) proposition that '*the future [...] is not exactly controllable, not precisely measured or measurable*', it emphasises the role of creating fields (or programmes) of intervention through processes of experimentation which provide space for developing '*particular forms of urban climate governmentality*' (Bulkeley et al., 2015, p. 42). In turn, specific local climate governmentalities (either directly or indirectly) contribute to the emergence of self-organising networks of actors for the delivery of sustainability transitions in cities.

4.3.3 Mediating urban low-carbon transitions – The interdependence perspective

Hodson and Marvin (2010) share the view that self-organisation is a key characteristic of the development of urban transition networks but, at the same time, take a more explicit interest in how networks involved in the governance of low-carbon transitions of urban socio-technical systems are constituted through a series of interactions, often facilitated by 'intermediary organisations' (Hodson et al., 2013; Hodson and Marvin, 2012; 2010; Kivimaa, 2014; Moss, 2009). Proponents of this approach contend that intermediation among conflicting interests, as a form of steering interaction processes, is crucial in enhancing the success of experimentation (Bush et al., 2017; Hamann and April, 2013; Hodson and Marvin, 2012; McCormick et al., 2013; Moss, 2009). Intermediaries can take up various forms (e.g. public-sector agencies, NGOs, utilities, ESCOs, etc.), may operate in and between various levels of government connecting diverse spheres (e.g. production and consumption, policy making and implementation, the production and application of visions of 'sustainable futures, etc.), sectors (e.g. housing and energy, energy and transport, etc.) and arenas of decision-making (Hodson and Marvin, 2012; 2010). Their common characteristic is that they operate in 'structural holes' (Ahuja, 2000; Carlsson and Sandström, 2008; Newig et al., 2010), bridging scarcely connected actor groups (knowledge and/or action systems; Cash et al., 2002) through brokerage and 'boundary management' (Warner et al., 2010; Williams, 2002). Thus, the role of intermediaries is to '*facilitate relationships between key actors and enable sharing and pooling of knowledge'* (Bush et al., 2017, p. 138) and resources to build local capacity for action. It has been proposed by Hodson and Marvin (2010) that intermediary organisations' capability to act largely depends on the specific resources available to them, including financial and human resources, established powers, appropriate (internal) organisational structures and cultures, relevant knowledge base and competence among staff, platforms for communication and opportunities for developing local / contextual presence and visibility. Previous research also acknowledged that intermediaries do not operate in vacuum; rather, they are part of a network of organisations and, therefore, interaction patterns within the network influence their possibilities for intermediation. In practice, the multilevel governance context which creates the space and necessity for boundary management also constrains the potential of intermediaries to successfully manage conflicts and, consequently, to steer transition processes. Thus, the embeddedness of the intermediary organisation in the fragmented multilevel governance landscape results in a situation where its potential to facilitate effective boundary management is dependent on the governance system in which it operates and which it aims to change (Bush et al., 2017; Hawkey et al., 2013; Hodson and Marvin, 2010).

An explanation for the emphasis on the need to build local capacity for governing transitions may be derived from two interconnected characteristics of this strand of studies. Firstly, the intermediation perspective in urban low-carbon transitions originated from research which focused explicitly on sector-specific change and, in particular, the energy infrastructure. Secondly, it was developed through empirical studies mostly from the United Kingdom, where electricity and gas networks have traditionally been centrally organised; therefore, the issue of decentralisation as a result of new technologies resulted in a transition environment characterised by conflict between the dominant sector-specific constellation of actors, artefacts and institutional framework operating on the national level and the cross-sectoral territorial interests involved in the governance of transitions on the sub-national (urban and regional) scale. Consequently, underlying logic for stressing the importance of conflict resolution, and the need for intermediaries in supporting that process, comes from the central assumption that transition experiments carried out in and by cities contribute to a shift in terms of relations between the nationally organised 'energy regime' and the emerging new urban governing arrangements, potentially leading to the rescaling of energy governance. Thus, a strong parallel can be drawn between the intermediation perspective on urban sustainability transitions and the interdependence perspective on governance networks, informed by historical institutionalism.

4.3.4 Managing transitions – The governability perspective

As discussed in Chapter 2, Transition Management (TM) has been developed to offer a new social coordination mechanism capable of rendering sustainability transitions governable. Thus, it represents a further step towards a strategic, coordinated response to the urban challenges posed by global climate change relative to the 'governing by experiment' and 'governing by intermediation' approaches. TM has originally been developed through national level case studies with a sector-specific focus (e.g Avelino, 2009; Frantzeskaki et al., 2012; Loorbach and Rotmans, 2010; Vinnari and Vinnari, 2014), but has recently become subject of growing interest on the local level (Loorbach et al., 2016; Næss and Vogel, 2012; Nevens et al., 2013; Quitzau et al., 2013; Roorda and Wittmayer, 2014; Wolfram and Frantzeskaki, 2016). Three separate -but interconnected- processes can be identified which contribute to the increasing local attention directed at TM, including the rising importance of the low-carbon transition agenda in international climate change negotiations; the strengthened profile of cities in the multilevel context of sustainability governance; and the pressure to 'do more with less', both in terms of minimising costs as well as maximising impacts of low-carbon activities in an era characterised by austerity politics (Nagorny-Koring and Nochta, 2018). Influenced by such processes, nowadays many local authorities are searching for innovative governance models with the explicit aim to enhance the efficiency of low-carbon experimentation processes in order to deliver on their sustainability ambitions and emissions reduction targets (Khan, 2013).

Rescaling transition management to the urban setting is still 'work in progress', but empirical work on governing low carbon transitions in cities and the subsequent acknowledgement of the role of experiments in transformation processes opened up a possibility to connect and tailor TM to the urban scale. Whereas experimentation was conceptualised as resulting from a predominantly self-organising activity of stakeholders and interested actors in the ‘governing by experiment’ and ‘governing by intermediation’ approaches, in TM it is viewed as part of a transition management cycle (see Section 2.4.2) which connects different governance tasks associated with short (operational), mid- (tactical) and long-term (strategic) goals and with their evaluation (reflexive) (Kemp et al., 2007; Loorbach, 2010, 2007). Thus, as claimed by TM scholars, experiments must be selected intentionally, on the basis of careful evaluation with regard to their potential to contribute to overall strategic goals and their fit to identified (tactical) pathways (Rotmans et al., 2001). As a result, the task of governing low-carbon transitions in the urban context is understood as the strategic steering, fostering and directing of self-organisation processes. Consequently, experimentation is interpreted as a tool to control innovation trajectories with the explicit aim of achieving low-carbon development (Karvonen et al., 2014).

In order to build capacity for steering experimentation processes, attempts to tailor TM to the urban setting build on work conceptualising the contexts in which experimentation takes place as ‘living laboratories’ (Evans and Karvonen, 2011; Karvonen et al., 2014; Voytenko et al., 2016). Living labs provide space for testing innovative initiatives in real-life settings in a collaborative environment, thereby accounting for the lack of knowledge about how complex systems respond to certain changes (Evans and Karvonen, 2011). Via combining TM principles with the concept of living laboratories, Nevens and his colleagues (2013) formulated the ‘Urban Transition Lab’ (UTL) framework, where UTLs are portrayed as *'facilitated sites for creating (social) innovation and within which social change agents can initiate or inflict urban sustainability transitions.'* (Nevens et al., 2013, p. 115).

In this way, the UTL concept aims to provide a response to criticisms directed at TM which pointed out that the toolbox that it offers is too generic to be useful to support low-carbon transitions in practice. More specifically, detailed guidance is given on the ways to set up a collaborative organisation ('transition team') to undertake the role of the 'transition manager'; decide about arenas for action both with regard to their content and membership which must be based on stakeholder mapping ('instrumental actor analysis'); gradually decentralise the governance of transitions (through involving further actors to deliver transition experiments); and to monitor and evaluate the process which becomes part of the portfolio of tasks of the transition team (Nevens et al., 2013). Through such processes of collaboration and decentralisation, proponents of the UTL approach claim to shift the attention away from 'steering' transitions as it appears in the TM methodology towards a

'governance approach for the co-creation of innovative pathways and processes in a strongly reflexive manner' (Nevens et al., 2013, p. 121).

In contrast to TM and its emphasis on a hierarchical conceptualisation of scaling up pilot projects into changing whole systems (clearly derived from a sectoral focus on innovation activities), the UTL concept acknowledges the possibility of bringing about systemic change through parallel experimental processes changing different elements of city systems, as argued by urban studies scholars (Bulkeley et al., 2014). However, this comes at the expense of potentially under-estimating the role of vertical local-national-international interactions in facilitating transitions.

The above discussion demonstrates that the TM and UTL approaches see the governance of urban responses to climate change through the lenses of governability. They contend that, due to the complexities involved, sustainable city transitions must be delivered through governance networks which are self-organising within limits set by the 'transition team'. The concept of 'living laboratories' is introduced to provide an institutional context, interpreted as a set of rules, norms, roles and logics of appropriateness, in which the networks must operate. Thus, the approaches clearly emphasise coordination and collaboration as opposed to conflict as the central processes within the networks, informed by the governability perspective on network governance. Having been developed and shaped through empirical studies mainly from the context of The Netherlands, this view is largely influenced by the consensus-seeking character of Dutch decision-making processes (cf. Skelcher et al., 2013).

4.4 CONCLUSIONS: THE OVERALL THEORETICAL POSITION

This chapter gave an overview on the existing academic research discussing the ways in which transition processes unfold on the international, national and local levels; the role of cities in the sustainable transformation of societies; and the ways in which cities and local authorities attempt to govern climate change, sustainable development and low-carbon transitions locally and globally. I argued that cities are crucial sites where transition action must take place: with the majority of the world's population already living in urban settlements, any transition towards low-carbon development paths must include the sustainable reconfiguration of cities and, by extension, the urban infrastructures on which they depend. Moreover, the growing number of urban initiatives signals that the need for low-carbon innovation is increasingly being recognised by city authorities and other actors who have a stake in delivering urban transitions.

As a result, the body of literature on the potential and options for governing sustainability transitions in cities has seen a significant increase in the last decades. From a network-theoretical perspective, this work could be organised into distinct strands of research which place emphasis on different characteristics of urban transition governance informed by the theoretical perspectives introduced in Chapter 3, including integration, governmentality, interdependence and governability.

Indications for inspiration from integration theory could be found in the research on transnational municipal networks; this research strand stresses that for developing potential to govern transitions locally, cities must collaborate and 'act globally'. With regard to local action, proponents of the 'governing by experiments' approach contend that experimentation can only deliver radical change if it is left to operate as a self-steering, self-organising process. Thus, city authorities' and other actors' role in steering transitions is to promote and nurture a type of 'governmentality' around transitions which facilitates low-carbon innovation without giving it an explicit direction. Taking a step towards directly influencing sustainability transitions in cities, the 'governing by intermediation' approach emphasises the conflicts arising from shifting relations between the usually nationally organised infrastructure regimes and the urban governance networks. It stresses the role of intermediary organisations in conflict resolution and boundary management between separate stakeholders and groups, but, in accordance with the interdependence perspective on governance networks, assumes that intermediation may be undertaken by any actors who has the resources to do so. In contrast, the ‘managing transitions’ perspective assigns the role of steering urban transition processes specifically to local authorities, and calls for the establishment of spaces where networked forms of governance can emerge (i.e. transition arenas).

Despite the multiplicity of approaches appearing the literature, the empirical analyses on which these are built come mainly from the context of the UK, Western Europe (The Netherlands in particular), and to a lesser extent, the USA and Germany. This chapter demonstrated that even focusing on such a limited set of geographical locations and politico-administrative settings, distinct approaches to transition governance were identified by the existing literature on the basis of empirical research in different places. However, very few comparative studies exist which could give further information how (and why) different governing approaches develop in different cities, and what local conditions influence their development. This results from a lack of comparative analyses based on constructed (theory-driven) sampling of the cases to be compared.

The empirical research presented in this PhD thesis aims to address this gap in the existing knowledge base. It does so by providing an explicitly comparative analysis of the governance of local low-carbon transitions in three cities from three different European countries with dissimilar contextual characteristics (cf. (Klijn et al., 2013; Skelcher et al., 2013). The conceptual and analytical frameworks developed on the basis of the literature review is presented in Chapter 5, along with the research design and methodology used to assess the cases individually and through a comparative perspective.

PART II.

EMPIRICAL RESEARCH

CHAPTER 5.

CONCEPTUAL FRAMEWORK, RESEARCH DESIGN AND METHODS

5.1 OBJECTIVES AND STRUCTURE OF THE CHAPTER

This chapter provides the basis of empirical investigations presented in the second part of the thesis. It discusses the conceptual framework developed from the review of existing literatures presented in Chapters 2, 3 and 4 (Section 5.2.1) which is used to refine and unpack the preliminary research questions generated from the Climate KIC research (Pioneer Cities and Transition Cities, see Chapter 1). Section 5.3 introduces the comparative research strategy; explains how it can contribute to answering the research questions; presents the chosen approach to comparison (Section 5.3.4); and the process of case selection (Section 5.3.5). The frameworks for the analyses of the cases individually and comparatively are discussed in Section 5.4. Following on from the analytical frameworks, Section 5.5 presents the case for conducting mixed method research to respond to the research questions, before discussing the various data collection methods employed in the PhD research. Reflections on the research design and methodology, including limitations and their implications for the validity and reliability of the findings and conclusions, are included in Appendix I (pp. 333-338).

5.2 CONCEPTUAL FRAMEWORK AND RESEARCH QUESTIONS

5.2.1 Conceptual framework: bringing the literatures together

The conceptual framework, developed on the basis of the literature reviews on socio-technical transitions, network governance and urban sustainability transitions, sets the direction for the empirical research and provides answers to the first research question:

RQ (1) What is the existing knowledge base regarding the potential and problems of network governance to support the transition to low carbon cities?

The kind of information necessary to respond to this question covers the ways in which transition processes are theorised and studied; the presence of governance networks in this literature; the distinct features and characteristics of governance networks and network governance; the identification of gaps in the transition literature which can be addressed through the network perspective; and the ways in which processes of network governance and sustainability transitions unfold in cities, including the potential for local authorities to influence these.

The literature review has revealed that transition studies informed by the socio-technical perspective rely heavily on the self-organisation of networks of stakeholders in facilitating and delivering sustainability transitions (complemented with steering from 'transition managers' to influence the direction of self-organisation processes). In fact, the Transition Management (TM) approach discussed in Chapter 2, Section 2.4.2, directly addresses the issue of governing sustainability transitions via network governance. It contends that governing low-carbon transitions represents a 'wicked' (or 'persistent') problem, because it takes place in a multi-actor, multi-scale context, where the stakeholders involved hold different perceptions, and the roles and rules are unclear. Thus, building on the 'governability' perspective of network governance research, TM claims that, in such an environment, networked forms of governance provide several advantages compared to hierarchical arrangements and market-style mechanisms and have the potential to render transitions governable. Consequently, the approach emphasises the benefits that network settings can offer for the decision-making process, without sufficiently engaging with the conditions necessary for governance networks to function 'well' (cf. Lewis, 2011). This is problematic, because the wider network governance scholarship (informed by theories other than governability, including intermediation, integration and governmentality) demonstrates that the diverse governance processes related to networks cannot be fully described and understood exclusively through the lenses of governability (Chapter 3). Although an explicit focus on governance networks is still lacking from much of the literature on governing sustainability transitions in cities, the overview of this body of work (Chapter 4) has demonstrated that the different governing arrangements found in different urban settings incorporated network principles in a variety of ways, in line with the theoretical perspectives appearing in the network governance literature. The work on urban transition governance builds on a somewhat broader empirical base compared to TM, including case studies from several countries (mainly from Europe and North America), indicating that certain contextually relevant conditions may influence the ways in which opportunities for governing within and via networks arise in different cities. However, the connections between contextual factors, self-organisation processes in transition arenas, and their impact in terms of advancing low-carbon transitions, requires further investigation.

‘Context’ has been defined as the exogenous environment in which network processes take place and which reflect specifics of scale, place, politics and power. The discussion in Chapter 3 demonstrated that, in addition to the influence from the exogenous environment, governance processes in networks are also affected by rules, norms and techniques developing internally, via interactions between the actors involved in the network. These endogenous processes, in turn, may have an impact on the external environment (politics and power). Finally, in order to be able to investigate the role of governance networks in advancing low-carbon transitions, their impact on transition processes must be assessed.

Thus, the PhD study aims to prove that (1) different contextual settings give rise to distinct local experiences related to governance networks; (2) the resulting network processes can only be meaningfully described by considering the entire spectrum of network-theoretical perspectives; and (3) that these provide different opportunities for local government steering aimed at supporting local low-carbon transitions. Finally, in terms of impact, the emerging dissimilarity between governance arrangements are expected to show varying potential for speeding up urban energy transitions. The rest of this chapter presents the empirical research questions, research design, analytical frameworks and methodology used to investigate the role of network governance in low-carbon transitions using the conceptual framework discussed above.

5.2.2 Refining the research questions for empirical analysis

The research questions related to the empirical part of this study can be unpacked and refined based on the results of the literature review and the conceptual framework. Table 5.1 introduces the research questions and related sub-questions:

PRELIMINARY RESEARCH QUESTIONS	SUB RESEARCH QUESTIONS
	What collaborative urban governance initiatives can be considered as parts of the local governance network involved in governing low-carbon transitions?
(2) How can the form, extent, trajectory and impact of a city's low carbon network governance be assessed?	What are the characteristics of the local transition governance network in terms of structure, process and the actors involved?
	How did the network develop over time as a result of setting up new arenas for decision-making?
	What is the role of the local governance network in the overall governance arrangement supporting urban low-carbon transitions?
	What similarities and differences can be found between the governance networks in the different cities in terms of structure, membership, process and role?
(3) What is the comparative level of development, potential and constraint on the low-carbon network governance systems in the cities chosen for analysis?	Can any contextual conditions be identified which are universally applicable to each of the cases and can explain similarities?
	Can any conditions be identified which result in differences across the cases analysed?
	How do similarities and differences across the cases affect the options to govern local low-carbon transitions in different contextual settings?
	Based on the comparative analysis, what conditions are favourable for delivering low carbon transition via network governance?
(4) In what ways can the potential of network governance be enhanced and constraints reduced in order to facilitate delivery of low carbon ambitions?	What conditions counteract (or hinder) the delivery of low-carbon ambitions via network governance?
	How do the issues identified through the comparative analysis impact the applicability of Transition Management and the Multi-Level Perspective?
	Are there any options to extend the applicability of the concepts in order to support low-carbon transitions in different urban settings?

Table 5.1 Preliminary research questions and related sub research questions for empirical analyses

As Table 5.1 suggests, RQ nr.2 involves questions related to the individual cases and the ways in which context, governance networks and impact influence each other in different urban settings. On the basis of parallel analysis of the different cases, a comparative research strategy needs to be designed to answer RQ nr.3. RQ nr.4 and the related sub research questions are concerned with the possible generalisations and practical recommendations that can be derived from the comparative and case analyses. In conclusion, the PhD study aims to contribute to theory as well as practice, both on the level of individual cases (specific urban settings) and in a more generic sense related to the implications posed by the city scale for governing sustainability transitions via governance networks.

5.3 COMPARATIVE RESEARCH DESIGN

5.3.1 Introduction to comparative research: definitions and objectives

Comparative methodology in the social sciences is as old as the field itself; as Nowak (1989, p. 34) argues, '*[s]ociology had to be comparative, almost by definition'*. The reason for this lies in the nature of social systems: certain aspects of social phenomena are impossible to manipulate with the aim of conducting experiments and observing the consequences of the changes introduced. Consequently, comparison may be used as a viable (albeit not perfect) substitute to experimental research in such cases (Denters and Mossberger, 2006; cf. Lijphart, 1975). The comparative approach allows the researcher to analyse a particular phenomenon in multiple contexts: Bryman (2003) describes it as a 'hybrid' design consisting of "n" number of case studies or cross-sectional studies, where the minimum of "n" is two. The aim of comparing is to generate insights about empirical regularities through evaluation against substantive and theoretical criteria (Ragin, 1987), in order to be able to make distinctions between factors that are universal and those that are case-specific. Thus, the essence of comparative research is to produce ‘comparable’ data from two or more socio-cultural settings (considered in either spatial or temporal terms) by using the same research tools in a consistent way (Hantrais, 2009).

5.3.2 Varying approaches to comparison

Central problems to comparative study include the selection of cases (decisions about the units, level and the scale of the analysis), deciding about variable (quantitative) or case orientation (qualitative), constructing equivalence for comparison, and establishing a conceptualisation of causality (Mills et al., 2006). These issues are highly interconnected, and the decisions taken in relation to them delineate the position of the research on the positivist – interpretivist/constructivist spectrum. Research closer to the positivist side tends to include a larger number of cases in order to create a sound basis for statistical analysis of predefined variables, resulting in (multiple) cross-sectional research design (Hantrais, 2009). In contrast, by taking an approach which can be placed on the interpretivist/constructivist end of the spectrum, researchers usually examine fewer cases but with greater attention to details and to generating rich data. The first approach often has a focus on finding similarities (regularities) between different cases with an aim of generalising and constructing evidence for theory generation and testing; while a case study-based analysis, aided by richer contextual information, may be more adequate to uncover differences and variance and, therefore, is generally appropriate for theory building (Eisenhardt, 1989; Ragin, 1987). The most important differences in terms of typical characteristics between research approaches on the two extremes of the positivist and interpretivist/constructivist spectrum are presented in Table 5.2.

POSITIVIST (UNIVERSALIST)	CHARACTERISTIC	INTERPRETIVIST (CULTURALIST)
High (large-n studies)	**Number of cases**	Low (small-n studies)
Some form of probability sampling based on given population	**Logic of case selection**	Theory-driven, based on constructed population
Variable (statistical)	**Orientation**	Case study
Distinction between independent and dependent variables	**Concept of causality**	Complex interaction processes
Quantitative	**Type of data collected**	Qualitative
Context-free (decontextualisation)	**Concept of context**	Context-bounded
Macro	**Level of analysis**	Micro
Convergence (finding regularities)	**Logic of comparison**	Divergence (finding variance)
Deductive	**Logic of reasoning**	Inductive
Theory generation / testing	**Contribution to theory**	Theory building

Table 5.2 Characteristics of different approaches to comparative research

(Sources: Hantrais, 1999; Mills et al., 2006; Ragin and Zaret, 1983; Rose, 1991; Rousseau and Fried, 2001)

Realising both the potential and risks involved in choosing approaches on the two extremes of the positivist – interpretivist/constructivist spectrum, many studies have attempted to establish various intermediate positions (Hantrais, 1999; Lammers and Hickson, 1979; Ragin, 2006; Teune and Przeworski, 1970). These approaches express an appreciation for the complexity of interaction processes between the social phenomenon in question and the context in which it is embedded (Ragin, 2006). However, they also contend that, in real-life settings, variation in relation to certain aspects of the interaction processes is limited, enabling some modest abstraction and generalisation (Hantrais, 1999; Rose, 1991). Thus, instead of being seen as an inhibiting factor for comparison, the context here is seen as part of the explanation and an enabling tool, with the social phenomenon under analysis being understood as context-dependent rather than entirely context-free or context-bounded (Hantrais, 1999).

5.3.3 Comparative research in public policy and administration

The role of comparative research in public policy and administration (PPA) has been identified as means to acquire a

> *'broad and realistic understanding of what public administration is all about, and what explanations there are for its way of functioning, its change and its continued existence'* (Kuhlmann and Wollmann, 2014, p. 2).

Thus, to a varying degree, examples for each of the aforementioned approaches can be found in comparative research in the field. The reason for this lies in the interdisciplinary nature of PPA research, covering law-related state sciences (i.e. constitutional law and policy science) as well as social-science-oriented administrative sciences (Bogumil and Jann, 2009; Kuhlmann and Wollmann, 2014; Lijphart, 1971). Small-scale comparative research mainly focuses on specific policies or interventions in terms of process and effects, while large-n studies of comparative politics conduct comparison on the macro level, describing similarities and differences between formal-institutional decision-making structures (Kuhlmann and Wollmann, 2014; Lijphart, 1971). Due to clearly defined national borders; administrative and legal structures; and shared social and cultural norms and beliefs, the 'nation state' as unit of analysis is widely used in comparative public administration research (Hantrais, 1999). Comparison of sub-national units is less common and started gaining attention only in the last decades (Ward, 2008). It is often argued that the scarcity of sub-national comparative research is rooted in the lack of viable meso-level concepts which could guide the comparison (Kantor and Savitch, 2005). Pierre (2005) argues that the concept of 'governance' and the related 'urban governance theory' has the potential to assist sub-national comparison on the urban scale in the European context. He contends that it is generic enough to be applicable in a variety of diverse settings while also highlighting the most important

> *'changes in urban bureaucracy such as the move towards a blurring of public-private boundaries, the rise of an increasing number of governance networks, and a greater inclusion of actors other than the local state in the pursuit of community goals'* (Kjaer, 2009, p. 137).

Most scholars adopting a comparative approach to study urban politics, policy and public administration agree that the difficulty of conducting a meaningful comparison on the sub-national level lies in finding a balance between the specifics of the context and universal concepts, between '*teasing out changes in the variables identified by the analytical framework*' as well as telling a good story (Pierre, 2005, p. 456). Thus, previous work on comparative urban governance emphasises the advantages of taking an intermediate position along the positivist - interpretivist/constructivist spectrum, while also acknowledging the difficulties involved in developing such an approach (Kantor and Savitch, 2005; Pierre, 2005; Ward, 2008).

5.3.4 The PhD research's approach to comparison

Following from the recommendations of urban governance scholars, this PhD study takes an intermediate approach to comparison: on the basis of the literature review and the conceptual framework, it is expected that an empirical investigation into governance networks operating in different cities across Europe will be able to identify both similarities and differences with regard to their potential and constraints in governing local low-carbon transitions. The discussion in Chapter 3 has demonstrated that, based on the existing network governance literature, it is possible to provide a descriptive baseline account of the phenomena that can be characterised as a ‘governance network’. The underlying rationale of the comparative research is, therefore, to investigate how and to what extent the ‘context’ influences the emergence and operation of governance networks in different places, and whether this has an impact on the local potential for advancing low-carbon transitions. Following on from the logic of comparative research, similarities between governance networks in different places signal the existence of universally relevant social and/or technological developments, while differences may be attributed to conditions arising from unique local issues. The reason for this is that the context in which networks operate is, to a certain extent, influenced by both top-down and bottom-up processes. At the same time, network governance processes also have a role in the production (and re-production) of the context (Lammers and Hickson, 1979). Therefore, the analysis conducted follows the logic recommended by Smith and his colleagues (2010; see Chapter 2, Section 2.3.3) who advocate for the appreciation of complexity involved in the co-evolution of social and technical change processes. In order to be able to generate and make use of data related to the context, a small-n design with case-study orientation was chosen for the research, allowing for an in-depth investigation into complex interactions among the different elements (context, networks and impact) of the study. With regard to data collection, the research makes use of both quantitative and qualitative methods with the aim of generating a rich information base to support the conclusions. The collection of empirical data on which the present study is built has been conducted in the period between December 2015 and October 2016.

5.3.5 Case selection

The selection of cases for empirical investigation follows the concept of the ‘constructed’ (theory driven) approach, influenced by the desire to cover a wide geographic area within Europe and to explore the impact of different local contexts on generic ideas related to urban transition governance. Thus, the cases were chosen on the basis of the ‘most different cases’ approach; Bryman, (2003) situated within a common European framework. The factors that informed the case selection process included the following:

- access to information and informants;
- results of previous comparative research on national context, state traditions and historical development trajectories;
- and indicative data about the capability to govern local infrastructure transitions.

Privileged access to information and informants was secured through involvement in the Climate KIC research, and the Transition Cities (TC) project in particular, which was operational during the first two years of the PhD research. As Transition Cities involved project partners from local authorities from a wide range of European countries with different institutional characteristics, choosing such a starting point did not constrain the potential for case selection based on the ‘most different’ approach. Through the TC project meetings I had the opportunity to personally engage with the representatives of the partner cities, which facilitated interest and willingness to participate in the study. As city representatives were generally medium/high level officers from the municipalities involved in the governance of low-carbon transition in their cities, their support was instrumental in gaining access to municipal documents, meeting minutes and publications for documentary analysis as well as in setting up interviews with key local actors. Moreover, the network mapping exercise conducted for the Transition Cities (TC) project (see Chapter 1, Section 1.2) gave useful preliminary insights into local low-carbon initiatives, the stakeholders involved in delivering them, and their relationships to each other. It also contributed to narrowing down the scope of the case studies to local low-carbon transitions in the energy infrastructure (power and heat), understood as systems related to supply and demand of electricity and heat, by demonstrating that this was considered one of the key sites for intervention in the partner cities (Transition Cities, 2015). Such decentralised energy projects provide space for local authorities and other local actors to enter nationally organised energy regimes within Europe whilst also contribute to the reduction of carbon emissions.

The review of previous comparative research on national context, state traditions and historical development trajectories was used to help reveal which cities would provide the most different contexts for the case studies (Kuhlmann and Wollmann, 2014; Loughlin et al., 2011; Painter and Peters, 2010; Pollitt and Bouckaert, 2004, 2011; Swianiewicz, 2014; Wilson and Game, 2011). The idea to include all eight cities participating in the TC project was rejected due to the limitations of PhD research (individual research to be conducted over a period of three years), and to the need to produce rich data on each of the case studies in order to adequately answer the research questions. To reduce the number of cases to a manageable amount, different characteristics of the Transition Cities partners were assessed, as shown in Table 5.3. Driven by the sampling method of most dissimilar cases, characteristics related to the (national) state structure; public administrative tradition; local government legal and fiscal authority; and the capability to govern local infrastructure transitions were considered. Indicative measures were used to estimate the fiscal authority of local governments (local authority spending relative to GDP) and the capability to govern local Sustainable Energy Transitions (labelled as SET in Table 5.3; i.e. role of the local level in energy systems management).

CITY	STATE STRUCTURE	PUBLIC ADMIN. TRADITION	LG LEGAL AUTHORITY	LG FISCAL AUTHORITY	CAPABILITY TO GOVERN SETs
BIRMINGHAM (UNITED KINGDOM)	Unitary-centralised	Public interest	Weak	Moderate	Weak
BUDAPEST (HUNGARY)	Unitary-decentralised	Rule-of-law (socialist cadre administration influence)	Moderate	Moderate	Moderate
FRANKFURT (GERMANY)	Federal-decentralised	Rule-of-law	Strong	Strong	Strong
VALENCIA / CASTELLON (SPAIN)	Quasi-federal-decentralised	Rule-of-law	Moderate	Moderate	Weak
BOLOGNA / MODENA (ITALY)	Unitary-decentralised	Rule-of-law	Moderate	Weak	Weak
WROCLAW (POLAND)	Unitary-decentralised	Rule-of-law (socialist cadre administration influence)	Moderate	Moderate	Moderate

Table 5.3 Data used for case selection from the partner cities of the TC project

(Sources: Kuhlmann and Wollmann, 2014; Loughlin et al., 2011; Swianiewicz, 2014; Transition Cities, 2015; Wilson and Game, 2011)

Based on the data collected, Birmingham and Frankfurt clearly represent two extreme cases with regard to nearly all categories justifying their appropriateness in relation to the logic of 'most different' case selection. Of the remaining four national contexts, Budapest and Wroclaw stand out in terms of their public administration tradition which is still, to a certain extent, influenced by the administrative culture developed during the communist regimes in Hungary and Poland. In this case, the criterion related to ensuring access to information and informants became important, and Budapest was selected due to the researcher's knowledge of the language which facilitated data collection (cf. Hantrais, 1999). Thus, based on their differences in terms of the characteristics related to governance and energy infrastructure, the three above mentioned cities were expected to provide sufficient variation with regard to the role of network governance in low-carbon energy transitions. Thus, the cases chosen for analysis include Birmingham (United Kingdom), Budapest (Hungary) and Frankfurt (Germany).

5.4 Frameworks for analysis

5.4.1 Framework for the analysis of individual cases

The analysis of the individual cases in a comparative study can be either variables or case study oriented. Yin (2013) argues that a case study orientation is particularly suited to research if the topics involved are defined in a broad rather than a narrow sense; connections between the studied phenomenon and its context are of interest to the research; and if the study aims to draw on multiple sources and types of evidence. Thus, according to Strauss and Corbin (1998), comparative research built on multiple case studies is particularly useful in generating rich information on phenomena which are still poorly understood. The reason for this is that the available knowledge base is either insufficient to differentiate between possible independent and dependent variables or, in other cases, indicate that interactions between the phenomenon and its context are complex and unpredictable. The conditions that influence the potential for governing low-carbon transitions in European cities fall into the category of lack of evidence, as demonstrated in Chapter 4; therefore, choosing a multiple case study analysis is well justified.

According to the conceptual framework presented in Section 5.2.1, case studies need to provide an analysis of the transition governance networks operating in the different urban settings; the characteristics of the local context in which networks operate; and their impact in terms of advancing local low-carbon transitions. Structured this way, the case studies aim at answering

RQ (2) 'How can the form, extent, trajectory and impact of a city's low carbon network governance be assessed?'

Thus, individual cases are analysed using sub-cases of (1) context; (2) governance network; and (3) impact. For the assessment of the sub-cases, frameworks and recommendations of previous studies and publications were translated into the research field of low-carbon transitions. Developing an original analytical framework to guide the collection and processing of the research data was necessary due to a lack of previous research investigating the role of network governance in urban low-carbon transitions. Table 5.4 presents the elements of the analytical framework and the references which provided the basis for the analysis of the case studies.

SUB-CASES	REFERENCES	ORIGINAL DESCRIPTION OF THE ELEMENT OF ANALYSIS	TRANSLATION INTO THE ANALYTICAL FRAMEWORK OF THE PHD STUDY
CONTEXT	(Torfing, 2005; cf. Klijn et al., 2013; Kooiman, 2003; Skelcher et al., 2013)	Societal and organisational fragmentation.	Analysis of the position of actors involved in the urban governance of transitions relative to the dominant infrastructure regimes (see also Geels, 2011).
		Complexity of contemporary decision-making situations characterised by high degree of uncertainty.	Local interpretation of urban low-carbon transitions in relation to problem definition, targets and goals, and actions to be taken.
		New societal dynamics related to the shift from 'government' to 'governance'.	A historical overview of the development of the urban low-carbon agenda in relation to changing perceptions about the roles of public and private actors in the governance process.
GOVERNANCE NETWORK	(Hendriks, 2008; Klijn and Koppenjan, 2015; Lewis, 2011; Marcussen and Olsen, 2007; Sandström and Carlsson, 2008)	Network and actor analysis	Analysis of the network structure and actors involved.
		Governance processes within networks	Governance processes within the network.
		Network embeddedness in the governance arrangement	The network's role in the decision-making process.
IMPACT	(Ansell et al., 2017; Loorbach, 2007, 2010; Loorbach and Rotmans, 2010; McGuire and Agranoff, 2011; Sandström and Carlsson, 2008)	Policy formulation, i.e. the ability to make decisions.	The governance network's capability to formulate long- and mid-term policies and strategies supporting low-carbon energy transitions.
		Policy implementation, i.e. the ability to implement decisions.	The governance network's capability to turn low-carbon strategies into concrete initiatives (short-term experiments).
		Policy outcomes, i.e. the ability to make 'good' decisions.	Overall progress towards carbon emissions reduction targets.

Table 5.4 Building blocks of the analytical framework for case study analyses

Following on from Table 5.4, the framework for the case study analyses is presented in Figure 5.1.

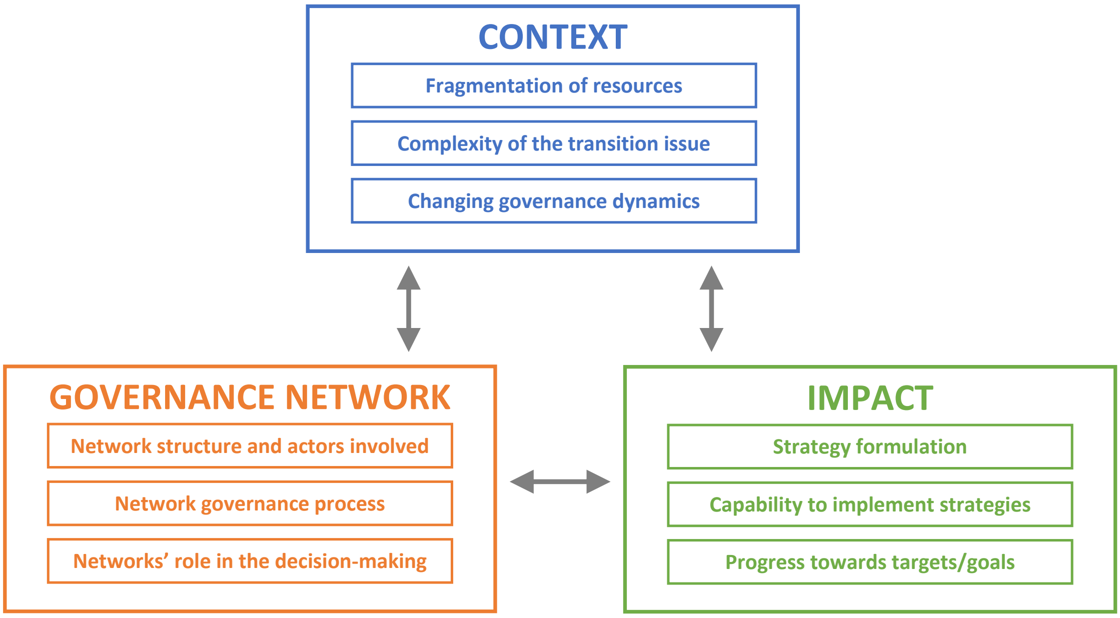


Figure 5.1 Framework for the analysis of individual case studies

In conclusion, individual cases are analysed using sub-cases of (1) context; (2) governance network; and (3) impact. Context is described in terms of factors related to (a) the fragmentation of resources between the energy infrastructure regime and the local governance system; (b) the complexity of the transition issue in terms of the state of local energy infrastructures, targets and goals to be achieved and strategies for action to achieve the goals set; and (c) changing governance dynamics related to the development of the local transition agenda and governance responses. The characteristics or local governance networks that are of interest for the comparison across cities include (a) the network structure and the actors involved; (b) the processes of network governance at play; and (c) the role of governance networks with regard to the decision-making process as a whole. The impact of governance networks within the context they must operate is assessed through the networks' potential for (a) strategy formulation; (b) implementing the agreed-upon strategies; and (c) the progress made towards achieving the local emissions reduction targets and goals in terms of infrastructure change. Thus, as discussed in Section 5.2.1, issues arising from scale, space, politics and power are divided into factors exogenous to local governance networks (context) and network-internal processes (governance network). The research acknowledges the role of contextual factors in shaping network-internal interactions. Furthermore, changes in the context resulting from network interactions are conceptualised as network impact.

5.4.2 Framework for comparative analysis

The comparative framework builds on the results from the case study analyses. It consists of three steps: first, comparison is made using the results of the assessment of the structure, process and role of governance networks involved in governing sustainable energy transitions in the different cities. The aim of comparing local governance networks along these three dimensions is to highlight similarities (or convergence) and differences (or divergence) between the ways in which they are structured, operate and contribute to the decision-making process around low-carbon ambitions. The second step involves the synthetisation of contextual factors which account for the similarities and differences found between networks. This follows from the assumption that similarities across the cases arise from the existence of 'universally relevant' factors, while differences are products of local, case-specific ones. Third, on the basis of the assessment of similarities and differences between networks and the relevant contextual factors which explain convergence and divergence, conclusions are developed in relation to impact, i.e. the networks' potential to support local low-carbon energy transitions in the analysed urban settings.

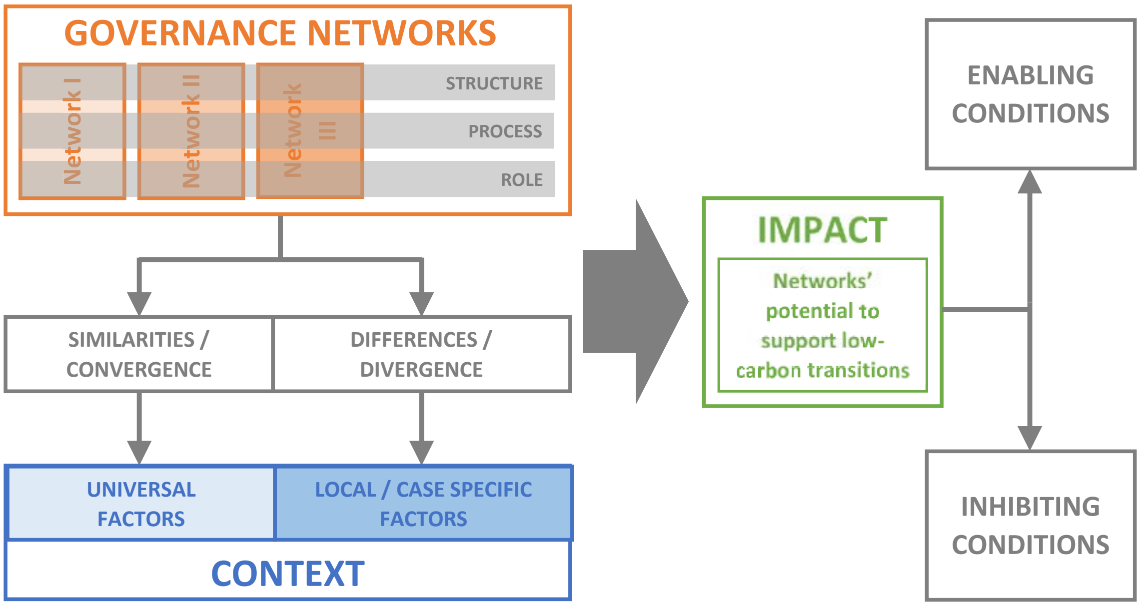


Figure 5.2 Framework for comparison across the cases

Thus, the comparative analysis presented in Figure 5.2 is designed to answer

RQ (3) 'What is the comparative level of development, potential and constraint on the low-carbon network governance systems in the cities chosen for analysis?'

Finally, the comparative analysis is expected identify specific conditions which enable or inhibit governance networks to govern local low-carbon energy transitions. On the basis of the results,

RQ (4) 'In what ways can the potential of network governance be enhanced, and constraints reduced, in order to facilitate delivery of low carbon ambitions?'

can be answered. In addition to practical recommendations on the options to improve the potential of governance networks to support low-carbon transitions, the comparative research is also expected to contribute to theory in relation to the applicability of the Multi-Level Perspective and the Transition Management concepts to the urban scale in different European cities.

5.5 METHODS OF DATA COLLECTION

5.5.1 The case for mixed methods in governance network research

Despite the potential advantages of mixed-methods studies based on both quantitative and qualitative data, Torfing and Sørensen (2014, p. 341) note that network governance research is still characterised by a '*profound lack of comparative and cross-national studies and a striking failure to combine qualitative and quantitative approaches*'. Klijn (2008) argues that the reason for this lies in the heterogeneous nature of network research in public policy and administration which encompasses multiple research traditions (see Chapter 3, Section 3.2.2) showing divergence in relation to network interpretations, their operational characteristics, roles in the decision-making process and so on. The diverse research focus in the field also led to differences with regard to research methods for studying networks in governance, referred to as 'analytical cliquishness' by Marcussen and Olsen (2007).

Geographically, there is a divide between the US and Europe - research in the United States, where the service delivery and implementation tradition has had the greatest impact, tends to be more quantitative and based on statistical and social network analysis (SNA) methods. Whereas European scholars, influenced by the traditions of policy network analysis and intergovernmental relations, are more inclined to use qualitative methods, *'emphasizing the economic and political resources that actors bring with them to networks, interdependence between network actors, as well as the larger institutional context in which network negotiation is embedded'* (Marcussen and Olsen, 2007, p. 273).

The divide in terms of conceptualising governance networks either as a phenomena worthy of investigation in their own right or merely as metaphor is also reinforced by the diverging interpretations of network connections (networks of influence versus decision-making; (Christopoulos, 2008)) and network actors (individuals versus organisations; (Lewis, 2011)). Studies into networks of influence between individuals are more likely to use SNA-related (quantitative) methods (e.g. Chen et al., 2009; Ibarra and Andrews, 1993), whilst qualitative enquiries are generally used for researching organisational networks of decision-making (e.g. Edelenbos and Klijn, 2007; Hislop et al., 2000). This is because the traditional use of SNA was restricted to the social context of individuals and their behaviours (Bergé et al., 2017) and the ways in which they influence each other. In contrast, Christopoulos (2008, p. 477) argues that

'although influence can be perceived as diffuse, decision-making is reserved for those endowed with decision authority and is therefore concentrated'.

Thus, despite the fact that in most policy contexts network actors (predominantly organisations rather than individuals) affect one another's perceptions and strategies, certain decisions can only be made by specific privileged actors.

Although much of the literature emphasises the difficulties and risks involved in mixing SNA with qualitative methods in network governance research, more recent contributions tend to point to the opportunities and benefits that a carefully formulated mixed methods research design can offer in terms of broadening the scope of network scholarship (Lewis, 2011; Marcussen and Olsen, 2007; Torfing and Sørensen, 2014). These publications stress the complementary nature of quantitative and qualitative data rather than the potential contradictions. In particular, Marcussen and Olsen (2007) argue that, by adopting a so-called ‘concurrence research strategy’, the different methods can be used to answer inherently different research questions. Consequently, by offering complementary information, different types of data may contribute to developing a more complete picture of the studied phenomenon. Similarly, Lewis (2011) emphasises the role of combining SNA data with narratives in maintaining a dual focus on structure and process in networks:

> *‘[m]ixing SNA with other methods adds the context to help interpret network data. It can also produce an outside view of network structure to add to an inside view of the content, quality and meaning of network ties. Importantly, mixing methods also provides a focus on network dynamics through mapping the evolution of network structure and also exploring the reasons for the changes’* (Lewis, 2011, p. 1229).

Lewis’s comment is particularly relevant for the PhD study. Both the conceptual and the analytical framework focused on the interplay between the network structure and the context. In addition to the possibility to investigate the relationship between structure and process, mixed methods research also provides opportunity to produce comparable data through network visualisation and analysis, and to find explanation for similarities and differences between the cases through the analysis of context. Therefore, both quantitative and qualitative data was collected to assess the network of actors involved in decision-making regarding the reconfiguration of urban energy infrastructures in the cities of Birmingham, Budapest and Frankfurt. The quantitative analysis is built on membership data of organisations (public sector bodies, companies and community/voluntary organisations) in local collaborative governance initiatives or arenas for decision-making (e.g. committees, working groups or advisory boards) operating (or in the case of Budapest, planned) at the time of data collection (December 2015 to October 2016). Qualitative data was collected from municipal documents, publications and meeting minutes on the one hand, and through semi-structured interviews with key local actors on the other. The following sections present the different methods of data collection in more detail, as well as the ways in which the information was obtained and used in the analysis.

5.5.2 Quantitative data: organisational network analysis

The structural analysis of energy transition networks in the PhD research is based on the method of social network analysis (SNA). SNA takes a relational perspective on social phenomena and presents it as a structure consisting of nodes and ties between them. Nodes may portray individual people, organisations, objects and so on, while ‘ties’ or ‘edges’ represent some form of connection between two nodes (Bergé et al., 2017; Edwards, 2010; Wasserman and Faust, 1994). These linkages are mapped through sociograms (network graphs) and are analysed using statistical methods. Network characteristics developed from statistical analysis can provide information both on the network as a whole (relational analysis, e.g. density or cohesion) as well as on the position of a particular node relative to the network (positional analysis, e.g. different types of centrality) (Burt, 1980). The explanatory power of SNA with regard to impact or outcomes lies with the different ways in which the structure enables or constrains flows of influence, information and resources (Marcussen and Olsen, 2007). For example, several studies have shown that an inverse relationship exists between network density (i.e. the proportion of possible versus present ties in the network) and potential for innovation and organisational change (Lewis and Ricard, 2014; Rowley et al., 2000).

For the purpose of the PhD study, governance networks involved in local sustainable energy transitions were reconstructed using information on the memberships of organisations (i.e. municipal departments, businesses, co-operatives, civil sector organisations, etc.) in collaborative governance initiatives, including committees, advisory boards or working groups. Initially, membership data was obtained through web searches, analysis of municipal documents, publications and meeting minutes (see Appendix II, pp. 339-343). Later on, this was revised, completed and validated via semi-structured interviews with key actors (see Appendix IV, pp. 348-351). Collaborative governance initiatives were conceptualised as decision-making arenas. This allowed for network visualisation through SNA techniques as two-mode or 'bipartite' graphs with two different types of nodes: organisations and decision-making arenas. Organisations were connected through network ties (edges) to the arenas in which they took part. Two-mode network visualisations were used to provide information on the number and size of decision-making arenas in each of the cities; on fragmentation and overlap (in terms of membership) between them; and on the types of actors involved in different initiatives.

In a second step, two-mode networks were converted into one-mode graphs by eliminating the collaborative initiatives. Connections between the remaining organisations were made on the basis of common memberships: network actors got connected to each other if they participated in the same decision-making arena(s). This way, relationships between actors and, consequently, the structure of the governance network, could be analysed directly. Basic network statistics were used to describe the whole network (size, density and centralisation) as well as certain individual actors based on the positions they occupied within the networks (degree, betweenness and closeness centrality; see Appendix V, pp. 352-363). The descriptions and details of statistical measures used in the PhD study are presented in Table 5.5.

NETWORK STATISTICS	DEFINITION	INFORMATION PROVIDED
Network size	The number of nodes in the network.	The number of decision-making arenas and of the actors involved, used as proxy for outreach to stakeholders.
Density	The proportion of ties present in the network compared to the possible total number of ties.	Overlap between decision-making arenas in terms of membership, related to the interconnectedness of the network.
Centralisation	The extent (proportion) to which one actor in the network holds all ties present in the network.	Indicates actor groups (communities) centralised around specific actors; helps to decide whether high density results from general interconnectedness, or from the presence of a few well-connected actors.
Degree centrality	The number of immediate contacts owned by any one actor, i.e. the number of ties/edges belonging to a node.	Helps to identify the most well-connected actors who are involved in multiple arenas.
Betweenness centrality	Calculated on the basis of how many times an actor (node) sits on the shortest path between two unconnected actors.	Helps to identify actors who connect separate groups and play a brokerage role in the network.
Closeness centrality	The measure of 'independence' of a node calculated from the distance between actors; actors positioned to the shortest distance to others have higher scores.	Helps to identify actors who have the greatest potential to influence the network processes.

Table 5.5 Network statistics used to analyse structural characteristics of governance networks in the different cities (Source: Prell, 2012)

The collected data were visualised as graphs using Gephi software (available from www.gephi.org). First, the membership data and certain characteristics of the organisations and arenas (nodes) were organised into Microsoft Excel spreadsheets. In a second step, the original datasets were disaggregated into two separate data files, one containing the list of nodes (arenas and organisations) and a different one which included the list of edges (connections between organisations and collaborative decision-making arenas). The lists of nodes and edges could be directly imported to Gephi to automatically generate the network graphs. The visualisation process to make the graphs more intuitive followed the technique recommended by Grandjean (2015): firstly, the 'Fruchterman Reingold' algorithm was applied to the automatically generated random graph layout which distributes nodes in a gravitational way (i.e. members of densely connected groups attract one another and repulse the rest of the network). Secondly, the 'Force Atlas 2' layout algorithm was used to spatialize the graphs and spread the groups out in order to ensure visibility (Grandjean, 2015). Nodes representing organisations were assigned different colours based on their sectoral origin (public, market or civil sector; pink, blue and green respectively). Nodes representing decision-making arenas were given a fourth colour (dark grey) to differentiate them from the rest of the nodes. In order to determine node sizes, their degree centrality measure was used as a proxy in the two-mode network. Centrality measures were calculated using the built-in statistics tools of Gephi with the exception of centralisation, which was calculated using formula Prell's (2012, p. 169). The two-mode visualisations were later converted into one-mode networks, consisting of organisations only, using the 'MultiMode Networks Transformations' plugin (available from gephi.org/plugins/#/plugin/multimode). The process of laying the network out followed the same procedure as in the case of the two-mode networks, combining the

‘Fruchterman Reingold’ and the ‘Force Atlas 2’ algorithms. Node size was determined using the betweenness centrality measure of each node.

The above described approach to network reconstruction generated comparable data across the different cities through the systematic use of the same methods and techniques for data collection and visualisation. This allowed for comparisons to be made regarding the network size, structure and the types of actors involved. With regard to the individual cases, network visualisations were also helpful in giving an overview and a baseline level understanding of the network processes at play.

5.5.3 Qualitative data: documentary analysis and interviews

The qualitative data used to describe the context of the network and the resulting network processes was obtained from multiple sources, including secondary data from written municipal documents, reports, publications and minutes from meetings of the collaborative initiatives surveyed for network analysis; and primary data generated by the researcher through semi-structured interviews conducted with key actors in the networks.

The documentary analysis was particularly useful in providing a starting point for both the quantitative and qualitative analyses, an overview of the shifting logics, policy goals and strategies related to the development of the low-carbon transition agenda in the different cities, and of related changes in terms of governance responses (i.e. the histories of network formation and change over time (Bogason and Zølner, 2007)). The majority of documents used in this study were publicly available from web databases of the local authorities; in addition, certain documents, e.g. meeting minutes, were obtained via requests from representatives of the cities in the Transition Cities project. Instead of using a systematic coding method, summaries were produced from each document in order to reconstruct the change processes in relation to the transition agendas. This approach was considered more appropriate for developing storylines and narratives from written material focusing on dynamics and change. Appendix II (pp. 335-339) contains the lists of documents collected from the different cities and analysed for the PhD research.

The information obtained from written documents was completed via interviewing key actors from the networks of each city. Respondents included actors involved in decision-making processes from the public (officers from the local authorities) and market sector (private companies) as well as community/voluntary organisations and NGOs. The type of information which I was looking for from the interviewees concerned their knowledge about local sustainable energy transitions, their involvement in collaborative initiatives and their ideas and experience in relation to the process, as well as drivers and barriers of collaborative policy making and implementation in their respective cities. An initial round of pilot interviews was conducted with city representatives involved in the TC project. These are listed in the List of interviewees (Interview 1.01, 2.01 and 3.01; see also Appendix IV, pp. 348-351). They were summarised in the same way as the subsequent main interviews and are similarly referenced in the case studies Pilots were also used to refine the preliminary list of interview questions and finalise the standard 'Interview topic guide' (see Appendix III, pp. 344-347) and to ensure that the concepts and wordings used in the questions were understandable to municipal officers working in the different urban settings and language contexts.

The interview topic guide, developed this way, was sent out prior to the interviews to all potential respondents via e-mail (see Appendix III, pp. 344-347). Further interviewees beyond the TC city representatives were identified in two ways: based on the results of the network analyses (central actors according to degree and betweenness centrality) and via snowball technique (i.e. the last question of every interview was about asking recommendations for potential further interviewees). Informed consent was obtained via the ‘Interview participant information sheet’ and an ‘Interview topic guide’ with the initial invitation for interviews. Invitations were sent via emails, and respondents were asked to confirm their availability for the interview. Positive response emails were archived as proofs of consent.

The interviews were semi-structured with only open-ended questions asked (Van Thiel, 2014, p. 94); between 9 and 13 interviews were conducted in each city. The interviews, with four exceptions, were recorded (subject to verbal consent at the beginning of each interview) and summaries were produced from the recordings. Responses to certain questions were fully transcribed if they were deemed to contain essential information for the study. In the cases of Interviews 1.01, 1.06, 2.01 and 3.01, the interviewees wished not to be recorded. Therefore, rich notes were taken during the interview which were subsequently written up in the same format as the summaries from the recordings. One interviewee wished to respond to the questions in writing (Interview 2.08); in this case, the written responses were used to produce the interview summary. Appendix IV (pp. 348-351) contains the lists of respondents and their affiliations.

Interview summaries were coded and analysed using specialised software (NVivo). Coding was developed to collect information and comments related to the following characteristics of network governance in the three cities: collaboration context description, constraints, drivers, within-municipality collaboration, local energy policy narrative, energy transition impact, stakeholders and summarising quotes. The interview data was used to triangulate, validate and complement the information collected via documentary analysis. It was particularly helpful with regard to reconstructing the development of the local sustainable energy agenda; evaluating the role of decision-making arenas in the transition governance processes; assessing the content of relationships between actors involved in the network; and gaining information on the impact of networking processes in relation to the outcomes (strategies and sustainable energy projects).

5.5.4 Reflections on reliability, validity and generisability

Reliability, validity and generisability are central concepts both in quantitative and qualitative research. Reliability broadly refers to the repeatability of the research and the findings and requires consistency within the employed analytical procedures, whereas validity considers the legitimacy of the connection made between the research findings and the conclusions drawn from these (Morse et al., 2002). Generalisability refers to the opportunities and limitations for deriving some form of universal knowledge from a particular research. In this study, reliability was ensured by combining secondary and primary data sources, using multiple sources where these were available, following standard procedures described above in the construction of both the quantitative and the qualitative parts of the research, as well as in interpreting the results. In terms of validity, two key questions were considered. First, establishing some form of objectivity in terms of seeking to distance the personal views and beliefs of the researcher in the process of deriving conclusions from the findings. Second, aiming to ensure the consistency of the understandings of concepts related to network governance theory across different cities and language contexts. This was especially important in order to fulfil the aim of the study: to highlight differences in terms of governance network structures and processes caused by variance in specific contextual conditions. Thus, generisability was considered in terms of attributing certain network governance outcomes to particular combinations of contextual conditions. Further information and reflections on the theoretical and methodological choices made in the study are included in Appendix I (pp. 333-338).

5.6 SUMMARY AND CONCLUSIONS

Opening up Part II (Empirical research) of the thesis, this chapter connected the results of the literature review to the empirical research through introducing the conceptual and analytical frameworks, research design and data collection methods used in the PhD study. On the basis of an extract of the discussions presented in the chapter, the research was granted full ethical approval by the Humanities & Social Sciences Ethical Review Committee (reference number: ERN_14-1456). The following three chapters included in Part II analyse the state of network governance relevant to low-carbon energy transitions in the cities of Birmingham (United Kingdom; Chapter 6), Frankfurt (Germany; Chapter 7) and Budapest (Hungary; Chapter 8). The comparative analysis of the cases, as well as the conclusions drawn on the basis of the results, form part of Part III (Chapters 9 and 10, respectively).

CHAPTER 6.

CASE STUDY 1.

ENERGY TRANSITION IN BIRMINGHAM

6.1 INTRODUCTION

6.1.1 Objectives and structure of the chapter

This chapter aims to address the second research question:

RQ (2) How can the form, extent, trajectory and impact of a city's low-carbon network governance be assessed?

It answers this question in the setting of the city of Birmingham, United Kingdom, by providing an overview of the contextually relevant conditions in which the governance network operates (Section 6.2); assessing the network characteristics (Section 6.3); and by evaluating its impact on advancing the local sustainable energy transition (Section 6.4). A diagram of the structure of Chapter 6 is shown in Figure 6.1.

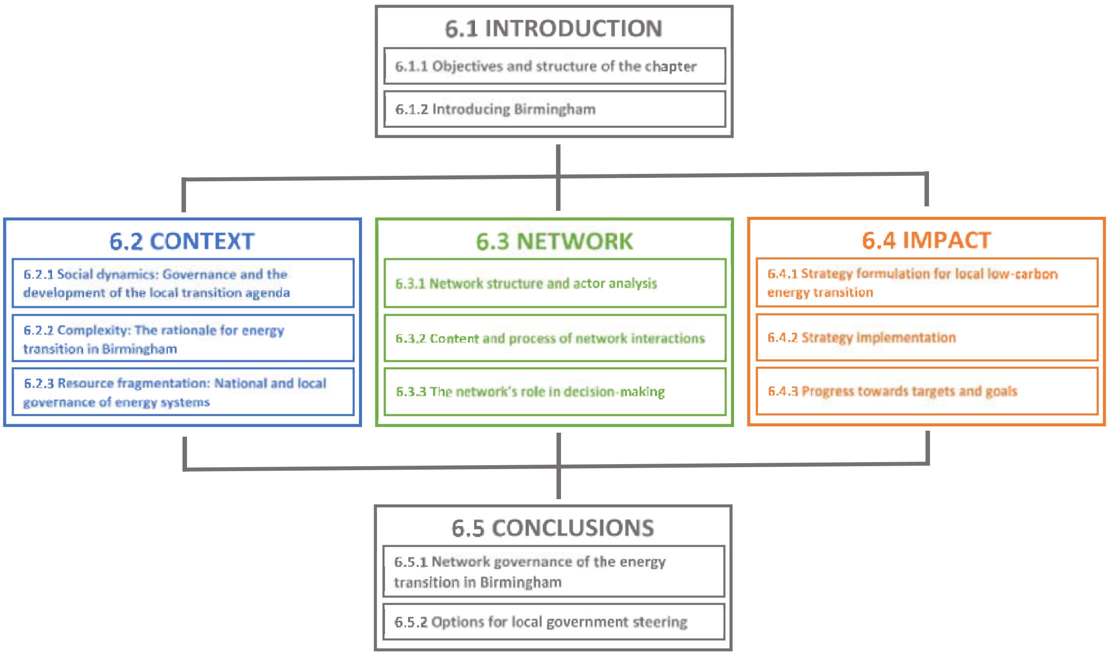


Figure 6.5 Diagram of the structure of Chapter 6 (Case Study 1. Energy transition in Birmingham)

The conclusions of the case study are presented Section 6.5 which is divided into two sub-sections. First, the operation of the governance network relevant to governing the local energy transition in Birmingham is described, through the lenses of normative integration, interdependence, governability and governmentality. This is based on the discussion presented in Chapter 3, Section 3.3. Second, building on the description of the network, I discuss the options available to the local government to steer the network processes.

6.1.2 Introducing Birmingham

Birmingham is the United Kingdom's second largest city after London. The city is a major transportation hub, located near the geographic centre of England. It is a regional centre for employment, business, industry, education, culture and leisure. The average age of the city's population is among the youngest in the whole of Europe and it is one of the most ethnically diverse among the cities of the United Kingdom (BCC, n.d.).

Table 6.1 presents generic statistical data about the city's population, size, its economic output and carbon emissions, compared with Budapest and Frankfurt.

CITY	COUNTRY	POPULATION[1] (2015)	AREA[2]	DENSITY[3] (2015)	PER CAPITA GDP[4] (2014)	PER CAPITA CO2 EMISSIONS[5]
BIRMINGHAM	United Kingdom	1 107 677	268 km^2	4152/km^2	25 500	4.4 t (2014)
BUDAPEST	Hungary	1 757 618	525 km^2	3349/km^2	38 900	4.7 t (2014)
FRANKFURT	Germany	717 624	248 km^2	2924/km^2	88 600	9.8 t (2013)

Table 6.1. Generic statistical data, Birmingham

[1]Source: Eurostat 'Population on 1 January by broad age group, sex and NUTS 3 region' in total number (available from http://ec.europa.eu/eurostat/data/database)

[2]Source: Eurostat 'Area by NUTS 3 region' in square km (available from http://ec.europa.eu/eurostat/data/database)

[3]Source: Eurostat 'Population density by NUTS 3 region' in inhabitants per km^2 (available from http://ec.europa.eu/eurostat/data/database)

[4]Source: Eurostat 'Gross domestic product (GDP) at current market prices by NUTS 3 regions' in Purchasing power standard (PPS) per inhabitant (available from http://ec.europa.eu/eurostat/data/database)

[5]Sources: BuCC, 2016; FCC, 2015; HM Government, 2016a

Birmingham was one of the seedbeds and centres of the industrial revolution: during the 19th century 'golden age' the city became referred to as the 'Workshop of the World' and the 'City of a Thousand Trades'. Some of the most significant discoveries of the era originated from Birmingham, including gas lighting and the steam engine. In turn, the highly uneven distribution of the benefits resulting from the fast economic growth led to a multiplicity of social movements aimed at improving the living conditions of industry workers.

Under the mayoralty of Joseph Chamberlain from the 1870's the city became one of the most influential models for 'municipal socialism' (Gehrke, 2016). The Council led by Chamberlain carried out a variety of civic improvements related to clean water and gas infrastructure, libraries, parks and access to schools and education for the public (Elementary Education Act 1870). From the 20th century, the wars fuelled the booming of arms and munitions manufacturing. Due to its military importance, Birmingham was heavily bombed during the Second World War. Post 1950, engineering and motor vehicle industry took up and provided employment for the continuously growing city. Global economic changes from the 1970's however made their mark on the local economy, and the decline of the British manufacturing sector resulted in extremely high levels unemployment (above 25% and 200 000 jobs at the worst times; BCC, 2008).

Consequently, in the last decades, Birmingham's leaders have been focusing on 're-inventing' the city and finding ways to bring back the prosperity and the world-leading role in innovation it once occupied (BCC, 2002). Large-scale regeneration projects started from the 1990's which generated growth in the conference and hospitality sector and, subsequently, brought retail sector investment to Birmingham (Be Birmingham, 2007). Ultimately, the developments succeeded in facilitating a move away from industry-based local economy to services and finance, and provided opportunity for the City Council and its partners to include sustainability in their programme (BCC, 2002).

6.2 THE BIRMINGHAM CONTEXT FOR ENERGY TRANSITION

6.2.1 Social dynamics: The historical development of the transition agenda and associated governance responses

Leaders of Birmingham reacted quickly to the developments of the early 1990's when the issue of sustainability first gained global attention. Led by a Labour administration at the time, the City Council placed sustainable development on its agenda and started working on making the city 'cleaner, greener and safer' (BCC, 2002). However, in the past twenty-five years the attention and resources provided for advancing sustainability within the City Council fluctuated, mostly following changes on the political level. From 2003, Labour lost control and the leadership of the Council fell onto a Conservative – Liberal Democrat coalition. Only nine years later, in 2012, was Labour able to take back overall control. Parallel to the changes in politics, responsibility for the issue of sustainable development shifted between governments and partnerships on different political-geographical levels. Figure 6.2 presents the main organisational bodies and collaborative initiatives set up over the past 25 years.

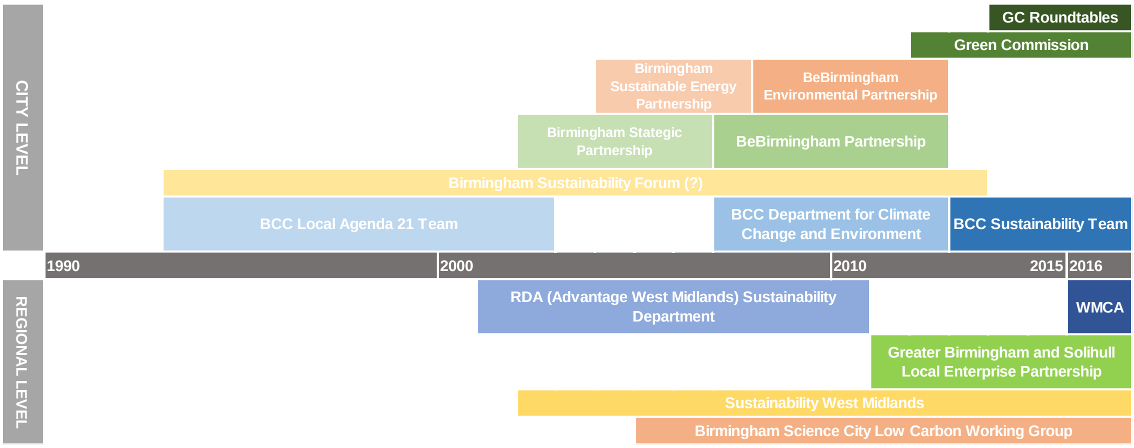


Figure 6.6 Timeline of organisational change in Birmingham's sustainable development leadership

In the beginning of the 1990's, a Local Agenda 21 Team had been set up within the City Council. The Team was made responsible for developing the local agenda for sustainable development. Having been produced via participation and citizen engagement through a series of 'Sustainability Forum' events, Birmingham's 'Local Agenda 21' (LA21) was published in 1997. The Forums provided opportunity for discussion between the public sector, interested organisations and citizens on priorities for local action to achieve sustainable development (BCC, 2002). Following the LA21, a variety of other sustainability-related municipal documents were produced in a similar manner, such as the 'Sustainability Strategy and Action Plan' and the 'Best Value Performance Plan', signalling the City Council's commitment to make progress on the issue. During this time, sustainability was interpreted in a broader sense including all interventions aimed at regenerating, rebranding and reinventing the city. The key themes of action revolved around social issues (education, healthcare and access to green spaces), waste management, improving safety across the city and making local governance more transparent, democratic and participative (BCC, 2002).

In 2003-2004, as a result of changes on the political level, the Local Agenda 21 Team within the City Council was abolished as a result of lack of political leadership (Interview 5, 2016). Public sector responsibility and ownership of the sustainable development issue was transferred to the regional level and was overtaken by the 'Sustainability Department', part of the newly established Regional Development Agency (RDA; in Birmingham: Advantage West Midlands; AWM). The regional development agencies were non-departmental public bodies charged with developing 5 to 10 years Regional Economic Strategies in their regions, coordinated by the Central Government ("Regional Development Agencies" n.d.). The RDA network was later abolished, and all agencies closed down by 2012.

Citizen engagement in urban sustainability issues continued locally through the establishment of the City Strategic Partnership (CSP), supervised by Advantage West Midlands and Birmingham City Council. The City Strategic Partnership had a role in supporting locally driven projects in areas such as regeneration, skills and training and business support (Be Birmingham, 2007). The CSP later become known as the Birmingham Strategic Partnership (2004), and evolved into the Be Birmingham Partnership in 2007 (Be Birmingham, n.d.).

On the regional level, Advantage West Midlands created 'Sustainability West Midlands' as a regional forum for collaboration to achieve sustainable development in the region (SWM, n.d./a). SWM is still operational in the form of a not-for-profit company and provides services and consultancy for local authorities in the West Midlands. More recently, the organisation also has also had a role in supporting the region's Local Enterprise Partnerships (including the Greater Birmingham and Solihull LEP) and the West Midlands Combined Authority (WMCA) (SWM, n.d./b). WMCA has officially been established in 2016 through a devolution deal developed via discussions between the West Midland region's nineteen local governments and three local enterprise partnerships and the Central Government (WMCA, n.d.).

In 2005, Birmingham was designated to be one of the six 'Science Cities' in England. The Science City initiative, set up by the National Government, aimed at promoting science and technology driven innovation for economic growth (BSC, 2015). Science City groups provide space for intersectoral cooperation between public sector, research and industry. The Birmingham Science City (BSC) alliance operates on the regional level, similarly to Sustainability West Midlands. BSC has a dedicated working group for developing and supporting innovative low carbon pilots and projects (BSC Low Carbon Working Group) with a diverse membership including universities, local authorities, businesses and voluntary organisations (BSC, n.d.).

Progress and successes on the regional level inspired Birmingham City Council, led by a Conservative-Liberal Democrat coalition at the time, to re-establish a sustainability department. The Department for Climate Change and Environment was set up in 2007 (Interview 5, 2016), led by the then Deputy Leader of the City Council, Cllr Paul Tilsley. During the same period, the focus and responsibilities of the Birmingham Strategic Partnership started shifting towards a more clearly defined interpretation of sustainability, as the previously established Birmingham Sustainable Energy Partnership, tasked with ensuring the delivery of the city's carbon reduction commitments towards the Central Government (20% CO_2 reduction from 1990 levels by 2010; 80% CO_2 reduction from 1990 levels by 2050; and 30% CO_2 reduction from housing from 1995 levels by 2010; BSP, 2007), was merged into the Birmingham Strategic Partnership (BSP). As a result of a variety of similar changes, an umbrella organisation was created in 2007-2008 called the ‘Be Birmingham Partnership’. Be Birmingham’s responsibilities included agenda setting as well as funding allocation (BEP, 2010) with a focus on promoting working across silos to better address local problems (Interview 5, 2016). Structurally, the umbrella organisation was made up of thematic sub-partnerships, as shown on Figure 6.2.

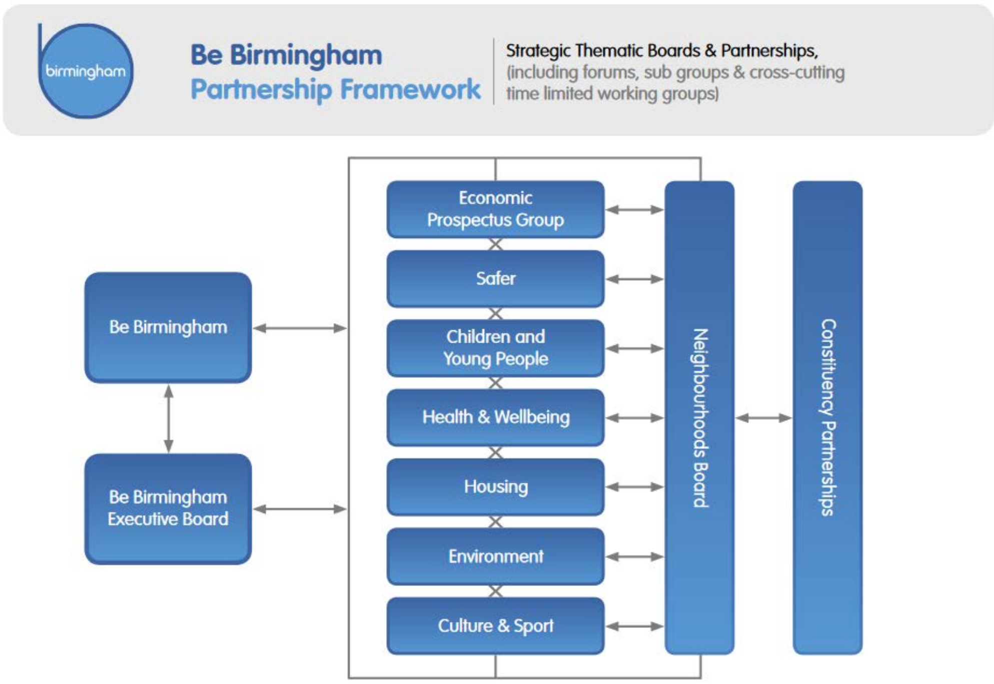


Figure 6.7 The organisational structure of the Be Birmingham umbrella partnership

(Source: bebirmingham.org.uk)

The sub-partnerships were set up as multi-sectoral collaborative initiatives with the aim of achieving more efficient resource allocation locally (Be Birmingham, 2007). Funding was provided through the Central Government’s Neighbourhood Renewal Fund (NRF). The NRF was a financial aid scheme aimed at achieving targets around crime, employment, health, education, the local environment and poor housing in deprived areas (Clarke et al., 2015). Sustainability was included in the portfolio of the Environment sub-partnership (BEP – Birmingham Environment Partnership). The BEP built on already existing community initiatives aimed at making the city ‘cleaner and greener’, and brought them together with businesses (through the Chamber of Commerce) and academia (Interview 5, 2016). The BEP had a significant budget which had to be used to support small-scale, community-led projects (Interview 5, 2016).

In 2008, when the Birmingham Sustainable Energy Partnership got merged into Be Birmingham, it became part of the Environmental Sub-Partnership, facilitating a shift regarding BEP’s main objectives (Interview 8, 2016). Consequently, BEP’s role has been redefined to include issues of promoting low carbon economy; ensuring progress on carbon reduction commitments included in the Local Area Agreement of Birmingham (LAA); increasing resource efficiency and reducing waste; preparing climate change adaptation strategies; promoting infrastructure development (energy, water and wastewater); and protecting biodiversity and green spaces (Be Birmingham, 2010). Figure 6.4 shows the organisational chart of BEP. Later on, the partnership was also made responsible for achieving the 60% carbon emissions reduction target by 2026, a commitment which was made by the City Council (and, in particular, Paul Tilsley) in the ‘Sustainable Community Strategy: Birmingham 2026’ (Be Birmingham, 2008).

Figure 6.8 The organisational structure of the Birmingham Environmental Partnership

(Source: Be Birmingham, 2009)

In 2009, Birmingham joined the Covenant of Mayors and prepared a 'Sustainable Energy Action Plan 2005-2020, which was to provide '*a guide and some general boundaries for a more detailed look at implementation*' (BCC, 2009a, p. 5).

Political changes around 2010 on the UK national level (from Labour Government to Conservative-Liberal Democrat Coalition) and in Birmingham's Local Authority (from Coalition Government to Labour Administration) triggered structural changes on the regional and local levels: the RDAs and the funding streams associated with them were closed and abolished by 2012 (Clarke et al., 2015). The combination of a range of factors (i.e. decrease in interest in low-carbon development in Central Government opposed to increase in Local Government; funding cuts; and the closing-down of supporting regional administrations) resulted in a view among Birmingham's leaders that targets and actions needed to be revised, and the organisational structure for sustainable development had to be reconfigured. Consequently, BeBirmingham was abolished, and the responsibilities of the BEP were transferred to the strategic level by setting up a new 'Green Commission', led by the 'Cabinet Member for Sustainability' (Cllr Lisa Trickett) and administered by the 'Sustainability Team' within the Council, the successor of the 'Department for Climate Change and Environment'. The Green Commission was given the role of a strategic advisory body for Birmingham City Council on issues related to sustainable development. In contrary to the Partnerships the Green Commission have not received direct funding. Work in the Commission started with reviewing the carbon reduction target: as a result of consultations with the Central Government's Department of Energy and Climate Change (DECC), the CO_2 reduction target was modified to fit the National Carbon Budgets (60% by 2027; GC, 2013a). Plans for pathways to achieve the target were drawn up in collaboration with stakeholders; the results were published in Birmingham's 'Low Carbon Roadmap' (GC, 2013b). Based on the core themes identified by the Roadmap, several thematic working groups ('Roundtables') were set up, including Green Growth, Buildings & Efficiency, Energy & Resources, Transport & Mobility and Natural Capital & Adaptation (GC, 2013b). The role of the Roundtables was to ensure and oversee the implementation of the Low Carbon Roadmap.

At the same time, the structural hole which has been created in the regional administration has been partially filled by the establishment of 'Local Enterprise Partnerships' (LEPs), set up in 2011 by the Central Government. Many of the responsibilities of the RDAs were transferred to the LEPs. The LEPs are collaborative organisations with local authority and business representation, responsible for deciding local priorities for investment in assets such as roads, buildings and facilities and to develop 'Enterprise Zones' (HM Government, 2015). Enterprise Zones (EZs) are areas dedicated for regeneration to deliver economic growth. The Greater Birmingham & Solihull LEP's major project is overseeing the development of the Birmingham City Centre Enterprise Zone which is expected to increase Birmingham's economic performance by over £2 billion per year (GBS LEP, 2016). The LEP structure, which includes several local authorities from the areas around the city, has made its impact on the Green Commission (GC): from 2014, the GC includes members outside of Birmingham related to the Greater Birmingham and Solihull LEP, extending its focus from the city level to the 'functional economic area'.

In an attempt to fill the structural vacuum and re-install regional governments in England, the UK Central Government has offered regions the opportunity to set up combined authorities and negotiate 'devolution deals' from 2011. Combined authorities are legal structures formed by two or more collaborating local authorities (HM Government, 2016b). Birmingham is part of the West Midlands Combined Authority (WMCA) which has officially been set up in 2016. WMCA includes nineteen local authorities from the West Midlands region, as well as three Local Enterprise Partnerships. The identity of the directly elected Mayor of the WMCA -Andy Street, the former chair of the Greater Birmingham and Solihull LEP- illustrates well the influence of the LEPs in the Authority. Specific tasks and responsibilities of the Combined Authority were still under discussion at the time of data collection, including the region's devolution deal with the Central Government. Sustainability West Midlands and Birmingham Science City are involved in the discussions around the Combined Authority's role in the region's low-carbon development.

6.2.2 Complexity: the rationale for energy transition in Birmingham

The United Kingdom, similarly to Birmingham on the city level, is generally considered one of the pioneers of early efforts to introduce the issue of sustainability to its political agenda. In fact, the country was among the first European states to produce a

‘Sustainable Development Strategy’ in 1994. Initially, under the Conservative Government of John Major, the UK’s sustainability strategy focused on findings ways to better include environmental factors in the existing policy making and implementation frameworks (Russel, 2007). Despite the early enthusiasm, evaluations conducted in subsequent years concluded that the new initiatives and strategies remained on the periphery of government activities, largely due to the lack of high-profile political support (Jordan, 2002). Later on, under the successive Labour Governments in the period 1997 – 2010, the scope has been extended to include a wider set of changes along the social and economic dimensions. Consequently, the notion of sustainable development has been reframed putting greater emphasis on integration and collaboration vertically, between government levels and horizontally, between the public and private/third sector (social dimension); clear commitments to control and reduce greenhouse gas emissions (environmental dimension; e.g. Energy White Paper 2007; Climate Change Act 2008); and on making the business case for low-carbon transitions (economic dimension; e.g. Stern Report 2006; Green Deal; support for community energy) (Hargreaves et al., 2013; Meadowcroft, 2005; While et al., 2010). Recent Conservative-led Governments have appeared to prioritise the economic dimension in terms of achieving sustainability through facilitating a shift towards ‘green economy’ and ‘green growth’ within a broader framework of comparatively higher levels of engagement with the market sector (Apostolopoulou and Adams, 2015; Wanner, 2015).

This fluctuation in terms of direction, together with various waves of restructuring public sector activities in the last few decades, has meant that roles and responsibilities with regard to sustainable development -both between the public and private sector as well as within particular organisations- remain unclear and change frequently. Within the central administration for example, the sustainability issue first belonged to DEFRA (Department for Environment, Food and Rural Affairs) until 2008, when DECC (Department of Energy and Climate Change) was established to oversee the implementation of the Climate Change Act 2008. A few years later in 2014, DECC got merged into BIS (Department for Business, Innovation and Skills), creating a new department called BEIS (Department for Business, Energy and Industrial Strategy), whose wide portfolio, as a result of the merger, includes leading the political and administrative agenda on business, industrial strategy, science, innovation, energy, and climate change.

Thus, it is rather unsurprising that the political commitment and seemingly broad support for sustainable development is at odds with implementation (Russel, 2007). In fact, successes achieved in terms of decarbonisation in practice are largely attributable to shifting the focus of the economy from industrial production and manufacturing to finance and services and to improvements in the electricity system (Foxon et al., 2009). Besides the reluctance of the public sector to lead sustainability transitions, further barriers to change specific to the energy sector include early market liberalisation in key sectors (e.g. electricity and gas infrastructure); asset privatisation (e.g. power plants); the unbundling of infrastructure ownership, management and energy supply (e.g. National Grid; private energy supply companies); centralised infrastructure architecture (optimised for large-scale energy generation); and access to fossil fuels (e.g. North Sea oil and gas) (Hawkey et al., 2013; Winskel, 2007). Thus, the large-scale investment needed to either change the grid architecture to be able to accommodate small-scale production, or to replace the large power plants running on fossil fuels with more environment-friendly technologies, is considered unjustified by the main stakeholders in the fully liberalised environment of the energy market.

Furthermore, the access to fossil fuels has resulted in a very different historical dynamic of narratives of energy production and supply compared to countries which were reliant on import to satisfy their energy demand (for example, Germany). In contrast, the parallel processes of growing energy consumption and declining domestic production have only recently arrived to a turning point: the county has become a net importer of hydrocarbons from 2005 (IEA, 2012). Therefore, concerns over the security of supply attracted the attention of only a small fraction of the population, and the ideational context around energy autonomy and around the necessity to switch to renewables to achieve independence is rather undeveloped in UK. The combination of the absence market (lack of a business case to switch to renewables due to high costs involved) and social (lack of wide-spread concern over energy security) pressures resulted in the outcome that sustainable development is mainly considered through the lenses of ideology (Interview 1.05, 2016). In the British political environment dominated by regular shifts between the Conservative and Labour parties characterised by largely opposing ideologies and perspectives on the welfare of citizens, this is highly problematic: despite a broad consensus on long-term carbon emissions reduction goals, not much progress has been made with regard to developing more detailed strategies (pathways) on how to achieve these and to bridge the gap between policy making and implementation.

The processes discussed above have significant consequences for the rationale and complexity of energy transition in Birmingham. First, the narrative based on the idea of ‘green growth’ is dominant locally, similarly to the national level. Consequently, sustainability transitions are mainly considered in an indirect way, to be achieved through green economic development based on low-carbon innovation. Birmingham's recent history gives a partial explanation for this: in the light of the decline of the British manufacturing sector and its consequences for the city's economy in the 1980's and 1990's, the sustainability discourse is seen as an opportunity to re-invent Birmingham and bring back the prosperity and the world-leading role in innovation it once occupied (BCC, 2002). Thus, economic growth delivered by low-carbon innovation is expected to '*make Birmingham more prosperous, healthier, fairer, resource-efficient and better for business'* and, consequently, enhance citizen's quality of life and well-being (GC, 2013a, p. 3). More recently, with the substitution of Regional Development Agencies by Local Enterprise Partnerships, the emphasis on green economy has been further strengthened due to the LEPs' role in allocating European and national development funds (GBS LEP, 2016).

Second, the issues pertinent to the national level related to the lack of political and administrative leadership are characteristic features of the local authority as well. There appears to be a high-level albeit superficial political commitment to sustainability due to the championship of the Deputy Leader of the previous Conservative-Liberal Democrat and the establishment of the role of 'Cabinet Member for Sustainability' in the current Labour administration (Interview 1.01, 2015; Interview 1.05, 2016). However, consensus across the different parties and among party members has not been achieved, undermining the possibilities of the sustainability champions to influence decision-making. This is further complicated by a lack of support from senior officers from the executive branch of the Local Government (Interview 1.05, 2016). Continuous cuts to budget and personnel in the recent years and the historical hierarchical-dependent relationship between Local Authority and Whitehall departments have both contributed to an organisational culture which prioritises the delivery of core services as opposed to broadening the portfolio of tasks, for example with energy infrastructure management (Interview 1.12, 2016; Interview 1.03, 2015). Thus, the Sustainability Team of the Municipality has to rely on external stakeholders to make the case for low-carbon transitions towards other departments within the Council.

The involvement of actors external to the Local Authority, often experts from industry with vested interest in the energy sector, leads to considering a third feature of the local energy transition rationale. The development of local agendas and, through this process, finding ways to involve local level actors (the Local Authority, small businesses and community energy cooperatives) in the wider organisational landscape of energy is highly problematic. One reason for this is that energy supply in the UK is dominated by the 'Big Six', i.e. six large multinational companies who together own over 80% of the energy market and generate three quarters of the energy needs of Britain according to Ofgem statistics (Ofgem, 2015). Furthermore, the regulation and operation of energy systems is also administered on the national level (Hodson and Marvin, 2010). These system characteristics contribute to path dependency in the reorganisation of energy supply and grid operation, because local actors do not get a voice in the related decision-making processes; profit-sensitive international corporations have considerable lobby powers towards national government, delaying or inhibiting any major transformation in supply structures; and, consequently, engaging in collaboration with local authorities with weak or no powers at all is not a priority for the main stakeholders. This situation potentially leads to difficulties in coordinating the development and delivery of local low-carbon energy agendas, as local governments have little leverage over the available partners (often multinational corporations) who possess the required technical and economic capabilities to assist in implementation (Webb et al., 2016).

Despite the high risks involved, Birmingham City Council established a target which exceeds the national level commitments: it aims to reduce emissions by 60% by 2027 (GC, 2013a). According to the recently completed 'Birmingham Carbon Plan Analysis' (GC, 2013c), the national decarbonisation efforts would only result in an approximately 40% emissions reduction. Thus, local action is necessary to cover the remaining 20% (GC, 2013c). The 'Birmingham Carbon Roadmap' (GC, 2013b, p. 6) proposed that the key areas of focus should include Buildings & Efficiency; Energy & Resources; Transport & Mobility; Natural Capital & Adaptation; and Catalysing Green Growth & Behaviour. However, no specific targets were developed for the thematic areas and, thus, the Roadmap can only be considered as a collection of ideas rather than a coherent plan which assigns responsibilities and ensures progress (Interview 1.09, 2016). The role of the Green Commission, set up to develop and oversee the city's low-carbon development is similarly unclear:

> *'The problem with the Green Commission is that it doesn't really have clear responsibility or authority; it's an advisory board. And, at the moment it's a bit of a 'talkshop': lots of good ideas are being talked about, but implementation is a shortcoming.*' (Interview 1.02, 2015)

Integrating efforts on different levels of government is hindered by the lack political and administrative leadership to advance low-carbon transitions on the national level; the structural hole in regional administration created by the abolishment of RDAs and the still currently unclear role of the WMCA; the continuously changing public sector organisational landscape; and the longstanding hierarchical relationship between the local and national administration levels reinforcing a particular silo mentality:

> *'[B]ecause it's a big area, the council exists in silos. And actually, our national government exists in silos. That has some implications for everybody doing that work and not just the Council (...). I think we are still trying to break that down as a city, because ultimately, transition requires you to focus on the place. (...) [T]his is an area, it has this housing need, the jobs are this, they're located here, you are looking at everything (...). You shouldn't really be doing anything that exists in its own bubble, but (...) that way of working still persists, partly because Whitehall in central government is siloed, and partly because we have followed, because that's where our money comes from.*' (Interview 1.12, 2016)

Partly as a result of difficulties with collaboration within the public sector, involving external stakeholders has traditionally been considered both as a necessity and an opportunity, focusing on the potential positive impacts:

> *'If you build good working relations with actors, it makes collaboration a much more positive process. It also, I think, makes people bring things more willingly to the table if you collaborate rather than tell them that they must do things. (...) We cannot require anymore (...) houses to be built to a certain standard. What we need to do is to work with planners, with developers, to say (...), 'this is our vision we want to build'. But we can't mandate that anymore because that has been taken away. But if you collaborate with people and have sensible discussions about where you want to go, what you want things to look like, that can also be equally productive.'* (Interview 1.04, 2016)

Despite the prevailing positive view about the effects of bringing external stakeholders to the decision-making table, an acknowledgement of the difficulties involved in trying to build connections with more powerful, profit-oriented organisations started to develop, related to potential mismatches between the interests of the City Council representing the 'common good' and those of private businesses orientated towards profit maximisation (Interview 1.06, 2016; Interview 1.09, 2016).

6.2.3 Resource fragmentation: National and local governance of energy systems

The organisation of the energy sector in the United Kingdom is highly centralised (Winskel, 2007). Local authorities have not had any role in energy supply since the nationalisation of the electricity grid in the 1940's when both the electricity and gas systems were nationalised. The UK under the Thatcher governments, has been a pioneer in market liberalisation: assets were privatised, and energy supply markets were opened up for market competition in the early 1980's. Thus, when sustainable development was first put on the international political agenda, energy systems were already operating on the basis of market competition between private energy producers and energy suppliers in the country. The role for energy policy making is retained by the Central Government, through the Department for Business, Energy & Industrial Strategy (BEIS). Both the electricity and gas markets are regulated by the 'Gas and Electricity Markets Authority' (GEMA), which operates through the 'Office of Gas and Electricity Markets' (Ofgem) and the 'Secretary of State for Energy and Climate Change' (Hassan and Majumder-Russell, 2014). Ofgem is a non-ministerial department within UK government, responsible for overseeing the everyday functioning of the UK energy market and for the protection of consumer rights by promoting and safeguarding market competition (Hassan and Majumder-Russell, 2014).

The electricity and gas grids are both highly centralised systems, consisting of high-voltage electric and high-pressure gas transmission infrastructures operated by National Grid Plc as natural monopolies, and regional distribution networks operated by several Distribution System Operators (DNOs; Ofgem, n.d.). The electric grid is composed of fourteen regional systems, operated by fourteen licensed DNOs whose ownerships belong to six companies. In the case of the gas grid, there are eight regional distribution systems, four of which are owned by National Grid (including the West Midlands gas network). The region's electricity network is operated by Western Power Distribution Plc, owned by a US corporation registered in Philadelphia. Neither National Grid (the Transmission System Operator) nor the DNOs are allowed to buy or sell electricity and natural gas. Instead, trade is organised within the frames of competitive wholesale and retail markets, dominated by six large energy supply companies (British Gas, EDF Energy, E-ON, npower, Scottish Power and SSE; UK Power, n.d.), half of which are owned by international corporations. Thus, the UK energy markets are characterised by centralised policy making authority, regulatory structure and grid architecture; the resulting domination of a small number of actors; and the extremely weak position of the local level among the actors involved.

More recently, with the development and spread of distributed generation technologies the landscape is changing, albeit very slowly. Cities such as Aberdeen, Bristol, London or Nottingham pioneered decentralised energy schemes across the UK, however, the share of decentralised generation is still under 10%; Ofgem, 2017) of the total energy demand. In Birmingham, only about 2% of the energy consumed is generated locally (Lee et al., 2016). The main energy sources in in Birmingham are gas, electricity and petroleum. Energy use in both the domestic sector and industry/commerce is dominated by natural gas, followed by electricity, whereas the transport sector uses almost exclusively petroleum products (Lee et al., 2016). Since neither electricity, gas or oil are available locally, all of these have to be imported. This means that over 98% of the energy consumed in the city is generated elsewhere (Lee et al., 2016). Thus, the actors shaping the functioning of energy systems in Birmingham operate mainly on higher levels -i.e. regional, national or international-, outside of the reach of the Local Government. Examples include BEIS, Ofgem, National Grid, British Gas, regional distribution network operators, energy power plant operators and private supply companies.

The energy generated locally is mainly produced by the Tyseley Waste Recovery Facility operated by Veolia, the City Centre District Energy Scheme operated by the Birmingham District Energy Company (owned by Engie), sewage treatment (Minworth, owned by Severn Trent Water), and solar PV installations, such as the Alexander Stadium's solar roof completed in 2005 (Birmingham Post, 2006). Furthermore, Community Energy Birmingham, a local renewable energy co-operative, has completed a number of solar PV community energy projects (CEB, 2018). The largest scale energy saving initiative in the city has been the Birmingham Energy Savers (BES) led by the Council in partnership with the energy company Carillion, designed to provide financial and professional assistance for the energy-efficient retrofit of existing buildings. Research into decentralised energy systems in carried out at universities regarding cryogenic energy storage at the University of Birmingham; bioenergy at Aston University and at Birmingham City University. A detailed overview of Birmingham's low-carbon energy initiatives is presented in Table 6.2.

TYPE OF INITIATIVE	PROJECT	ACTORS INVOLVED	ENERGY PRODUCED	RELEVANCE FOR LOCAL ENERGY TRANSITION
COGENERATION AND DISTRICT HEATING	Birmingham District Energy Scheme (large-scale CHP)	Birmingham District Energy Company (owned and operated by ENGIE – a multinational company registered in France); European Bioenergy Research Institute (Aston University)	56 GWh heat/year 51 GWh electricity/year 8 GWh chilled water/year	This is a trigeneration scheme producing heat, electricity and cooling mostly for public and commercial buildings in the city centre (including a few social housing tower blocks). The scheme currently runs on natural gas. Only recently ENGIE started to cooperate with Aston University's European Bioenergy Research Institute (also located in Birmingham) in order to find new renewable energy sources for operating the district energy networks. EBRI's Pyroformer™ technology is expected to supply the scheme with biogas in the future when the technology matures.
WASTE-TO-ENERGY SCHEMES	Tyseley Energy Recovery Facility (incineration)	Veolia Environmental Services	217GWh electricity/year 1.13% of electricity demand (app. 40 000 households)	The plant converts about 350 000 tonnes of municipal waste into electricity annually. The waste heat is not utilised: Tyseley is not a CHP scheme. Veolia has an integrated waste management contract with BCC, managed by the Fleet & Waste Management Team ending in 2019 (BCC, 2014). In 2019, the ownership of the plant will automatically be transferred to the Council.
	Birmingham Bio Power Plant (biogas production)	Birmingham Bio Power Plant Ltd, subsidiary of MWH Treatment Ltd (multi-national corporation with headquarters in the USA); Webster & Horsefall (landowner)	Biogas equivalent of 92 GWh energy/year (app. 17 000 households)	The biomass power plant is part of the planned wider 'Tyseley Environmental Enterprise District Scheme'. It uses gasification technology to produce biogas, part of which is fed into the regional gas distribution system.
	Sewage Treatment	Severn Trent Water Plc (water and sewage company of the region);	750 m^3 biogas/year (app. 4200 households)	The Minworth Sewage Treatment Facility treats wastewater using anaerobic digestion technology, which produces methane from sewage sludge. Part of the methane is used to run turbines generating electricity and heat (both to be used on site), and another part is injected into the national gas grid.
RENEWABLES (SOLAR AND WIND)	Commercial /public solar PV installations	npower (subsidiary of the German RWE); Birmingham City Council (as building owner);	100 kWh electricity/year (Alexander Stadium solar roof); 40 MWh electricity/year (Birmingham Airport solar roof)	Solar PV installations on commercial and public buildings were carried out in the early 2000's by the energy supplier npower. Energy produced by these schemes is used locally, in the building where they are located. Altogether, the contribution of these schemes to the total local consumption is negligible.
	Solar energy community schemes	Community Energy Birmingham (co-operative; previously 'Sustainable Moseley', SusMo);	<20 MWh electricity/year	CEB operates as a citizen's co-operative. Community initiatives in Birmingham started operating in the early 2000's when funding was available through the Neighbour-hood Renewal Fund. A number of small schemes were set up, mainly on community buildings (including a church, a mosque, a school, the Moseley Exchange, the local allotment's pavilion and a leisure centre).
ENERGY SAVING FROM BUILDINGS	Demonstrator scheme	Summerfield Residents Association; Birmingham City Council; Family Housing Association; Be Birmingham; Urban Living;	N/A	The Summerfield Ecovillage project was delivered through £2.7 million investment in 2006. It succeeded in providing 329 low-income owner-occupied houses with free eco installations (solar panels, super insulation and energy efficient heating); jobs as trainees for 20 unemployed people to deliver the installations; and converting six buildings into energy-efficient social housing. The Ecovillage became a 'best practice' example promoted by Eurocities and attracts visitors from across Europe.
	Assistance for energy-efficient retrofit (Birmingham Energy Savers, BES)	Carillion Plc (British multinational private company); Birmingham City Council;	N/A	On the European EPC rating scheme, 61% of Birmingham's housing stock scores as inefficient (E to G). BES was set up in 2006 as major retro-fit programme designed to improve over 60,000 houses over its lifespan, designed to take advantage of Central Government funding (Green Deal). Due to the discontinuation of the GD, BES did not achieve high results and is currently being redesigned to fit other funding sources.
ENERGY STORAGE	Local hydrogen energy storage	University of Birmingham	N/A	Demonstration project of cryogenic energy storage providing a small amount of electricity for the University's grid, with research and operation responsibilities undertaken by the Birmingham Centre for Cryogenic Energy Storage (BCCES).

Table 6.2 Low-carbon energy initiatives in Birmingham

The overview of the sustainable energy initiatives, and the actors involved, highlights the fact that energy systems governance on the level of project delivery and operation is dominated by national and multinational private for-profit companies in Birmingham. The City Council is seldom involved in the realisation of initiatives. Its role is more apparent in delivering community projects but, even in these cases, is mainly restricted to financing (i.e. providing assistance in finding Central Government or EU funding schemes which can be leveraged). Consequently, Birmingham City Council's authority appears to be limited both with regard to energy policy making and regulation, as well as project delivery and operation.

6.3 ANALYSIS OF THE TRANSITION GOVERNANCE NETWORK IN BIRMINGHAM

6.3.1 Network structure and actor analysis

Various partnerships and working groups have been established in Birmingham and in the region in the last two decades, many of which are still operational in 2016. In order to reconstruct the network of decision-making in the city, currently existing sustainability-related formal collaborative organisations have been surveyed. The collected data included information about the functioning of these initiatives, their role in the policy making process and the lists of member organisations. Table 6.3 provides basic information on the surveyed collaborative governance initiatives which have been conceptualised as arenas for decision-making related to the low-carbon development of Birmingham, with particular attention paid to initiatives explicitly aimed at tackling the issue of energy transitions. In this section, the structural characteristics of the energy transition governance network are analysed to set the scene for the following investigations into network processes and the role of the network in decision-making about sustainable energy futures in Birmingham.

Name	Date of Formation	Administrative Level	Number of Members	Description
Green Commission	2013	City	25	Advisory body to Birmingham City Council
GC Green Growth Roundtable	2014	City	21	Thematic advisory group to the Green Commission
GC Energy & Resources Roundtable	2014	City	20	Thematic advisory group to the Green Commission
GC Buildings & Efficiency Roundtable	2014	City	19	Thematic advisory group to the Green Commission
GC Transport & Mobility Roundtable	2014	City	17	Thematic advisory group to the Green Commission
GC Natural Capital & Adaptation Roundtable	2014	City	17	Thematic advisory group to the Green Commission
Sustainability West Midlands (SWM)	2002	Regional (West Midlands)	53	Not-for-profit company limited by guarantee by public organisations; regional sustainability advisor
Birmingham Science City Innovative Low Carbon Working Group (BSC LCWG)	2005	Regional (West Midlands)	37	Cross-sector network aimed at promoting science and technology driven (low carbon) innovation
Greater Birmingham And Solihull Local Enterprise Partnership (GBS LEP)	2011	Regional (Birmingham, Solihull, Southern Staffordshire & Northern Worcestershire)	18	Partnership set up by the UK Central Government to drive regional economic growth; distributing ERDF and national funds

Table 6.3 Collaborative governance initiatives (decision-making arenas) in Birmingham

The local governance network for low carbon transition was reconstructed using the membership lists of the collaborative governance initiatives presented in detail in Table 6.3. The two-mode network, showing the different organisations' memberships in decision-making arenas relevant to low-carbon energy transitions, is shown on Figure 6.5.

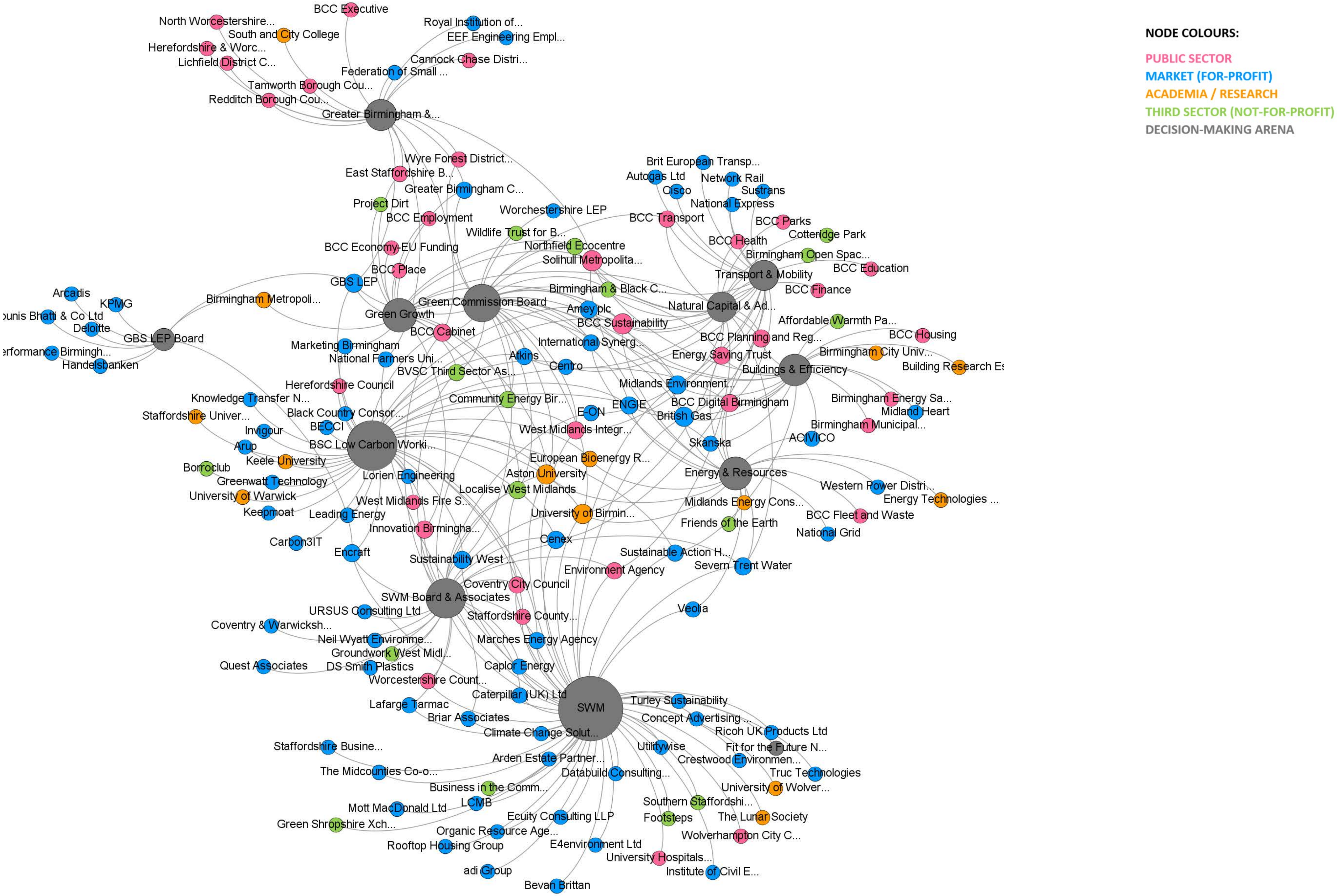


Figure 6.9 The governance network of decision-making for low carbon transition in Birmingham (two-mode visualisation)

This bipartite (i.e. constructed of two different kinds of nodes, organisations and collaborative initiatives) network is used in this study to provide quantitative data on the size of the network, referring to the number of arenas and actors involved, the overlap between the memberships of the different decision-making arenas as well as the overall connectedness in the network. The Birmingham network consists of a total of 159 nodes which are connected to one another through 263 edges, accounting for a graph density score of 0.021. This means that just over 2% of all possible connections are present in the graph, indicating a relatively sparse network structure. The low network centralisation score (0.32) signals a fairly balanced network with regard to the memberships of different arenas. Thus, although a high proportion of actors participate in one arena only, no one arena is dominating the network due to its high membership numbers.

The core of the network can be reconstructed by zooming in the actors which are involved in more than one decision-making arena and, therefore according to the network logic, are considered more influential. The core network identified this way is presented in Figure 6.6.

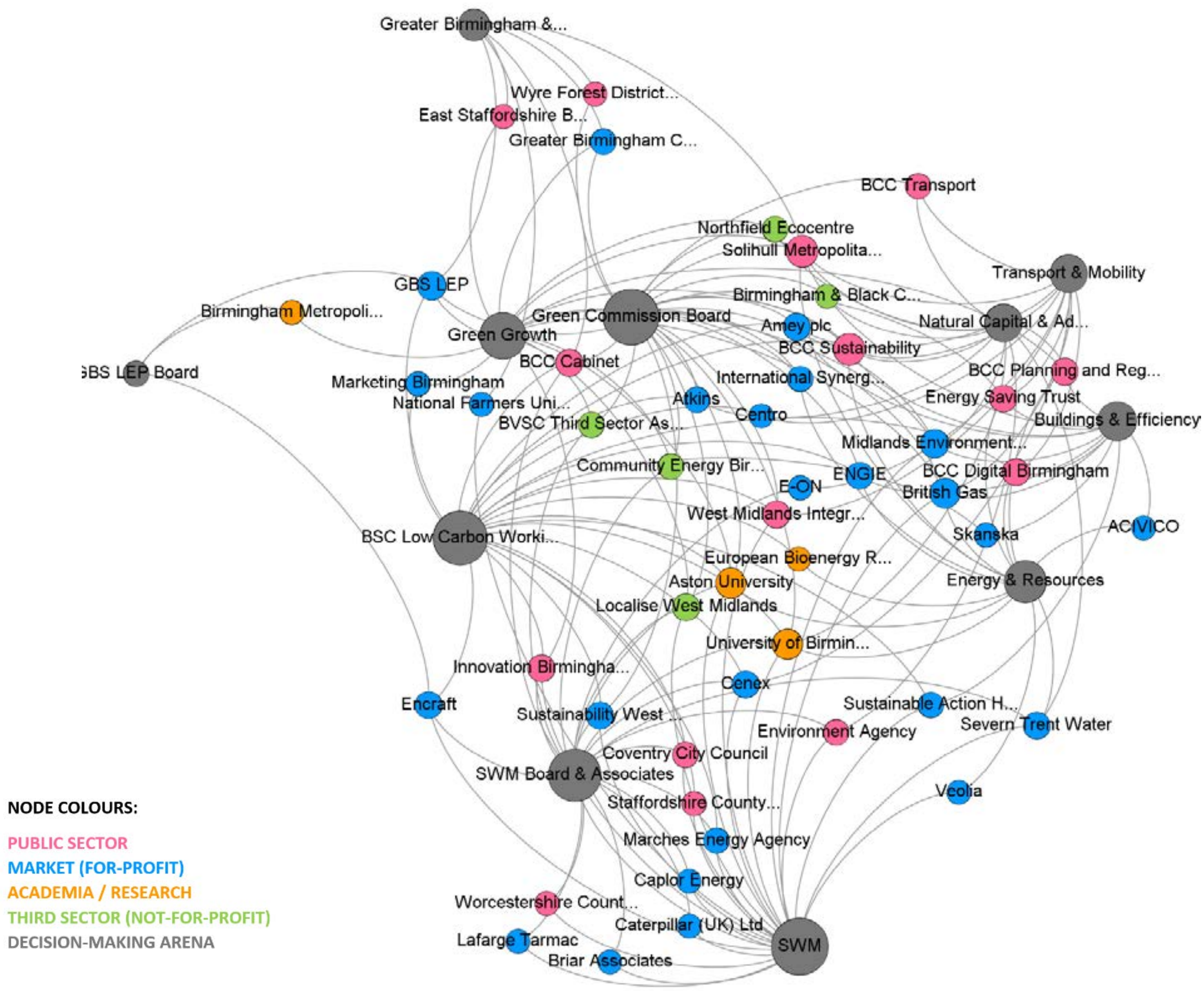


Figure 6.10 The core group of the sustainable energy governance network in Birmingham (two-mode visualisation)

The core network retains a significant proportion of the actors and edges from the whole network: it includes 49 member organisations (33% of the total of 148), the decision-making arenas, and 164 edges (62% of the total of 263). Network density increases to 9.5% from 2.1% , despite the relatively populous core compared to the entire network, while the centralisation score remains relatively low (0.32). Consequently, instead of one arena or actor dominating the network, the organisational landscape can be considered balanced.

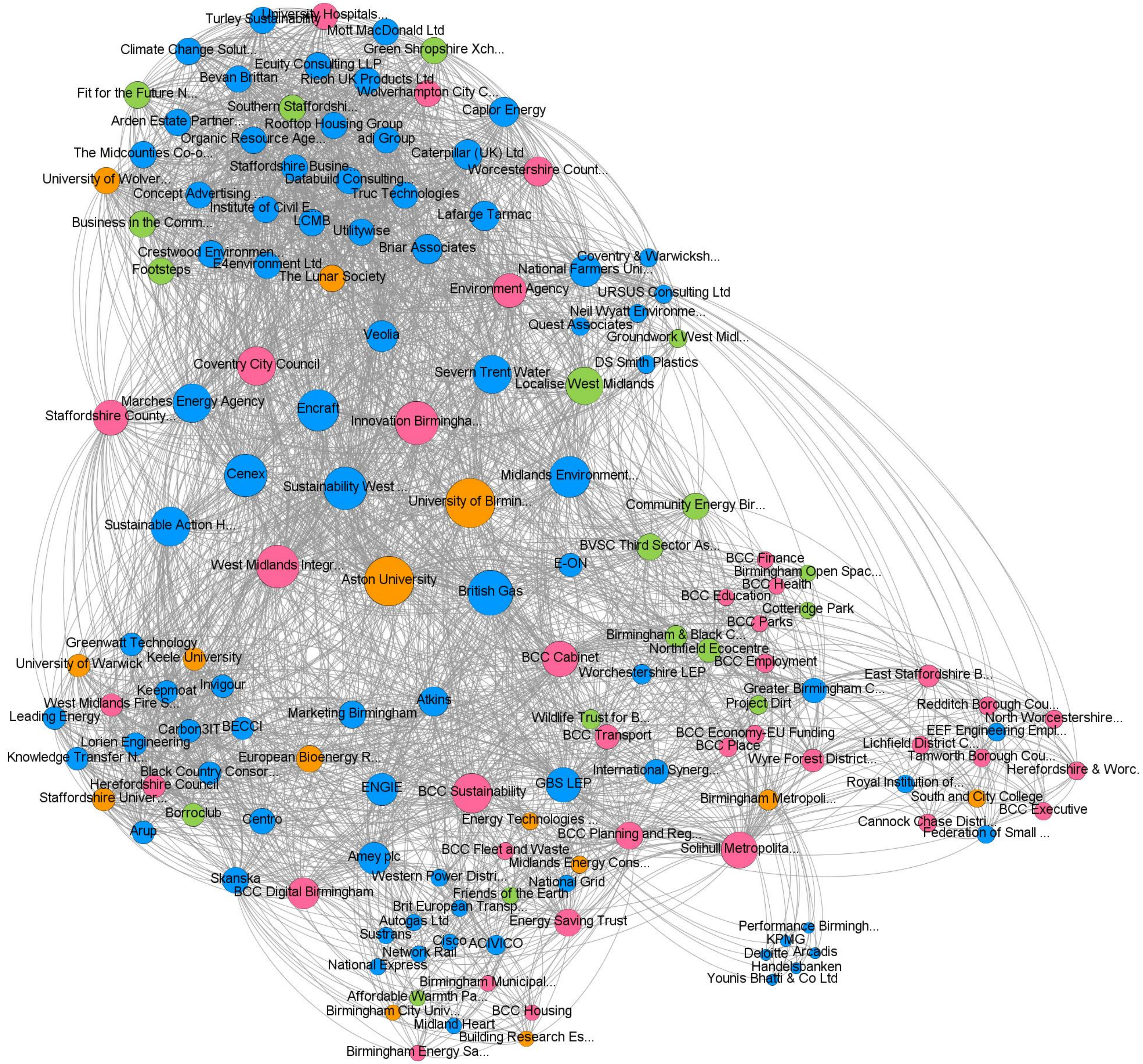
In terms of the shares of different sectors in the whole network and the influential core (Table 6.4), no significant difference exist between the whole network and the core group.

Instead, both are dominated by market sector actors, signalling that businesses have an important role in Birmingham's energy agenda not only with regard to implementation but also on the strategic level.

SECTOR	SHARE OF TOTAL IN WHOLE NETWORK	SHARE OF TOTAL IN CORE NETWORK
MARKET	55%	52%
PUBLIC	24%	31%
CIVIL/VOLUNTARY	12%	10%
ACADEMIA	9%	6%

Table 6.4 Sectoral shares in the entire network and the core group

In a second step, the two-mode network analysed above was converted into a one-mode graph emphasising the connections between organisations which were involved in the same decision-making arenas. The one-mode network data was used to determine the actors occupying central positions in the network, according to the statistical measures of degree, betweenness and closeness centrality (Chapter 5, Section 5.5.2). The one-mode visualisation of the whole network is shown on Figure 6.7. Figure 6.8 presents the relationships between organisations in the core group. The centrality scores of each actor involved in the network are included in Appendix V (pp. 352-363).



NODE COLOURS:

PUBLIC SECTOR

MARKET (FOR-PROFIT)

ACADEMIA / RESEARCH

THIRD SECTOR (NOT-FOR-PROFIT)

DECISION-MAKING ARENA

Figure 6.11 Governance network of decision-making for low carbon transition in Birmingham (one-mode visualisation)

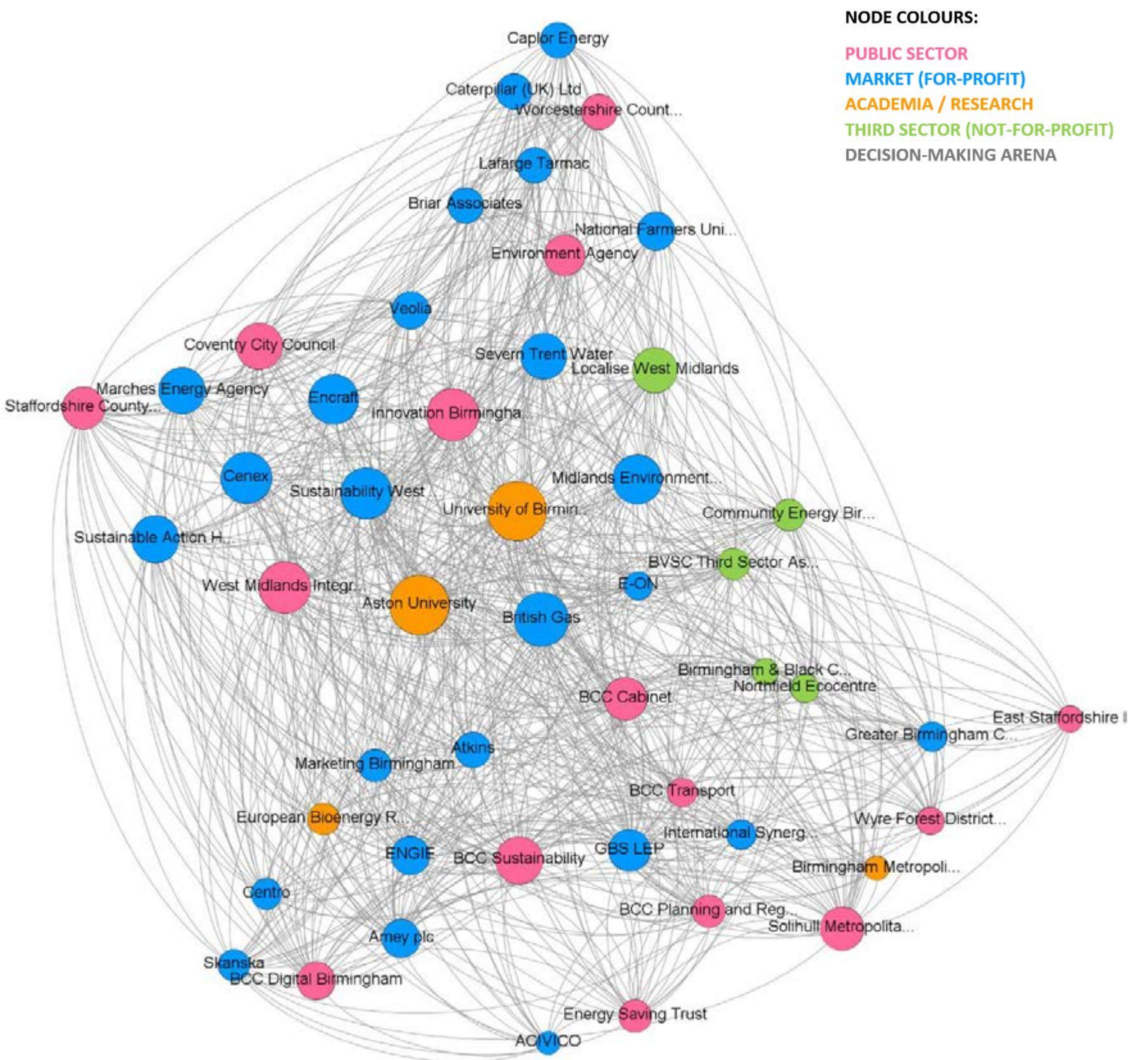


Figure 6.12 The core group of the sustainable energy governance network in Birmingham (one-mode visualisation)

According to the various centrality measures, the most influential organisations in Birmingham's network are less locally and more regionally or nationally oriented actors. The main features of the network structure are the following: first, research institutions (e.g. Aston; EBRI; University of Birmingham), regional organisations (e.g. Sustainability West Midlands, West Midlands Integrated Transport Authority, Midlands Environmental Business Company, GBS LEP) and private companies (British Gas, ENGIE, Veolia, Severn Trent Water, Cenex, Encraft, etc.) appear among the more influential network actors. Second, community organisations are found in similar positions within the network, indicating that they are only involved in particular thematic groups (mainly related to housing and natural capital). Third, Birmingham City Council is represented by the Cabinet member and the Sustainability Team in the network, while traditional council departments occupy more peripheral positions. Fourth, the Greater Birmingham and Solihull LEP scores relatively low on all centrality measures, compared to its key role in distributing EU and National funds. Fifth, the only renewable energy company involved among the more influential actors is a community initiative (Community Energy Birmingham), while the energy domain is represented by supply companies such as British Gas and ENGIE, and consultancies (Encraft, Marches Energy Agency).

In conclusion, the structural analysis highlights the role of access to funding streams (own capital or EU / national funding) in becoming influential in the low-carbon energy network of Birmingham. The only exemption is the GBS LEP which is responsible for distributing national and European funding, indicating that decisions made within the sustainability network have potentially low impact on the LEP's decisions in terms of allocating funding for to support economic development. The centrality of research institutions suggests that the transition agenda in Birmingham has a strong R&D focus which carries the risk of neglecting the issue of how innovative pilot and small-scale projects might be upscaled to benefit the city's wider society. At the same time, large-scale developments are driven by influential profit-oriented companies and mature, market-ready technologies, further complicating the upscaling of pilots. The influence of the third sector appears to be restricted to particular themes, mostly outside of the energy domain (e.g. energy saving from buildings). The polycentric network structure indicates a dispersion of powers in terms of influence over the network, and no clear hierarchical divide can be found between the public and private sectors. This, together with the relatively peripheral position of the traditional City Council departments, indicates that the Council's Sustainability Team may be forced into an intermediation role between the Municipality and the sustainability network, but potentially lacks the ability to significantly influence the operation of either of them.

6.3.2 Content and process of network interactions

The arguments presented in Chapter 5 around the difficulties and potential benefits involved in conducting governance network analysis which takes into account both structure and process (Bergé et al., 2017; Christopoulos, 2008; Lewis, 2011) point to the value of collecting qualitative information on how governance processes within and between the different decision-making arenas play out in practice. This is important in order to better understand the functioning of the governance network, and to validate, evaluate, clarify and complement the conclusions drawn from the structural analysis based on quantitative data.

The analysis of the network structure and the actors involved highlighted that the sustainable energy governance network in Birmingham is characterised by polycentricism and the dispersion of powers among a relatively large core group of actors; significant overlaps in membership between arenas; lack of hierarchy between the public and private sector.

First, polycentricism and the large core group result from a combination of the historical tendency to attempt to govern sustainable development through partnerships on the one hand:

'[T]hey've always had to have the perspective of 'you are a partner or you are nothing'. They need partners to survive, they need partners to do that work.' (Interview 1.12, 2016).

On the other, from the process of selecting stakeholders to participate in the collaborative initiatives (Interview 1.02, 2015; Interview 1.03, 2015; Interview 1.06, 2016; Interview 1.08, 2016):

'The Green Commission has been formed by who the city already knew. It's sort of a club of well-known people without mapping the stakeholders and deciding what areas should be included, (...) and it tends to be non-controversial because of the people who sit on there. (...) [T]hey haven't really addressed proper stakeholder engagement.' (Interview 1.02, 2015)

The UK's centralised system of energy infrastructure governance is only one of the reasons behind the dispersion of powers among the actors. Another particularly relevant issue in Birmingham is the multiplicity of actors who have a role in deciding about the use of funding for low-carbon development, including the Municipality, the Local Enterprise Partnership, the council departments, universities and various research institutions (Interview 1.03, 2015; Interview 1.08, 2016; Interview 1.10, 2016).

Second, due to the overlaps in membership between the different decision-making arenas, the structural analysis did not bring to the front any significant divide between the arenas actively involved in shaping the formulation of the agenda of Birmingham City Council (i.e. the Green Commission and its roundtables), and those that can only influence it more indirectly (i.e. SWM, Birmingham Science City Low-Carbon Working Group or the LEP), and neither between those operating on the regional and on the local levels. Interviewees pointed out that overlaps existed not only in terms of membership, but also with regard to responsibilities between the different arenas:

> *'It's one of the problems with Birmingham constantly which you'll come across which are almost like overlapping networks or groups who are trying to achieve the same thing.'* (Interview 1.05, 2016)

The main cause for this was the structural hole in public sector activity on the regional level, and the resulting confusion around the roles and responsibilities of the different levels with regard to low-carbon development (Interview 1.05, 2016; Interview 1.07, 2016; Interview 1.08, 2016). The high number of decision-making arenas, and the overlaps between them, made arriving to decisions difficult due to discussions taking place in parallel ('*you can be over-initiatived';* Interview 1.04, 2016).

Third, no clear hierarchical relationship was identified between the actors which have a formal role decision-making (i.e. public sector actors and the LEPs) and the private sector (i.e. for-profit companies and not-for-profit community organisations and associations) through the analysis of the network structure. Interviews indicated that the reason for the Municipality appearing as only one of the many actors in the network visualisation was the internal fragmentation within the Local Authority:

> *'[T]here is no culture of collaboration. (...) Local government departments don't work with each other unless they are told by central government.'* (Interview 1.06, 2016)

However, vertical integration with higher levels of government was also seen as problematic, due to the hole in the structure of the public sector on the regional level; the particular dynamics of interaction between the National Government and the City Council

(‘*Sometimes there is (...) a deliberate move to do things differently here than (...) the national direction’*; Interview 1.04, 2016) which was further worsened by the political preference for austerity in recent years in Central Government (Interview 1.03, 2015; Interview 1.08, 2016); and the lack of a systematic plan and framework on the national level on the roles and responsibilities of different public sector levels and bodies in relation to sustainable energy (Interview 1.02, 2015). The fragmentation within the Municipality resulted in a lack of shared local understanding about low-carbon development and the role of local sustainable energy systems (‘*[i]nternally the Council isn’t joined up to pursue a common agenda.*’; Interview 1.05, 2016).

The lack of shared understanding, and the traditional large municipal departments’ loose connection to the network, meant that sustainability wasn’t *‘considered as part of the standard function of the service’* but rather *‘a kind of an additional element to it’.* (Interview 1.03, 2015) This situation counteracted successful and fruitful collaboration both with regard to strategy and implementation, and made the task of the Sustainability Team of intermediating between the sustainability network and the council departments relatively difficult:

> *‘There is a dissonance between political ambitions set down and strategy and policy, and the attitudes of key senior officers within the authority. And if you don’t get an alignment through that, all you get is frustration; both on those who are trying to pursue an energy transition and the external stakeholders, because they get frustrated and they walk away from what they see as good opportunities within the city.’* (Interview 1.05, 2016)

6.3.3 The network's role in decision-making

Collaborative working had been around since the early days in the process of delivering on Birmingham City Council's sustainable development ambitions. Initially in the 1990's, collaborative initiatives were more related to citizen engagement (BCC, 2002). Later, as a result of the central Labour Administration's focus on collaboration and 'joined-up government' and funds being made available for collaborative decision-making, a range of partnerships (Birmingham Strategic Partnership, Be Birmingham, BEP, etc.) were set up in Birmingham. The Partnerships were leading the sustainability agenda at the time, and although the Municipality was involved in managing them, it did not take up a coordination role and did not act as a champion or 'role model' (Interview 1.05, 2016; Interview 1.08, 2016):

> *'The Council has been addressing sustainability matters since Rio '92 with Local Agenda 21, but it has been doing that on a very low level. [W]ith Paul Tilsley we were able to start to increase the council's position on that agenda, and I think we made quite a lot of progress, but one of the difficulties was that the Leader of the council, who was a Conservative, wasn't particularly interested in climate change or sustainability. While it was written into the policies of the Council, it always felt that there wasn't what I'd call a real high-level political leadership. [I]t just felt as almost like a single politician doing it.'* (Interview 1.05, 2016)

Thus, although stakeholders were actively involved in formulating strategies and working on their implementation through allocating Central Government funding for various initiatives, these activities had little impact on the related decision-making processes within the City Council (Interview 1.08, 2016). This situation started changing recently, with setting up the Green Commission in 2012. The new arenas set up at this time were designed to directly influence strategic agenda setting at the Municipality (Interview 1.03, 2015; Interview 1.05, 2016). The Green Commission and its roundtables are actively involved in formulating strategies in some cases -for example the preparation of the Low-Carbon Roadmap-, and also provide space to consult work produced externally, by the Council itself or through commissioning out to consultancies or other organisations (Interview 1.10, 2016; Interview 1.11, 2016). However, the Green Commission has no direct access to financial resources. With regard to implementation, it acts as an advisory body for Birmingham City Council and the Greater Birmingham and Solihull LEP (Interview 1.02, 2015). The main role of other arenas, including the SWM (Sustainability West Midlands) and the Science City Low Carbon Working Group, is to provide space for networking and relationship building between (mostly professional private sector) organisations and companies (Interview 1.06, 2016; Interview 1.07, 2016).

6.4 IMPACT: NETWORK SUCCESSES AND FAILURES

6.4.1 Strategy formulation

One of the core considerations of the sustainability transitions literature is to find ways to introduce long-term thinking into the decision-making process around low-carbon innovation. This can be achieved through the formulation of strategic plans which set out long-term goals and mid-term interim targets and pathways. The ability to produce such material in network setting indicates the level of development of shared understanding in relation to the nature of the problem, the goals to be achieved and the necessary action to create pathways for the delivery of low-carbon ambitions.

Birmingham's long-term goals are expressed most predominantly in terms of CO_2 emissions reduction targets. The current target of 60% was first established under the leadership of the then Deputy Leader of the City Council, Cllr Paul Tilsley. The target year was initially 2026, i.e. the commitment was to decrease emissions by 60% compared to 1990 in the upcoming 20 years after the decision was made in 2006 (BCC, 2009b). The target was set unilaterally by the Council without consultation without a wider consultation with local stakeholders or other levels of government (Interview 1.03, 2015). Later, when the national targets and Carbon Budget periods were set in 2008 and the following period, the city's target had to be revised to achieve a better fit with the national framework. As a result of a consultation period with DECC / BEIS (Interview 1.04, 2016), the target year was changed to 2027 to coincide with the Carbon Budget periods. However, consultation with external stakeholders, or modification of the target based on the progress achieved in the period 1990 – 2012, have not been considered.

Consultation processes started after the new target was published, with setting up the Green Commission. At this initial stage the role of the Commission was to deliver a 'Low Carbon Roadmap' (GC, 2013b) for Birmingham which was expected to identify the core thematic areas to focus on. The Roadmap was produced through extensive collaboration among a smaller set of stakeholders, one of whom was the Sustainability Team. External stakeholders were actively involved in the production of the plan, instead of providing a forum for consultation over material prepared by the Municipality (Interview 1.02, 2015). Although key focus areas were identified, no agreement was made on their individual role and target in achieving the overall CO_2 reduction target. Thus, the roundtables were set up to further develop the action plans in the different thematic areas without a clear, tangible definition of the goals expected to achieve through identifying potential for interventions. This lack of direction resulted in an inability to produce tangible results in terms of credible pathways on how the overall target should be achieved. Such issues also signal a lack of capacity or capability of the City Council, and the Sustainability Team in particular, to steer decision-making processes in the network.

Economic development plans, which set out the vision to build a green economy based on low-carbon innovation, were produced by the Greater Birmingham and Solihull LEP (GBS LEP, 2016). The two processes had little connection to each other and it is not clear how the LEP activity contributes to delivering on the carbon reduction target. In conclusion, although some strategic documents were published by Birmingham City Council, it is unclear what the role of different sectors (e.g. energy systems, planning, housing, transport, economic restructuring) might be in the process of implementation (Interview 1.02, 2015).

6.4.2 Strategy implementation

A strategic approach to implementation appears to be problematic in Birmingham despite the Sustainability Team's aspirations to coordinate low-carbon investment in the City:

> *'We are essentially trying to ensure that there is coordination and collaboration rather than a patchwork approach. (…) I see Birmingham's role within that is the clockwork role, so we need to try and make sure there are planned investments, but also allowing space for local innovation and local people to come in and have a part in that.'* (Interview 1.03, 2015)

This issue points to the complications involved in developing a shared understanding about sustainable development, low-carbon transition options and about the role of the City Council in that process and highlights the adverse impacts on the potential to deliver on the strategic goals.

Different understandings in these core questions between departments is particularly problematic with regard to using legislative powers for implementation. Although the majority of the powers to regulate core sectors influencing energy production and consumption are concentrated on the national level, the Planning Department does have a key role determining Birmingham's future urban development. However, due to the still prevalent silo mentality between the municipal departments (Interview 1.12, 2016), sustainability is not a core consideration for the Planning Department (Interview 1.03, 2015, Interview 1.05, 2016). Thus, instead of requiring to build new developments to a certain standard (as laid out in the existing strategic city development plans), the Council often ends up in a negotiation process with developers in which many of the original goals, including the ones related to sustainability measures, are compromised on (Interview 1.04, 2016; Interview 1.05, 2016).

Due to the historical trajectory of energy infrastructure governance in the United Kingdom, Birmingham City Council's capability to use indirect authority (i.e. authority exercised through the ownership of municipal utility companies) is also weak. Consequently, implementation in the energy system is dominated by private companies regulated on the national level (e.g. Veolia, ENGIE, npower, British Gas, etc.). In parallel to the growing influence of the market sector on the energy transition agenda in the city, the previously more active third sector (community initiatives) has been pushed to the background (Interview 1.08, 2016). The City Council's influence over the implementation phase is, therefore, restricted to the early phase of setting up projects by highlighting opportunities for investment for businesses and funding opportunities to leverage (Interview 1.03, 2015). However, initiatives are carried out and operated with little interference from the Municipality.

In terms of impact these issues translate into a mix of innovative, but small-scale and isolated pilot projects (e.g. injecting biogas into the district heating grid; and cryogenic energy storage pilot at the University of Birmingham), and the employment of less imaginative, commercially viable technologies based on a market-approach (e.g. waste incineration; and natural-gas-fuelled cogeneration; Interview 1.11, 2016). Thus, due to the inherently different characteristics of these two approaches, upscaling pilots is particularly difficult (Interview 1.10, 2016). This issue leads to a mismatch between ambitions on paper and projects on the ground: Birmingham City Council are *'very good at developing strategies, not particularly good at implementing them'* (Interview 1.02, 2015). Therefore, in terms of impact

> *'there is lot of stuff going on, but none of it has completely transformed the way energy flows into and is used within (...) that specific urban landscape.'* (Interview 1.09, 2016)

6.4.3 Progress towards targets and goals

Birmingham has a carbon reduction target of 60% by 2027, compared to 1990 baseline (GC, 2013a), set for the total emissions generated in the city. The target year has been recently amended to fit the Central Government's carbon budget periods set out in the National Carbon Plan 2011 (HM Government, 2011). The Carbon Plan confirmed the national target of 80% CO^2 reduction by 2050 set out by the Climate Change Act 2008 (HM Government, 2008), and introduced an interim target, 50% emissions reduction by 2027 (HM Government, 2011). As the city's reduction target is greater than what the

United Kingdom as a whole aims for, there is a need for taking action locally. This is well articulated in the reports and documentation published by Birmingham City Council (see f.e. BCC, 2009a; GC, 2013c, 2013b).

According to the latest statistics released by DECC/BEIS which contain local carbon emissions data until 2014 (HM Government, 2016a), the city achieved a reduction equivalent to 28% compared to 2005 baseline in terms of total carbon emissions ('Subset' data based on estimates within the scope of influence of Local Authorities; HM Government, 2016a) and 33% compared to 1990 baseline (GC, 2013b). Estimates and projections show that the city seems to be on track to achieve its long-term target (see Figure 6.9).

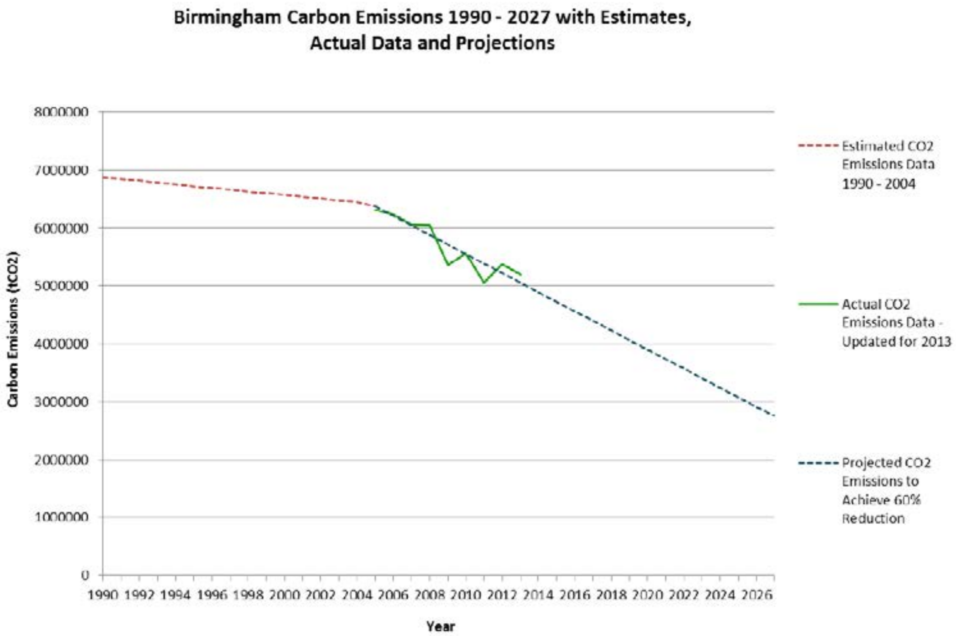


Figure 6.9. Birmingham Carbon Emissions 1990 – 2027

(Source: www.makingbirminghamgreener.com/useful-information)

However, this decrease in total emissions is better understood by assessing the changes in terms of sectoral shares and their changes in the period 2005-2014. Emissions from the market sector (industry and commerce) were down from 41% to 38%; the share of the domestic sector remained constant at around 35%, while emissions from transport increased from 22% to 26.5% by 2014 (HM Government, 2016). Thus, the majority of emissions reduction is achieved through the decarbonisation of economic activity. This, considering the role of industry and manufacturing in the city's economy in the past, means that results stem from the restructuration process from carbon-intensive industrial production to services, rather than any other efforts. Another driving force behind emissions reduction in the two sectors mentioned above is the decarbonisation of the national electricity grid (Foxon, 2013).

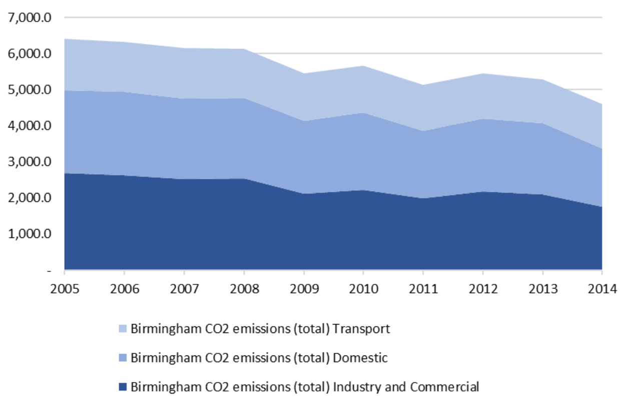


Figure 6.10. Emissions by Sector (kt CO2)

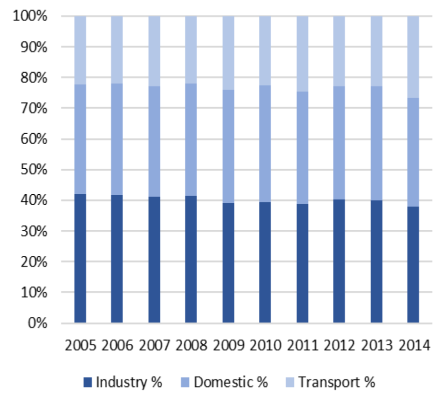


Figure 6.11. Emissions by Sector

Thus, despite initial success in keeping emissions reduction on track to achieve the 2027 target, the continuation of this trajectory cannot be taken for granted. Whilst retrofitting the aged housing stock (25% of buildings are from before World War I; Transition Cities, 2015) provides a huge opportunity for reducing carbon emissions in Birmingham, its implementation is not straightforward due to issues related to energy pricing, awareness among citizens, and lack of appropriate funding mechanisms (e.g.

from Central Government sources). In industry and commerce, population growth is likely to offset further large-scale decarbonisation effects. Thus, while investment in green economy seems necessary, the relative location of work places, residential areas and services must also be carefully planned to avoid further rise in traffic and carbon emissions from transport. These interrelated processes underline the key role of organisations responsible for deciding about economic priorities (i.e. the Greater Birmingham & Solihull LEP) and for city planning (BCC Planning and Regeneration) in facilitating the delivery of low-carbon ambitions.

6.5 CONCLUSIONS

6.5.1 Network governance in the energy transition in Birmingham

The analysis presented in this chapter demonstrated that the emergence and operation of the energy transition network in Birmingham -both in terms of structure and process- are influenced by a complex interplay of various context-dependent factors.

The development of the broader transition governance network in Birmingham resonates well with the governability perspective, resulting from a bottom-up process in various decision-making arenas with membership overlaps over the last two decades. However, the governance network has not been successful in rendering local sustainability transitions 'governable' which to this date remains characterised by sporadic, isolated initiatives and a mismatch between strategy and implementation. Instead, governance processes in the network are driven by a sense of interdependence between the public and private sector resulting from the contracting out of key services and activities relevant to low-carbon energy transition, such as waste treatment and district heating, to private companies. As a consequence, negotiation processes taking place in the decision-making arenas are characterised by conflicts of interest between the local authority, the market sector and community organisations.

As leadership of the network (and the sustainability issue) within the Municipality has been superficial and changed frequently, to role of decision-making arenas set up by other public bodies has become important in facilitating collective action. These initiatives enabled an integration process between external stakeholders also involved in the various partnerships and other decision-making arenas set up periodically by the Municipality from the early 2000's. This process further diminished the Local Authority's potential to steer network processes by contributing to the development of horizontal relationships in the core group of the network.

The gap between the public and private sector created this way counteracts the possibility to set up experimentation processes on a collaborative basis (involving actors from both sectors) on the implementation level which could provide space for new governmentalities to arise. Thus, sustainable energy transition appears as a combination of isolated small-scale pilots and market-driven mature technological solutions, making the upscaling of low-carbon innovation extremely difficult.

6.5.2 Options for Local Government steering

The network characteristics described above have consequences for the Local Government in relation to its potential to steer the network processes. The structural analysis has shown that the most influential City Council department in the sustainable energy network is the Sustainability Team and the Cabinet, through the Cabinet Member for Sustainability. Other, more resourceful large Council departments do not appear among the more influential actors in the network.

Thus, due to the lack of hierarchical relationship between the public sector and the market and third sector on the one hand, and that of a shared understanding between departments of the role of the Municipality in sustainability transitions on the other, the Sustainability Team has been facing various challenges in attempting to perform steering in the sense of network management. In the absence of resources and authority, the Team has mainly been involved in interest intermediation between external stakeholders and the City Council despite not being able to significantly influence the outcomes of decision-making processes in either of these spheres. However, the iterative intermediation role seemed to contribute to raising its profile both within the Municipality and in the network through access to both professional knowledge and to municipal processes resulting from the brokerage position.

Despite the promising signs, the Sustainability Team has been dismantled during 2017, after the data collection period of this study. The majority of team members have been made redundant. Moreover, the Green Commission has not had any meetings since 2016, signalling a continuing uncertainty about the Municipality’s commitment to low-carbon development.

CHAPTER 7.

CASE STUDY 2.

ENERGY TRANSITION IN FRANKFURT

7.1 INTRODUCTION

7.1.1 Objectives and structure of the chapter

This chapter aims to address the second research question:

RQ (2) How can the form, extent, trajectory and impact of a city's low-carbon network governance be assessed?

It answers this question in the setting of the city of Frankfurt-am-Main, Germany, by providing an overview of the contextually relevant conditions in which the governance network operates (Section 7.2); assessing the network characteristics (Section 7.3); and by evaluating its impact on advancing the local sustainable energy transition (Section 7.4). A diagram of the structure of Chapter 7 is shown in Figure 7.1.

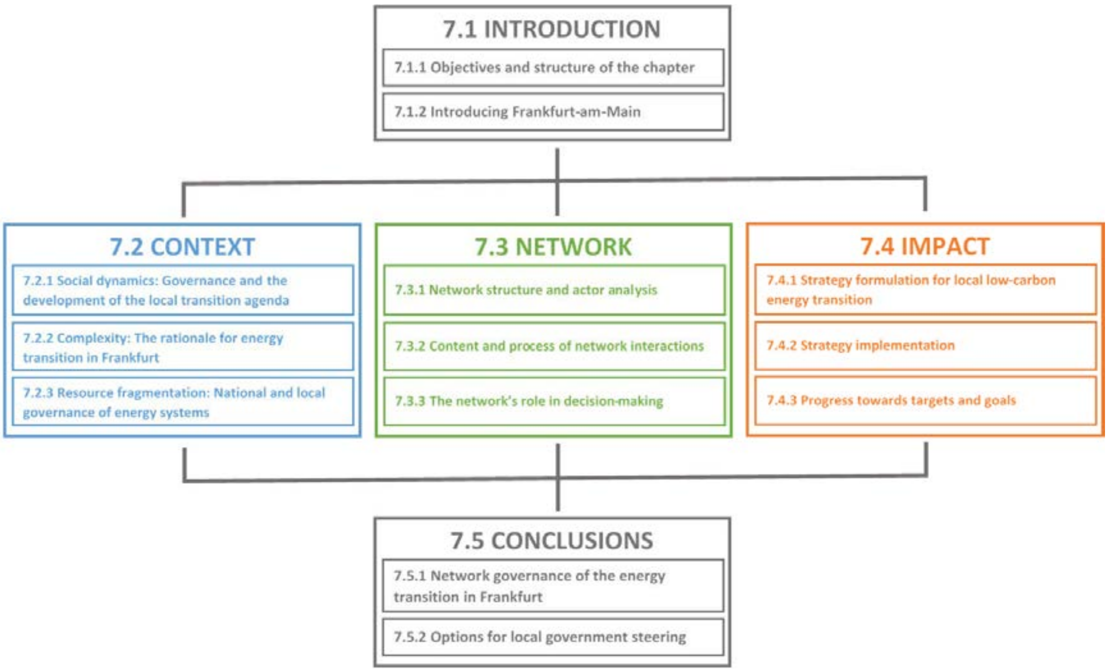


Figure 7.1 Diagram of the structure of Chapter 7 (Case Study 2: Energy transition in Frankfurt)

The conclusions of the case study are presented Section 7.5 which is divided into two sub-sections. First, the operation of the governance network relevant to governing the local energy transition in Frankfurt is described, through the lenses of normative integration, interdependence, governability and governmentality. This is based on the discussion presented in Chapter 3, Section 3.3. Second, building on the description of the network, I discuss the options available to the local government to steer the network processes.

7.1.2 Introducing Frankfurt-am-Main

Frankfurt is the financial capital of Germany and the Eurozone. It is the fifth largest city in Germany and the most populous in the State ('Bundesland') of Hesse. The surrounding Frankfurt-Rhein-Main metropolitan area has a population of 6 million, making it the second largest agglomeration of Germany behind the Rhine-Ruhr region. The city is a major European transportation hub, both in terms of air, rail as well as motorway travel. Frankfurt is a growing city, with a 17% rise in population occurring over the last 15 years (FCC, n.d./a). Table 7.1 presents generic statistical data about the city's population, size, its economic output and carbon emissions, compared with Budapest and Birmingham.

CITY	COUNTRY	POPULATION[1] (2015)	AREA[2]	DENSITY[3] (2015)	PER CAPITA GDP[4] (2014)	PER CAPITA CO2 EMISSIONS[5]
BIRMINGHAM	United Kingdom	1 107 677	268 km^2	4152/km^2	25 500	4.4 t (2014)
BUDAPEST	Hungary	1 757 618	525 km^2	3349/km^2	38 900	4.7 t (2014)
FRANKFURT	Germany	717 624	248 km^2	2924/km^2	88 600	9.8 t (2013)

Table 7.1 Generic statistical data, Frankfurt

[1]Source: Eurostat 'Population on 1 January by broad age group, sex and NUTS 3 region' in total number (available from http://ec.europa.eu/eurostat/data/database)

[2]Source: Eurostat 'Area by NUTS 3 region' in square km (available from http://ec.europa.eu/eurostat/data/database)

[3]Source: Eurostat 'Population density by NUTS 3 region' in inhabitants per km^2 (available from http://ec.europa.eu/eurostat/data/database)

[4]Source: Eurostat 'Gross domestic product (GDP) at current market prices by NUTS 3 regions' in Purchasing power standard (PPS) per inhabitant (available from http://ec.europa.eu/eurostat/data/database)

[5]Sources: BuCC, 2016; FCC, 2015; HM Government, 2016a

Frankfurt is the wealthiest of the three cities and it is one of the largest and most influential trading centres in the world. Nowadays, Frankfurt's trade fair centre ('Frankfurt Messe', jointly owned by the City Council of Frankfurt (60%) and the State of Hesse (40%); Messe Frankfurt, n.d.), hosts over 40 events a year attracting more than 1.5 million visitors and over 40 000 exhibitors.

Excluding a few short periods, the city was led by its own administration as a free, independent city ('Kreisfreie Stadt') since the 13th century. Its legal status and geographical location contributed to Frankfurt's emergence as one of the most influential economic centres in Europe and in the world. Despite the devastation caused by air strikes during the world wars in the first half of the 20th century, the city quickly regained its position as a major economic hub in the post-war period. The fast economic and population growth fuelled the redevelopment of the inner-city area.

The emblematic skyline featuring numerous skyscrapers has been shaped by the growth of the finance industry. The 'Messeturm' (Trade Fair Tower) was the first high-rise building constructed in 1988. The 299 m tall Commerzbank headquarters opened in 1997. At that time, it was Europe's highest office building, and also one of the pioneering energy-efficient towers in the city. Today over 100 high-rise buildings form the city's skyline, including the Deutsche Bank 'Greentowers' and the European Central Bank headquarters. Despite the dominance of the financial sector, industry and manufacturing are also major contributors to Frankfurt's economy (FCC, n.d./b). The most important local industrial site is the Höchst Industrial Park which develops and produces chemical, pharmaceutical, biotechnology and related products (Infraserv, n.d.).

The preservation of green spaces around the city has, for a long time, been a priority for Frankfurt City Council. As a result, the city today is one of the 'greenest' in Europe with over 90% of the population having immediate access to green areas (Frankfurt Green City, n.d./a). Green spaces occupy over half of the city's land in the form of city parks, municipal forests, agricultural land and the green belt ('Grüngürtel'); most of which are owned and maintained by Frankfurt City Council.

7.2 THE FRANKFURT CONTEXT FOR ENERGY TRANSITION

7.2.1 Social dynamics: The historical development of the transition agenda and associated governance responses

Frankfurt has been one of the pioneer cities to incorporate the sustainability issue in the local political agenda. By the 1990's, around the time when the Bruntland Report and the Agenda 21 was published, the local branch of the German Green Party (Die Grünen; 'The Greens') has become part of the ruling coalition in the City Council. The Greens have since had a continued presence in the local coalition government, despite several changes in terms of leadership over the past decades. Frankfurt City Council is currently led by a grand coalition consisting of the CDU ('Christian Democratic Union') and the SPD ('Social Democratic Party of Germany') and The Greens. The timeline in Figure 7.2 shows the main organisational bodies and collaborative initiatives set up over the past decades.

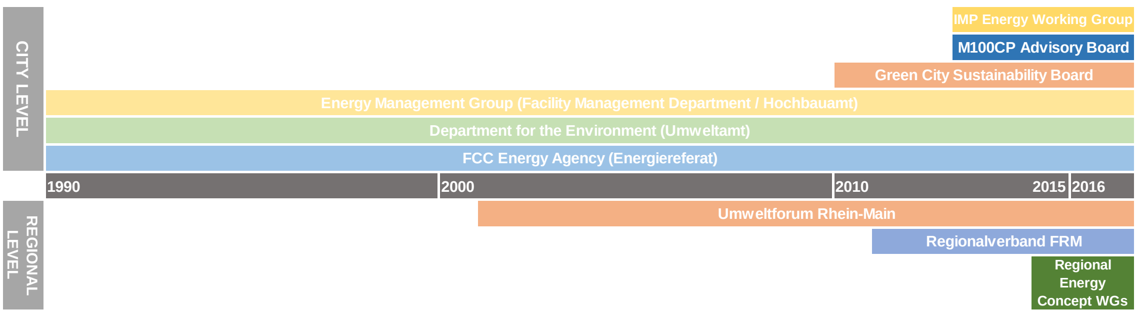


Figure 7.2 Timeline of organisational change in Frankfurt's sustainable development leadership

In 1990, the sustainability issue was one of the crucial points of the first coalition contract between The Greens and the SPD. The contract also established that a member of the Green Party – Cllr Tom Königs -, was to be appointed to 'Deputy Mayor for

Environmental Affairs' (Interview 2.03, 2016). The deputy mayors are elected members of political parties who get appointed to their roles during the coalition forming process after the elections. The deputy mayors, together with the Lord Mayor – who is a politician from the leading party in the coalition-, form the cabinet (FCC, n.d./c) leading the City Council.

One of Königs's first initiatives was to set up an international cooperation network between European cities and COICA (Coordination of Indigenous Organisations representing the indigenous peoples of Amazonian rainforests) called the 'Climate Alliance of European Cities with Indigenous Rainforest Peoples'. The role of the Climate Alliance network was to build connection between the greenhouse gas 'producers' (i.e. the cities of Europe) and those most vulnerable to the effects of climate change; to develop common emissions reduction targets for the signatories; and to provide a platform for knowledge and experience sharing and lobbying (Climate Alliance, n.d./a). Initially, the CO_2 reduction target was set to 50% by 2010. However, due to lack of sufficient progress (Interview 2.02, 2016), it was revised and modified to 10% reduction every 5 years until 2030. In order to coordinate the necessary work to achieve the targets set by the Climate Alliance, the Deputy Mayor established the Frankfurt Energy Agency ('Energiereferat') as part of the Department for the Environment ('Umweltamt'; Interview 2.03, 2016) in 1990. The Energiereferat has been operational since, led by a Director reporting directly to the Deputy Mayor for Environmental Affairs.

The tasks of the Agency were set out to include the development as well as the implementation of Frankfurt City Council's energy strategy. Employing only a few members of staff at the time (Interview 2.01, 2016), the work initially started with developing a methodology for collecting robust and reliable statistical data of greenhouse gas emissions in the city on the one hand, and about the potential for energy saving and energy efficiency on the other (Interview 2.03, 2016; Interview 2.02, 2016). Based on the initial results, the first local energy plan - or ‘Energiekonzept’ – of Frankfurt entered into force in 1997 which was revised and updated in the period between 2005 and 2007. Both energy plans focused on themes revolving around energy saving from buildings (electricity as well as heat), energy efficiency through heat and electricity cogeneration (CHP) and, to some degree, renewables deployment (Duscha et al., 2008; Interview 2.03, 2016). By promoting cogeneration, these strategies provided the backdrop for Frankfurt’s CHP revolution (Friedel and Neumann, 2001; see also Section 7.2.3). The 2008 Energiekonzept also expressed the need for the enlargement of the Energiereferat. As a result, the Agency currently employs ten people working in three units responsible for (1) energy systems; (2) energy efficiency in buildings; and (3) behaviour change (Interview 2.01, 2016).

While the Energiereferat was made responsible for delivering the goals set out by the energy strategies through collaboration with external partners (businesses and citizens), the same role in relation to the Municipality’s own estates (including council houses as well as municipal buildings) was assigned to the ‘Energy Management Group’ (EM Group) within the Municipality’s Building Construction Department (‘Hochbauamt’). Energy management for municipal buildings has had a long history in Frankfurt: the predecessor of the EM Group, the so called ‘Energiebüro’ was established as early as 1983 (Frankfurt Green City, n.d./b/b). The EM Group has a key role in advancing the City Council’s image as a best-practice model for other stakeholders in the city (Interview 2.02, 2016). In 2007, when the Council passed the ‘Passivhaus Resolution’ in which it committed itself to build all new and refurbish existing publicly owned buildings (as well as any other buildings constructed on land purchased from the Municipality) to passive-house standard (FCC, 2007), the EM Group was made responsible for providing technical assistance for passive-house construction and refurbishments (Linder, 2017).

With regard to collaboration with external stakeholders, the first initiatives were set up under the leadership of Tom Königs in the 1990's. The most important of these was a program called '50 Eco-Audits for Frankfurt' (50 Öko-Audits für Frankfurt; Interview 2.01, 2016), facilitated by German federal policy and funding for eco-audits as well as the 'Eco-Management and Audit Regulation' of the European Union (1995). In the beginning of the 2000's, the Department for the Environment (Umweltamt) established a platform for networking for the companies and partners who participated in the eco-audit program. The initiative was named 'Umweltforum Rhein Main' (Environment Forum of the Rhein-Main Region) and is still currently operational. The Umweltforum aims to facilitate the development of innovative projects and initiatives through cooperation between businesses, universities, third sector organisations and public sector bodies from the region (Umweltforum, 2015).

At this time, the sustainability agenda in Frankfurt was clearly dominated by the local authority. This situation only began changing in the last decade with Frankfurt's application process for the European Green Capital Award 2014/2015 which started in 2010. The application procedure was expected to speed up the sustainable transformation of the city, and gave a new impulse to collaboration internally, between municipal departments as well as externally, with stakeholders and citizens (Interview 2.03, 2016). Citizen forums and workshops were held throughout 2012 around five thematic areas including economy and consumption; planning and building; education; climate and open spaces; and mobility (Frankfurt Green City, n.d./a). In the final round, the outcomes of the consultation processes were discussed and evaluated by the 'Nachhaltigkeitsforum' ('Sustainability Board'). The Board consisted of 21 members from the public sector, politics, businesses, professional associations, civil society organisations, academia and so on (Frankfurt Green City, n.d./d; Interview 2.05, 2016). The final 'Green City Concept' earned Frankfurt a place among the three finalists of the 2014/2015 Award.

The core themes of the Green City consultations were further developed in the subsequent years. By 2015, the City produced a 'Masterplan 100% Climate Protection', a 'Masterplan Industry' as well as a 'Mobility Strategy'. Following the success of the Green City consultations, the masterplans were developed through participatory processes involving stakeholders from the relevant sectors and areas. Sustainability was a central element in each of the strategic plans, but energy transition was explicitly discussed in the Masterplan 100% Climate Protection (M100CP). The document set out Frankfurt's new long-term carbon emissions target of approximately 95% by 2050 which was to be delivered through reducing energy demand by half and generating the remaining half from renewable sources (FCC, 2015). The ways in which this could be achieved were first assessed by an independent research institute (Fraunhofer Institut für Bauphysik, Kassel). The scenarios were later discussed in a collaborative setting through the 'Klimaschutzbeirat' ('Masterplan Advisory Board') led by the Energiereferat. Prominent stakeholders were invited to participate in the Advisory Board (FCC, n.d./d), partly based on stakeholder mapping conducted by the Energy Agency (Interview 2.01, 2016) and partly on the membership of the previous Green City Sustainability Board (Interview 2.05, 2016). Parallel to the M100CP, the Masterplan Industry was developed in a similar collaborative setting, led by the 'Frankfurt Economic Development Agency', part of the

Department of Economy (Frankfurt Green City, n.d./e). In the years after the financial crisis, the Masterplan Industry's objective was to strengthen Frankfurt's position as a prime location for industry with the aim of further diversifying the local economy dominated by the financial sector (Rentmeister, 2015). The process began in 2012 with identifying the most important action fields and with setting up working groups for a deliberation process. The identified core themes were discussed in eight working groups, including industrial site development; digital infrastructure; energy; logistics; industry attractiveness; employment and qualification; administration processes and services; and innovation and value creation of the future (Rentmeister, 2015).

Following the completion of the thematic masterplans, the City Council started working on an integrated urban development concept through a participatory process called 'Frankfurt Deine Stadt'. The project has been led by a working group including members of various city departments (FCC, 2016; Interview 2.07, 2016) and, at the time of data collection, was in the stage of consultation with citizens through a range of participatory events.

Through the development of the Masterplan 100% Climate Protection, the Municipality had to realise that the city must collaborate with the surrounding Rhein-Main Region in order to deliver on its transition ambitions: half of the future (reduced) energy demand of the city would have to come from outside the city limits according to the projections (FCC, 2015). This acknowledgement prompted a dialogue process between Frankfurt City Council and the 'Regionalverband' (Regional Authority of Frankfurt-Rhein-Main, representing the 75 local authorities in the region). The collaboration was aided by the timely appointment of a Green Party member as Deputy Director of the Regionalverband, creating favourable conditions for collaboration on energy policy. As a result, a commitment was secured from the Region for developing renewable energy production systems which would be able to supply half of the city's future energy demand (FCC, 2015; Interview 2.03, 2016), mainly from solar and wind energy. Following Frankfurt's example, the Regionalverband started a participative process in 2014 with the aim of producing a 'Regional Energy Strategy' ('Regionales Energiekonzept FrankfurtRheinMain'; Regionalverband, n.d.). Throughout 2015, workshops in five thematic areas were organised including energy systems, housing, mobility, economy and finance (Regionalverband, 2016). The proceedings of the workshops are being processed to create a comprehensive strategy for energy systems development in the region by 2050.

7.2.2 Complexity: The rationale of energy transition in Frankfurt

In Frankfurt, such as the case more generally in Germany, the current sustainability and low-carbon transition agenda has its historical roots in the environmental movements of the era of the oil crises in the 1970's and 80's. The German economy, being almost entirely dependent on oil import through the Organization of the Petroleum Exporting Countries (OPEC), was heavily by the oil embargo of the Arab member countries (Planète Énergies, 2015). As a result, energy policy has since been focusing on reducing energy demand as well as increasing local energy production. Strict measures were developed and implemented to reduce demand through improving efficiency in the production of heat and electricity and via insulating buildings (Morris and Pehnt, 2012). Moreover, significant investments were made to increase energy production from nuclear power as well as renewables, especially wind (Planète Énergies, 2015). Public opinion on nuclear power shifted as a result of the Chernobyl catastrophe in 1986, resulting in a turning point in German energy policy. The pressure from citizens and environmental movements pushed the Government to turn away from nuclear power and focus more on the development of renewable energy technologies (Papadakis, 2014). This rationale has later been adopted in the German 'Energiewende' (Energy Transition) which is the Federal Government's energy strategy focusing simultaneously on promoting the deployment of renewable energy technologies through the Renewable Energies Act (EEG), as well as on the complete phasing-out of nuclear energy by 2022 (Morris and Pehnt, 2012). As a direct consequence, Germany is currently one of the main global investors in renewable energy innovation and deployment.

The rationale for low-carbon energy transition in Frankfurt has to be understood against the backdrop of this German national context. Due to the fast economic growth in the post-war period, Frankfurt became one of the areas with the largest energy demand in the country by the 1970's. Thus, when the oil crises hit West Germany, plans were being drawn up for new nuclear processing plants in the area. In this period, the city saw continuous and often violent riots between the contra-nuclear grass-roots environmental movements and the authorities (Interview 2.03, 2016; Papadakis, 2014). On the political level, the party representing the civil environmental initiatives - The Greens - gained support quickly on the federal, as well as the state (Bundesland of Hesse) and local levels. One of the emblematic figures of The Greens, Joschka Fischer - who later became Vice-Chancellor of Germany under Schröder's government – got involved in politics through the demonstrations in Frankfurt in the 70's. Before starting his career in the Federal Government, Fisher had been Minister for the Environment of the State of Hesse in the 1980's and played an important role in encouraging local governments to take action and develop their own local energy plans (such as Frankfurt's Energiekonzept; Interview 2.03, 2016). This initiative was later taken up by the Federal Ministry of the Environment

('Bundesumweltministerium') which began providing funding for local governments to employ energy officers and to organise collaborative processes with citizens and stakeholders ('Kommunaler Klimaschutz' program; FGG, n.d.).

The factors that are important and influential in shaping the rationale and the complexity for low-carbon transition in Frankfurt can be derived from the aforementioned developments. The first is the pursuit of energy autarky: the transformation of energy systems is a core element in the sustainability transition processes, but not only due to emissions reduction commitments. Rather, the narrative builds significantly on energy security through autonomy of supply, reflecting concerns over the high reliance on imported fuels for energy production and consumption. Due to the dispersion powers within Germany's federal system of public administration, concerns over energy security can only be dealt with through an enabling and supportive national framework which acknowledges the role of local governments and other local actors in the transition process. Second, the continuing influence of The Greens in shaping the dominant ideas about how transitions should be achieved has meant that transition and emissions reduction processes have become intertwined with a major transformation of the energy supply systems both in terms of energy sources, ownership and grid architecture (Bayer, 2015). In line with the Party's political programme, the transition agenda ('Energiewende') envisions a more democratic energy supply system with considerable contribution from citizens: while the majority of conventional large power plants often operating on coal are owned by four big companies (EnBW, E.ON, RWE and Vattenfall), the same companies own only about 5% of the currently installed renewable generation. In contrast, private citizens' share in renewable generation accounts to approximately 46% of the total renewable input while the rest is owned by industry (self-supply), project developers and banks (Bayer, 2015). In 2015, over 30% of Germany's electricity supply was met by renewable generation.

However, despite being a national leader among German cities in terms of electricity generated locally from renewable sources, renewables accounted only for approximately 8% of Frankfurt's energy demand in 2013 (FCC, 2015). This points to the third issue which is relevant both in the wider German context as well as in Frankfurt: the successes of measures and interventions aimed at reducing energy demand and increasing energy efficiency have been weakened by economic growth fuelled partly by the energy-intensive sectors of manufacturing and industry. Frankfurt's high economic output has a clear impact on local carbon emissions and resists any decarbonisation efforts. Energy consumption and total emissions from industry and commerce are relatively stable since 2005 (FCC, 2015), despite the progressive policies introduced by the City Council. Due to lack of success in directly engaging market actors in the energy transition agenda of the city, a dominant ideational context has developed within the Council and beyond which sees economic players as customers whose energy demands must be satisfied rather than partners in reducing emissions (Interview 2.05, 2016).

This situation is highly problematic in the light of Frankfurt's emissions reduction target of approximately 95% by 2050, expected to result from a complete shift from fossil-fuels to renewable energy (FCC, 2015). However, the fact that this target corresponds to the Federal Government's goals of cutting CO2 emissions by 40% by 2020, 55% by 2030, 70% by 2040 and, ultimately, by 80-95% by 2050 (FGG, 2017) brings it within the horizon. In order to achieve the emissions reduction goals, various pathways have been developed through the Masterplan 100% Climate Protection which have the potential to halve local energy demand and substitute the remaining generation with renewables through co-operation with the surrounding Rhein-Main Region (FCC, 2015). Solar, wind and biomass are considered as the main sources of renewable energy (Interview 2.02, 2016), with half of reduced demand being met from generation within the city limits and the other half coming from the Region:

> *'[W]hen you look outside the window and you look at the roofs, in 2050, almost every roof will have at least a solar thermal plant or a PV plant.'* (Interview 2.02, 2016)

Consequently, energy transition is considered as a complex issue involving, on the one hand, vertical integration and collaboration between different levels of government (specifically, local and regional):

> *'There is no way around it, we have to work more closely with the regional side here around Frankfurt. But Frankfurt, of course, it's a magnet for many things, not only for jobs, but also for energy. […] At the same time, we have very little space here, very limited possibility in terms of working with renewable energies, so it's […] clear that to fulfil our targets in a long perspective there has to be a more integrated approach with the region in order to compensate for the limited available space which […] we have available in the city, within the city territory. And I would say that that is clear for everyone.'* (Interview 2.07, 2016)

Moreover, ongoing changes in the structure of energy systems and in the process of energy supply prompt closer collaboration with private sector organisations and citizens:

[Energy transition] 'will not be and it should not be organised in a central way, we should not be organised by big companies, but by hundreds or thousands of decentralised associations and energy producers' (Interview 2.03, 2016)

At the same time, there is an understanding that the relationship between local governments and the federal and state governments, in terms of roles, will not change significantly:

*'On the national level (...) it is not possible to develop such kinds of instruments and new facilities and ideas. The national level can make a framework, laws, they can support ideas, but as the former Deputy Mayor for the Environment (...) said, cities are the laboratories.' (*Interview 2.03, 2016)

7.2.3 Resource fragmentation: National and local governance of energy systems

In Germany, roles and responsibilities regarding the regulation and operation of energy systems (including electricity and gas) are dispersed between federal and state level ministries, transmission system operators, as well as several regional and local operators. Federal energy policy in Germany is formulated by the Federal Ministry of Economic Affairs and Energy ('Bundesministerium für Wirtschaft und Energie', BMWi). The most important pieces of legislation concerning German energy policy, including electricity and gas, are the Energy Industry Act ('Energiewirtschaftsgesetz', EnWG; 1935/2005) and the Renewable Energies Act ('Erneuerbare-Energien-Gesetz', EEG; 2000/2017) (Uwer and Zimmer, 2014). The Renewable Energies Act is the primary legal background of Germany's energy transformation, the 'Energiewende'. Through the EEG, the country committed itself to a complete phase-out of nuclear energy by 2022, as well as to a 100% shift towards renewable energies by 2050 (FGG, 2017). Adherence to the law is enforced and monitored via several agencies involved in energy regulation with the regulatory responsibilities dispersed between the federal and state (Länder) levels (IEA, 2013). The main regulatory duties are assigned to the Federal Network Agency (FNA; 'Bundesnetzagentur') which falls under the authority of the BMWi but constitutes a separate entity: the decisions approved by the FNA's directorate, irrespective of the situation, cannot be overthrown by the government (IEA, 2013). The Federal Environment Agency (Umweltbundesamt), working under the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, controls environmental issues related to energy industries, and administers the trading of greenhouse gas emissions under the Kyoto Protocol (Uwer and Zimmer, 2014).

As a consequence of the country's central location in continental Europe, high energy demand and high production and storage capacity, both the electricity and gas networks are tightly interconnected with those of the neighbouring countries, such as Poland, France, Austria, Norway or Switzerland. Internally, German energy infrastructures are best described as a collection of several main transmission and regional and local distribution systems (Bayer, 2015). The country's four autonomous high-voltage electricity transmission grids are owned, maintained and operated by four Transmission Systems Operators (TSOs) as natural monopolies. Similarly, the ownership, maintenance and development of natural gas transmission networks is also distributed among multiple TSOs (IEA, 2013). However, due to the energy regulation culture preceding the introduction of market competition (i.e. exclusive concession contracts with local authorities and related demarcation agreements), and to the absence of major centralisation efforts from the federal state, the downstream energy distribution systems (both electricity and gas) are still rather decentralised and characterised by a large number of actors involved, as well as the strong position of municipal companies previously referred to as 'Stadtwerke' (Uwer and Zimmer, 2014). The Stadtwerke functioned as *de facto* territorial monopolies previous to the liberalisation and deregulation of the electricity and gas markets in 1998 (Bayer, 2015).

The Stadtwerke are the owners of urban infrastructures (including water, electricity and gas systems, waste and sewage management and transport) and provide the related services to citizens. Recently, big energy companies such as EnBW, E.ON, RWE and Vattenfall started to invest in the municipal utilities, and through shares and concession contracts they also own or operate a significant portion of the distribution networks (Bayer, 2015). In Frankfurt however, the water, electricity and gas infrastructures are operated by the company 'Mainova', in which the City Council retained the majority of shares (about 75%; Stadtwerke Frankfurt, 2015). Mainova is involved in the local energy supply on all levels, including energy production, distribution through its subsidiary (NRM Netzdienste Rhein-Main GmbH), and it is the 'default supplier' in the city and its surroundings. Despite the possibility to switch to other competitive suppliers since the liberalisation of the markets, over 80% of consumers are still supplied by Mainova (FCC, 2015).

According to the Energiereferat's statistics (2015), energy consumption in Frankfurt was dominated by electricity (38%), natural gas (30%) and district steam and heat (27%) in 2013 (excluding transport). Local generation covers about 30% of electricity and 47% of heat used for space and water heating and for industrial processes (FCC, 2015). Energy produced from local sources, including waste incineration, biomass and renewables account for approximately one fifth of the demand (Regionalverband, 2016). The rest is met by fossil fuel generation locally from Mainova’s own plants and via purchasing from the wholesale market. Nevertheless, as neither coal, gas nor petroleum products are available locally, these are imported to the city’s power plants from elsewhere, mostly outside of Germany. Table 7.2 shows the local initiatives relevant to energy production, consumption and low-carbon transition in Frankfurt.

TYPE OF INITIATIVE	PROJECT	ACTORS INVOLVED	ENERGY PRODUCED	RELEVANCE FOR LOCAL ENERGY TRANSITION
COGENERATION AND DISTRICT HEATING	Large-scale co-generation and district heating	Mainova AG (majority owned by the Municipality of Frankfurt);	47% of heat demand 24% of electricity demand	District heat, steam and electricity produced locally from four local power plants running on gas and coal and in four smaller plants from waste incineration, biomass treatment and biogas production (FCC, 2015).
	Block-type cogeneration and district heating ('Blockheiz-kraftwerk')	Mainova AG (majority owned by the Municipality of Frankfurt);	10% of heat demand 2% of electricity demand	Several hundred installations of block-type CHP units ranging from 5 kWel (installed in a kindergarten) to 4000 kWel (powering the offices of the German Federal Bank) (TC, 2014).
WASTE-TO-ENERGY SCHEMES	Waste incineration (MHKW Nordweststadt)	Müllheizkraftwerk Frankfurt-am-Main GmbH (jointly owned by Mainova and the municipal waste management company, FES GmBH);	100GWh electricity/year Heat for 30000 households	The plant converts 9500 tonnes of municipal waste per week to steam and electricity via cogeneration, equivalent to nearly 500 000 tonnes annually.
	Biomass Power Plant (Biomasse-Kraftwerk Fechenheim)	Mainova AG (majority owned by the Municipality of Frankfurt);	70 GWh electricity/year 95 GWh steam/year	Mainova's biomass power plant converts waste timber from municipal forests into energy using CHP technology. Constructed in 2005, it burns about 13 tonnes of waste wood per hour. The electricity produced is equivalent to the demand of about 20 000 households. The steam is supplied to industrial and commercial consumers (Mainova, 2009).
	Biogas production	Rhein-Main Biokompost GmbH (owned by FES); Infranova Bioerdgas GmbH (jointly owned by Mainova and Infraserv, the owner and operator of the Höchst Industry Park);	Plant 1: 1.65 million m^3 biogas/year Plant 2: 80 GWh worth of biogas/year (app. 4000 households)	FES's biogas plant is fuelled by municipal bio-waste and green waste from city parks and gardens. The gas produced is fed into the local grid and is used by Mainova in block-type CHP units to produce electricity and heat. Industrial organic waste and sewage is converted into energy at the Höchst Industry Park (Frankfurt's largest industrial site of chemical and pharmaceutical production).
RENEWABLES (SOLAR AND WIND)	Large-scale solar and wind	Mainova AG (majority owned by the Municipality of Frankfurt);	200 GWh electricity /year (app. 13% of the company's generation)	Mainova invests in onshore and offshore wind, solar and hydroelectric power plants, most of which are located outside of the Rhein-Main Region.
	Local solar electricity generation (Frankfurt)	ABG AG (majority owned by the Municipality of Frankfurt);	0.13 GWh electricity /year	The municipal housing company, ABG AG installed about 3000 m2 of solar panels on social housing buildings. Tenants are given the opportunity to invest in the solar PV schemes and may earn a 4% fixed return on their investment per year (frankfurt-greencity.de).
	Local solar electricity generation (Frankfurt-Rhein-Main Region)	Citizens' co-operatives (e.g. Sonneninitiative e.V or SolarInvest Main-Taunus e.G);	23 GWh electricity /year (total)	Citizens' cooperatives are active in investing in solar power in and around Frankfurt. Co-operatives rent roof space from building owners, install PV panels and sell the electricity to the grid operator, Mainova (Interview 2.04, 2016). Altogether there are over 1100 solar power plants installed within the city boundaries.
	Solar thermal energy	Building owners (not organised into co-operatives);	16 GWh heat/year	Solar thermal energy is being produced in over 1700 small-scale solar thermal power plants (FCC, 2015) which is used for water and space heating in the individual buildings where the installations are located.
ENERGY SAVING FROM BUILDINGS	Direct assistance and expert advice on energy saving from the Municipality	Energiereferat (municipal energy agency); Umweltamt (environment department);	N/A	A service provided free of charge by the Municipality of Frankfurt to citizens and businesses through various programs (e.g. Eco-Audit Program Energiepunkt; eClub; 'Frankfurt Saves Electricity'; Eco-Profit; LEEN – Learning Energy Efficiency Networks; frankfurt-greencity.de) and individual assessments for large organisations (e.g. Commerzbank, European Central Bank; Interview 2.03, 2016)
	Consultancy through partners	Caritas e.V (charity organisation of the German Catholic Church); Energiereferat;	N/A	Providing assistance and advice on reducing the energy bills of disadvantaged households through energy efficient modernisation (Interview 2.03, 2016; Interview 2.07, 2016). Caritas and the Municipality collaborated to train long-term unemployed people to become energy consultants and carry out energy assessments.
	'Passivhaus' Resolution	Frankfurt City Council; Energiereferat; Energy Management Group (Hochbauamt); ABG AG;	N/A	The Passivhaus Resolution requires any building built by the Municipality or constructed on land acquired from the Municipality to be built to passive-house standards (FCC, 2007). The total floor space of passive-house buildings reached over 600 000 sqm in 2015 (about 2500 apartment and 1000 office buildings; frankfurt-greencity.de).
	Behaviour change	Umweltlernen e.V;	N/A	Umweltlernen ('environmental learning') association, funded by the Municipality, organises several initiatives to raise awareness to the importance of energy saving (e.g. energy management training for school teachers and staff, educational programs for school children; programs to reduce emissions from food consumption; Interview 2.06, 2016)

Table 7.2 Low-carbon energy initiatives in Frankfurt

By reviewing the actors involved in low-carbon energy initiatives it becomes clear that the local governance of energy systems is dominated by municipal companies (operation) and agencies/departments (strategy). Consequently, although energy policy-making and regulation is overseen by federal level ministries (and to a lesser extent, by Hessian state authorities), Frankfurt City Council has considerable influence over the development trajectory of local infrastructures partly through its territorial authority, and partly due to its ownership of various municipal companies such as Mainova (energy company), FES (waste management company), and ABG (municipal housing company).

7.3 TRANSITION GOVERNANCE NETWORKS IN FRANKFURT

7.3.1 Network structure and actor analysis

While there is a long tradition of collaboration between stakeholders (e.g. the Energiereferat and external actors) in relation to implementation, access to agenda setting and to the formulation of (energy) strategies were restricted to municipal bodies up until the last few years. The first arena for strategic decision-making was set up in 2010 which has been followed by several others later. Table 7.3 shows the surveyed collaborative governance initiatives which have been conceptualised as arenas for decision-making about the sustainable future of the city, with particular attention paid to initiatives explicitly aimed at the reconfiguration of local energy systems in the selection process. In this section, the focus of the analysis are the structural characteristics of the energy transition network in order to set the context for the following investigations into network processes and the role of the network in decision-making about sustainable energy futures in Frankfurt.

Name	Date of Formation	Administrative Level	Nr. of Members	Description
Umweltforum Rhein-Main	2001	Region (Frankfurt-Rhein-Main)	155	Cross-sectoral sustainability network led by the Department of Environment
FGC Sustainability Board	2010	City	25	Advisory board for the 'Frankfurt Green City' initiative, originally set up for the city's 'European Green Capital' application process
M100CP Advisory Board	2013	City	32	Advisory board for Frankfurt's 'Masterplan 100% Climate Protection'
IMP Advisory Board	2013	City	25	Advisory board for Frankfurt's 'Industry Masterplan'
IMP Energy Working Group	2013	City	12	Thematic advisory group for Frankfurt's 'Industry Masterplan'
Regional Energy Concept – Energy Working Group	2014	Region (Frankfurt-Rhein-Main)	24	Thematic advisory group for the Regional Energy Concept
Regional Energy Concept – Economy Working Group	2014	Region (Frankfurt-Rhein-Main)	13	Thematic advisory group for the Regional Energy Concept
Regional Energy Concept – Mobility Working Group	2014	Region (Frankfurt-Rhein-Main)	26	Thematic advisory group for the Regional Energy Concept
Regional Energy Concept – Housing Working Group	2014	Region (Frankfurt-Rhein-Main)	30	Thematic advisory group for the Regional Energy Concept
Regional Energy Concept – Finance Working Group	2014	Region (Frankfurt-Rhein-Main)	16	Thematic advisory group for the Regional Energy Concept

Table 7.3 Collaborative governance initiatives (decision-making arenas) in Frankfurt

The local governance network for energy transition was reconstructed using the membership lists of the collaborative governance initiatives presented in detail in Table 7.3. The two-mode network, showing organisations' involvement in decision-making arenas, is presented in Figure 7.3.

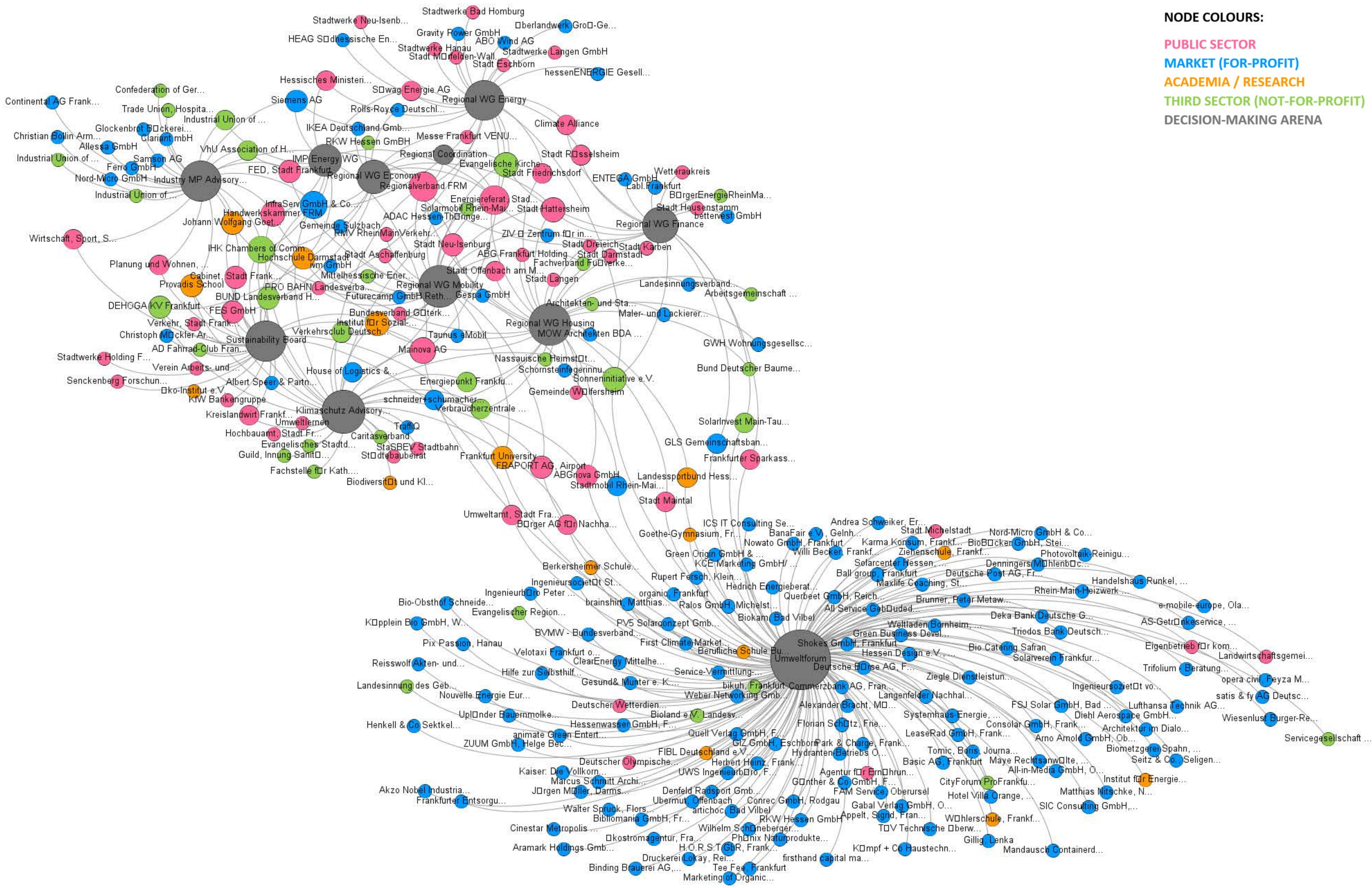


Figure 7.3 Governance network of decision-making for low carbon transition in Frankfurt (two-mode visualisation)

The bipartite (two-mode) network showing organisations' involvement in collaborative governance arenas provides information on network size (i.e. the number of arenas and actors involved), the overlap between the memberships of different arenas and the overall connectedness of the network. In the case of Frankfurt, the whole network consists of a total of 281 nodes which are connected to each other through 363 edges, accounting for a graph density score of 0.009. Thus, less than 1% of all possible edges are actually present in the graph, indicating a relatively sparsely connected network with little membership overlap between the different arenas. The relatively high network centralisation score of 0.55 signals not only that most organisations participate in a single arena, but also that one particular arena dominates the network in terms of size (Umweltforum).

The core of the network can be reconstructed by zooming in the potentially more influential actors involved in at least two arenas (i.e. have a degree centralisation score of at least 2). The core network identified this way is shown on Figure 7.4.

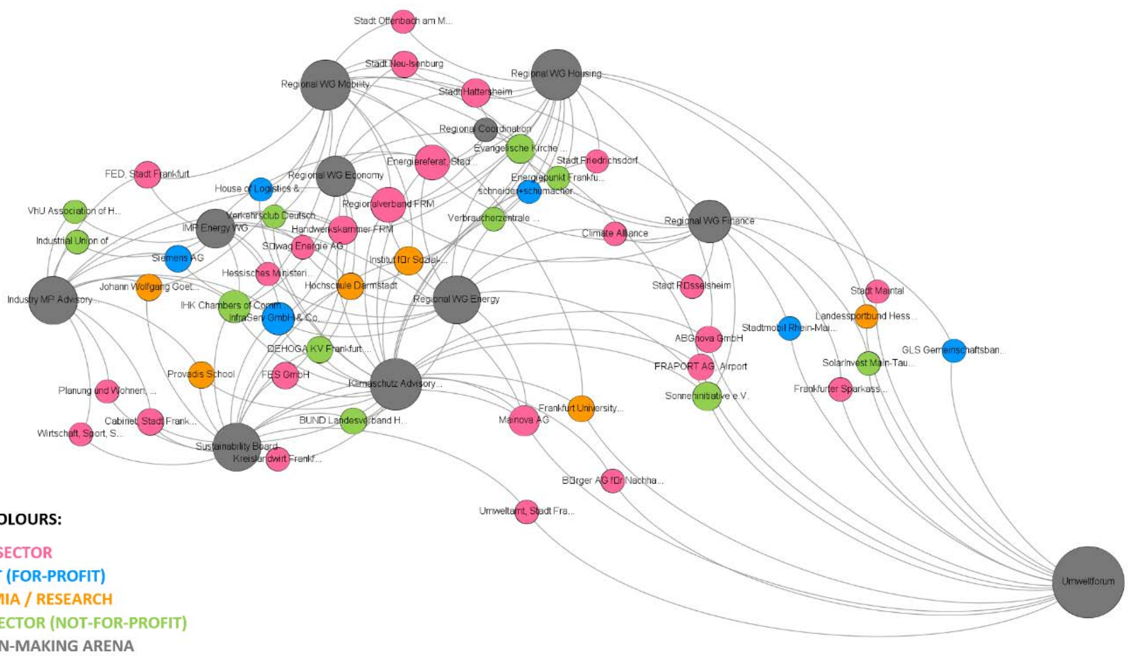


Figure 7.4 The core group of the sustainable energy governance network in Frankfurt (two-mode visualisation)

This core network contains a small fraction of the actors involved in the original (whole) network: only 47 organisations remain from the total of 270 (17%). In the core group, network density increases to 8.5% from 0.9% and the score drops from 0.55 to 0.31, due to the elimination of most of the Umweltforum members who are not involved in any other initiative. The low network centrality indicates that, instead of one arena or actor dominating the core network, the organisational landscape can be considered balanced.

The shares of actors from different sectors in the original and the core network (see Table 7.4) reveals that most market actors (companies and private businesses) are only involved in one arena (Umweltforum) and, therefore, do not appear in the core group. The more influential core of the network seems to be dominated by the public sector and, to a lesser extent, civil organisations and associations.

SECTOR	SHARE OF TOTAL IN WHOLE NETWORK	SHARE OF TOTAL IN CORE NETWORK
MARKET	60%	13%
PUBLIC	21%	51%
CIVIL/VOLUNTARY	13%	23%
ACADEMIA	6%	13%

Table 7.4 Sectoral shares in the entire network and the core group

In a second step, the two-mode network analysed above was converted into a one-mode graph, emphasising the connections between organisations involved in the same decision-making arenas. The one-mode network data was used to determine the actors occupying central positions in the network, according to the statistical measures of degree, betweenness and closeness centrality (Chapter 5, Section 5.5.2). The one-mode visualisation on the entire network is shown on Figure 7.5. Figure 7.6 presents the relationships between organisations in the core group. The centrality scores of each actor involved in the network are included in Appendix V (pp. 352-363).

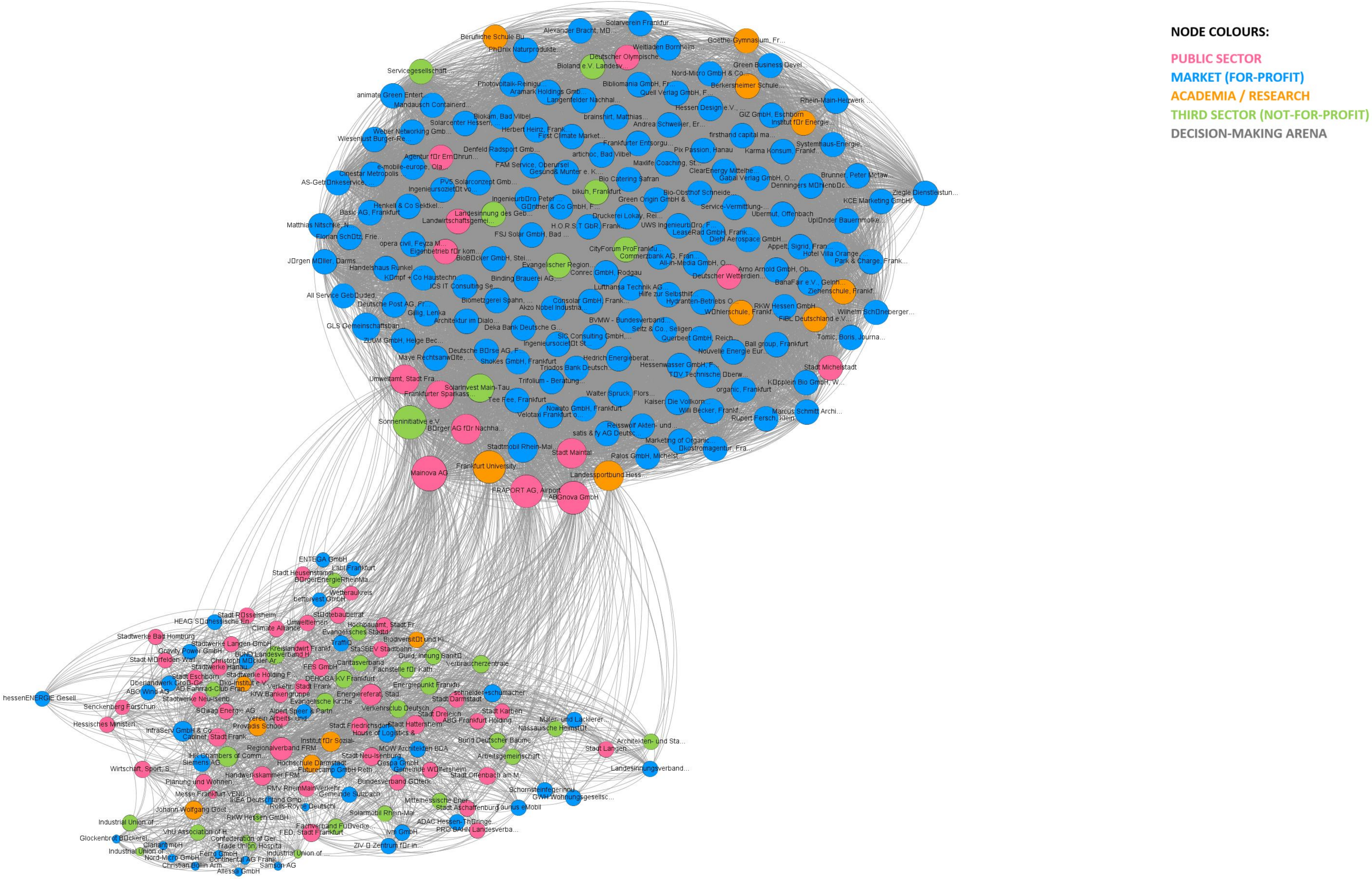


Figure 7.5 Governance network of decision-making for low carbon transition in Frankfurt (one-mode visualisation)

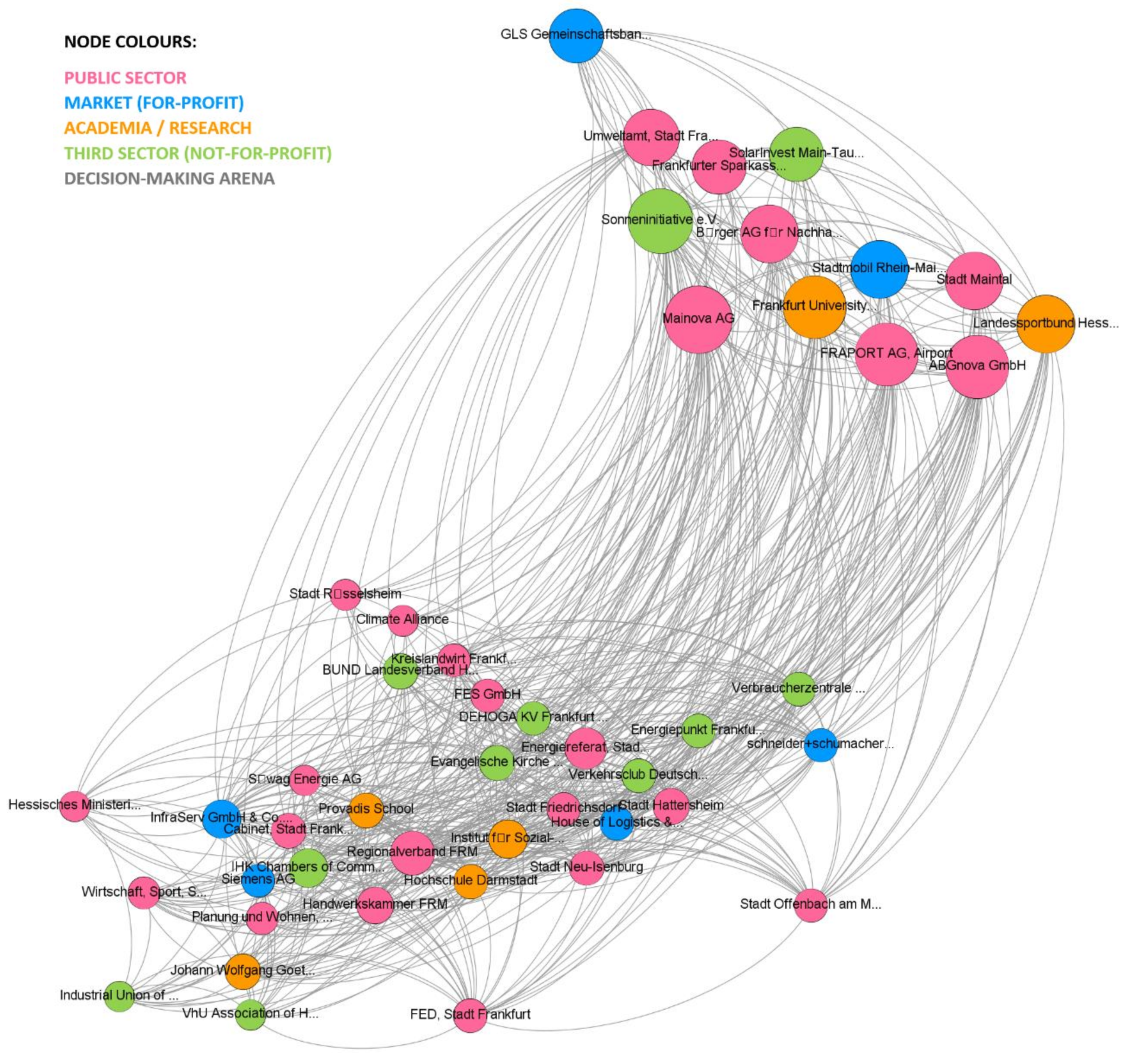


Figure 7.6 The core group of the sustainable energy governance network in Frankfurt (one-mode visualisation)

Due to the relatively large membership of the Umweltforum compared to the other arenas, organisations involved in this collaborative initiative emerge as well-connected actors and possess the highest scores with regard to degree centrality. However, the overwhelming majority (over 90%) of these organisations are only members of one arena and, consequently, have low scores in terms of betweenness centrality. This indicates that they don't occupy strategic (brokerage) positions within the network. Instead, such key positions are occupied by public bodies (Umweltamt, Regionalverband, Energiereferat, etc.), companies owned by the public sector (Mainova, Fraport, ABGNova), co-operatives (Sonneninitiative e.V., Bürger AG für Nachhaltiges Wirtschaften, GLS Gemeinschaftsbank e.G, SolarInvest Main-Taunus e.G), various associations (IHK Chambers of Commerce and Industry, Handwerkskammer FRM – Craftsmen's Union) and research and academic institutions (Frankfurt University of Applied Sciences, Institut für Sozial-ökologische Forschung ISOE).

Overall, the structural analysis demonstrates that the sustainable energy network in Frankfurt is characterised by high level of authority and influence from the local and regional public sector. The central role of energy co-operatives represents a move towards social innovation in sustainable energy supply. Compared to the public and third sector, actors from the market remain in the background, pointing to either inability or unwillingness from the part of Frankfurt City Council to engage with private businesses and companies. In the following sections, the findings of the structural analysis are clarified and complemented with additional information and insights obtained through interviews with local actors who appeared to occupy key positions in the network.

7.3.2 Content and process of network interactions

The arguments presented in Chapter 5 around the difficulties and potential benefits involved in conducting governance network analysis which takes into account both structure and process (Bergé et al., 2017; Christopoulos, 2008; Lewis, 2011) point to the value of collecting qualitative information on how governance processes within and between the different decision-making arenas play out in practice. This is important in order to better understand the functioning of the governance network, and to validate, evaluate, clarify and complement the conclusions drawn from the structural analysis based on quantitative data.

The structural analysis (see Figure 7.3 and 7.5) points to a clear divide between the Umweltforum and the rest of arenas. Due to its extensive membership, the Forum and its members appear to be well-connected according to the quantitative data collected. However, interviews with network actors revealed that, in contrast to other initiatives, interaction between stakeholders in this setting is mostly confined to informal networking and information exchange about experiences with energy efficiency; that the membership of the group is fluctuating; and that meetings are infrequent and only involve parts of the group (Interview 2.02, 2016; Interview 2.03, 2016; Interview 2.04, 2016):

> *'We're just networking. We are meeting, and we are talking about the things (...). There's always some people who can do things together, but it's not the intention of the group. We just want to [sensitise] the people in the companies (...) with the theme of energy saving. (...) Working group[s] acquire members (...) for each event, and so it's floating between members who is on what working group.'* (Interview 2.04, 2016)

Opposed to the Umweltforum, the rest of the arenas set up more recently by the Energiereferat and the Regionalverband, involve fewer actors and have more of a thematic focus (Interview 2.03, 2016; Interview 2.07, 2016; Interview 2.08, 2016). This, together with relatively low levels of integration often resulted in conflicts between the decision-making processes taking place in the different arenas (for example in the case of the M100CP Advisory Group and the Energy Working Group for the Industry Masterplan; Interview 2.02, 2016; Interview 2.05, 2016). The key brokerage positions were occupied by the Energiereferat and the Regionalverband, connecting the different themes by participating in the majority of collaborative initiatives. Besides intermediating between arenas, these organisations also had a role in connecting strategy to implementation:

> *'[O]ther cities also had these advisory boards, but we also had […] this networking. So, in many cases […] we had bilateral or trilateral projects, because this advisory board sometimes is only about meeting and talking and eating. (…) But the network will only maintain if you have projects together with them.'* (Interview 2.03, 2016)

According to the interviewees, the dominance and leading role of public sector bodies resulted in two distinct outcomes. First, the difficulties in engaging with actors from the market sector, many of whom were international companies, led to the development of locally focused agendas and further complicated their involvement in subsequent networking processes:

> *'All the companies being based here, they do have their own sustainability initiatives and those are very often decided in Switzerland or in the US or in France, where the headquarters are. So there the local debate about what should be done isn't the most influential part. (…) I think this plan [the Masterplan 100% Climate Protection] is much more helpful and gives much more guidance to the SMEs. (...) For them, the local market might be more important than the international market.'* (Interview 2.05, 2016)

Second, a dominant perception has developed among citizens that civil action was not necessary, as the City Council and the Regional Authority were leading the agenda on sustainability transitions:

> *'NGOs are normally more strong [sic] if they fight against something, against nuclear power, against lignite power, etc. But then in some cases, in the campaign for electricity saving, then the city is looking 'where are the citizens, where are the ambassadors?'. (…) In Frankfurt, as I know from the Friends of the Earth (…) they are more active (…) on the question of city climate, on green spaces, on (…) protecting birds in the city, but not so active on the energy side.'* (Interview 2.03, 2016)

The energy co-operatives, now occupying central positions in the network, started from other towns from the surrounding region and spread to Frankfurt later on, mainly through setting up projects there (Interview 2.03, 2016; Interview 2.04, 2016). After initially infiltrating the stakeholder network on the implementation level, they recently gained influence in strategic decision-making, mainly through the collaboration processes organised by the Regionalverband.

Vertical collaboration between different levels of government in Frankfurt has always been highly dependent political alignment between the ruling coalitions, especially in the relations between the City Council, the Regional Authority and the state administration of Hesse (Interview 2.03, 2016). However, the Federal Government is too many steps away from the local authorities to become directly involved in local transitions; rather, it provides a supportive framework which leaves room for manoeuvre for the local level to achieve their ambitions as they see fit. Despite the difficulties involved in engaging in discussion across governmental levels, regional collaboration has always had a role in the low-carbon network in Frankfurt, as many of the professional bodies (e.g. the IHK Chambers of Commerce and Industry and the various trade unions) are organised on the regional level.

7.3.3 The network's role in decision-making

The role of networks in the decision-making process about sustainable energy in Frankfurt was restricted to implementation until 2010. In this period, various 'clubs' were established from companies and other organisations participating in the initiatives led by the Energiereferat which were aimed at promoting energy efficiency (see also Section 7.2.1). The functions of these groups (with the Umweltforum being the most prominent among them) were mostly restricted to information exchange, sharing experience and 'networking', understood as engaging in social interaction with representatives of other organisations. Although these initiatives were not directly involved in strategy formulation, they contributed to building connections with stakeholders (Interview 2.03, 2016; Interview 2.04, 2016).

The idea of stakeholder involvement in strategic decision-making gained support only in the year 2010 through the European Green Capital application process. Although several collaborative initiatives were set up in the subsequent years, these have not diminished the role of the local government in the formulation of strategies. Instead, decision-making arenas are used to give advice and consult about decisions discussed within Frankfurt City Council:

'In general, the KSB [Klimaschutzbeirat – M100CP Advisory Board] is a pure consultancy council. If someone needs the expertise of the KSB he/she will get that consultancy service.' (Interview 2.08, 2016).

Thus, the primary role of collaborative initiatives is to build engagement for the sustainability agenda rather than to actively co-produce strategies due to lack of authority, capacity and competence within the City Council to do so. Consequently, the relationship between public sector bodies (municipal departments and companies) and the private sector retains a hierarchical flavour, moderating the blurring of boundaries between the two.

7.4 IMPACT: NETWORKS IN THE TRANSITION PROCESS

7.4.1 Strategy formulation for local low-carbon energy transition

Long-term thinking can be introduced to the local decision-making context through the formulation of strategic documents which may set out long-term goals (visions) or mid-term interim targets and pathways. The ability to produce such material in network settings gives indication about the development of shared understanding in relation to the nature of the problem, the goals to be achieved and sequences of action which provide pathways to deliver on the ambitions.

In the case of Frankfurt, long-term goals are expressed in terms of a complete shift away from fossil fuels to renewable energy sources by the year 2050. Consequently, instead of the binding target, carbon emissions are addressed indirectly – the Council estimates that by decarbonising the processes which deliver power, heat and transportation services to citizens, CO_2 emissions will decrease approximately by 95%

(FCC, 2015). However, neither the target year, nor the renewable energy target itself were subject to consultation with stakeholders outside the Municipality. Instead, the task was undertaken by Frankfurt City Council, based on expert reports prepared by research institutions as consultancy pieces (Interview 2.02, 2016). Later on, the absence of deliberation with interested actors had consequences for the emerging processes of pathway creation in the decision-making arenas: some actors (albeit mostly from industry and services), questioned the feasibility of the targets which they deemed too detached from the everyday functioning of the city's economy (Interview 2.05, 2016).

Thus, consultation processes with local actors were mostly restricted to developing pathways to achieve the goals set by the Council and to building engagement for the transition agenda. Despite the initial frustration, the Masterplan 100% Climate Protection was successfully developed and published, mainly due to extensive negotiations with actors from the market sector. The main outcome of the negotiations was that the scenarios (contained in the initial consultancy material) envisioning more radical innovation were abandoned (Interview 2.05, 2016) and the responsibility to deliver on the renewable energy target was spread out to the region (Interview 2.02, 2016; Interview 2.07, 2016). The M100CP established that a complete shift to renewables is only possible through generating half of the future energy demand of Frankfurt outside the city limits, in the more rural Rhein-Main Region. These issue is currently being considered through the deliberative processes of the Regional Energy Concept formulation.

Another strategic document which touches on the subject of the future energy supply of Frankfurt is the Masterplan Industry. As the working group which prepared the Masterplan's position on energy transition consisted mainly of actors from the market sector with little overlap with regard to participation in the M100CP consultations, the commitments made remained superficial and voluntary (Interview 2.02, 2016; Interview 2.05, 2016). The very little overlap between the M100CP Advisory Board and the Energy Working Group and Central Advisory Board for the Masterplan Industry, apparent from the network analysis, offer an explanation for such differences. Thus, although strategic documents in relation to energy transitions exist and were published by Frankfurt City Council, the lack of engagement from the market sector may hinder the delivery of ambitions.

7.4.2 Strategy implementation

Due to the limiting the scope of negotiation processes to pathway building and to the apparent dominance of the City Council, strategy formulation is to some extent detached from the low-carbon transition network in Frankfurt. As a result, implementation is more successful in areas over which the Municipality has direct (through legislative powers) and indirect authority (through the ownership of utility companies); and where it directly collaborates with stakeholders on specific projects which then are treated as demonstrations of best practice and models to follow for other actors.

An example for implementation through legislative powers is the Passivhaus Resolution which is supported by the regulatory role of Frankfurt City Council in determining local building codes and standards. Indirect authority is exercised through the central roles of Mainova AG (energy), ABG AG (housing) and FES GmBH (waste management) in the energy transition process – the majority of sustainable energy initiatives are being delivered directly by these companies or others partly owned by them (see Section 7.2.3). Examples of collaboration with external stakeholders on the implementation level include direct negotiations with actors from the market sector (e.g. Commerzbank or the European Central Bank) and various programs providing assistance for energy efficient retrofits for citizens (see Section 7.2.3). As a result of planning processes around the Commerzbank tower in 1992, and the following collaborative initiatives organised by the Energiereferat, finance institutions headquartered in Frankfurt have become champions of the city's energy efficiency agenda for office buildings (Interview 2.03, 2016).

In fact, participants for the decision-making arenas were invited partly on the basis who the Municipality had already collaborated with on the implementation level, and outreach to other actors was limited (Interview 2.02, 2016). The interviews conducted in Frankfurt suggested that this was inescapable and the result of conscious decisions:

> *'In Germany there is a saying 'typical suspicious people', [they] are the people you always have to invite as one man from the company x and so on. And so, we invited well-known, you know, typical people (…). But it's very important to have these supporting people, when you can phone directly in a certain company and say 'I have an idea, would you help me'. (…) It is also important for the Energy Agency that we need these connected people.'* (Interview 2.03, 2016)

Following this rationale implies that network processes may have little impact on implementation, as building on existing networks and collaborations and largely neglecting actors outside of the City Council's circles carries the risk of producing unrealistic agendas and undeliverable goals. However, the approach also seems to contribute to developing a core group of stakeholders with real commitment to the

Municipality's agenda. One result of this process is the now dominant view among main stakeholders that multinational companies can be considered simply as customers of energy which can be produced locally, with municipal commitment and the involvement of new actors, such as energy co-operatives.

7.4.3 Progress towards targets and goals

The carbon reduction target of the city of Frankfurt is approximately 95% by 2050 which is expected to result from a complete abandonment of non-renewable energy sources by the same year (FCC, 2015). This corresponds to the Federal Government's maximum target which aims to cut greenhouse gas emissions by 40% by 2020, 55% by 2030, 70% by 2040 and 80-95% by 2050, compared to 1990 baseline (FGG, 2017; IEA, 2013). Additionally, Frankfurt also has interim targets resulting from its membership in the Climate Alliance network which requires partner cities to cut their emissions by 10% every 5 years, equivalent to 50% reduction by 2030 (1990 baseline; Climate Alliance, n.d./b).

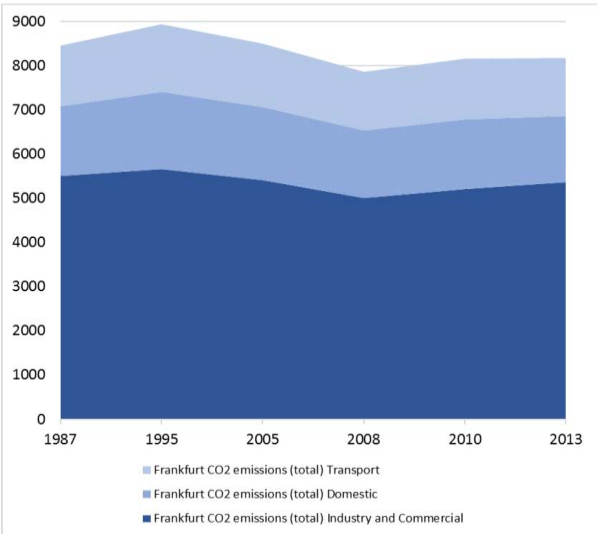


Figure 7.7 Emissions by Sector (kt CO2)

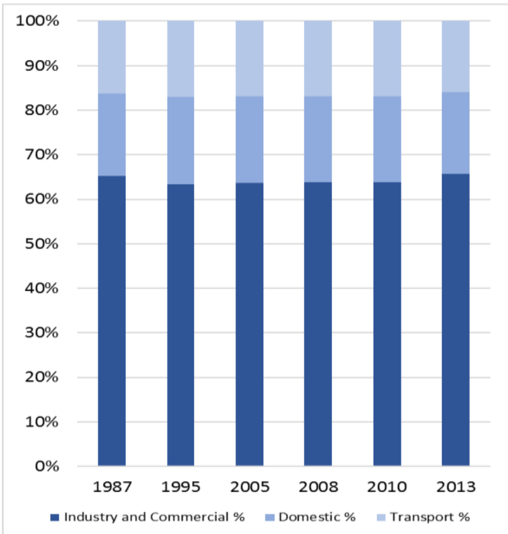


Figure 7.8. Emissions by Sector (% of total)

Frankfurt's reduction commitments are based on per capita targets. Despite the Energiereferat's calculations of 18% reduction in CO2 emissions between 1995 and 2013, further sharp decline is necessary to achieve the 2030 target (FCC, 2015). Moreover, the total emissions generated in the city have only decreased by approximately 5% in the same period. The city's thriving economy has a clear impact on the shares of the different sectors in CO^2 emissions: the market (commerce and industry) sector is responsible for over 65% of the total emissions (see Figure 7.7).. The remaining 35% is distributed almost evenly between the domestic (18%) and transport (17%) sectors (FCC, 2015) (see Figure 7.8). With regard to network governance processes, this means that Frankfurt City Council needs to find a way in engaging with economic players from commerce and industry and must develop a perspective on how to support a shift towards a less carbon-intensive economy (Interview 2.05, 2016).

7.5 CONCLUSIONS

7.5.1 Network governance of the energy transition in Frankfurt

The analysis presented in this chapter demonstrated that the emergence and operation of the energy transition governance network in Frankfurt -both in terms of structure and process- are context-dependent and arise from a complex interplay of locally relevant experiences and perceptions related to sustainable energy on one hand, and to collaborative governance on the other.

The governability perspective is the most applicable to the Frankfurt case out of the three cities in characterising collaboration through networked forms of governance with external stakeholders, including private businesses and community organisations.

Rendering the transition process governable through collaboration nevertheless remains resource and time consuming and involves trade-offs. The prime example for this is the emerging perspective of treating international companies simply as consumers of energy, rather than partners in the transition process, in order to avoid involving actors in the decision-making arenas over whom the Municipality has less leverage. Thus, the hierarchical relationship between the public sector and external stakeholders in the governance network is ensured this way, providing opportunity for Frankfurt City Council to steer network processes and outcomes. Due to the favourable conditions for municipal steering, the interdependence perspective is less relevant in Frankfurt. The continuing hierarchical order between the public and private sector in the network results from the Local Authority's strong position in relation to the key processes and infrastructures of energy transitions.

While network governance on the city level is best described in terms of governability, collaboration among public and private stakeholders operating on different organisational levels represent an integration process where the mutual dependence between actors can only be understood in relation to the common goals and shared interest. Such vertical integration is not only helpful in negotiating the roles and rules of energy transitions among the local, regional, and to a lesser extent, the state and national levels, but also in providing credibility to transition agendas through the alignment of commitments.

Network governance processes on the strategic level are strengthened via direct collaboration in implementation between actors from the public and private sector. Consequently, pilot initiatives have started changing the operation of central actors in the energy system of Frankfurt, for example in the case of the block-type CHP pilot which resulted in the reorganisation of roles and rules among affected actors, including Mainova. Thus, experimentation involving actors from different sectors, led by the Energiereferat, seems to contribute to the emergence of new governmentalities in the energy domain. These reorganisation processes, however, seem not to challenge the role and position of Frankfurt City Council relative to actors from other sectors.

7.5.2 Options for Local Government steering

The network characteristics described above have consequences for the Local Government in relation to its potential to steer network processes and outcomes. The structural analysis presented in Section 7.3.1 highlighted the central role of public bodies, including the municipal Energiereferat and the regional Regionalverband in the network. Interviews also indicated that the position of public bodies is strengthened through internal collaborative processes aimed at building shared understandings of sustainability transitions within the Municipality and the Regional Authority.

Consequently, on the local level, the Energiereferat has the capacity and capability to perform network management in the stakeholder network instead of having to focus its resources solely on intermediation. All decision-making arenas in Frankfurt are set up by the Municipality, and by the Regionalverband on the regional level, providing opportunity for the public sector to set the frames and to influence the content and outcomes of network governance processes. As discussed previously, this comes at a price due to alienating stakeholders who do not accept the leadership of the City Council or the Regional Authority. Consequently, it is still an open question whether Frankfurt will be able to deliver on its ambitious commitments regarding low-carbon development in the absence of engagement from the market sector.

CHAPTER 8.

CASE STUDY 3.
ENERGY TRANSITION IN BUDAPEST

8.1 INTRODUCTION

8.1.1 Objectives and structure of the chapter

This chapter aims to address the second research question:

RQ (2) How can the form, extent, trajectory and impact of a city's low-carbon network governance be assessed?

It answers this question in the setting of the city of Budapest, Hungary, by providing an overview of the contextually relevant conditions in which the governance network operates (Section 8.2); assessing the local governance network's characteristics (Section 8.3); and by evaluating its impact on advancing the local sustainable energy transition (Section 8.4). A diagram of the structure of Chapter 8 is shown in Figure 8.1.

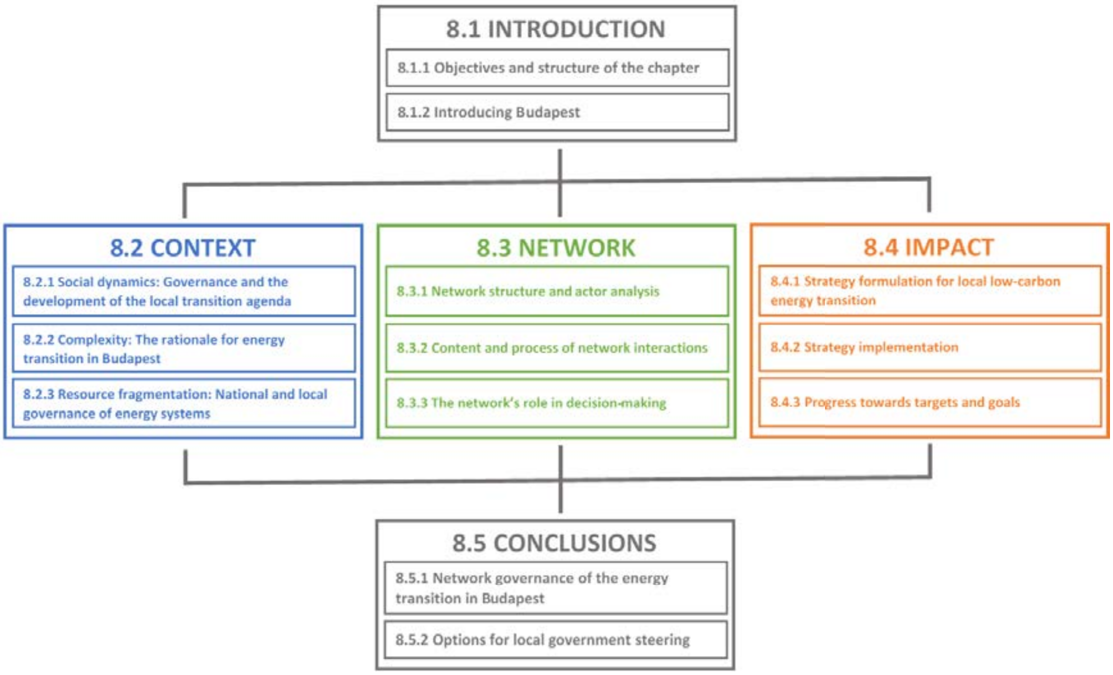


Figure 8.1 Diagram of the structure of Chapter 7 (Case Study 2: Energy transition in Budapest)

The conclusions of the case study are presented Section 8.5 which is divided into two sub-sections. First, the operation of the governance network relevant to governing the local energy transition in Budapest is described, through the lenses of normative integration, interdependence, governability and governmentality. This is based on the discussion presented in Chapter 3, Section 3.3. Second, building on the description of the network, I discuss the options available to the local government to steer the network processes.

8.1.2 Introducing Budapest

Budapest is the administrative, economic and cultural capital of Hungary. It is one of the largest cities in Continental Europe with over 1.7 million inhabitants living within the administrative limits. The metropolitan area of Budapest has a population of over 3.3 million, equivalent to one third of the Hungary's total. The city is located in the centre-north of Hungary, spread on the two banks of the Danube River. It is a major transportation hub: various highway and railway links connecting Western and Eastern Europe connect here. Table 8.1 presents basic statistical data about Budapest's population, size, its economic output and carbon emissions, compared with Birmingham and Frankfurt.

CITY	COUNTRY	POPULATION[1] (2015)	AREA[2]	DENSITY[3] (2015)	PER CAPITA GDP[4] (2014)	PER CAPITA CO2 EMISSIONS[5]
BIRMINGHAM	United Kingdom	1 107 677	268 km^2	4152/km^2	25 500	4.4 t (2014)
BUDAPEST	Hungary	1 757 618	525 km^2	3349/km^2	38 900	4.7 t (2014)
FRANKFURT	Germany	717 624	248 km^2	2924/km^2	88 600	9.8 t (2013)

Table 8.1 Basic statistical data, Budapest

[1]Source: Eurostat 'Population on 1 January by broad age group, sex and NUTS 3 region' in total number (available from http://ec.europa.eu/eurostat/data/database)

[2]Source: Eurostat 'Area by NUTS 3 region' in square km (available from http://ec.europa.eu/eurostat/data/database)

[3]Source: Eurostat 'Population density by NUTS 3 region' in inhabitants per km^2 (available from http://ec.europa.eu/eurostat/data/database)

[4]Source: Eurostat 'Gross domestic product (GDP) at current market prices by NUTS 3 regions' in Purchasing power standard (PPS) per inhabitant (available from http://ec.europa.eu/eurostat/data/database)

[5]Sources: BuCC, 2016; FCC, 2015; HM Government, 2016a

Budapest is a relatively new city: it was formed in 1873 with the unification of three previously separate settlements including Buda, Óbuda and Pest. Despite its relatively short history as a unified city, the area has been inhabited since the Middle Age. Over the past centuries the settlements had to be rebuilt and reorganised several times, most recently after the World War II. Having been one of the major sites of battle between the German and the Soviet army, the majority of Budapest's buildings were damaged or destroyed, as well as all bridges over the Danube. The reconstructions took over 15 years under Soviet rule, but by the 1970’s the city recovered. New developments started in transport (i.e new underground lines) and housing (i.e. Soviet-style prefabricated reinforced concrete tower blocks organised into a ring of residential areas around the historical city centre).

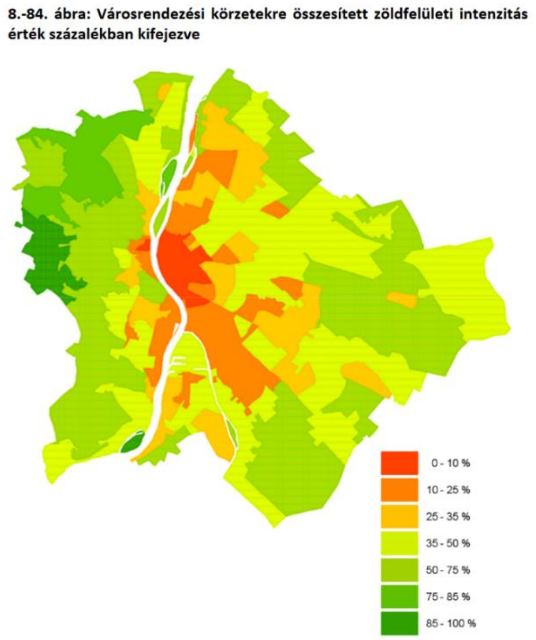


Figure 8.2 The spatial pattern of urban green coverage in Budapest

The subsequent shift from communism to capitalism in 1989 did not deliver the initially expected large-scale redevelopment and modernisation of Budapest. Instead, economic growth has been confined to specific districts located in central Pest and in Buda, and inequality between the developing and relapsing areas has been on the rise since the 1990’s. Simultaneously, a wave of suburbanisation started which resulted in a 17% decrease in the total population of the urban area since the peak in the 1980’s (Tosics, 2004). Albeit this tendency began to shift in 2005, commuting to and from the agglomeration is nowadays the main cause of heavy traffic, noise and air pollution in the city centre (Pálfi, 2013).

Lack of access to green spaces in areas with rising value and price of real estate further exacerbates the negative impacts of this issue on citizens’ wellbeing. Although on average about 47% of the city’s territory is covered by forests, parks and other green areas (BuCC, 2016), the distribution of these is highly uneven (see Figure 8.2): in the inner-city areas, less than 10% of land is covered by vegetation (BuCC, 2016).

8.2 THE BUDAPEST CONTEXT FOR ENERGY TRANSITION

8.2.1 Social dynamics: The historical development of the transition agenda and associated governance responses

In the 1980's and 1990's when sustainable development first gained global attention, Budapest's leaders were busy developing and implementing the various changes necessary to deliver the system transformation from communism to capitalism. In Hungary, the change process brought about a significant shift in terms of the role of local government: central administration got associated with communism and, therefore, the new leadership of the country decided to take decentralisation to the extreme. The new Constitution which entered into force in 1989 essentially equated decentralisation with democracy and affirmed the right to self-government of local level administrations (Keresztély and Scott, 2012). In the dual government system of Budapest this meant that the City Authority (Municipality of Budapest) and the district authorities of the twenty-three administrative city districts became equals with no hierarchical relationships among them (BuCC, n.d./a). Instead, responsibilities for different tasks were distributed between the two autonomous levels. The shift from central rule to local autonomy (complemented with severe budget constraints) brought about significant changes in the decision-making of city planning and development: the central government-coordinated mid- and long term strategic planning process got replaced by yearly budgeting and short-term development plans (Tosics, 2006). The diminished potential for city-wide long-term planning, in turn, contributed to the differential development of the various city districts, facilitating the growth of spatial inequality and segregation (Keresztély and Scott, 2012; Kovács and Hegedűs, 2014; Tosics, 2006). It took over a decade for the city's leaders to acknowledge the pressing need for a long-term concept to guide the ongoing post-communist regeneration processes. From the early 2000’s, several concepts and programs were developed which, albeit in a rather broad sense, formulate a position for the Local Government on sustainability in Budapest. The timeline in Figure 8.3 presents the sustainability-related developments in Budapest’s organisational landscape over the past three decades.

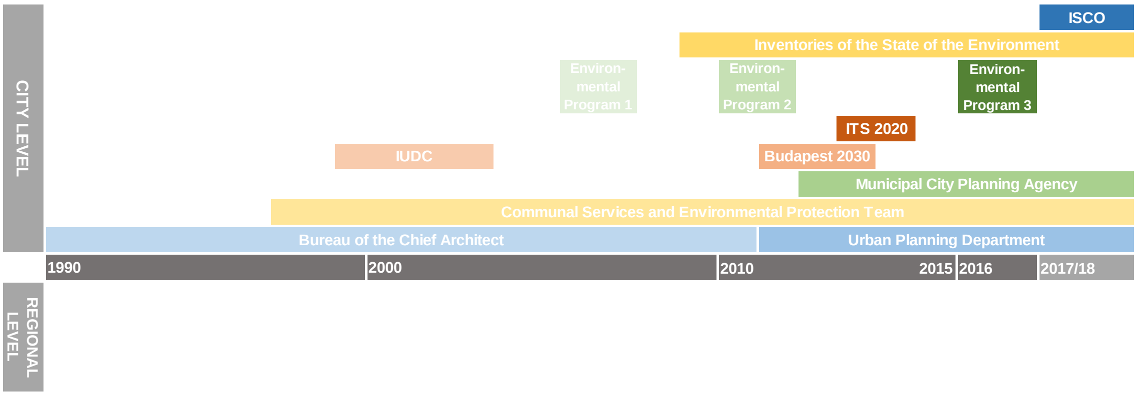


Figure 8.3 Timeline of organisational change in Budapest's sustainable development leadership

The first Integrated Urban Development Concept (IUDC; ‘Budapest Városfejlesztési Koncepció’) was adopted in 2003 by the council assembly (BuCC, 2003). The preparation of the document took five years due to extensive negotiations with the Hungarian Central Government, as well as with citizen groups and experts (academics and researchers), coordinated by the City Council (BuCC, 2003). Results of the consultations were incorporated in the final Concept produced by various research organisations and consultancies, commissioned by the ‘Bureau of the Chief Architect’ of the Municipality (now Planning Department). It was envisaged that the Concept would provide guidance for urban development for the upcoming 20-30 years (BuCC, 2003). The overall goal that the IUDC expressed was to reintegrate Budapest into the European network of metropolises by focusing on seven core themes encompassing a wide range of issues from facilitating economic growth and job creation, speeding up the regeneration of the built environment and the modernisation of urban infrastructures (transport, sewage; district heating; waste management and green spaces) to developing a new leadership model based on a community sense among citizens and collaboration with neighbouring local authorities (BuCC, 2003). The document discussed environmental protection (and indirectly, sustainable development and energy transition) in terms of regeneration and modernisation of existing infrastructures. For example, the ambition to preserve the city's extensive district heating (DH) networks (1/3 of Budapest's apartments are heated through district heating; BuCC, 2003) was necessary to emphasise due to a wave of disconnections of consumers driven by the perceived high fees of DH complemented by the newly acquired citizens' right to do so.

Despite having been developed to guide long-term planning, the IUDC got replaced by the 'Budapest 2030' concept produced between 2011 and 2013. According to the foreword of the new urban development concept the revision was made necessary by the '*significant changes in economic, social and other conditions*' (BuCC, 2013, p. 7) (BuCC, 2013:7), resulting from Hungary's joining the European Union in 2004. Preparation for the new EU budget period (2014-2020) was also cited as a reason to update the Concept. However, it is likely that the change on the political level also had a role in developing a new concept. In 2010 after sixteen years, the right-wing Federation of Young Democrats (FIDESZ) took over control of the Council from the coalition City Government of the Alliance of Free Democrats (SZDSZ) and the Hungarian Socialist Party (MSZP). The directly elected City Mayor was also replaced by a formally independent but FIDESZ sympathiser mayor.

The coordination of the preparation of the 'Budapest 2030' concept was the first major project of the Municipal City Planning Agency (BFVT; 'Budapest Főváros Városépítési Tervező Kft.'). BFVT had operated as an independent for-profit company before having been acquired by the Municipality in 2012 (BFVT, n.d.). The new concept was prepared by groups of *experts* due to its apparent *complexity* (BuCC, 2013, p. 7), in contrast to the previous IUDC which gave more opportunity to the general public to get involved in setting long-term goals (BuCC, 2003). The majority of work was delivered in-house by BFVT, and external consultancies and research organisations were brought in only to develop thematic areas where the Agency lacked specialised knowledge. The process was supervised by the Municipality's Planning Department. Consultations were held with the Mayor, the Deputy for Urban Development, other council departments and municipal companies; the latter, however, was mainly restricted to information gathering. Public consultations started only when the long-term goals were already set by the expert panel, in the phase of prioritisation of goals and the creation of interim targets. According to Körmendy (2017), this is a longstanding problem in policy making for urban development in Budapest which counteracts meaningful participation from the civil society.

The Budapest 2030 Concept expressed four overarching goals: strengthening the city's position as a European capital; developing a value and information-based sustainable economy; developing a diverse, sustainable urban structure; and enhancing the quality of life of citizens and reducing inequality (BuCC, 2013). Environmental sustainability, infrastructure development and the city's climate change agenda were scattered around the second and third themes. Climate protection and emissions mitigation goals and action prioritised the energy efficient modernisation of the existing infrastructure and building stock, although the ambition to encourage the spread of renewables (solar and geothermal energy) was expressed as well but without clear targets to be achieved (BuCC, 2013). The document also identified that the main obstacles to deliver on the ambitions was the absence of appropriate finance mechanisms and the lack of financial resources: modernising the infrastructure built under the communist system with a lack of focus on efficiency would require major capital investment (BuCC, 2013). This problem is further exacerbated by the financial dependence of Budapest City Council on the National Government, as the overwhelming majority of revenues raised in the city are redistributed on the national level. Consequently, city regeneration and development are also largely influenced by EU grant opportunities. In turn, the financial dependence on the National Government and the EU makes it difficult for the Local Authority to engage in strategic long-term planning (Interview 3.05, 2016).

The environmental agenda of Budapest City Council is established through a series of five-year Environmental Programs, which provides a thematic framework for implementation complementing the long- and mid-term concepts. It identifies more concrete thematic areas for action, as well as planned developments and options to finance these (BuCC, 2017; 2011). The Environmental Programs do not provide new input into the goals developed by the long- and mid-term plans. The Programs being prepared by the Municipal City Planning Agency and other consultancies, supervised by the Asset Management Department. When Budapest joined the Covenant of Mayors in 2009-2010, a Sustainable Energy Action Plan was prepared which became a section of the subsequently produced Budapest Environmental Program 2011-2016 (BuCC, 2011).

The progress is being monitored annually through the production of reports called 'Inventory of the State of the Environment of Budapest' ('Budapest Környezeti

Állapotértékelése') which also serve as the bi-annual monitoring of carbon emissions required by the Covenant of Mayors (BuCC, n.d./b). Data collection for the inventories is carried out in collaboration between the Municipal City Planning Agency and the 'Communal Services and Environmental Protection' Team within the Asset Management Department of the Municipality. The Team is responsible for managing contracts with the municipal utility companies (Interview 3.02, 2016).

Although Environmental Programs were being produced for internal use of the municipality since 2002, the first publicly accessible Program was developed in 2007 via a similar consultation process as the Integrated Urban Development Plan. Participation was encouraged by the establishment of a formal body called the 'Urban Forum for Environmental Consultation' ('Fővárosi Környezeti Konzultációs Fórum'). Parallel to the Integrated Urban Development Strategy, the Environmental Program was also revised by the FIDESZ administration in 2011. The development of the Budapest Environmental Program 2011-2016 was commissioned out to a private consultancy (Env-in-Cent Kft.), supervised by the Council's 'Commission for Urban Development, Transport and Environmental Affairs' set up in 2010 (BuCC, 2011). The Commission was also made responsible for the allocation of funding for projects related to sustainable development through the 'Environmental Protection Fund' set up in 2009 (Interview 3.05, 2016). All members are local politicians and councillors from the different parties from the city and district levels; executive officers and other stakeholders have no role in the Commission.

As the above discussion demonstrates, climate change and low-carbon transition related issues have so far been discussed exclusively in relation to urban development and regeneration goals. Emissions reduction has not been given specific consideration; instead, the monitoring activity is expected to ensure that projects driven by grant opportunities and political priorities also deliver the carbon targets (Interview 3.02, 2016; 3.03, 2016). However, as the issue of urban sustainability is increasingly being treated as a main priority on the European level, funding is being made available for local authorities to engage with local sustainable transformations. Application for European and national funding is assigned to the Department of Investment and Project Management which is only loosely connected to the Asset Management Department to the Planning Department, creating a mismatch between long-term strategy, short-term action and operation.

Budapest has recently applied for funding to develop a climate strategy for the city (Interview 3.01, 2016; Interview 3.05, 2016); so far, only the feasibility study has been conducted which was part of application documentation. The feasibility study was prepared by the Municipal Planning Agency (Interview 3.08, 2016). Moreover, a smart city strategy is currently being formulated in relation to Budapest's application to organise the 2024 Olympic Games (Interview 3.05, 2016). Parallel to the progress on the strategic level, attempts are being made to overcome some of the implementation barriers to low-carbon innovation. The Municipality is setting up a so-called 'Urban Development Fund' with (financial and legal) support from the European and national level. The fund will be targeted at urban innovation projects carried out by either the public sector or private investors, start-ups and small- and medium-sized companies (Interview 3.05, 2016). In order to enhance the municipal utility companies' potential for leveraging funding and attracting investment, the City Council has developed a concept to set up an 'ISCO' ('Innovative Services Company') taking the currently popular 'ESCO' ('Energy Services Company') model as inspiration (Ernst & Young, 2014). The main task of the company will be to aid the integration of innovation activities in the public service system of Budapest; bring down costs by preparing strategies for synergistic development; and raise the necessary funds for project delivery (Ernst & Young, 2014). In terms of organisational structure, the ISCO is planned to be set up as a separate entity with its own management structure. It is expected to operate in close collaboration with the relevant departments at the municipality to ensure that the projects realised will contribute to achieving the city's strategic goals (Interview 3.09, 2016). To support the work of the ISCO management board, a multi-stakeholder advisory board is advised to be set up, consisting of representatives of the municipal companies and utilities, departments, senior officers from the City Council and experts from consultancies and research organisations (GRID Consulting, 2015).

8.2.2 Complexity: the rationale of energy transition in Budapest

In the 1970's and 1980's, when environmentalist movements first gained support in Western Europe, Hungary was still member of the communist bloc. In this period, political and economic priorities in the East were driven by a strategy of forced industrialisation under communism. Thus, the system change presented the National Government with a complex issue of simultaneously having to deal with the restructuration of the economy (from centralised state communist to liberal capitalist model), society (reinstating the democratic order) and, consequently, of the politico-administrative system. This situation, together with an enthusiasm toward neoliberalism which proved successful in reviving the economy of the 'role model' Western states, created an environment in which the notion of 'sustainable development' was interpreted in its broadest sense, including the economic, social and environmental dimensions (Kerekes, 2006). The system change from communism to capitalism was seen as a means to deliver on the ambitions along all three dimensions: it was expected to enhance the well-being of citizens by reinstating democracy, to produce economic growth through a shift from centrally coordinated economic activity to market competition, and to address concerns over environmental degradation and pollution through abandoning the communist focus on heavy industries. Thus, the environmental agenda emphasised the role of mitigating and preventing environmental degradation resulting from industrial processes.

The reduction of CO_2 emissions has so far not been an explicit concern on the national level on its own right (NGH, 2012); rather, it has been treated as an economic opportunity for the country to leverage revenues from the EU Emissions Trading System. The restructuration of the economy and the marginalisation of the role of carbon-intensive heavy industry resulted in a carbon saving of 43% by 2009 compared to the 1987 baseline, well over-performing the requirements resulting from the Kyoto Protocol (6% reduction by 2012 compared to 1987 levels; NGH, 2012). Moreover, the carbon intensity of energy had already been relatively low in Hungary, due to an extensive use of gas for heating and hot water production, and the role of nuclear energy in electricity supply (over 50% of the electricity demand is met by nuclear power; IEA, 2017). Thus, initial successes were achieved without the need to take a strategic approach on the national level, by gradually introducing market competition to various sectors of the economy. In fact, the 'First National Climate Change Strategy' was prepared and approved by the parliament as late as 2008 (for the period 2008-2025). The preparation of a strategy became necessary due to Hungary's commitment to implement the Kyoto Protocol. The Strategy, produced by the left-wing government of the Hungarian Socialist Party, was developed through a public consultation process with citizens, interested parties and experts (NGH, 2008). It was later revised and extended with an outlook to 2050 in 2012 when the government was overtaken by the FIDESZ. Both documents took a bottom-up approach, meaning that instead of taking a specific reduction target as a starting point for back-casting, they built on scenario analysis on the basis of extensive data collection about trends and opportunities in various sectors (NGH, 2012, 2008).

Overall, the positive experience with market mechanisms in reducing emissions contributed to the development of a dominant view among the leaders of the country that direct action (aimed explicitly at emissions mitigation) was not required, as further modernisation and innovation would be sufficient to deliver the country's international commitments towards the United Nations and the European Union. This apparent enthusiasm and confidence in continuing success in decarbonisation underpins the relatively easy and uncomplicated ratification processes of the 2013-2020 extension of the Kyoto Protocol and the Paris Agreement. Moreover, Hungary was the first of all European countries to sign and ratify the Paris Agreement in 2015. Nevertheless, instead of a strategic approach, commitments and implementation are dominated by the politics of the day: for example, electricity grid decarbonisation is driven by the political decision to gradually replace the existing nuclear power plant with new-built blocks, also expanding its capacity. However, independent studies conducted by the EnergiaKlub Climate Policy Institute in collaboration with the German Wuppertal Institute found that the new power plant will have a negative impact both on the economy and the environment (EnergiaKlub, n.d.). Meanwhile, no economic or ecological assessments were published by the National Government to justify the necessity of the investment. Being built from Russian interstate loan, the project will reinforce the country's energy dependence on Russia. This is problematic from an energy security perspective, because Hungary is already reliant on Russian gas import to satisfy 80% of its demand (Kaderják et al., 2011). In order to defend the investment into nuclear energy and to avoid having to allocate funding for the modernisation of the centralised electricity grid, the National Government provides little encouragement for investment into renewables for citizens or for-profit investors. The spread of solar or wind energy technologies is hindered by lack of support from central government (i.e. no specific strategies or goals and very limited support mechanisms on the national level), legal challenges (i.e. windfarm constructions are essentially banned over the entire territory of the country; the use of solar panels is restricted in listed buildings and neighbourhoods) and relatively high costs and low returns (i.e. environmental tax on solar panels due to embedded carbon; low feed-in tariffs and government-dictated low energy unit price for consumers).

In this energy policy context, dominated by political will and market mechanisms rather than rational decision and leadership from the public sector, Budapest City Council decided to abandon the idea of taking up the complex challenge of decarbonising the local energy systems. Instead, the focus is on facilitating win-win situations where urban regeneration and growth (projects driven by grant opportunities and political priorities) also contributes to emissions reduction:

> *'So, for example, we did not build a fourth underground line to save energy and carbon. But when we were planning 'Metro 4', one of the aspects to consider was how much less CO_2 would be emitted in the capital with the completion of this project.*' (Interview 3.03, 2016)

In implementation, this approach translates into system improvements to existing infrastructure (e.g. district heating networks and public lighting); and the energy-efficient modernisation of the aged and/or low-quality housing blocks. Regarding the first issue, the Municipality has recognised the need to build more active working relationship among its utility companies, facilitated through the planned ‘Innovative Services Company’ (ISCO; Ernst & Young, 2014; GRID Consulting, 2015). In relation to stakeholder involvement, the ISCO Advisory Board represents the first formal collaborative initiative which aims at integrating stakeholders into the decision-making process, albeit only on the implementation level. Initially, participation is planned to be restricted to municipal companies, utilities and departments only. This expected to ensure the development of a productive collaborative environment due to the existence of a common interest (i.e. the interest of the Municipality; Interview 3.00, 2016). With regard to the second theme, implementation is driven by a project-focused approach, and temporal collaborations are set up on a case-by-case basis. The City Council takes part only in large-scale projects with a city-wide impact or in cases of modernisation of council-owned social housing representing less than 1% of the city’s housing stock (Interview 3.03, 2016). The organisational work for smaller scale projects is undertaken by the individual district councils where the development is located (Interview 3.06, 2016) with no major interference from the Municipality as a result of the absence of a hierarchical order in the two-tier system of local government. In conclusion, the perceived complexity of the governance of transitions in Budapest is relatively low compared to the other two cities. The reasons for this include the low number of actors involved; the existence of some common frames of reference among the actors (i.e. the interest of the Municipality); and the lack of pressure to formulate new governing arrangements (due to the successes achieved through improvements to existing systems, which so far been successful in delivering on CO_2 reduction commitments). Moreover, there is also an acknowledgement of Central Government authority among the leaders of the City

Council which results in a lack of ambition to take action in transforming energy systems which are traditionally centrally regulated and operated.

8.2.3 Resource fragmentation: National and local governance of energy systems

Due to historical development trajectories (i.e. extensive nationalisation and centralisation under the communist regime), major energy systems in Hungary are centrally regulated and operated on the national level. Although both the electricity and gas markets were partly liberalised and limited market competition was introduced by 2008 due to compliance with EU regulations, the share of public sector ownership in energy companies is still significant (f.e. MVM Group, MOL Group, FOGAZ Ltd, ENKSZ), especially after a recent wave of re-nationalisation under the current conservative FIDESZ Government. As a further limitation to the free market competition, the Government also re-introduced fixed and controlled energy prices for domestic consumers in 2011 (Zsebik, 2012).

During the reorganisation of formerly centrally owned and operated systems which started in 1992, assets (power plants) plants were sold or taken over by separate private or semi-private companies. The ownership of locally relevant infrastructures (for example heat networks) was transferred to local governments; however, the authority to regulate these was retained by the National Government. Electricity and gas infrastructures are organised on the national level both in terms of regulation as well as operation. The main policy-making body in the energy sector is the ‘Ministry of National Development’ (‘Nemzeti Fejlesztési Hivatal’; IEA, 2017) which is also responsible for climate policy within the Government. Coordination with other ministries, the Prime

Minister's Office and the market and civil sphere with regard to the specific theme of sustainable development is ensured by the 'National Commission for Sustainable Development' ('Nemzeti Fenntartható Fejlődés Tanács', NFFT). The NFFT is responsible for advising the formal decision-making bodies on sustainable development related issues. The primary role for energy regulation and related law enforcement and monitoring are delegated to the Hungarian Energy and Public Utility Regulatory Authority ('Magyar Energetikai és Közmű-szabályozási Hivatal'; MEKH). Although MEKH is a separate entity, its operation is supervised by the Ministry of National Development (IEA, 2017), creating a risk of being affected by short-term political priorities instead of following a coherent, long-term approach (Interview 3.03, 2016).

Similarly to Germany and the United Kingdom, the Hungarian electricity and gas networks also consist of high-voltage and high-pressure transmission grids and regional distribution networks. Electricity transmission systems are owned and operated by a single transmission system operator (Hungarian Independent Transmission Operator Company Ltd; MAVIR), owned by the MVM Group which integrates several state-owned energy generators, supply companies and system operators (MVM, n.d.). The six separate distribution systems are operated by various system operators (DSOs), some of which owned by the German RWE and E-ON holdings and one by the Hungarian state-owned utility holding, ENKSZ ('First National Utility Provider'). DSOs are also allowed to act as supply companies; together they have a share of over 75% of the retail market (Energiapédia, n.d.). The remaining share and the wholesale open market is distributed among just over 30 competitive providers (MEKH, 2018). Gas transmission networks are operated by the FGSZ (Földgázszállító Zrt; 'Natural Gas Transmission Closed Company Ltd'), part of the MOL Group whose major shareholder (with app. 25% of shares) is the

Hungarian State (MOL Group, 2017). Natural gas distribution systems are operated by five distribution system operators, two of which are owned by the Hungarian state through public limited companies (Novak, 2014).

Budapest City Council has neither indirect (regulation) nor direct (operational) authority over electricity and gas systems. Electricity networks in the city are operated by ELMŰ, a subsidiary of Innogy / RWE, excluding the public lighting systems. Public lighting is provided by the company BDK ('Budapest Public Lighting Ltd'), with shared ownership between the system operator (ELMŰ; 50%) and the Municipality (50%) (BDK, n.d.). Budapest's natural gas distribution systems are operated by one of the state-owned DSOs called FŐGÁZ ('Natural Gas Distribution Closed Company Ltd'). Communication between the Municipality and FŐGÁZ are restricted to sales and emissions data collection for the 'Inventory of the State of the Environment of Budapest', published annually (Interview 3.08, 2016).

Thus, Budapest City Council can only influence local energy systems indirectly, through its utility companies including the district heating company (FŐTÁV) and the waste management company (FKF), whose ownership was transferred to the Municipality during the post-communist reorganisation in the early 1990's (FŐTÁV, n.d.). Even in these cases, regulation authority regarding the conditions of service as well as maximised unit prices for consumers in the district heating sector is retained by the National Government through the Ministry of National Development, and the Hungarian Energy and Public Utility Regulatory Authority.

Table 8.2 shows the local initiatives relevant to energy production, consumption and transition in Budapest.

TYPE OF INITIATIVE	PROJECT	ACTORS INVOLVED	ENERGY PRODUCED	RELEVANCE FOR LOCAL ENERGY TRANSITION
COGENERATION AND DISTRICT HEATING	Large-scale co-generation and district heating	FOTAV Ltd (municipal district heating company); Budapest Power Plant Ltd (BERT; owned EP Energy registered in the Czech Republic)	33% of the total domestic heat demand 3% of national electricity demand (eq. to 15.5% of the local electricity demand)	District heat and electricity produced locally from nine large-scale gas-fuelled power plants, several small generators and one waste incineration plant. The city's heat network consists of four isolated grids. The vast majority of the heat and electricity are produced in the CHP power plants owned and operated by BERT (a private for-profit company) which as a contract with FOTAV until 2021, regulating the amount of thermal energy supplied to FOTAV's district heating networks as well as the unit rate. Thus, FOTAV is unable to install new generation capacity without significantly expanding the existing DH networks by connecting new customers.
WASTE-TO-ENERGY SCHEMES	Waste incineration (Rakospalota Energy Recovery Facility or 'HuHa I')	FKF Ltd (municipal waste management company); *FCSM Ltd (municipal waste water management company; HuHa II)*	240GWh electricity/year (45 000 households) 180 GWh heat/year (13 000 households)	Budapest's waste incineration plant operated as a heat and power cogeneration plant since its modernisation in 2005, through burning 420 000 tonnes of municipal solid waste per year (app. 60% of the total non-recyclable waste generated in the city). Plans for a second plant ('HuHa II') are currently being drawn up which will operate on mixed fuel made up of municipal solid waste and sewage sludge. Energy generated in the two incineration plants together is estimated to cover 25% of FOTAV's heat demand.
	Geothermal energy (thermal water waste heat)	FOTAV Ltd (municipal district heating company); BGYH Ltd (Budapest Healing Baths and Hot Springs Ltd, owned by the Municipality); FANK Ltd (Budapest Zoo, owned by the Municipality) Municipality of Budapest (Deputy Mayor);	Zero-carbon heating for 26 Zoo buildings	Pilot project for waste heat utilisation from thermal springs carried out in collaboration by three municipal companies. Heating for Zoo buildings is provided by geothermal energy using the waste heat of the nearby hot spring well supplying the largest thermal baths in Budapest (Szechenyi Baths). Through the utilisation of geothermal energy, Budapest Zoo was able to cut its CO_2 emissions by 500 tonnes per year. Hot water springs in Budapest deliver app. 70 million litre of hot water daily, the majority of which is not utilised.
RENEWABLES (SOLAR AND WIND)	Small-scale local wind and solar	Associations of apartment owners; District Councils	Below 1% of local electricity demand	Small-scale solar thermal and solar PV installations as part of the energy efficient modernisation of Soviet-style prefabricated reinforced concrete housing blocks and district council buildings.
ENERGY SAVING FROM BUILDINGS	Energy saving from buildings	Associations of apartment owners; District Councils	N/A	The energy efficient modernisation of domestic, commercial and public buildings is a central element of Budapest's development strategy and of the National Energy Concept. Grants and preferential loans are being made available by the national government through the 'National Energy Conservation Programme', the 'Green Investment Scheme' and the 'Panel-Block Apartment Programme' specifically designed to update poorly insulated reinforced concrete housing blocks built in the 1960's and 1970's. Budapest's Sustainable Energy Action Plan (SEAP) estimates that by retrofitting poorly insulated prefabricated concrete and traditional brick housing blocks energy use for heating in the domestic sector can be reduced by 35%. The most emblematic exemplary project so far has been the energy efficient modernisation of a housing block called 'Faluhaz' ('Village House' – the name is a reference to the fact that the complex houses 886 apartments, as many as a smaller town or village) completed in 2009.
	Behaviour change	N/A	N/A	Facilitating behaviour change, providing information and raising awareness around issues such as climate change and its local effects, energy use and waste management are central elements of all documents produced by Budapest City Council. However, no concrete projects have so far been realised.

Table 8.2 Low-carbon energy initiatives in Budapest

The assessment of the sustainable energy initiatives and the actors involved in their delivery makes it visible that energy systems governance on the implementation level is dominated by the various municipal utility companies in Budapest, with little interference from the City Council. It also highlights that collaboration (excluding the geothermal energy project) is not prevalent in implementation. Instead, municipal companies operate their respective systems, and emissions reduction is achieved through gradual improvement to existing infrastructures.

8.3 THE TRANSITION GOVERNANCE NETWORK IN BUDAPEST

8.3.1 Network structure and actor analysis

The low-carbon energy governance network in Budapest is different from the networks analysed in the other two cities: no sustainable development orientated formal collaborative governance initiative was operating in Budapest at the time of data collection in 2016. However, interviews with local stakeholders revealed that informal collaboration processes take place regularly when new strategic plans or environmental programs are being produced (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.05, 2016; Interview 3.06, 2016; Interview 3.07, 2016; Interview 3.08, 2016; Interview 3.11, 2016). Interviewees also emphasised that the structure of collaboration is loose, often consisting of data collection only (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.05, 2016). Informal collaboration processes, based mainly on interview data and on the authorship of strategic documents constitutes part of the Budapest network analysed in this study. These relate to the preparation of integrated urban development plans (IUDPs;

Budapest 2030 and ITS 2020), environmental programs (Environmental Program 2011-2016; 2017-2021), the annually published inventories (see Section 8.2.1), and the Compact of Mayors application documentation. The planned ISCO Advisory Board, consisting of representatives of the Municipality, municipal utilities, research organisations and consultancies provides the rest of the data on which the network was built.

Name	Date of Formation[1]	Administrative Level	Number of Members[2]	Description
Strategic planning (IUDPs)	1998-2003 2011 - 2013	City	11	Partners involved in the development of the Budapest 2030 and the ITS 2020 concepts
Environmental Programs	2007 2011 2016	City	5	Partners involved in the development of the Environmental Program of Budapest 2011-2016
Inventories of the State of the Environment / SEAP	2010-	City	14	Partners involved in the development of the inventories published annually
ISCO	2017/2018	City	13	Planned members of the intersectoral advisory board to the ISCO management
Compact of Mayors application	2016-2017	City	4	Partners involved in the development of the documentation required for joining the international Compact of Mayors initiative

Table 8.3 Collaborative governance initiatives (decision-making arenas) in Budapest

The local governance network for energy transition was reconstructed using the lists of organisations involved in (informal) collaborative processes and in the planned ISCO Advisory Board presented in detail in Table 8.3. The two-mode network visualisation, emphasising organisations' involvement in the various processes (conceptualised as arenas for decision-making about transitions) is shown on Figure 8.4.

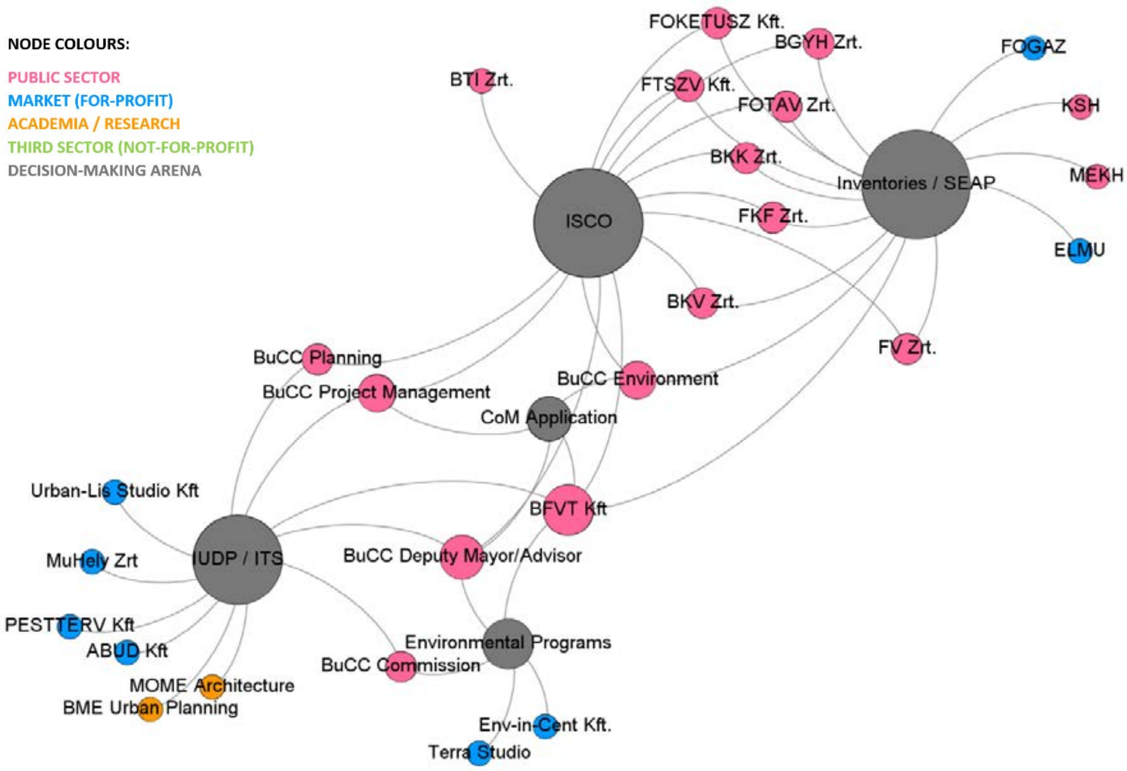


Figure 8.4 Governance network of decision-making for sustainable energy in Budapest (two-mode visualisation)

In the absence of formal initiatives, the graph shows a partly informal, partly planned network structure. Therefore, the connections between organisations in this network are weak compared to the other two cities. Nevertheless, the network visualisation provides valuable information on key actors and their characteristics who have the possibility to influence to process of decision-making in relation to sustainable energy in Budapest.

The bipartite network consists of 32 nodes of which 5 are classified as decision-making arenas. The nodes are connected to each other through 47 edges, accounting for a graph density score of 0.097. This means that just under 10% of all possible connections are present in the graph, indicating a relatively sparse network structure considering the low number of actors involved. The network centralisation score is 0.38, indicating that arena memberships are relatively balanced.

The core of the network can be reconstructed by zooming in on the actors involved in more than one collaborative initiative and, therefore according to the network logic, are considered more influential. The core network modelled this was is presented in Figure 8.5.

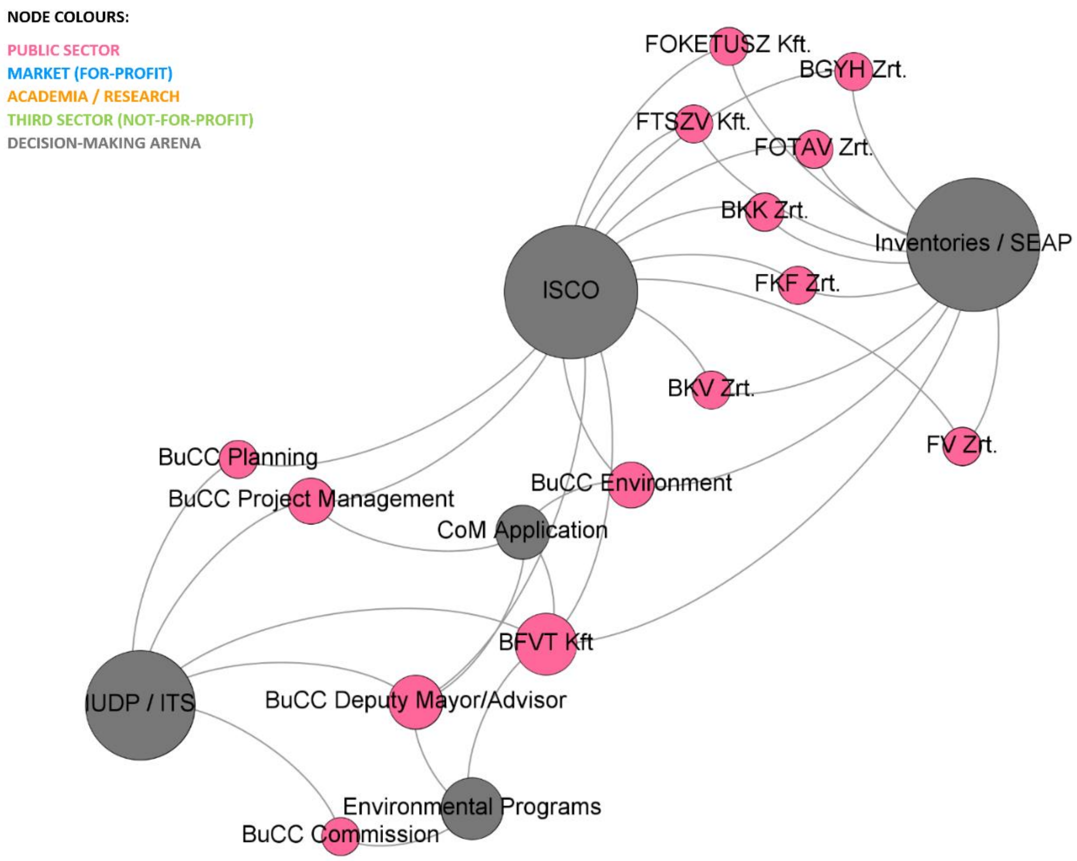


Figure 8.4 Core group of the governance network of decision-making for sustainable energy in Budapest (two-mode visualisation)

14 organisations of the total of 27 belong to the core group (52%) which are connected to each other through 35 edges (73% of the total of 47). These proportions result in an increased network density of 0.205 and an increased centralisation score of

0.58. Thus, some arenas dominate the core network (the ISCO Advisory Board and the Inventories/SEAP preparation group). These initiatives, however, are less relevant for strategic decision-making within the Municipality. As the visualisation shows, the high network density results from the low number of actors involved instead of a particularly high connectedness between actors (the relationship between the number of nodes and density is exponential and inversely proportionate). In fact, only three of the 14 actors are involved in more than two initiatives. This indicates that decision-making in Budapest remains controlled by a small number of organisations which only rarely interact with each other. Long- and mid-term planning (IUDP / ITS and the Environmental Programs) is visibly separated from shorter term decision making and monitoring. Only two of the actors, the Municipal City Planning Agency, the Deputy Mayor and, to a lesser extent, the Communal Services and Environmental Protection Team (Asset Management Department) are involved in both types of activities.

The assessment of the shares of different sectors (presented in Table 8.4) show an overwhelming dominance of the public sector both in the whole network as well as the core group. The lack of representation from other sectors signals the Municipality's inability and/or unwillingness to engage in collaboration with external stakeholders.

SECTOR	SHARE OF TOTAL IN WHOLE NETWORK	SHARE OF TOTAL IN CORE NETWORK
MARKET	26%	0%
PUBLIC	67%	100%
CIVIL/VOLUNTARY	0%	0%
ACADEMIA	7%	0%

Table 8.4 Sectoral shares in the entire network and the core group

Energy transition is only discussed in relation to other (sustainable) development goals and none of the collaborative initiatives focus explicitly on the energy sector. Thus, the core group, as well as the wider network, are both dominated by organisations whose primary profile falls outside of the energy sector, with the exemption of the municipal district heating company, FŐTÁV. In conclusion, steering or coordinating low-carbon transitions in the energy sector is not a priority for Budapest City Council.

In order to better visualise the connections between organisations, the two-mode network graphs were converted into one-mode ones. In the one-mode graphs, organisations got connected to each other if they participated in the same collaborative initiative. The one-mode network data, containing only one type of nodes (organisations) is more appropriate to determine central actors in the network according to the measures presented in Chapter 5, Section 5.5.2. The one-mode visualisation of the whole network is shown in Figure 8.6. Figure 8.7 presents connections between organisations in the core group. The lists of centrality scores of the individual actors are included in Appendix V.

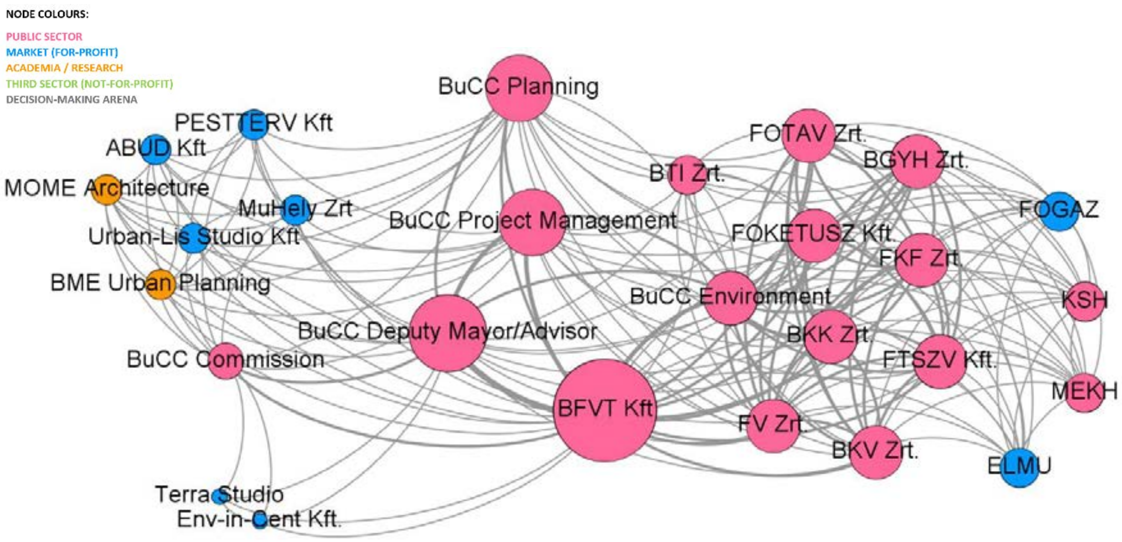


Figure 8.6 Governance network of decision-making for low carbon transition in Budapest (one-mode visualisation)

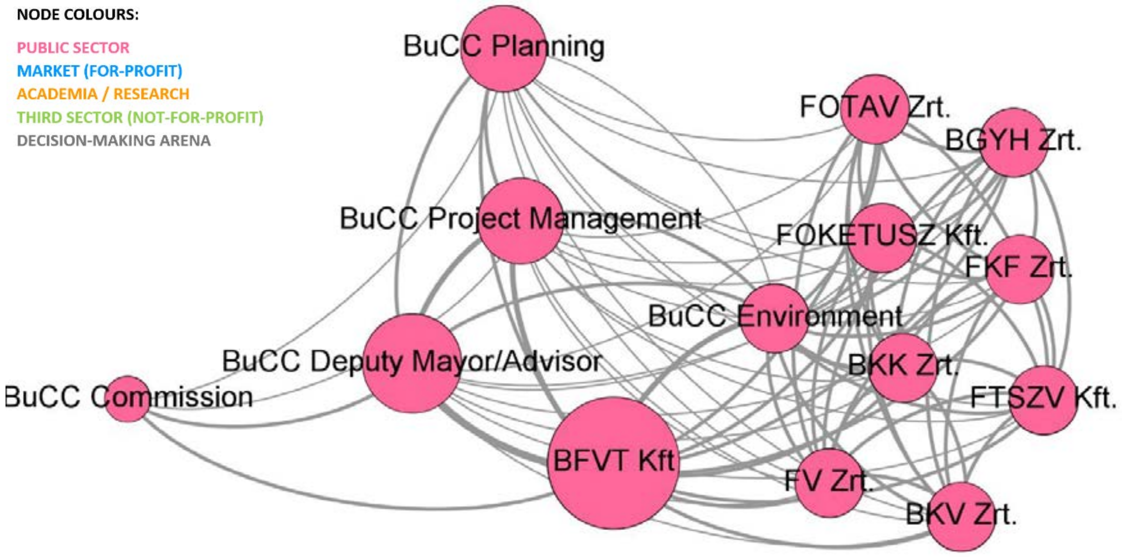


Figure 8.7 The core group of the sustainable energy governance network in Budapest (one-mode visualisation)

As Budapest currently has no specific climate change or low-carbon transition strategy and sustainability related issues are discussed within the frames of urban development and regeneration. Consequently, the network is dominated by municipal bodies which possess authority to influence strategic urban development (BFVT, the Deputy Mayor, and the Project Management and Planning departments). BFVT, the Municipality's Planning Agency occupies an important brokerage position within the network. This signals a high-level internal fragmentation within the City Council: tasks related to decision-making and the monitoring of the impact of the delivery of projects and initiatives belong to separate departments which one interact on a case-by-case basis. BFVT is responsible for the preparation of both strategic documents related to planning and delivery, as well as the Inventories of the State of the Environment related to monitoring progress. It plays an intermediary role between the two separate groups of organisations, but has no decision-making power on its own. Instead, it is an organisation responsible for the administrative tasks related to the preparation of documentation under the supervision of Council departments and the Deputy Mayor.

In conclusion, the structural analysis demonstrates that the ideas of collaborative decision-making and stakeholder involvement have so far not been embraced by Budapest City Council. The network characteristics underpinning this assertion include the absence of formal collaborative initiatives, the low number of arenas and the relatively few actors involved in the planned/informal network. Outreach to the private sphere, including both the market sector and community organisations, appears to be negligible.

8.3.2 Content and process of network interactions

The arguments presented in Chapter 5 around the difficulties and potential benefits involved in conducting governance network analysis which takes into account both structure and process (Bergé et al., 2017; Christopoulos, 2008; Lewis, 2011) point to the value of collecting qualitative information on how governance processes within and between the different decision-making arenas play out in practice. This is important in order to better understand the functioning of the governance network, and to validate, evaluate, clarify and complement the conclusions drawn from the structural analysis based on quantitative data.

In the case of the Budapest network, the analysis of the structure and of the actors involved revealed a relatively small network, dominated by local government departments, municipal utilities and companies, with very limited involvement of the private sector. Collaboration with the market sector is rendered complicated by the absence of legal framework for public-private ventures (Interview 3.03, 2016; Interview 3.05, 2016; Interview 3.06, 2016). This issue extends to public-sector owned companies as well with regard to their involvement in collaborative initiatives with private businesses (Interview 3.07, 2016; Interview 3.11, 2016). From the perspective of the market sector, internal bureaucracies and the resulting slow decision-making mechanisms of local governments in Budapest, including the City Council as well as the District Councils, acted as barriers to collaboration (Interview 3.12, 2016).

Another defining feature of the governance network in Budapest is the apparent divide between strategic planning and the arenas dedicated to short-term decision making and the monitoring of progress. It also uncovered that collaboration on the strategic level was restricted to a small number of actors (BFVT, the Deputy Mayor, Planning and Project Management departments and the Commission), mainly politicians and senior officers. Many interviewees noted that this situation created a divide between professional knowledge and expertise and the decision-making process (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.06, 2016; Interview 3.07, 2016; Interview 3.11, 2016):

> *'There is this Project Management Department which coordinates some of these processes, but there isn't a professional view in the leadership. So, the Municipality does not have an energy officer, (...) nor does it have a dedicated organisational body to whom these issues could be assigned to, a professional organisation I mean, which has appropriate professional expertise.'* (Interview 3.07, 2016)

Interviewees from different City Council departments highlighted that fragmentation exists within the Council as well, most notably between decisions about investment and the monitoring of trends and progress (Interview 3.02, 2016; Interview 3.10, 2016):

'[T]hese things work in a somewhat different way within the Municipality, so it is not our [Communal Services and Environmental Protection Team] role, who by the way have the knowledge, to decide what can be done, what would be good to get done and what developments will be prioritised. (...) Instead, they [Project Management] go ahead with what they can get money for. (...) Of course they look at (...) what is worth it to do, but this [professional reasoning] is often not the main consideration.' (Interview 3.02, 2016)

The structural analysis emphasised the role of the Municipal City Planning Agency (BFVT), appearing in the most central brokerage position, in intermediating between the different actors. However, questioned its capacity and capability for intermediation due to lacking any decision-making powers or authority (Interview 3.03, 2016; Interview 3.06, 2016; Interview 3.07, 2016; Interview 3.11, 2016).

Stakeholders expected the City Council to initiate and steer collaborative processes, at least between companies owned by the Municipality (Interview 3.04, 2016; Interview 3.07, 2016; Interview 3.11, 2016). However, there is an apparent incapability (due to lack of financial and human resources) and/or unwillingness to steer collaboration processes from within the Municipality:

'There isn't a central will which would look at the city's interest from a distance. (...) The utility companies operate independently, but neither the Asset Management Department, nor the Municipality as a whole looks at what how an integrated optimal functioning of the utility companies could be achieved. So, everybody proceeds driven by their own partial interests, and the reason for this

is, being honest, (…) is the lack of central will and central coordination.' (Interview 3.07, 2016)

Collaboration between the various government levels (vertical integration) is complicated due to a lack of salience of the transition issue:

> *'There isn't, from the highest government levels down to the local, a detailed, strategic plan (…) about the roles and responsibilities of the national government, those of the counties and local authorities. (…) Thus, we don't know how to act upon it. (…) Consequently, there isn't any cooperation between local governments either, because there is nothing which would make them cooperate.*' (Interview 3.06, 2016)

Consequently, due to difficulties with both horizontal integration between local stakeholders, as well as vertical integration with other levels of government, the decision-making system of sustainable development and energy transition is characterised by high levels of fragmentation. Fragmentation in turn results in the lack of innovative, cross-cutting initiatives which would provide opportunities for new configurations of actors to arise, contributing to the persistence of the traditional hierarchical mode of decision-making, combined with a reliance on market mechanisms.

8.3.3 The network's role in decision-making

Decision-making in Budapest was restricted to small group of actors (senior level municipal officers and elected politicians) who possessed the authority to do so. The move towards a more networked and collaborative decision-making process has been slow, and the traditional hierarchical model (in the case of municipal investment) and market mechanisms (in cases where the Local Authority has no direct control over investment and innovation processes) appeared to persist (Interview 3.05, 2016; Interview 3.10, 2016; Interview 3.12, 2016). Currently, network processes are disconnected from decision-making and involve mainly data gathering and information exchange (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.07, 2016; Interview 3.08, 2016):

> *'Budapest City Council has a company, BFVT [Municipal City Planning Agency]. The production of the Inventories of the State of the Environment in Budapest, with the involvement of relevant organisations, colleagues and experts, on an annual basis is part of their public service contract. (...) They organise the data gathering from, firstly, different units of the Municipality, secondly, publicly owned utility companies and, thirdly, (...) from energy suppliers.'* (Interview 3.03, 2016)

This situation only recently started to change, with the development of the ISCO concept. The idea behind the ISCO model is that some form of collaboration, through more optimal resource allocation, can lead to more innovative initiatives while also cutting costs for Budapest City Council and maximising the impact of investments (Interview 3.05, 2016; Interview 3.09, 2016). As the Municipality has no experience with formal collaborative governance mechanisms, and due to the negative public opinion in relation to informal collaboration (mostly interpreted as corruption; Interview 3.03, 2016), the ISCO is seen as a pilot initiative which, in case it proves successful, can be extended to involve external stakeholders in the future (Interview 3.09, 2016). The initial phase is expected to contribute to strengthening the position of the Municipality in the multilevel context through developing working relationships between its units and companies as well as a common reference framework. This is seen as important in order to prevent the take-over of the agenda by business interests of multinational companies, which cannot be influenced by the Municipality due to lack of authority (Interview 3.09, 2016).

8.4 IMPACT: THE NETWORK'S ROLE IN FACILITATING TRANSITIONS

8.4.1 Strategy formulation for local-low carbon energy transition

Long-term thinking can be introduced to the local decision-making context through the formulation of strategic documents which may set out long-term goals (visions) or mid-term interim targets and pathways. The ability to produce such material in collaborative settings gives indication about the development of shared understanding in relation to the nature of the problem, the goals to be achieved and the necessary action to create pathways for the delivery of low-carbon ambitions.

It has already been discussed earlier in this chapter that reducing carbon emissions is not in itself a priority for Budapest City Council. Instead, emissions reduction is envisaged to be achieved through urban development and regeneration, by improving the efficiency of existing systems and by extending their operation. Resulting from the indirect approach to carbon control, the process of target setting in Budapest is different from the method followed in the other two cities. Taking a more hands-off approach, Budapest City Council commits to CO_2 reduction targets on the basis of the annual progress monitoring conducted for the Inventories of the State of the Environment. Emissions trends are developed using the rich and reliable statistical data collected each year, and commitments are made via developing projections for the future (Interview 3.02, 2016; Interview 3.03, 2016). In an environment characterised by severe financial constraints, the Municipality's intention is to make sure that the interventions aimed at improving the city also contribute to CO_2 reduction.

Thus, the main outcome of the governance processes in the Budapest network is related to the monitoring of emissions. Although the Inventories are expected to make an impact on target setting with regard to long-term visions, pathways and short-term action to some degree, the influence is rather uncertain and indirect. Instead, strategic (long- and mid-term) decision-making is undertaken outside of the network setting. In the near future, the ISCO concept is expected to contribute to decision-making in terms of short-term action (experimentation), at least within the public sphere. The lack of ambitious targets and a strategic approach from the part of the City Council indicates that reducing carbon emissions is, currently, not a priority in Budapest. Although senior officers within the Municipality perceive emissions reduction as an important issue (Interview 3.02, 2016), a dominant view has developed within the Council that the steering of market processes and citizens' behaviour is outside of the scope of the local public bodies. The reasons behind this belief include the lack of consensus of over the role of the public sector with regard to influencing people's lives in the post-communist context; the lack of cross-party consensus over goals and the ways to achieve them ('*the next [government] does not develop different approaches to achieve the goals more efficiently and effectively, but rather for the sole reason of doing it differently than the ones before';* Interview 3.07, 2016); and the fear of failure and negative press coverage which restricts interaction with citizens and the private sector (Interview 3.04, 2016; Interview 3.07, 2016). This approach began to change only recently, mainly as a result of EU recommendations and funding allocation criteria for urban development projects: the

Municipality has started working on a ‘Smart City Vision’ (BuCC, 2017), a ‘Climate Change Strategy’ and an ‘Integrated Energy Strategy’ in 2017.

8.4.2 Strategy implementation

The approach taken by Budapest City Council -discussed in the previous section- signals an acknowledgement within the Council that it lacks the resources and commitment to efficiently steer low-carbon innovation processes in Budapest. As a result, implementation mainly focuses on issues over which the Council as some form of authority, either in terms of legislative power or company and asset ownership.

In the energy sector, the potential for implementation through legislative powers is limited, as the Municipality has no regulatory role with regard to energy systems, including electricity, gas as well as district heating. Formally, the Council has a role in determining local building codes and standards as the national building regulation framework only provides a baseline for minimum compliance. The potential to use regulation in practice as means to facilitate the reduction of energy use in buildings is, however, limited due to the lack of financial resources to support retrofit projects and to the Central Government-dictated artificially low energy unit price acting as a barrier to invest in energy efficient improvements. Moreover, the National Government has the power to unilaterally override local decisions in particular cases, and it often does so. The most recent example for this was the ‘Liget Project’, the rehabilitation of the city’s largest public park via turning the area into a cultural district with new museums and the renovation of the existing cultural institutions. Due to the national level importance of the project, the regulatory role for the area was overtaken by the National Government, leaving the Municipality with no means to intervene (Interview 3.10, 2016). In fact, the relationship between the National and the Local Government is '*not smooth, to say the least*' (Interview 3.07, 2016; cf. Interview 3.11, 2016).

The City Council also has a possibility to facilitate the implementation of its strategic plans via indirect authority through the ownership of public utility companies, such as FOTAV (district heating), FKF (waste management) and FCSM (waste water management), BDK (public lightning) and FOKETUSZ (parks and green areas management). However, the regulation of energy-related activities of these companies is retained by the National Government.

Collaboration between municipal companies and between the companies and council departments is rather undeveloped, even several decades after the transfer of ownership to the Local Authority from the national level. As discussed previously, one of the main reasons for difficulties with collaboration among public sector bodies is the City Council's lack of capacity, capability and/or willingness to intermediate and manage the interaction processes. One recent example of the positive effect of municipal intervention on implementation is the geothermal heating system of Budapest Zoo. Although the project started to develop organically, through a collaboration between the Zoo management and FOTAV, the delivery was complicated due to conflicts with BGYH, the company who owns the hot spring well and operates the Széchenyi Thermal Baths, also owned by the Municipality (Budapest Zoo, n.d.). The intermediation of diverging interests needed high-level intervention from the Deputy Mayor for Urban Development to secure the delivery of the project (Interview 3.04, 2016). The successful implementation indicates that the City Council has the potential to intermediate between local actors and to manage their interactions.

The difficulties discussed above resulted in a situation where the relationship between strategic plans, implementation and progress monitoring remains unclear:

> *'As long as the urban development concept produced does not contain any binding targets, it is easy to have it approved by the Council assembly. This gives some guidance for the Council, and until it doesn't become necessary to spend money on it, the ink can take it. But when these things need to be implemented, the goals set in the concept, difficulties arise. It can go either way.'* (Interview 3.08, 2016)

8.4.3 Progress towards targets and goals

Budapest is a signatory of the Covenant of Mayors initiative, by which the city committed itself to reduce the total carbon emissions generated locally by at least 15% by 2016, 21% by 2020 and 30% by 2030 compared to 2005 baseline (BuCC, 2017; 2011). Budapest City Council also expressed interest in further reducing CO_2 emissions to 2 tonnes per capita per annum by 2050, equivalent to an approximate total reduction of over 65% (2005 baseline); however, this target is not legally binding (BuCC, 2011). These commitments currently exceed the Hungarian national commitments based on European commitments, i.e. reducing carbon emissions by 20% by 2020. Due to the decline of heavy industries, the country over-performed these targets by the early 2000's and, subsequently, was granted a 10% quota increase for the 2013-2020 period (Euractiv, 2010).

Budapest City Council estimates that carbon emissions have already been curbed by approximately 15% by 2013 (compared to 2005 baseline; see Figure 8.8), despite a 2% rise in total population (BuCC, 2017). At the same time, per capita emissions fell from slightly over 6 tonnes p.a. to 5 tonnes p.a. in the same period (BuCC, 2017) (see

Figure 8.8). In terms of the shares of different sectors, the main contributors to CO_2 emissions were industry and commerce (39%) and the domestic sector (38%) in 2013 (see Figure 8.9).

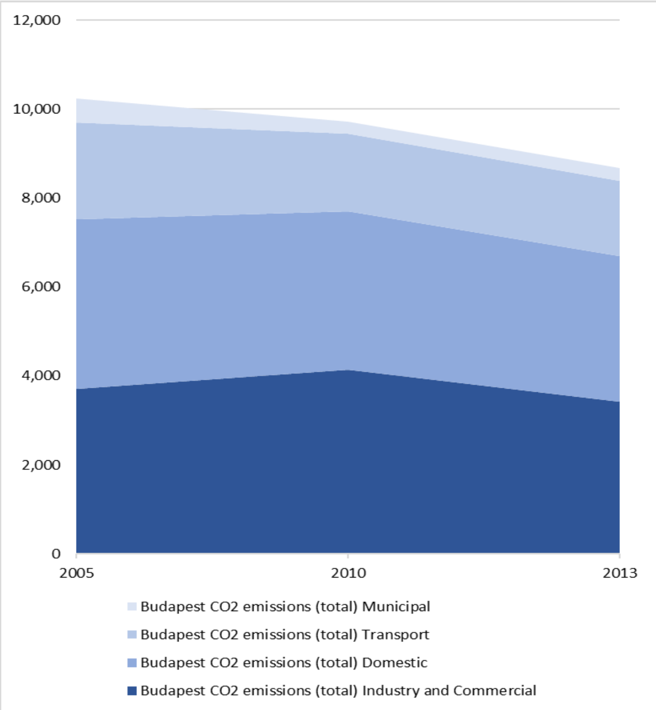


Figure 8.8 Emissions by Sector (kt CO2)

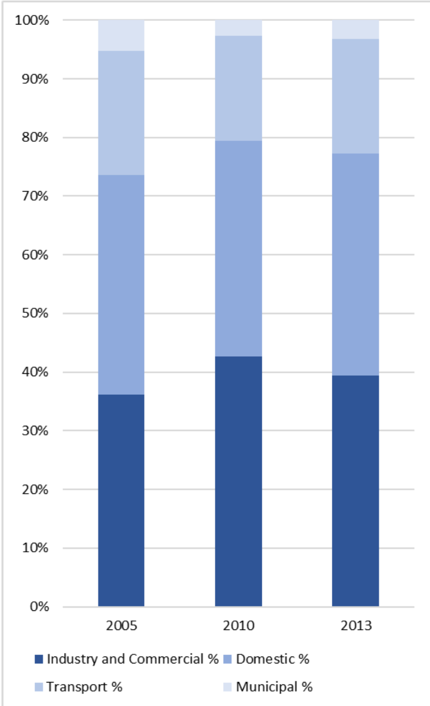


Figure 8.9 Emissions by Sector (% of total)

The relatively low share of the transport sector (20%) resulted from the extensive use of public transport in the city. Budapest City Council estimated that its own estates contributed to carbon emission by approximately 3% of the total (BuCC, 2016) . Overall, emissions decreased in all four sectors; however, the decline seems to be less dominant in the industrial and commercial sector. The relatively high share of the domestic sector indicates a significant potential for emissions reduction through retrofitting the city's ageing building stock. However, funding mechanisms only exist for Soviet-style reinforced concrete housing blocks, despite the city's significant stock of pre-war period buildings also in need of energy efficient refurbishment (Interview 3.10. 2016).

In conclusion, a specific strategy for promoting energy transition is yet to be developed in Budapest. So far, sustainable energy has been discussed indirectly, in relation to urban development and regeneration. The progress is hindered by a lack of interest in renewables on the national level, and the limited territorial authority and financial resources of Budapest City Council. As a consequence, there are no ambitious plans to facilitate a radical shift in the city's energy systems (BuCC, 2017, 2013).

8.5 CONCLUSIONS

8.5.1 Network governance of the energy transition in Budapest

The analysis presented in this chapter demonstrated that the emergence and operation of networked forms of governance in the local energy sector in Budapest (both in terms of structure and process) are context-dependent and arise from the interplay of locally relevant experiences and perceptions related to sustainable energy on one hand, and to collaboration on the other.

Low-carbon innovation in Budapest is best described by the 'governing by experiments' approach. It develops on a case-by-case basis by setting up projects and pilots where and when opportunities arise, for example when European or national level funding has been raised. However, the real-world 'governing by experiments' approach taken by Budapest City Council seems to make a limited contribution to developing new governmentalities for sustainable energy. Due to various legal and cultural barriers to collaboration between the public and market sectors and civil organisations, only those low-carbon initiatives are considered which can be delivered within the Municipality's circles, i.e. by the municipal utility companies. Here, hierarchical relationships between the Council and the companies resist to structural organisational change, and collaboration among the utility companies is restricted to a few isolated initiatives. Thus, interdependence between different actors from various sectors remains unaddressed.

Although more active leadership and management from the Municipality has the potential to facilitate a process of normative integration among the stakeholders, this opportunity remains unexploited. The reason for this can be found in the unwillingness and/or incapacity of Budapest City Council to facilitate collaboration among its departments, companies and utilities. Thus, the organisational landscape of sustainability transitions (at least in the case of energy systems) is characterised by high levels of fragmentation both horizontally and vertically. Consequently, implementation is restricted to isolated initiatives driven by political choice and grant opportunities, and energy efficiency improvements to existing infrastructure.

8.5.2 Options for Local Government steering

The network characteristics described above have consequences for the Local Government in relation to its potential to steer network processes and outcomes. The structural analysis presented in Section 8.3.1 highlighted the lack of engagement both with the market sector and community organisations (civil society). Instead, access to decision-making arenas in the Budapest network is reserved to municipal leaders, politicians, departments and publicly owned companies.

Interviews indicated that this situation contributes to a culture where, although the Municipality does have the resources to determine the ‘common interest’ among the actors involved, this opportunity is exploited only on a case-by-case basis in the case of particular initiatives or projects. Thus, Budapest City Council has so far not experimented with developing a steering approach to governing sustainability transitions in the city. As a result, innovation processes emerge organically in the private sphere, and public-sector initiatives are set up separately, directly by the Municipality or public utility companies owned by the city administration. Albeit this situation has started to change in the past few years, there is still much confidence among the city's leaders that market mechanisms will be capable of delivering the local emissions reduction commitments. In contrast, leaders of the municipal companies called for more horizontal, network-like interactions between the City Administration and the more professionally oriented company leaders and experts. From their perspective, such collaboration could provide a more solid technological basis for the low-carbon development of the city, enhancing the success and impact in implementation. The newly established ISCO is expected to provide space for such interaction. Therefore, it can be considered a governance experiment which has the potential to contribute to changing the role of the Municipality towards more 'steering' than 'rowing'. However, its success is still to be seen in the upcoming years.

PART III.

FINDINGS AND CONCLUSIONS

CHAPTER 9.

COMPARATIVE ANALYSIS

9.1 INTRODUCTION

9.1.1 Objectives and structure of the chapter

The empirical part of this research was aimed at investigating the operation of governance networks of low-carbon transitions in three cities in Europe (including Birmingham, Budapest and Frankfurt). Chapters 6, 7 and 8 analysed the three governance networks operating in the cities with a case study approach, focusing on the features of the networks, the contexts in which they operate and their impact with regard to local sustainable energy transitions.

On the basis of the case study analyses, this chapter seeks to answer

RQ (3): What is the comparative level of development, potential and constraint on the low-carbon network governance systems of the case study cities?

The main assumption guiding the research agenda of this study was that governance networks operating in different places show dissimilar characteristics, and that this divergence arises as a result of variance in the local contextual settings which constitute their environment. Following this assumption, it was hypothesised that, as a result of this divergence, the local governance networks, emerging as a result of interactions in local transition arenas, may have varying potential to support low-carbon transitions and, consequently, may provide different options for city authorities to influence network processes with the aim of delivering on the city's low-carbon agenda.

The aim of this chapter is, first, to evaluate the validity of this assumption through a comparative analysis of the governance networks found in the three cities; second, to identify what local contextual conditions contribute to similarities and differences between the networks; and third, to investigate how such divergence and convergence influences the networks' impact in terms of advancing sustainable energy transitions. Figure 9.1 shows the logic of the comparative analysis presented in this chapter.

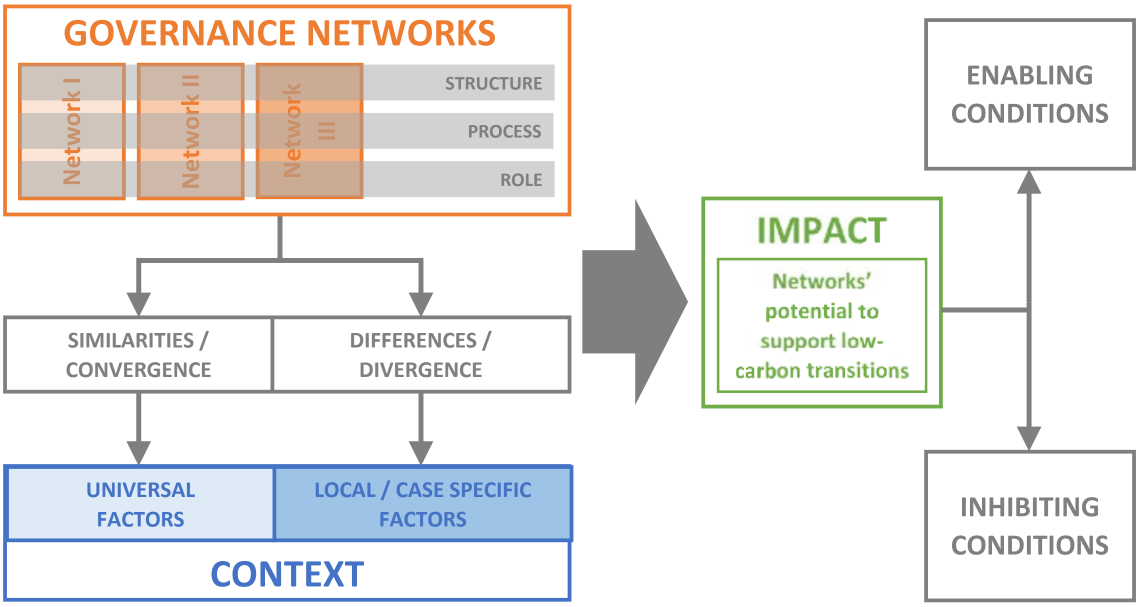


Figure 9.1 The logic of the comparative analysis (see also Chapter 5, Section 5.4.2)

The Chapter is structured as follows: Section 9.2 presents a comparative analysis of the governance networks involved in decision-making about sustainable energy transitions in the case study cities. The analysis discusses the network structure and actors involved, the network process, and its role in the overall decision-making around local sustainable energy transition. Similarities and differences between the networks are discussed in relation to context-dependent factors along the dimensions of agenda development and governance responses, energy transition rationales and resource fragmentation in Section 9.3. Section 9.4 considers the ways in which governance networks influence the energy transition processes in the different cities. The comparative analysis presented in this chapter provides the basis for deriving conclusions about the role of governance networks in urban low-carbon transitions and the resulting implications for the applicability of the sustainability transition theories (i.e. Multi-Level Perspective (MLP) and Transition Management (TM)) in different urban settings.

9.1.2 Introduction: local governance in the United Kingdom, Germany and Hungary

This short overview on the key characteristics of the dominant public policy and administration traditions in the three countries – where the case study cities are located – is aimed at setting the scene for the comparison of the governance networks of local low-carbon energy transitions.

In Europe, the role of local governments in the multilevel governance context has been strengthened in recent decades. The rising importance of the European Union and a parallel 'authority migration' process (Gerber and Kollman, 2004) resulted in powers being shifted to supra- and sub-national levels (Jessop, 2002, 2011, p. 2011; MacLeod and Goodwin, 1999). Nevertheless, previous cross-national comparative research demonstrated that certain key characteristics of the national politico-administrative settings, and their impact on the local level, have a significant influence over the ways in which local governance unfolds in different countries. In order to consider this issue with regard to the cases featured in this study, Table 9.1 introduces the key features of national and local political and administrative settings relevant to the case study cities.

	BIRMINGHAM	BUDAPEST	FRANKFURT
NATIONAL CONTEXT	England / United Kingdom	Hungary	Germany
STATE STRUCTURE	Unitary-centralised	Unitary-decentralised	Federal-decentralised
PUBLIC ADMINISTRATIVE TRADITION	Public interest	Rule-of-law (with socialist cadre administration influence)	Rule-of-law
LOCAL GOVERNMENT LEGAL AUTHORITY	Weak (service delivery-oriented)	Moderate (due to ongoing re-centralisation)	Strong
LOCAL GOVERNMENT FISCAL AUTHORITY[1]	Moderate	Moderate	Strong

Table 9.1 Different political and administrative characteristics in the case study cities

Sources: (Copus et al., 2017; Kuhlmann and Wollmann, 2014; Loughlin et al., 2011; Swianiewicz, 2014; Wollmann, 2008)

[1] Interpreted as the proportion of local government spending within the public sector, relative to national GDP (Gross Domestic Product).

According to previous studies (Copus et al, 2017; Kuhlmann and Wollmann, 2014; Swianiewicz, 2014; Wollman, 2008), out of the three countries considered, local authorities have been found to be most dependent on the central government in the UK. Here, within a unitary and centralised state structure, local governments' responsibilities have traditionally been limited to delivering core services to citizens in accordance with central government guidelines. Although this situation is beginning to change, the dominant austerity politics and resulting budget constraints for local governments counteract (or at least, delay) any radical change (Lowndes and Pratchett, 2012). This dependency relationship has had a strong influence on the functioning of Birmingham City Council:

'I think where we'll always have the biggest difficulties is… because we are so siloed, because it's a big area, the council exists in silos, and actually our national government exists in silos. […] That way of working still persists, partly because Whitehall in central government is siloed, and partly because we have followed, because that's where our money comes from.' (Interview 1.12, 2016)

In the unitary-decentralised Hungarian context local governments have more room for manoeuvre relative to the UK, but increasing re-centralisation from the national level and limited local authority powers in relation to taxation weaken the position of Budapest City Council by contributing to financial dependence on the National Government. Moreover, the Council's legal authority on territorial issues is also limited due to a dispersion of roles and responsibilities between the city government and district authorities operating in a dual, non-hierarchical system (BuCC, n.d.). The organisational culture developed during the communist era has a large role in maintaining fragmentation in the public sector and beyond:

'[P]eople believe that everyone is each other's competitor. That if there is money available, it must be spent as soon as possible, because they [Central Government or the EU] may take it back tomorrow. These instincts are still very strong today and this situation makes it difficult [to collaborate].' (Interview 3.04, 2016)

Local governments in the German federal and decentralised state structure enjoy considerable autonomy from higher levels of government and authority over local issues compared to the other two countries (Kuhlmann and Wollmann, 2014). This situation resulted in a sense of capacity and capability for self-government in Frankfurt City Council:

‘[W]e are a city and we have city rights […]. And within the city we had the free rights of trade against the kings. […] And Germany […] was based on […] these free rights, and it is also now.’ (Interview 2.03, 2016)

The above shows that structural variations in national-local relationships in the different countries have a significant effect on the ways in which local governments operate. This indicates that local authorities in the different cities potentially occupy different positions relative to actors from higher levels of government, as well as the market sector and civil society. Thus, it is expected that a comparative analysis of the governance networks made up of actors from the public, market and third sectors should identify differences in terms of network structures, processes and impact. The rest of this chapter provides a comparison of the governance networks involved in facilitating low-carbon energy transitions in the three cities, and seeks to explain similarities and differences through contextually relevant constraints and opportunities. Finally, it considers the impact of this variation in terms of potential to support local low-carbon transitions.

9.2 COMPARATIVE ANALYSIS OF THE GOVERNANCE NETWORKS IN THE THREE CITIES

9.2.1 Network structure and actors involved

Analysis of the governance networks in the case study cities built on an inventory of collaborative governance initiatives, including advisory bodies, working groups and stakeholder forums relevant to local sustainable energy transitions, which were either already operational or were being established (with known membership details) in the period of data collection in 2015-2016 (see Chapter 5). In two out of three cities, namely in Birmingham and Frankfurt, formal collaborative initiatives were found. In Budapest, the move towards more deliberative governance mechanisms was less apparent compared to the other two cities, and ongoing collaboration was limited to informal settings and occasional interaction. The Budapest network data was also extended to include the ISCO Advisory Board which was under consideration in an official approval process in the Council assembly in 2016. Table 9.2 presents the findings of the analysis of the network structures in the case study cities.

STATISTICAL MEASURES	BIRMINGHAM	BUDAPEST	FRANKFURT
Whole network			
Type of network	Formal	Informal + Planned	Formal
Network size	159	32	281
Arenas (collaborations)	11 (9+2)	5 (4+1)	11 (10+1)
Organisations (actors)	148	27	270
Number of connections	263	47	363
Network density (%)	2.1	9.5	0.9
Centralisation	0.32	0.38	0.55
Core group			
Organisations (actors)	49 (33%)	14 (52%)	47 (17%)
Number of connections	164 (62%)	35 (73%)	140 (38%)
Network density (%)	9.5	20.5	8.5
Centralisation	0.32	0.58	0.31

Table 9.2 Basic network data on governance networks in the case study cities.

Structural characteristics which formed part of the analysis included measures related to the size of the network (i.e. the number of actors involved in collaborative initiatives), network density (i.e. degree of connectedness) and network centralisation (i.e. membership differences between the arenas). The statistical measures were also used to gain insights about the relations between the whole networks and their core groups.

The structural analysis revealed a comparatively decentralised and polycentric network in Birmingham. Network characteristics which support this assertion include the high density and low centralisation scores in both the core group and the network as a whole, and the populous core network relative to the total number of stakeholders involved in the whole network. The largest of these was found in Frankfurt, involving almost 300 organisations. However, the smaller core group compared to the size of the whole network relative to Birmingham's network, combined with a significant increase in density, highlighted a more evident divide between the core and the periphery. This indicates that the core group had more potential to assume a leading role in the network processes compared to Birmingham's network. Density measures were found to be somewhat lower in Frankfurt than in Birmingham, indicating slightly less overlap between arenas in terms of membership (and by extension, responsibilities and tasks assigned to these). Compared to the other two cities, the move towards network governance was less apparent in Budapest. This was highlighted by the absence of formal collaborative initiatives, as well as the low number of arenas and actors involved in the partly planned, partly informal, network. The involvement of fewer actors allowed for a higher density score, which was even more evident in the core group. The less articulate difference between the core and the periphery in terms of the number of actors involved indicated a more closed and exclusive network than in Birmingham and Frankfurt.

Variation with regard to sectoral representation (including public, market, third sector and academia) in the composition of local sustainable energy networks highlighted further differences across the cases. Sectoral shares in the whole networks and core groups are shown in Table 9.3.

	BIRMINGHAM	BUDAPEST	FRANKFURT
Whole network			
Public % (inc. publicly owned companies)	24%	67%	21%
Market % (private businesses)	55%	26%	60%
Third % (voluntary organisations & citizens' groups)	12%	0%	13%
Academia % (inc. private research institutes)	9%	7%	6%
Core group			
Public % (inc. publicly owned companies)	31%	100%	51%
Market % (private businesses)	52%	0%	13%
Third % (voluntary organisations & citizens' groups)	10%	0%	23%
Academia % (inc. private research institutes)	6%	0%	13%

Table 9.3 Sectoral representation among network actors in the different cities.

With the exception of Budapest, the other two cities showed similarities in relation to the shares of different sectors on the level of the whole networks (i.e. when actors on the peripheries of the networks who were only members in one arena / initiative were included). Budapest stood out with an overwhelming influence of the public sector in the core group as well as in the network as a whole – demonstrating a lack of integration with the market and community sphere in decision-making processes around local sustainability transitions. Differences between the networks in Birmingham and Frankfurt became apparent by focusing on the core groups: while sectoral shares in Birmingham remained similar to those in the whole network, a significant shift could be observed in the case of Frankfurt. The share of public sector organisations increased sharply, indicating their potentially central role in the formulation and implementation of the local sustainable energy agenda. As opposed to Frankfurt, the market sector remained influential in Birmingham's core group, signalling a more apparent blurring of boundaries between the public and private sectors through the network than in the other two cities.

On the actor level, three types of centrality scores were considered: degree, betweenness and closeness centrality. Degree centrality is calculated on the basis of actors' connectedness to others ('popularity'). Betweenness centrality measures actors' role in bridging unconnected groups or actors. Closeness centrality connects the notion of influence to actors' potential to draw on different sources of information available through their connections with others. The complete lists and centrality scores of network actors in the three cities can be found in Appendix V (pp. 352-363).

In Birmingham, the weak position of the local level in the energy sector translated into a network dominated by organisations with a more regional or national level focus who had access to funding (from own sources or from the Central Government and the EU), i.e. research institutions, private companies and business associations, while public sector bodies occupied less central positions. In contrast to Birmingham, alongside community initiatives (co-operatives), public sector organisations and companies were among the most central actors in Frankfurt. The prevailing form of market sector influence was limited to collective professional organisations and associations (i.e. Chamber of Commerce and guilds/unions). In Budapest, actors with the highest centrality scores included the Municipal City Planning Agency, the Deputy Mayor for Urban

Development and municipal departments, indicating a disconnect between implementation and monitoring activities (undertaken by less influential actors) and decision-making. The lack of connection between strategic decision-making, implementation and monitoring, the absence of formal decision-making arenas, and the relatively low number of actors dominating the whole of the network indicated the persistence of the traditional hierarchical model in Budapest.

9.2.2 Governance processes in the networks

In order to develop a more accurate interpretation of the results of the structural analysis, qualitative data was collected from municipal documents and semi-structured interviews in relation to the content of network connections. Describing governance processes within and between decision-making arenas has been important for determining the network's contribution to more effective horizontal (between public, market and third sector) and vertical (different levels of government) coordination and integration.

Decision-making arenas with different responsibilities were found in all three cities, involving various actors from the different sectors. This difference was most significant between arenas which had a role in local strategy development and, thus, direct influence over the city councils' sustainability agenda on the one hand; and arenas with more professional orientation focused on implementation and project delivery with mainly indirect influence on the other. In Birmingham, the divide between the different types of collaborations was less significant, signalling a move towards horizontal integration. The close connection between the local authority-led strategic initiatives and the rest of the network contributed to the development of network interactions based on horizontal relations between the different sectors. This, together with a lack of shared understanding about sustainable development within the City Council, put the Sustainability Team (to whom the coordination of the network processes was formally assigned) in a difficult position where they had little influence over the decision-making processes both in the network and within the Council. However, the brokerage position between the Municipality and the stakeholder network allowed the Sustainability Team to slowly start developing authority based on relational (network-internal) rather than external resources. Thus, although more integration between the different sectors was seen as a necessity to make any progress, a trade-off was also highlighted between better integration and the Municipality's ability to steer network interactions.

As opposed to Birmingham, in Frankfurt and Budapest the divide between collaborative initiatives focusing on strategy development and on implementation was more emphasised. Thus, horizontal integration between sectors and arenas was less developed. In turn, this meant that the public sector was, to a certain degree, able to retain control over strategy development. In Frankfurt, this resulted in (and reinforced) difficulties with engaging with the market sector dominated by multinational corporations, and a lack of interest from citizen groups to participate in collaborative processes since, from their perspective, the Municipality was leading a sufficiently progressive agenda (Interview 2.03, 2016). Thus, although the lack of significant influence from the market sector made the development of well-defined strategic goals and documents possible, it also posed a risk over the potential to deliver those goals due to a lack of consensus between the sectors. Intermediation between the public and private sector, between strategy and implementation and different levels of government was undertaken by the Energiereferat, mitigating some of the issues arising from lower levels of integration among the separate groups. The brokerage role further strengthened the position of Energiereferat in addition to having access to particular resources (e.g. authority to make decisions, representing the 'common good', professional competence among employees, financial resources; etc.).

In Budapest, governance network processes were weak compared to the other two cities, partly due to a lack of salience of the sustainability issue within the City Council. The authority to make decisions was retained by politicians and senior level officers. The combination of the persistence of the hierarchical model, and the market mechanisms functioning in parallel to it, contributed to maintaining high levels of fragmentation along several dimensions. These include strategy and implementation; professional knowledge and strategic decision-making; and investment and monitoring. The task of steering interactions and collaboration between municipal departments and companies was largely neglected by the leaders of the City Council. Consequently, hierarchical command-and-control mechanisms appeared to be less successful in developing a shared understanding of the type of changes needed to achieve sustainability. Moreover, the absence of a legal framework made collaboration with the private sector complicated. This was an important factor in the development of an inward-looking organisational culture within the City Council. A type of intermediary role was assigned to the Municipal City Planning Agency (BFVT), but due to a misalignment between resources and responsibilities (in particular the lack of influence/authority over decision-making), BFVT was less successful (and engaged) in counteracting the negative effects of fragmentation than either Birmingham's Sustainability Team or Frankfurt's Energiereferat.

Vertical integration between different levels of government received less emphasis in all of the three cases. No public sector actors were involved in any of the networks from the national level. In Birmingham, due to a structural gap in public administration systems, the regional level was represented by professional associations and semi-private collaborations, reducing the public sector's potential to influence governance processes in the network. In Frankfurt, integration between the local and the regional level was influenced by political alignment between the different governments. More recently, collaboration became more efficient due to an acknowledgement of interdependencies and a resulting division of powers and responsibilities between Frankfurt City Council and the Regional Authority of Frankfurt-Rhein-Main. In Budapest, vertical integration was hindered by the absence of a regional authority, by the difficult relationship with the National Government, and the lack of interactions between the City Government and the district authorities.

The described governance network processes were interpreted in the conclusion sections of each case study using the theoretical perspectives of governability, governmentality, interdependence and integration, introduced in Chapter 3, Section 3.3 (pp. 55-67). Table 9.4 highlights the most important findings that could be constructed from the case studies based on the four theoretical approaches. This is important for deriving conclusions for the applicability of Transition Management (TM). TM is almost exclusively influenced by the governability perspective, neglecting the diversity of network governance processes at play which have an effect on the overall network impact.

	BIRMINGHAM	**BUDAPEST**	**FRANKFURT**
Governability	Points to the difficulties with network governance in settings where there is no clear hierarchical relationship between the public and private sector.	Highlights the incapacity and/or unwillingness of the local authority to establish transition arenas and lead the governance network.	Highlights the necessity of a hierarchical relationship within the network between the local public sector and private stakeholders in order to be able to 'govern' via networks.
Interdependence	Describes the network processes developing from the horizontal	Points to the lack of need for collaboration in network settings to	Points to the problem of recognising the existing interdependence between

	relationship between the local authority and the private sector.	deliver cross-cutting initiatives among stakeholders to achieve the set goals in terms of carbon emissions reduction.	the public sector and corporate industry stakeholders. Neglecting interdependency relationships results in difficulties with reducing overall CO_2 emissions.
Governmentality	Highlights the lack of influence of the municipality over constructing a new governmentality paradigm, leading to mismatch between strategy and implementation.	Highlights the dominant view in the local authority that collaboration in network settings with private sector stakeholders is both inappropriate and inefficient, resulting in the comparative underdevelopment of governance networks.	Describes the shift in focus from treating corporate industry stakeholders as partners in carbon emissions reduction to consumers of energy.
Integration	Describes the reasons why a hierarchical relationship between local authority stakeholders and the private sector could not develop historically.	Points to the issues with integration between the public and private sector in a context where free market competition, coupled with public sector hierarchies, is deemed sufficient and efficient in delivering on emissions reduction targets.	Highlights the role of vertical integration across different levels of public sector in order to maintain its position within the network, and the credibility of proposed targets and strategies.

Table 9.4 Interpreting governance processes in networks using different theoretical perspectives

9.2.3 The role of networks in decision-making

Different parts of governance networks may fulfil a variety of functions with regard to the ways in which they are involved in the decision-making process (Torfing and Sørensen, 2014). Internal network processes may be characterised by simple information exchange; networking and building relationships (e.g. to ease potential resource pooling); developing common problem understanding, ownership and engagement through consultation and expert advice; or actively deliberative decision-making to prepare policies, guidelines or strategies (Klijn and Koppenjan, 2015; Sørensen and Torfing, 2009; Torfing, 2005). Building on information acquired from municipal documents and interviews with the stakeholders involved in the networks, the roles of governance networks in relation to the broader decision-making process are presented in Table 9.5.

Network function	BIRMINGHAM	BUDAPEST	FRANKFURT
Information exchange	✓	✓	✓
Networking, building relationships	✓		✓
Building engagement, advising and consulting (passive)	✓	✓	✓
Facilitating collective action through preparing policy, guidelines or strategies (active)	✓		

Table 9.5 The different roles undertaken by the identified networks in the case study cities.

Decision-making arenas driven predominantly by information exchange were found in all three cities. In Budapest, this function was predominant in the existing informal networks, as the most regular interactions between actors were related to the production of the annual 'Inventories of the State of the Environment' (Interview 3.02, 2016; Interview 3.08, 2016).

Networking and relationship building as a functional characteristic was restricted to cities where a significant number of private sector organisations (including businesses and third sector bodies) participated in the collaborative governance initiatives, namely in Birmingham and Frankfurt (Interview 1.06, 2016; Interview 1.11, 2016; Interview 2.04, 2016; Interview 2.05, 2016). In fact, these types of interactions were most dominant in arenas relevant for implementation which had a more professional orientation (e.g. Birmingham Science City Low Carbon Working Group and Sustainability West Midlands in Birmingham, and the Umweltforum in Frankfurt).

Decision-making arenas taking up an advisory role were found in all three cities. In Birmingham and Frankfurt, these initiatives had been operating for a few years set up to provide expert advice for policy making and strategy development for the municipalities, and through this process, to build engagement for the strategic goals expressed in these (Interview 1.02, 2015; Interview 2.08, 2016). In the case of Budapest, the consultation process was to be restricted to the implementation level with the ISCO Advisory Board, planned to be established in the near future as part of the interventions related to the city's 'Climate Change Strategy' (BuCC, 2017; Interview 3.09, 2016), currently under development.

Actively participating in the preparation of guidelines and strategies as a network function could only be found in Birmingham, in relation to certain decision-making processes within the Green Commission (Interview 1.02, 2015; Interview 1.04, 2016).

The involvement of networks in the decision-making process provides information about the roles and power relationships between the public and the private sector, as perceived by the local authorities. In Birmingham, power relationships were considered to be more horizontal due to more equal resource distribution between the public and private spheres. This resulted in a setting where the local Sustainability Team's options to 'govern' the network were restricted to intermediation, as described in Chapter 3, Section 3.4.2 (pp. 68-69). In Frankfurt, despite a clear appetite for intersectoral collaboration from the Municipality, the structural and functional characteristics of the existing networks indicated the dominance of public sector organisations and a more hierarchical relationship between the public and private sphere. Thus, the local Energiereferat was found to possess the resources required to combine hand-on and hands-off strategies and acted as network manager as introduced in Chapter 3, Section

3.4.3 (p.69). The move towards involvement of businesses and community organisations in the decision-making process was almost entirely lacking in Budapest, indicating that the Council has either no interest, capacity or possibility to engage in collaboration with the market and/or third sector. Thus, Budapest City Council has so far not experimented with developing a steering approach (e.g. any form of meta-governance) to governing sustainability transitions in the city.

9.3 THE ROLE OF THE CONTEXT: CONVERGENCE AND DIVERGENCE

9.3.1 Local dynamics of agenda development and governance responses in the different cities

Interpreted as the historical development of the sustainability agendas in the case study cities and the related governance responses, the social dynamics related to sustainability transitions showed significant variance between the different cities. Although network governance was (at least) considered in some form in each of the three cases, the pace and extent of moving towards more networked forms of governance differed substantially.

Birmingham City Council has a long tradition of collaborating with stakeholders in various domains, including urban regeneration. Networked forms of governance, such as public-private partnerships, started appearing as early as the 1990s. A few years later, initiatives focusing on finding ways to reduce carbon emissions in the city were mostly set up from previous collaborative efforts aimed at co-ordinating urban regeneration

(Interview 1.02, 2015; Interview 1.03, 2015; Interview 1.08, 2016). Initially, these decision-making arenas were more influential on the level of implementation; this later changed gradually, and with the Green Commission, collaboration has become a feature of mid- and long-term strategic planning. However, the historical development of the sustainability agenda in Birmingham was characterised by fluctuation and periodic change with regard to political commitment; public administration structure, i.e. roles and responsibilities within the local government and between the local and regional level; and the collaborative organisational structures relevant to sustainable development. The oldest arenas in Birmingham are those operating at a distance from the Local Government, primarily involving actors from the market sector (Birmingham Science City Low Carbon Working Group and Sustainability West Midlands). Collaborative initiatives with closer ties to the City Council have been subject to constant reorganisation processes over the last two decades. However, the overview of the historical developments (see Chapter 6, Section 6.2.1) revealed that these reorganisations affected only the formal frameworks of collaboration: many key actors remained influential despite the constant changes to the organisational structure. Thus, in contrast to many external stakeholders, the involvement and role of City Council departments in the network has not been stable over the past three decades.

In Frankfurt, collaboration in the 1990s was restricted to a case-by-case approach, with the Energiereferat working with specific stakeholders on the delivery of individual projects (Interview 2.03, 2016). In a gradual process similar to that in Birmingham, network arenas set up in the early 2000s had more of an implementation focus (Umweltforum). Later, collaboration became also a feature of strategic decision-making starting from 2010 (Sustainability Board, M100CP Advisory Board, etc.). The historical development of the sustainability agenda in Frankfurt was characterised by a relative continuity in terms of political commitment (i.e. the continued presence of The Greens in the city government which secured cross-party support for the sustainability agenda); and public administration structure within the Municipality (e.g. Hochbauamt Energy Management Group, Energiereferat, Umweltamt, etc.). Although new arenas were set up over time, somewhat changing the organisational landscape related to sustainable development, these arenas have had different focus, role and themes and were not set up to replace others. A similar division of roles and responsibilities developed between the Local Government and the regional level due to a mutual understanding of interdependence between the city and the region.

Out of the three case studies, networked forms of governance were the least dominant in Budapest. Collaborative initiatives were set up on a case-by-case basis during the preparation periods of various strategic municipal plans (Interview 3.02, 2016), such as the long-term focused Budapest 2030 and the mid-term Environmental Programs. The most regular collaboration process developed around the monitoring activities related to the Inventories of the State of the Environment published annually. However, this was mostly restricted to information exchange and data gathering. A collaborative arena is expected to be introduced to decision-making on the implementation level by the ISCO Advisory Board. Relative to the other two cities, the historical development of the sustainability agenda in Budapest was characterised by a lack of political ambitions and commitments; difficulties resulting from the reorganisation of the state and the economy in the early 1990s (i.e. unclear roles and rules resulting from decentralisation, fragmentation and constant reorganisation processes driven by political change); a lack of experience and legal framework to engage in collaboration with the market sector and community organisations. However, parallel to the rising importance of the low-carbon transition issue within the Municipality, an experimentation process started which aims at reducing fragmentation both within the sphere of the local public sector (ISCO), as well as between the public and private sector and citizens (i.e. a ‘Climate Change Platform’ included as part of the City Climate Change Strategy currently under development; BuCC, 2017).

9.3.2 Similarities and differences in the rationales for energy transitions

The complexity of ongoing energy transition processes in the case study cities was defined as the dominant local perceptions around the problem definition, the targets and goals to be achieved, and the actions to be taken to reach the targets. Much of the existing literature on governance networks draws on a nearly axiomatic assumption that contemporary governance problems, including that of governing low-carbon transitions, are complex due to the multiplicity of actors having a stake in the issue at hand; their diverging perceptions, interests and strategies; and to the lack of established and mutually accepted roles and rules in the governance processes. In contrast, the discussions on the locally dominant rationales for sustainable energy transitions in the case study cities in Chapters 6, 7 and 8 demonstrated that the ‘complexity’ of the low-carbon transition issue is highly context-dependent and develops from locally relevant politico-administrative (including the impact of EU and national frameworks), economic (market processes related to decentralisation) and social (nature and extent of interest from wider society) pressures. The context, emerging from the interplay of developments in the three spheres, has been shown to contribute to locally dominant rationales within the municipalities. These, in turn, have an effect on the patterns of collaboration between the public and the market and civil sectors.

Energy transition goals and priorities are rather vague in Birmingham (as well as in the United Kingdom nationally) as a result of relatively low levels of economic and social pressures which could facilitate change. On the national level, energy markets are designed to favour large-scale energy production and centralised systems of distribution, while regulation is characterised by a priority for driving down the unit price of energy (Winskel, 2007). Thus, from an economic perspective, the high costs (financial as well as organisational) involved in changing system architecture to accommodate the requirements of small-scale dynamic generation, and in the roll-out of decentralised technologies, act as barriers to change and result in the lack of a business case for decentralisation in the fully liberalised UK energy sector dominated by profit-oriented multinational companies. Access to fossil fuel reserves and the resulting low levels of dependence on import in the past were important factors in the development of a consumer attitude which takes energy supply for granted. Therefore, thus far concern over the security of supply has not reached a wider audience – resulting in a lack of social pressure to facilitate the reorganisation of energy systems. The interplay of these processes, combined with a lack of political consensus between the dominant parties, resulted in shortcomings in terms of direction over the role of the transformation of the energy sector in reaching the overall carbon emissions targets, both at the national as well as at the local level. Thus, no strategic vision and approach has developed either locally or nationally around the future of the energy infrastructure, despite the rather ambitious emissions reduction goals. In the absence of public sector leadership, low-carbon development is driven by an opportunistic, market-based approach. As a result, influencing sustainable energy transition processes in Birmingham has been interpreted as a complex problem, due to the necessity to engage with the market sector and, to a lesser extent, the third sector; the lack of common interest between the actors involved from different sectors and levels; and a lack of established roles and rules due to the absence of tangible and credible targets in the energy sector.

In contrast, carbon reduction targets in Germany are addressed only indirectly, resulting from a gradual but complete shift to renewable sources by 2050; in fact, emissions reductions are only expressed in terms of estimates (i.e. between 80 and 95% by 2050). Public sector leadership on the energy transition (Energiewende), both locally and at the federal level, is driven by pressure from civil society. Due to the country's high energy consumption and reliance on fossil fuel imports, and the associated complications related to the security of energy supply, there is a society-wide support for renewable energy – with it being the only option to reduce Germany's dependence on imported fuels and to move towards energy autonomy. As a consequence of the dispersion of powers between the different levels of government in the German federal decentralised system, the relatively decentralised structure of energy infrastructures, and the strong position of municipal energy companies in energy supply (for example, Mainova in Frankfurt), a division of powers and responsibilities developed between the Federal Government, the state and local governments, as well as private companies and citizens. Consequently, in Frankfurt (and also in other cities and regions), the local emissions reduction ambitions are aligned with the national targets – strengthening the credibility of commitments towards external stakeholders. The comparatively decentralised structure of existing energy systems, and the lower priority of keeping down the unit price of energy in terms of regulation – focusing instead on reducing demand – provides a window of opportunity in terms of economic viability of investment into more decentralised energy production. Thus, a more strategic approach with clear targets for the energy sector has developed in

Germany and in Frankfurt, focusing on infrastructure reconfiguration and less so on the need to facilitate ‘green growth’. Consequently, the complexity involved in sustainable energy transition processes in Frankfurt can be contained within certain limits. Although multiple actors are involved in the process, the public sector and civil society are in powerful positions compared to the market sector. The resulting hierarchy between the public sector representing the ‘common good’ and private sector interests ensures a certain level of shared understanding (dominated by the views of the Municipality) and convergence of interests. Moreover, due to tangible targets and an alignment of goals between different levels of government, roles and rules are more clearly defined compared to Birmingham.

The low-carbon transition issue, and energy transition within that, was the least influential in the Budapest context out of the three case study cities. Consequently, the carbon emissions reduction targets of Hungary mainly come from the compulsory European commitments rather than developing as a result of internal pressures. Due to the historical development path of the country, fast progress has been made in terms of reducing carbon emissions since the fall of communism. This can be attributed mainly to the introduction of market competition and to the abandonment of energy and carbon intensive heavy industries, but also to the inherited energy systems characterised by centralised structures on different levels (national for electricity and gas, and municipal for heat), carbon-efficient production (e.g. nuclear power for electricity and natural gas CHP for heat) combined with aged, inefficient transmission and distribution systems. This situation, together with an absence of National Government support for renewable energy technologies and the government-dictated artificially low unit price of energy result in a lack of business opportunity to invest in decentralised energy production and in the reorganisation of energy infrastructures. However, opportunity for continuing emissions reduction arises from improvements to the existing systems, both with regard to the national electricity and gas grids, as well as the local district heat networks. In a similar vein to Birmingham and the UK, concerns over energy security have not reached a wider audience outside of the professional sphere, due to the possibility to import cheap fossil fuel from Russia through the infrastructure and connection developed under the communist era. Thus, instead of reducing carbon emissions, the sustainability agenda both on the national level and in Budapest is driven by a focus on facilitating 'green growth' through market mechanisms building on positive experience from the recent past. However, this agenda is detached from the issue of low-carbon energy which is dominated by energy efficiency improvements to existing systems. Consequently, although facilitating sustainable development may be considered as a complex problem in Hungary and in Budapest, this characterisation is less applicable to ongoing changes in the energy sector, as the already existing and operating systems can deliver on the commitments through system improvement. Thus, collaboration is not considered as a necessity, but an option at best, to achieve the targets and goals. Common interest is ensured by the Municipality's authority over all actors involved in the Budapest network. Moreover, due to the lack of pressures which could result in changes in the organisational landscape, an established understanding of roles and rules exist among the actors, making negotiations in network settings less relevant to governing the low-carbon energy transition in Budapest.

9.3.3 Resource fragmentation and its effects on the networks of governance

With regard to resource distribution, energy policy making and regulatory tasks were assigned to higher levels of public sector bodies in all three cases, limiting the possibilities of local governments to influence the trajectory and pace of transitions. The empirical research confirmed that windows of opportunities for municipalities to intervene emerged mainly around decentralised technologies connecting heat and power production and energy efficiency to other services offered by the city municipalities such as waste and sewage management, education, healthcare and social housing.

Because of the UK's highly centralised energy system dominated by central government bodies and national / international corporations, local authorities (including Birmingham City Council) have little or no leverage over energy systems on the operational level. The UK Central Government and local authorities started to recognise the benefits of developing local energy systems only in recent years. Consequently, municipalities possess no licence, experience and financial and human resources to build, manage or operate energy infrastructure in England (Webb et al., 2016). Thus, distributed generation projects in Birmingham are being carried out by private sector companies which are in contractual relationship with the Council (Veolia and Engie in Birmingham). Moreover, the frequent change of Central Government priorities and the lack of a coherent national energy transition support framework has a negative impact on local low carbon initiatives.

Due to the energy regulation culture preceding the introduction of market competition (i.e. exclusive concession contracts with local authorities, as well as demarcation agreements), and to the absence of major centralisation efforts from the federal state, German energy systems are still rather decentralised and characterised by a large number of actors involved, as well as the strong position of municipal companies (formerly called ‘Stadtwerke’; Bayer, 2015). In Frankfurt, Mainova owns and operates the water, sewage, electricity, gas and extensive district heat and steam infrastructure within the city limits, and acts as a supply company towards consumers. However, despite the comparatively high share of local energy production relative to demand (about 35%; FCC, 2015), the local power plants mainly run on fossil fuels (gas and some coal). Due to ownership of the utility company, as well as a social housing company (ABG), Frankfurt City Council remains a major actor in terms of determining the city’s future energy supply. Collaboration between the Council departments and the utilities is aided by personal relationships between the employees, as prior to the market liberalisation, the utilities have been part of the city administration (Interview 2.01, 2016; Interview 2.02, 2016; Interview 2.03, 2016). Parallel to the Council’s efforts, the federal level framework for energy transition (Renewable Energies Act) provides opportunities for private sector companies and citizens to get involved in energy production. As a result, several large solar power co-operatives operate in and around Frankfurt, bringing new actors into the existing stakeholder network.

In a similar vein to the British centrally organised systems, the management and operation of electricity and gas networks is dominated by national and international public bodies, public limited companies and private corporations in Hungary, too. However, Budapest City Council occupies a ‘middle ground’ between Birmingham and Frankfurt in terms of potential for influencing local energy transitions, as it owns the utility companies responsible for district heating supply and waste, water and sewage management. These are separate, mainly autonomously operating companies. Even over two decades after the transfer of the ownership of utility companies from a local branch of the central administration (under the communist era) to the Municipality, collaboration among the companies as well as with the Council is still underdeveloped. In contrast to Frankfurt, there has been no historical integration of utility companies in the municipal structure in Budapest. Thus, the possibility for employees from the different spheres to develop personal relationships with each other did not exist. The two-tier non-hierarchical local government structure (city and district councils) exacerbates the issue of fragmentation of authority and resources. With regard to energy transition, there is no Central Government commitment to increase decentralised generation capacity within the city limits. Carbon emissions mitigation is envisaged to be delivered through a new nuclear power plant and the expansion of energy generation from biomass, biogas and geothermal sources without significant changes to the centralised architecture of the grids at the national level (Zsebik, 2012). Thus, energy infrastructure priorities established in the local urban development plans mainly include improvements to existing systems, and the ongoing initiatives provide little or no room for new players to enter the process and for developing new collaborations between stakeholders.

9.4 NETWORKS' IMPACT ON TRANSITION PROCESSES IN BIRMINGHAM, BUDAPEST AND FRANKFURT

9.4.1 Introduction: progress towards targets in a comparative perspective

The previous sections discussed how different local contexts enable or constrain the formulation and operation of governance networks in the three case study cities. Variation in terms of context and networks was also expected to have an impact on the advancement and direction of local energy transitions. The comparison of the carbon emissions reduction targets and the progress made so far in the case study cities is presented in Table 9.6.

	BIRMINGHAM	BUDAPEST	FRANKFURT
Target	60% CO2 reduction by 2027	21% by 2020 (65% by 2050)	95% by 2050 (55% by 2030)
Emissions reductions achieved (per capita)	28% (2014; compared to 2005 baseline)	15% (2013; compared to 2005 baseline)	18% (2013; compared to 1995 baseline)

Table 9.6 Carbon emissions reduction targets and progress in the case study cities

(Sources: BuCC, 2017; FCC, 2015; DECC, 2014)

The discussion presented in the case study chapters demonstrated that the market sector (industry and commerce) retained a significant role in carbon emissions in each of the three cities, despite the attempts to strategic intervention from the local authorities. Consequently, emissions reductions achieved so far result mainly from the global trend in city economies of switching the focus from carbon intensive industry and manufacturing to services and finance (Sassen, 2011). However, in none of the case study cities has substantial progress been achieved in terms of decarbonising infrastructure systems. Thus, the energy transition seems to be at an early stage in all three cities included in this study.

9.4.2 Networks' impact on strategy formulation

Network impact in the cities chosen for analysis was considered in the case study chapters both in terms of their achievements to formulate strategies, as well as implementing them.

Stakeholders involved in the governance networks expressed a view that Birmingham City Council and its networks were successful in developing strategies for low carbon development, but potential for implementation was lacking and sustainability priorities were often compromised in the implementation stage (Interview 1.02, 2015; Interview 1.05, 2016; Interview 1.12, 2016). This was attributed to a lack of credible, common low carbon development perspective among the City Council departments which often had diverging priorities (Interview 1.03, 2015; Interview 1.05, 2016; Interview 1.12, 2016). The Council's Sustainability Team recognised this issue and used the networking processes and their results to improve its influence over the other departments, with the aim of building internal support for the sustainability agenda (Interview 1.04, 2016; Interview 1.06, 2016). However, this situation resulted in a self-reinforcing process, as the lack of buy-in from municipal departments was mentioned as a barrier to engaging key stakeholders from the private sector by the interviewees (Interview 1.03, 2015; Interview 1.04, 2016). Consequently, network management and the co-ordination of the transition agenda proved to be challenging tasks for the Sustainability Team both within the Municipality and external to it.

Stakeholder networks in Frankfurt were instrumental as advisory bodies for the City Council; their main role was to express their opinion on the plans and strategies developed within the Council. Through preliminary consultations among municipal departments, a shared perspective could be developed which was presented to network members as a common view of the whole Council (Interview 2.07, 2016; Interview 2.08, 2016). Actors involved in the networking processes from the side of the Municipality felt that these large networks were not effective in directly facilitating change. Nevertheless, it was considered necessary to invite the reputable, well-known stakeholders from the local sphere to enhance the credibility of the municipal transition strategies, and to maintain connections with main local actors (Interview 2.03, 2016). In terms of implementation, direct collaboration with stakeholders in relation to specific projects, on an occasional basis, was seen as a more effective way to make progress towards advancing transitions (Interview 2.02, 2016; Interview 2.03, 2016).

Although no formal governance networks were set up by Budapest City Council by 2016, stakeholders involved both in the formulation and implementation of municipal strategies and projects expressed a need for more collaboration across separate actor groups (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.06, 2016; Interview 3.07, 2016; Interview 3.11, 2016). They felt that there was a disconnect between the work conducted at the Environmental Department related to monitoring progress, and agenda setting undertaken by the Project Management Department and the Mayor and his Chief Advisors (Interview 3.02, 2016; Interview 3.03, 2016; Interview 3.05, 2016). They noted that this could be improved via enhanced internal communication and collaboration. Stakeholders with professional background (mainly working for the municipal utility companies) in energy systems believed that better decisions could be made if more professional expertise were involved in the process. By doing so, priorities other than direct costs could be considered. Thus, they expressed a need to provide more space for networked forms of governance (Interview 3.04, 2016; Interview 3.06, 2016; Interview 3.07, 2016; Interview 3.11, 2016). However, they saw their own role in developing networks as rather passive participants and considered the facilitation and steering of network processes a task to be undertaken by the Municipality (Interview 3.04, 2016; Interview 3.07, 2016; Interview 3.11, 2016; Interview 3.12, 2016).

In summary of the above, strategic documents which were, to some extent, relevant to low-carbon energy transitions were found in all of the three cities chosen for analysis. In this sense, the potential for the development of long- and mid-term strategies did not correlate with the extent and form of moving towards networked types of governance, according to the results of the case studies. Instead, network settings were more important in gathering support for strategies developed or approved by the local authorities. This finding was in line with Christopoulos's (2008) comments in relation to the need to differentiate between influence (in which governance networks may have a role) and authority to make decisions (assigned to particular governmental levels and bodies).

9.4.3 The impact of network processes on implementation and delivery

This section considers the potential (i.e. success or failure) of the urban transition governance networks to connect mid- and long-term strategy formulation to short-term implementation (i.e. infrastructure change 'on the ground').

The more polycentric and less hierarchical networks in Birmingham represented the most apparent move towards network governance based on negotiations and compromise out of the three case studies. However, interviewees involved in the transition arenas (collaborative initiatives) described networking processes as messy and often inefficient (Interview 1.02, 2015; Interview 1.03, 2015). The networks were found to be dominated by private companies and academic institutions, and a lack of buy-in from large municipal departments and senior officers was apparent (Interview 1.03, 2016; Interview 1.05, 2016; Interview 1.12, 2016). In terms of the local energy transition, this situation translated into isolated, small-scale initiatives set up by research institutions (for example, the European Bioenergy Research Institute at Aston University; and the Energy Institute at the University of Birmingham); and the employment of mature technologies where profit could be realised by private sector companies such as Veolia or Engie. As a result of positive experiences with cogeneration (CHP) and district heating (DH), and due to the resulting influence of Engie over the views of the Municipality, the energy transition discourse in Birmingham was dominated by the possibilities to expand these systems (Interview 1.02, 2015; Interview 1.03, 2015). Consequently, the issue of energy generation from renewables (e.g. solar power) was abandoned, and renewable energy was represented by small community initiatives in the network. Overall, on the implementation level the low-carbon transition issue was not considered as a main priority for the development of the city, despite the Council's political rhetoric. This was highlighted by the separation of decision-making for economic development and for sustainability; the lack of support from the executive branch of the Council (i.e. traditional large municipal departments and senior officers); and the move towards mature and economically viable technologies which could be financed from the market.

In comparison to Birmingham, the implementation of low-carbon transition strategies (as well as project delivery) was driven by the public sector in Frankfurt.

Initiatives were often undertaken by municipal companies over which the Council had direct authority (Interview 2.06, 2016). The involvement of private companies was less successful and the high energy demand of the market sector acted as a lock-in mechanism for high-carbon energy generation (i.e. CHP fuelled by coal and natural gas; Interview 2.02, 2016; Interview 2.03, 2016). 'Solar revolution' in Germany, and in Frankfurt, was supported by the federal level framework for renewable energies. However, actors involved in solar energy co-operatives pointed out that it was easier to set up projects in the countryside than in the city, and complained about the complications inherent to the urban decision-making processes involving several actors (Interview 2.04, 2016). Although the resources of the Energy Agency (both in terms of expertise and authority as well as connectedness and brokerage) were deciding factors in upscaling the decentralised block-type cogeneration capacity in Frankfurt, the roll-out of this technology did not require significant change in terms of the grid architecture which remained centralised and operated by Mainova. The block-type CHP was offered as a service to consumers by the company (Transition Cities, 2015). However, it remained unclear whether a similar upscaling mechanism would be applicable to the switch to solar power in Frankfurt. The reasons for this include the differences in terms of ownership structure of solar power compared to the existing generation technologies, and the consequent significant changes required to accommodate it within the urban infrastructure systems.

Budapest has yet to develop both a climate change strategy and a transition agenda, as well as a governance network to support the development of these plans. At the time of data collection, the low carbon transition process materialised in isolated projects driven by grant opportunities, coming mainly from the European level. This situation resulted in a common perception among stakeholders that it was not only financially challenging to prepare strategic documents for low carbon transitions, but also impractical due to the nature of the process of how new projects were set up (Interview 3.02, 2016; Interview 3.03, 2016). Parallel to the absence of collaboration, transition activities were limited to projects administered by the utilities owned by the City Council. Although the municipal ownership of these companies was cited as an advantage in building collaboration (i.e. providing 'common' interest through the Council's authority to determine it; Interview 3.04, 2016; Interview 3.09, 2016), initiatives aimed at facilitating collective action on the ground were lacking. Collaboration was limited to certain projects; according to the interviewees, in these cases the City Council's ability to set goals and determine the direction of development based on authority was seen as beneficial in terms of closing arguments and arriving to compromises (Interview 3.04, 2016). As a result, stakeholders felt that a more active steering from the Municipality could result in more collaboration and more innovative and synergistic projects (Interview 3.06, 2016; Interview 3.07, 2017; Interview 3.10, 2016; Interview 3.11, 2016). The stakeholders questioned the potential of the ISCO to take up such a steering role, as it was planned to be set up as a separate entity, rather than an integral part of the administration. It was felt that the initiative is more likely to simply add another layer to the existing fragmented organisational landscape instead of providing space for building connections (Interview 3.09, 2016; Interview 3.10, 2016; Interview 3.11, 2016).

In conclusion, the ways in which the implementation of strategies started to unfold in the different cities was highly influenced by the context, and through that, the structures of local governance arrangements involved in the delivery of low-carbon ambitions. Crucially, higher levels of integration via horizontal coordination in transition arenas in the case of Birmingham did not result in better or more potential to implement mid- and long-term strategies. Instead, a degree of hierarchical relationship between the public and private sector, as it was the case in Frankfurt, could be associated with success in terms of implementation.

9.5 CONCLUSIONS

The comparative analysis of the governance networks in the cities of Birmingham, Budapest and Frankfurt in Section 9.2 demonstrated that significant differences exist between the networks in terms of structure (size, density, topography and actors involved), process (within-network decision-making) and role (type and extent of network embeddedness in the whole of the decision-making process). The analysis also showed that the differences were caused by two interrelated issues, including varying degrees of integration between the public and market sector and civil society; and dissimilar patterns of power relationships between the actors from the various sectors.

The discussion in Section 9.3 showed that both integration and power-relationships were affected by the local dynamics of historical sustainability (and sustainable energy) agenda development and related governance responses; the locally relevant rationales for low-carbon energy transitions; and the patterns of authority dispersion and resource fragmentation in the different multilevel governance settings. It has been demonstrated that particular contextual factors within these themes provide constraints and opportunities which influence the governance networks operating in the different cities. These are related to scale (urban), place (geographical location), and politics and power – issues which are currently insufficiently addressed in the sustainability transitions literature (see Chapter 2). The contextual factors relevant to integration and power relationships influencing the energy transition governance networks in the case study cities is presented in Table 9.7.

ELEMENTS OF THE CONTEXT	INTEGRATION	POWER RELATIONSHIPS
Dynamics of historical sustainability agenda development and related governance responses	Previous experience with collaborative (networked) governance initiatives.	Continued presence in the network and local government steering / leadership.
Rationales for low-carbon energy transitions and resulting complexity	Necessity and degree of change in physical infrastructure and/or organisational structure to deliver carbon reduction targets.	Clear direction offering credibility for low-carbon energy transition (tangible targets; alignment between national, regional and local targets; division of labour between different levels).
Patterns of authority dispersion and resource fragmentation	Resource distribution between actors as a result of dispersion of authority (vertical) and form/extent of market liberalisation (horizontal).	Role of local actors in the energy systems and opportunities for new (local) actors to join.

Table 9.7 Context-dependent processes influencing governance networks in the case study cities.

As mentioned above, the extent of integration between the actors had an effect on power relationships within the networks, and vice versa. Overall, more integration did not automatically lead to better outcomes in terms of strategy development; implementation of strategies; and progress towards low-carbon energy transition goals. The reason for this was that the establishment of transition targets and related strategies were closely connected to local government activity and commitments. Consequently, in order to deliver on the carbon targets and strategic goals, specific power relationships were needed to ensure sufficient influence over implementation from the municipal bodies made responsible for the delivery of transition ambitions. This results from the particular feature of the flow of influence (or information) through the network connections which may be directed towards either of the actors involved in a particular connection where outcomes are generally more reflective of the more powerful actors' interests. Case studies of the transition networks in Birmingham and Frankfurt demonstrated that in multilevel governance contexts where resources external to the network processes are (to some degree) distributed among multiple, relational powers become important. In particular, bridging roles between the municipality and external stakeholders; between the strategic long-term decision-making processes and implementation and project delivery; and between local and regional governments were found to be relevant for the development of transition processes. However, more integration between the actors restricts the possibilities for such brokerage positions to arise, and to be filled by an intermediary organisation. Consequently, more integration between stakeholders made it more difficult for the local government to steer network processes by decreasing the possibility to control the flows of influence and information, for example in the case of Birmingham. Through comparing the cases of Birmingham and Frankfurt to Budapest, it was shown that due to the local governments' dominant role in the establishment of transition targets and related transition strategies, intermediation was more successful where it was undertaken by a municipal body.

In conclusion, the comparative analysis of the governance networks involved in decision-making around sustainable urban energy transitions in the case study cities of Birmingham, Budapest and Frankfurt demonstrated that:

- Different contextual settings offer different opportunities for network governance to emerge which is at odds with the universalist perspective dominating the current scholarship on managing sustainability transitions;
- The emerging networks vary in terms of structure and actors involved, governance processes within the networks and the ways in which they contribute to decision-making for transitions; and

- The above variation has a significant impact on the ways in which transition processes unfold locally.

Such differences were found to be particularly relevant to the capacity and capability of local government bodies to steer (or manage) network governance processes by providing varying potential to successfully intermediate between scarcely connected actor groups. However, despite the differences, overall impact in terms of reducing carbon emissions on the ground has been so far driven by global processes of economic restructuration (i.e. the shift from industry-based city economy to services and finance) rather than by local interventions.

CHAPTER 10.

CONCLUSIONS

10.1 INTRODUCTION

This thesis set out to build a better understanding of the role that networked forms of governance can play in the currently unfolding transitions to low-carbon urban societies in Europe. The importance of considering this problem stems from various developments emerging parallel to each other in different spheres and domains. These include the increasing recognition of the urban scale's significance in global sustainability transitions; the enthusiasm and interest at the local level to pioneer low-carbon development; and the acknowledgement of the lack of capacity and capability of city governments to single-handedly deliver urban transformations. These processes stimulated academic interest in developing new coordination models to facilitate and support low-carbon innovation at various organisational scales, including the urban. As a result, windows of opportunity were created for academic research to develop and test novel governance mechanisms with the aim of finding ways to better support low-carbon transitions in practice, and for practitioners to influence the academic research agenda. The current enthusiasm towards collaboration and networked forms of governance in low-carbon urban development is the result of such interaction (Nagorny-Koring and Nochta, 2018).

Based on previous research conducted within the frames of Climate KIC's Pioneer Cities (PC) and Transition Cities (TC) projects (see Chapter 1, Section 1.2), the following research questions were generated in order to address the research objective:

RQ (1): What is the existing knowledge base regarding the potential and problems of network governance to support the transition to low-carbon cities?

RQ (2): How can the form, extent, trajectory and impact of a city's low carbon network governance be assessed?

RQ (3): What is the comparative level of development, potential and constraint on the low carbon network governance systems of the case study cities?

RQ (4): In what ways can the potential of network governance be enhanced, and constraints reduced, in order to facilitate delivery of low-carbon ambitions?

This chapter presents the most important findings arising from the study, starting with systematically providing answers to the above listed questions, before going on to consider the implication of the findings for the applicability of the MLP and TM in different urban settings.

The chapter is structured as follows: Section 10.2 summarises the conclusions derived from the review of the existing literature in the first part of the thesis (Chapters 2, 3 and 4) in order to answer RQ (1). The outcomes of the case study analyses (Chapters 6, 7 and 8) are used to address RQ (2) in Section 10.3. Experiences acquired from the comparative analysis of the energy transition governance networks are discussed in Section 10.4 with the aim of answering RQ (3). Section 10.5 presents the practical recommendations developed on the basis of the PhD research in relation to RQ (4). Finally, Section 10.6 presents the contributions of the thesis to the existing knowledge related to governing low-carbon transitions via network governance in the cities of Europe. Reflections on the theoretical approach and the research methodology are included in Appendix I (pp. 333-338).

10.2 Insights from the literature review: Governing sustainability transitions in cities

The first research question was aimed at building an understanding of the connections that exist, or can be made, between the separate research fields of sustainability transition theories; governance and policy networks; and urban governance:

RQ (1): What is the existing knowledge base regarding the potential and problems of network governance to support the transition to low-carbon cities?

In order to address this issue, the thesis started with presenting the literature on sustainability transitions, including the relevant definitions, theories, conceptual frameworks and analytical models in Chapter 2. The chapter introduced the dominant ideas related to theorising sustainability and low-carbon transitions, including socio-technical regimes and the Multi-Level Perspective (MLP). It provided an overview of the new models of social coordination supporting low-carbon innovation developed on the basis of these theoretical underpinnings such as Technological Innovations Systems (TIS), Strategic Niche Management (SNM) and Transition Management (TM). It considered the role of stakeholder involvement in the models, and presented a review of the critical comments that they received. The chapter closed with identifying the research gap in the sustainability transitions literature which relates to the role of network governance in low-carbon transitions.

Low-carbon transitions have been characterised as complex problems in this literature. Complex problems have been shown to ‘persist’ due to being rooted in deep structural failures of contemporary societal systems. As a result, solving them requires the systemic reorganisation of the ways in which current societies function, involving radical social as well as technical change in terms of structure (e.g. organisations, institutions), culture (e.g. norms and behaviour) and practices (e.g. routines, skills) (Loorbach and Rotmans, 2010; Nevens et al., 2013; Rotmans et al., 2001). Facilitating low-carbon transitions, therefore, demands joint action from multiple actors operating within and between various organisational and geographical scales and contexts. However, due to the existence of a normative goal, i.e. achieving a shift from the current high-carbon social and economic development path to a carbon-neutral one, self-organisation processes arising from the joint action of stakeholders need to be directed towards achieving this specific outcome. Consequently, the interpretation of network governance, arising from self-organisation in transition arenas, follows a logic informed predominantly by the theory of governability (Agranoff and McGuire, 2003; Klijn and Koppenjan, 2015; Koppenjan and Klijn, 2004). In other words, governance mechanisms developed in the transitions literature, and the TM model in particular, aim at rendering change processes governable through the steering of governance processes which emerge in transition arenas.

In contrast, Chapter 3 aimed at providing a more complete conceptualisation of the network governance phenomena in order to expose the universalist perspective of TM and the MLP. It introduced the origins of the concept, and the different theoretical perspectives underpinning the various strands of the literature. It discussed the diversity of network governance processes relevant to the theories of interdependence, governability, integration and governmentality, as well as the different options to steer governance processes in networks. Finally, a few shortcomings of the literature were highlighted.

The review stressed the diverse processes which may develop in governance networks that cannot be described exclusively by the governability perspective. Instead, it was shown that a variety of theories exist which provide different explanations for the emergence, formulation and operation of governance networks in real-world settings. Thus, even though a baseline definition of the empirical phenomenon which can or cannot be considered 'governance network' exists (Torfing, 2005) based on overlaps between the various research strands, empirical research into networks operating in different settings needs to consider the broader literature to provide descriptions which have explanatory power.

Based on this literature review, I argued that diversity emerges as a result of influence from the context in which networks operate. Thus, by providing empirical evidence for the effects of contextual factors on governance networks and their impact with regard to transitions, the PhD research set out to prove that TM and the MLP present an oversimplified view of the social and technological change processes involved in urban low-carbon transitions. Consequently, their potential to describe transitions, and to render them governable, is likely to be limited to specific contextual settings.

Following on from this conclusion, Chapter 4 focused on the specific issues arising from low-carbon transitions in cities, and presented the literature on collaboration and stakeholder involvement in urban governance using a network-theoretical framework. The chapter concluded that studies into the urban governance of carbon control identified different network governance processes, albeit they did not focus explicitly on assessing these. Nevertheless, examples for each network-theoretical perspective could be found in the in the literature on urban governance responses related to the mitigation of local carbon emissions.

The results of the review indicated that the context (defined as a particular combination of factors arising from scale, place, and politics and power) has a significant influence on governance networks and their impact in the specific case of urban sustainability transitions. This, in turn, implies that different governance networks are likely to provide different options for local governments to intervene in network processes with the aim of maximising their impact in facilitating urban low-carbon transitions.

Consequently, it can legitimately be assumed that the applicability of the MLP and the TM model is largely determined by the context, through its influence over the development networks and governance processes in networks, as well as with regard to network impact. The MLP and TM therefore may be more successful in supporting transitions where contextual factors allow governance networks to develop and function in the specific way best described by the governability perspective. However, they may be less applicable in settings where networks are characterised by processes explained by other theories relevant to the network concept. Thus, the knowledge gap identified through the literature review worthy of further investigation related to the role of the local context; the ways in which certain processes influence the structure and functioning of governance networks; as well as their impact in terms of advancing low-carbon transitions.

10.3 NETWORKS IN CONTEXT: A CASE STUDY APPROACH

On the basis of the proposition formulated through the review of the existing literature, the second Research Question related to the development of a case study approach which could be used to assess the characteristics of governance networks in particular urban settings, the features of the context in which they operate, as well as the resulting impact:

RQ (2): How can the form, extent, trajectory and impact of a city's low carbon network governance be assessed?

The literature review concluded that the context which forms the environment of the particular network in question requires more attention than what the current scholarship assumes in order to gain a more complete picture about the form, extent, trajectory and impact of networks. Thus, a case study approach was deemed appropriate to generate insights about the governance networks operating in the three cities. The analytical framework developed for the case study analyses included the description of the context along dimensions related to the evolution of the local sustainability agenda, the complexity of energy transitions, and organisational fragmentation. On the basis of the results of the literature reviews, it was expected that such contextual factors would help interpreting the characteristics of the networks in the different cities in terms of structure, internal governance processes and role in decision-making. By doing so, they possess explanatory power in terms of network impact, related to the ability to develop strategies, to turn strategies into implementation and on the overall progress towards transition targets (see Chapter 5, Section 5.4.1).

Organisational fragmentation as a possible source of divergence between transition trajectories in different places has been mentioned by Geels (2011) who connected it to the overlap between the (urban) governance systems and the (national) infrastructure regimes. The case study analyses presented in this study provided empirical evidence that the nature and extent of the overlap between the local governance network and the energy infrastructure regime was a significant, albeit not deterministic, factor in shaping the power relationships within the networks between the public sector, the market and civil society. The results demonstrated that organisational fragmentation can only give preliminary insights into the interdependence between the actors from various sectors, about their potential to facilitate transitions, and the governability of network processes by local authorities.

The social dynamics of the co-evolving sustainability (sustainable energy) agenda development, and the governance initiatives tasked with developing and implementing these, was most relevant for understanding the history and experience with collaborative networked forms of governance in the cities. Moreover, it also provided information on the trajectory of network governance (i.e. formulation of the first network arenas; the expansion of the network through setting up new arenas; and changes in terms of roles of network arenas, for example from implementation to strategic levels). With regard the different theoretical perspectives on network governance, the historical overview highlighted distinct processes of network integration in the different cities, and opportunities for specific local governmentalities to arise. These, in turn, shaped actors' perceptions about their interdependency relationships, adding a new layer on top of the patterns of vertical and horizontal resource fragmentation.

The locally relevant rationales of transitions in the different cities were found to be influential in terms of the problem definition (i.e. costs and benefits of local sustainable energy transition), the transition targets and goals to be achieved, and the actions to be taken to reach the targets. Through the case studies it became clear that the most important factors in shaping the complexity of the issue were related to the locally relevant politico-administrative (local frameworks influenced by the national, and to a lesser extent, European levels), economic (market processes related to infrastructure decentralisation) and social (nature and extent of interest from wider society) pressures. The outcome of the interplay between these three features was key in developing particular interpretations of the energy transition issue in relation to the city's sustainable development and the reduction of local carbon emissions. As the authority to set city-wide transition targets was reserved by the local governments, the problem interpretation was an important factor in shaping the public-sector opinion on collaboration with the market and third sector. Thus, interdependency relationships were interpreted in relation to the problem definition and the goals to be achieved (as perceived by the local authorities). In turn, collaborative initiatives (i.e. transition arenas) were important in providing space for new governmentalities to arise. Thus, the description of contextual factors related to resource fragmentation, social dynamics and complexity were crucial to interpreting the results of the analyses of the governance networks in the different cities.

The structural analysis based on quantitative network data provided an initial overview of the characteristics of the local governance networks and the actors involved. Qualitative data collected from network actors were key in describing the governance processes in the networks and in completing the structural analysis of the networks. It was demonstrated that networks developed from various decision-making arenas set up by local or higher levels of government, pointing to the role of local authorities in shaping the emergence of network governance in the urban setting. In terms of the role of networks in the decision-making processes around sustainable energy transitions, collaborative arenas were found to be most relevant for local or regional strategy development and for building connections between stakeholders to facilitate cross-cutting initiatives. However, project delivery was mostly undertaken by spinoff companies created for the delivery of particular pilots by the relevant actors.

Finally, with regard to impact, case studies also demonstrated that the different governance networks' potential to develop mid- and long-term strategies and to implement these was heavily influenced by local contextual. However it is worth noting that, to date, municipal strategies and their implementation have not had a substantial effect in terms of overall progress in actual carbon emissions reductions in any of the cities. Instead, falling emissions rates resulted mainly from the global tendency of the reorganisation of urban economies from carbon-intensive industrial production to services and finance. This finding indicated that emissions reduction in cities has so far been driven by macro-economic processes outside of the reach of local authorities. However, assessing the role that cities can play in the global transition to low-carbon societies was not part of this study.

In conclusion, the PhD research demonstrated that a case study analysis combining the assessment of governance networks, context and impact can provide important insights into the role that networks play in facilitating local low-carbon transitions. This issue has so far been overlooked in the developing literature on sustainability transitions. Thus, this thesis has made a contribution to the existing knowledge by demonstrating that network processes that are at play in different places are more diverse than what the governability perspective, and by extension the MLP and TM, assume. Instead, the different perspectives listed by Torfing (2005) provided a more complete understanding of how different networks and governance processes in these develop. Thus, they contributed to establishing links between governance networks and their impact in terms of low-carbon energy transitions, highlighting the benefits of this kind of analysis when it comes to determining the opportunities for managing low-carbon transitions via networks. The diversity of networks was attributed to local contextual conditions. Three contextual factors were identified to be particularly relevant here: the historical development of sustainability agendas and related governance responses, the rationales for transitions, and the patterns of resource fragmentation. The analytical framework developed through the three case studies is expected to be transferrable to other cities as well, providing a basis for further research.

10.4 COMPARATIVE PERSPECTIVE: UNDERSTANDING THE ROLE OF THE CONTEXT

The case studies presented in the previous section were designed with the ultimate aim of developing a comparative analysis in order to address the third research question:

RQ (3): What is the comparative level of development, potential and constraint on the low carbon network governance systems of the case study cities?

Thus, while Chapters 6, 7 and 8 analysed the governance networks in relation to local contextual factors and the impact they made on sustainable energy transitions, the comparative analysis presented in Chapter 9 set out to identify similarities and differences between the cases, and to give an explanation for their emergence. The comparison demonstrated that dissimilar contextual conditions offer different opportunities for network governance to emerge. It provided empirical evidence for the variance with regard to network structure and actors involved, network-internal governance processes, and the ways in which they contribute to the overall decision-making process for transitions. Moreover, it was found that these differences have an effect on impact in terms of strategy development and implementation for the local sustainable energy agendas, due to providing varying options for local governments to steer network processes. However, in none of the cities have the interventions become driving forces of reducing carbon emissions.

With regard to the changing modes of governance presented in Chapter 3, the role of the context in the emerging governance network processes in Birmingham, Budapest and Frankfurt indicated that no universal, well-defined shift from traditional bureaucracies and/or mechanisms based on market principles to networks took place in any of the cities. Instead, change processes in reality were found to be more complicated and messier because both the hierarchical and market-style modes of governing, as well as network governance, were employed in varying combinations in the different cities. Networks started emerging (or are projected to do so in the case of Budapest) from arenas set up by local, regional or central authorities. Decision-making arenas introducing a more deliberative form of coordination mechanism to the sustainability domain have been established with the aim of tackling local low-carbon transition which were deemed to be difficult or impossible to effectively deal with using other mechanisms. Consequently, in none of the cities was the entire issue of sustainability transitions, including policy and strategy formulation as well as implementation, exclusively dealt with via networks. Instead, context-specific combinations emerged creating distinct local assemblages of governance arrangements including mechanisms based on hierarchies, markets and networks.

This finding was in line with the strand of public administration literature which claims that new mechanisms tend to create new layers and opportunities for social coordination but do not systematically replace old practices. Similar conclusions were expressed by Pollitt and Bouckaert (2011) in relation to the introduction of market-style mechanisms to substitute (or, as later was recognised, supplement) traditional hierarchical decision-making in certain domains of public administration. They argued that despite the initial enthusiasm surrounding the changes termed collectively as 'New Public Management' (NPM) and their impact on the future of the public sector, the extent to which NPM substituted traditional hierarchies in practice was heavily exaggerated (see also Chapter 3).

It was demonstrated through the comparative analysis that the ways in which recent public-sector reforms had played out in the different countries in the energy sector had a major impact on the potential (and/or willingness) of governing local low-carbon transitions via network governance in the various cities. Out of the three countries, the United Kingdom went furthest on the way towards market liberalisation of a previously centralised and nationalised energy infrastructure, creating simultaneously a fragmented, multi-actor environment for energy decision-making, and excluding local authorities from energy systems management. Thus, decentralised energy technologies opened up a new 'playing field' in an 'institutional void' providing space for new actors to join, including local governments. In the absence of tradition, competence and capability to manage energy infrastructures within Birmingham City Council, network governance provided the opportunity for agenda development about the energy futures of the city and for negotiations about the roles of various actors in these. Despite the apparent enthusiasm in employing network governance in the strategy formulation and implementation process, market-style mechanisms (i.e. the contracting out of waste management and the operation of district heating (DH) systems) remained dominant. Hierarchical command-and-control style mechanisms, however, were found to be more relevant to the national level.

A rather different starting point for network governance was observed in Frankfurt. Here, due to the absence of centralisation efforts from the federal and state level and the continuous development of local decentralised energy infrastructure originating from the 1920's, the Local Authority could be considered an important player in the energy sector, and consequently, in the sustainable transformation of the city's energy infrastructure. Thus, even though decision-making arenas were set up, they were rather seen as providing opportunities to make the decision-making process more transparent (i.e. by informing stakeholders about the City Council's plans first-hand) and to ease implementation (i.e. by consulting certain decisions made within the local government before publication). However, the rather hierarchical relationship between the local (and regional) authority and private stakeholders remained dominant, as well as the regulatory approach (e.g. 'Passivhaus' Resolution). Market solutions were employed less extensively, in relation to certain issues, such as developing new business models for the municipal energy company or establishing a local feed-in tariff for heat and power cogeneration (CHP).

In the case of Budapest, similarities with both Birmingham (i.e. relatively weak local government in terms of financial and human resources) and Frankfurt (i.e. comparatively less apparent blurring of boundaries between public and private sector; limited market competition in the energy sector due to the national regulatory framework and the importance of publicly owned companies) were revealed. However, the ways in which network governance was envisaged to be utilised by the City Council was rather different from the other two cities. The parallel issues of the weak policy and strategy formulation powers of the Municipality in the energy sector; the existence of aging decentralised energy infrastructure; and that of the non-viability of renewable micro- and decentralised generation translated into an energy transition agenda which included initiatives that were possible to deliver within the turf of the local authority. Consequently, no decision-making arenas were set up for policy and strategy formulation. The modernisation of existing energy infrastructure (based on CHP, DH and waste-to-energy) did not require the renegotiation/understanding of roles and responsibilities among stakeholders, while the add-on projects required collaboration between municipal utility companies only. Thus, networked forms of governance were envisaged to support communication and synergies among the public utilities owned by the City Council. In the absence of initiatives which could have given rise to new governmentality logics, the traditional hierarchical mode of decision-making persisted in the case of agenda setting, and the market approach remained dominant in the electricity and gas sectors, supervised by the National Government.

The analysis of the governance arrangements relevant for the local sustainable energy transitions demonstrated that, to a varying extent, all three coordination mechanisms were employed in various parts of local decision-making processes. Despite the similarity in material terms in relation to the realised decentralised energy projects, diverse place and time-specific hybrid governance arrangements (Christensen and Lægreid, 2011; Skelcher, 2012; Skelcher et al., 2013) were identified. Thus, no clear shift(s) from the traditional state hierarchical model and the market-type mechanism (NPM) to a network governance-based New Public Governance (NPG) could be confirmed at this level of analysis. Instead, different context-dependent assemblages emerged as governance arrangements to support low-carbon transitions. The only common point revealed by the analysis was that, to some degree, the introduction of networked forms of governance was considered in all of the case study cities. Considering network governance resulted from international climate change governance processes (i.e. United Nations recommendations) and the European frameworks following these.

10.5 NETWORKS AND IMPACT: RECOMMENDATIONS FOR PRACTICE

The fourth research question considered the development of practical recommendations for governing low-carbon transitions in cities across Europe:

RQ (4): In what ways can the potential of network governance be enhanced, and constraints reduced, in order to facilitate delivery of low-carbon ambitions?

The findings of the comparative analysis in Chapter 9 demonstrated that different perspectives and interpretations of network governance emerged in the various cities, and that contextual factors were key in explaining dissimilarities. The context, which could be successfully described using the framework developed in Chapter 5 and applied through the case study analyses, was found to contribute to different power relationships, and understanding of roles and rules between actors from the public, market and civil sectors. These, however, did not depend only on the structural characteristics of resource fragmentation, but also on previous local experience and competence both with regard to collaborative forms of governance as well as infrastructure management, and on the ways in which local actors interpreted large-scale macro developments (i.e. rules of the market and the role of governments in interventions, energy security, dependence and its consequences). From the interplay of these conditions, context-specific resource distributions developed among the relevant actors from the various sectors contributing to certain hierarchical relationships in the networks.

This could largely be attributed to the fact that although sustainable development is a cross-cutting issue and, consequently, systemic sustainability transitions need to include the reorganisation of ways in which societies and the economy function currently, the currently unfolding attempts to govern urban low-carbon transitions are still characterised by a sectoral focus (e.g. housing, transport or energy systems; Transition Cities, 2015). This is important, because due to the pre-existing conditions of how these systems operate in particular settings, established roles and rules exist which influence interactions between the actors. Consequently, they potentially counteract or hinder the emergence of any substantial change, resulting in solutions which maintain the status quo. Lewis (2011) described this problem in terms of the difference between policy networks and network governance (cf. Blanco et al., 2011). The latter, understood as a coordination mechanism based on horizontal relationships, is not the only mechanism at operation in established policy networks. Instead, hierarchical relationships between the actors involved in policy networks have implications for the degree to which particular interactions can be characterised as network governance. This problem seems especially relevant on the urban scale in the energy domain which, so far, has been overlooked in the literature on managing sustainability transitions.

It follows from the discussion above that decision-making taking place in thematic arenas based mainly on traditional sectoral themes potentially makes it difficult to facilitate any meaningful change. Such sectoral focus was found both in Birmingham (e.g. Green Commission) as well as Frankfurt (e.g. Regional Energy Concept working groups). In these cities, issues of green economy and finance, transport, energy systems, and housing were discussed in separate working groups or roundtables, broadly corresponding to sectoral and municipal departmental silos. This was problematic due to several reasons. First, established interests and hierarchies between actors operating in the various sectors prevailed. Second, opportunities for intersectoral cooperation were limited. Third, outcomes in terms of enhanced collaboration and reduced fragmentation within the local authorities was limited.

Therefore, in order to give space to network governance processes based on horizontal coordination, the results of the present study indicate that more attention should be given to setting up transition arenas which are truly cross-cutting in terms of focus. Scholars of network governance pointed out that the natural policy contexts where governance networks 'organically' appear are 'institutional voids' (Hajer, 2003), i.e. spaces where no functioning hierarchical order is in place. In these situations, horizontal relationships gain prominence, providing space for negotiation among actors to achieve consensus on newly defined roles and rules, leading to organisational change. Therefore, abandoning sectoral silos and focusing on the locally relevant 'windows of opportunity' in terms of policy and strategy formulation and implementation may present an option to enhance the success of network governance in the context of the local government. Such an approach can also provide options for governance networks to transcend the boundaries between strategic decision-making, implementation and project delivery. The importance of connecting such activities was highlighted by several interviewees from the case study cities (e.g. Interview 1.05, 2016; Interview 2.03, 2016; Interview 3.07, 2016).

In conclusion, the results of the PhD research indicate that more attention must be given to contextual factors when deciding about the ways in which networks are set up (scope and role in the decision-making process) to overcome the limitations and risks posed by existing power relationships. Contextual factors which are of particular importance are the following: dynamics of historical sustainability agenda development and related governance responses; rationales for low-carbon energy transitions and resulting complexity; and patterns of authority dispersion and resource fragmentation (see Chapter 9, Section 9.5). Thus, the conscious exploitation of existing institutional voids (informed by knowledge about the context) where governance networks can operate more similarly to what TM describes may result in more impact in terms of facilitating reorganisation processes and low-carbon transitions.

10.6 CONTRIBUTIONS TO THEORY

10.6.1 The applicability of the Transition Management concept in cities

The aim of this thesis was to provide insights about the practical applicability of the Transition Management (TM) framework in different urban settings through presenting a more comprehensive account of the development of governance networks, network processes, and network impact in different urban settings. A basic assumption of the TM approach, being based on the Multi-Level Perspective (MLP), is the conceptualisation of the functioning of socio-technical systems as results of the complex interplay between the macro-, meso- and micro-levels. Due to the unpredictability of the results of interaction processes, socio-technical systems are characterised as Complex Adaptive Systems (CASs). Thus, providing direction for system innovation towards low-carbon futures in TM becomes a problem of managing CASs. Due to uncertainty about cause-effect relationships in the system in question, strategic planning based on projections is deemed impossible, or at least leading to suboptimal outcomes. This results in the need for more adaptive and responsive governance mechanisms, and a move *away* from planning through hierarchical command-and-control to steering from a distance. Steering societal processes provides space for self-organisation but also offers the possibility to direct these self-organising processes towards the normative goal of low-carbon transitions. It follows from this logic that TM implicitly assumes a very particular power relationship between actors whose interaction determine the potential for self-organisation on the one hand, the potential for steering on the other.

The case studies presented in this PhD research demonstrated that even within the European Union there is more divergence between local possibilities for self-organisation (i.e. network governance based on horizontal coordination) and steering than what TM accounts for. Self-organisation is expected to develop within and between specific decision-making arenas in the context of urban sustainability transitions. In contrast, the case studies revealed that self-organisation processes are highly dependent on the power-relationships between the various actors involved in these arenas. Established power relationships, acknowledged by the actors involved in the arena, counteracted the emergence of self-organisation processes based on horizontal relationships.

The conclusions drawn from the case analyses also indicated that local contextual factors which were important in determining such power relationships couldn't simply be described in terms of the formal distribution of resources resulting from the ways in which energy markets were organised in the case study cities. Experiences from the past, as well as local interpretations of global processes and the appropriate local responses to these, also had a role in how power relationships between the local actors were perceived by the actors themselves.

In turn, these power relationships had an influence on the local governments' potential for steering the self-organisation processes emerging within and between transition arenas. The degree of the move away from the hierarchical command-and-control coordination to market-style mechanisms in the 1980's and 1990's, and the consequences of this shift, in the particular national and local settings was found to be especially relevant to determining the potential of the local government to steer governance processes in the transition arenas. Thus, different options for steering became available to local government bodies in the different places. In Birmingham, located in the UK context where privatisation and market liberalisation went the furthest out of the three cases, the capacity for steering via network management was limited. Consequently, the main role of the local government body was to facilitate self-organisation processes through interest intermediation between actors (including the departments of the Municipality as well as external stakeholders). However, it was shown that in the absence of external resources, network-internal relational resources (i.e. brokerage) could be used to iteratively strengthen the impact of the Council's Sustainability Team over the separate spheres of actors. The potential for managing transitions through a network management interpretation of steering was most applicable in the German context in Frankfurt. Due to less significant impact in terms of market liberalisation, a more hierarchical relationship between the public and private sector was apparent, providing opportunities for the Energiereferat to provide direction to the self-organisation processes in the network. The perceptions about power relationships in the context of Budapest made the emergence of self-organisation processes more complicated, at least on the local level. In contrast to Torfing's (2014) expectations, network processes were more relevant to national level decision-making in Hungary and less so on the local level. This issue contributed to the development of a rationale within Budapest City Council that influencing the ongoing transition processes was not possible. Instead, the Council decided to set arenas up based on authority rather than any form of meta-governance through the exclusive involvement of municipal bodies and companies. As this process in Budapest was still in an early phase, it was not possible to draw direct conclusions on how successful this strategy might be in terms of changing the ways in which the municipality operates and reducing carbon emissions.

In conclusion, albeit TM may provide a useful concept in particular settings (Nagorny-Koring and Nochta, 2018), it is important to consider the implicit assumptions which it makes about the relationships between actors relevant to the criticisms of neglecting issues of scale, place, and politics and power. It has been shown, through comprehensive analyses of the governance networks, network processes and network impacts informed by the different network-theoretical perspectives (governability, governmentality, integration and interdependence), that different combinations of contextual conditions contribute to the development of differences among the networks, processes and impacts. Thus, one option for a more successful implementation of TM in cities needs to involve the analysis of power relationships, and the conditions that maintain these in order to ensure that impact is delivered in terms of advancing low-carbon transitions. Moreover, a careful design of decision-making arenas for transitions is necessary, where horizontal relationships prevail between the actors but at the same time local governments have the capacity to steer network processes towards low-carbon development.

10.6.2 Lessons for the MLP and the socio-technical perspective

Albeit the primary aim of the research was to investigate the applicability of TM in different urban settings, the findings also highlight issues related to scaling down the Multi-Level Perspective to the urban scale. However, in order to justify the conclusions for the MLP and the socio-technical perspective, it is important to consider how the current focus on facilitating low-carbon transitions emerged from the sustainable development discourse of the 1980's and 1990's.

As discussed in Chapter 2, sustainable development was first defined in terms of finding a positive balance between social, economic and environmental interests to better serve the needs of the present as well as future generations. The environmental perspective included in the sustainability concept was initially more focused on the preservation and conversation of green spaces and reducing pollution from human activities which was considered to be the main cause of environmental degradation. The concept of climate change, i.e. that pollution does not only damage the environment directly, but it also changes the whole ecology of the planet, become comparatively more emphasised in the subsequent years. As a result, the environmental agenda of the sustainable development concept became more focused, and the governance task clearer: cutting greenhouse gas emissions, and carbon-dioxide in particular, has become a priority. Global carbon-dioxide (CO_2) emissions inventories showed that the major source of emissions is burning fossil fuels resulting in a belief that a change in the ways in which we use energy as a global society is necessary. Thus, sustainability transitions were defined in a narrow sense as low-carbon transitions, i.e. shifts towards carbon neutral technologies.

The view that low-carbon transitions involve the reorganisation of the society in parallel to technological change was added to the discourse on the adoption of new technologies later on, as a result of analyses of historical transitions which showed that new technologies in certain cases transformed the functioning of societies. Thus, a *direct* connection was established between the social and the technological, on the basis of co-evolutionary ideas.

This is important for the understanding of change inherent to sustainability transition theories, which subscribe to the logic of the punctuated equilibrium model, where change between periods of relative stability happens as a result of comparatively short periods of systemic reorganisations (transitions), resulting from co-evolution between the social and technological system components. Thus, the task was redefined to understand the ways in which reorganisation processes start and end, i.e. what causes imbalance and how the system finds the new equilibrium as a result of interaction between various system components.

The Multi-Level Perspective (MLP) has become the most successful model in describing socio-technical change. According to the MLP, system equilibrium is maintained by alignment between macro, meso and micro levels which contribute to the development of dominant socio-technical regimes. As regimes gain power through increasing returns, they act as a selection environment and via the selection process they place constraints on the ways in which agency can be exercised by the actors in the socio-technical system. At the same time, the macro and meso-level processes are seen as developing from a collective agency, i.e. the sum of interpretations of agents. Thus, the role of the micro (niche) level is emphasised in bringing about change through new or different interpretations of constraints and possibilities. Based on the MLP, low-carbon transitions can be brought about by strengthening the possibility for new ideas to arise in niches and by ensuring take-up by the regime through making it more responsive to change.

In contrast to the conclusions of the MLP, the case studies (in particular, Budapest; and to a lesser extent, Frankfurt) analysed in this thesis demonstrated that low-carbon development can also be achieved gradually, without the complete reorganisation of the physical and social infrastructures which determine the ways in which energy is used for human activities. Thus, the case studies indicate that the context has a relevance not only for the emergence of different network structures and processes and associated impacts on transitions, but also more broadly, for the applicability of the punctuated equilibrium model of change. The reason for this is that combinations of contextual conditions have a mediating effect on the nature, pace and extent of interactions between the social and the technological spheres. This, in turn, implies that although it might be possible to describe the sum of changes related to the shift to low-carbon societies on the global level on long time scales as a transition process from one relative state of equilibrium to another, this assumption does not necessarily scale down directly to the national or sub-national levels in different parts of the world. In turn, this issue also has a consequence for the applicability of TM on the urban scale which is based on an MLP-informed view of change and path dependency.

10.7 FINAL REMARKS

In summary of the conclusions presented in this chapter, the results of the case study and comparative analyses demonstrated that issues related to scale, place, and politics and power have an effect both on the applicability of the descriptive-analytical (MLP) and prescriptive (TM) frameworks dominating the sustainability transitions literature. These findings and conclusions emerged in the specific case of city transitions towards low-carbon decentralised energy. However, the research methodology can be applied to other empirical cases of sustainability transitions.

Overall, the present thesis made three main contributions to the existing knowledge. First, the universalist character of contemporary discourses on sustainability transitions was exposed and the necessity to better understand the implications of contextual factors on collaboration patterns relevant to the governance of urban low-carbon transitions was expressed. Second, in order to support this claim, a comparative framework and methodology was developed and tested to assess the role of networked forms of governance in governing transitions in different urban settings. The third and main theoretical contribution considers the applicability of the TM model: the study provided empirical evidence that the implicit assumptions (related to place, scale and politics & power) built into TM about the functioning of collaborative governance networks, based on the governability perspective, limit its applicability in different cities where these assumptions do not hold. Moreover, the findings also indicated that the link between technological change required for urban low-carbon energy transitions, and organisational change in local governance arrangements, is heavily context-dependent, in contrast to the assumptions TM and the broader MLP and socio-technical perspectives.

APPENDIX I.

REFLECTIONS ON THE APPROACH TO THEORY AND METHODOLOGY

Due to the lack of previous empirical research in the area chosen for analysis in this PhD research, original conceptual and analytical frameworks had to developed. These were derived from integrating information from multiple fields of literature. Moreover, the role of context played a central role in the analysis presented throughout the thesis. Consequently, I felt necessary to include reflections over a few issues related to the approach I took in relation to theory, considering the impact that my own frames of reference might had on the research agenda and approach (Section I/I), and the implications for generalisation from the results (Section I/II). Two further issues are discussed in this appendix in connection to methodology: the role of language and culture (Section I/III), and the implications involved in analysing secondary data (Section I/IV). These issues were particularly relevant at the stage of data collection and processing.

I/I. THE ROLE OF THE RESEARCHER'S PERSONAL VIEWS AND BELIEFS IN COMPARATIVE SOCIAL RESEARCH

In the course of the research project, a range of conscious decisions had to be made. These included issues related to the particular social phenomenon for analysis; the research questions to be asked; and the research design and methodology which can provide answers for these questions. However, these decisions are largely determined by the researcher's personal views and beliefs about the phenomenon under analysis. With regard to comparative research in particular, Green (1994, p. 6) argues that '*no comparison is completely neutral*', because '*[t]he way in which the question is asked implies part of the response'*. The reason for this is that choices regarding the selection of units, scale and the scope of analysis, the approach, variables or factors are inevitably influenced by the researcher's mindset, socio-cultural experiences and accumulated cultural and linguistic knowledge, in addition to the practical factors such as the time and budget available for the project (Hantrais, 1999; Van Thiel, 2014). Minimising interference between my own biases and the research project has not been an easy task and, in fact, I can't be completely certain that I succeeded in achieving it. However, I believe that receiving feedback from my two PhD supervisors with very different backgrounds and views was extremely helpful in this process. So was presenting my research in front of a variety of audiences ranging from colleagues and peers at the Institute of Local Government Studies and the School of Government and Society, as well as the Department of Civil Engineering; on various academic conferences related to social network analysis, organisational and regional studies; and on workshops organised by Climate KIC for the academic community involved in sustainability transitions research.

I/II. GENERALISATION: OPPORTUNITIES AND LIMITATIONS

The desire to generalise from the findings is central to the comparative research strategy, and the possibility to conduct a meaningful comparison may be compromised by the absence of any universally applicable concepts which can be used to construct equivalence across the cases (Hantrais, 1999; Rose, 1991). This issue is further exacerbated by embarking on a research based on the selection logic of most dissimilar cases, a problem which was particularly relevant to the present study (Hantrais, 2009; 1999). In addition, the case study orientation, and the resulting small-n research strategy, carries the risk of not examining enough cases to be able to produce reliable conclusions. In the case of the present study, common frames of reference were provided by international frameworks (related to the United Nations, the European Union and various transnational municipal networks) in the social sphere, and by assess to similar technological solutions for decentralised energy generation from a technological standpoint. The key concepts used in the research, related to governance and networks, were defined in a way which ensured transferability across the cases based on the pre-existing literature (for definitions see Chapter 3, Section 3.2.3).

With regard to generalising from cross-national comparative research conducted on the sub-national level, both opportunities and risks should be considered. First, it cannot be assumed that results derived from the analysis in a particular sub-national context hold in the case of all other possible sub-national units within the same national context (Hantrais, 1999). However, based on a careful assessment of the contextual factors which contribute to the ways in which the studied phenomenon develops in certain places, cross-national comparative research offers the possibility to make generalisations across countries and regions (Hantrais, 2009). In order to exploit this potential, the present study developed a transferable methodology and tested it in substantially different contexts in three cases. However, it does not claim that results of the analysis of the case study cities automatically hold in other urban settings in the respective countries.

I/III. LANGUAGE AND CULTURE IN CROSS-NATIONAL COMPARATIVE RESEARCH

The majority of the literature used in this study is written in English. This issue became relevant in the empirical part of the research, with regard to the case studies from the German and Hungarian linguistic environments (cf. Burling, 1970; Duranti and Goodwin, 1992). It was expected that difficulties would arise during data collection from Frankfurt and Budapest, as well as with regard to interpreting the collected information. The role of dissimilar frames of reference to interpreting the various concepts related to social coordination central to the research had to be considered both in the case of written documents as well as interview responses.

However, during the data collection period of the first case study in the context of Birmingham it became clear that the specific terms used in the academic literature did not enter the spheres of practice even in the English-speaking environment. As a result, concepts of governance, networks and network governance had to be translated into more widely used expressions such as collaboration or stakeholder involvement for data collection. In order to ensure conformity with the concepts described in the academic literature, it was necessary to gather rich information on the features of the phenomena which documents and respondents considered as collaboration and stakeholder involvement. Despite making data collection more complicated and time-consuming, this issue also provided the opportunity to make certain that the case study analyses remained comparable.

I/IV. THE ISSUES OF SECONDARY DATA ANALYSIS

Both primary and secondary data were used in the PhD research. Primary data was generated through semi-structured interviews, and secondary data was obtained from web searches, municipal documents, reports, publications and meeting minutes. Both quantitative (network memberships) and qualitative (e.g. the historical development of networks and transition agendas) information was obtained from various secondary sources. All secondary sources used in this study were official documents originating either from the local authorities or the collaborative governance entities (e.g. in the case of meeting minutes). One common feature of the various types of secondary data is that they were not collected and assembled by the researcher (Cowton, 1998), resulting in complications related to the validity and reliability of the data that they contain.

However, these complications are not necessarily negative. Reliability and validity may be enhanced by the relative objectivity of published documents (e.g. statistics, progress reports) and by the fact that they were written within the same historical time frames as the phenomena at their focus, providing scope for more accurate representation (Van Thiel, 2014). This, however, comes at the expense of 'loss of control' and oversight for the researcher over how the data was produced (Cowton, 1998), or whether it is, indeed, accurate (Bryman, 2003).

These issues are relevant to the PhD research in the following ways: first, the overwhelming majority of the documents used were produced and published by the municipalities, carrying the risk that the discussions and representations of historical developments are one-sided. Second, the reliability of statistical data presented in municipal reports, e.g. related to historical carbon emissions trends and measures, could not be verified. Third, problems related to accuracy emerged in relation to obtaining membership data from web searches, municipal documents and meeting minutes: as memberships changed fairly often in many instances, these changes were not always administered in the relevant data sources. In order to minimise the effects of false information, the following strategies were employed: wherever it was possible, multiple documents were contrasted to gain a more accurate understanding of historical processes. In addition, interviews with key stakeholders were used to complete, validate and triangulate the data obtained from written sources, as recommended by Olsen (2004).

APPENDIX II.

LISTS OF MUNICIPAL DOCUMENTS SELECTED FOR ANALYSIS

BIRMINGHAM

TITLE	BY	DATE	AVAILABLE FROM
PUBLICATIONS			
Towards A Sustainable City. Birmingham City Council Achievements. Local Agenda 21 1992-2002	Birmingham City Council	2002	On request from Birmingham City Council
Birmingham Climate Change Strategy and Action Plan. Consultation Document.	Birmingham Strategic Partnership	2007	http://www.bebirmingham.org.uk/documents/bham_climate_strat_final.pdf
Preparing for A Feasibility Study for Decentralised Energy In Birmingham	Birmingham Sustainable Energy Partnership	2007	http://localisewestmidlands.org.uk/wp-content/uploads/de_birmingham1.pdf
Birmingham 2026. Our Vision for The Future. Sustainable Community Strategy.	Be Birmingham Partnership	2008	http://www.bebirmingham.org.uk/documents/Final_Sustainable_Community_Strategy-Birmingham_2026.pdf
Birmingham Sustainable Energy Action Plan	Birmingham City Council, Be Birmingham Partnership	2009	http://www.bebirmingham.org.uk/uploads/Birmingham%20Sustainable%20Energy%20Action%20Plan%20SUBMITTED.pdf
Birmingham Environmental Partnership. 08/09 Annual Report.	Birmingham Environmental Partnership	2009	http://www.bebirmingham.org.uk/uploads/BEP%20Annual%20Report%2008-09.pdf
The Birmingham Declaration on Climate Change	Birmingham City Council	2009	On request from Birmingham City Council
Birmingham Climate Change Action Plan 2010+	Birmingham City Council	2010	http://www.bebirmingham.org.uk/uploads/Birmingham%20Climate%20Change%20Action%20Plan.pdf
Birmingham Environmental Partnership. 09/10 Annual Report.	Birmingham Environmental Partnership	2010	http://www.bebirmingham.org.uk/documents/BEP_Annual_Report_09-10.pdf
Birmingham Energy Strategy. Common Evidence Base for Birmingham's Energy - Summary	Sustainability West Midlands	2010	http://www.sustainabilitywestmidlands.org.uk/wp-content/uploads/Birmingham-Energy-Strategy-Common-Evidence-Base-November-2010.pdf
Birmingham Energy Strategy. Strategic Issues and Options	Sustainability West Midlands	2010	http://www.sustainabilitywestmidlands.org.uk/wp-content/uploads/Birmingham-Energy-Strategy-Issues-and-Options-November-2010.pdf

Birmingham Big City Plan. City Centre Masterplan.	Birmingham City Council	2011	https://bigcityplan.birmingham.gov.uk/
Tyseley Environmental Enterprise District. A Framework for Action	Birmingham City Council	2011	https://www.birmingham.gov.uk/info/20054/planning_strategies_and_policies/70/local_development_orders/5
Birmingham Carbon Plan Analysis	Green Commission	2013	http://www.makingbirminghamgreener.com/useful-information/
Birmingham's Green Commission. Carbon Roadmap.	Green Commission	2013	http://www.makingbirminghamgreener.com/useful-information/
Birmingham's Green Commission. Building A Green City.	Green Commission	2013	http://www.makingbirminghamgreener.com/useful-information/
Report on Birmingham's Carbon Dioxide (Co2) Emissions Reduction Target Baseline	Green Commission	2013	http://www.makingbirminghamgreener.com/useful-information/
Report on The Impact of National Policy and Programmes On Birmingham's Carbon Dioxide (Co2) Emissions To 2027	Green Commission	2013	http://www.makingbirminghamgreener.com/useful-information/
The Economics of Low Carbon Cities. A Mini-Stern Review for Birmingham And the Wider Urban Area	Centre for Low Carbon Futures	2013	https://www.sustainabilitywestmidlands.org.uk/resources/the-economics-of-low-carbon-cities-a-mini-stern-review-for-birmingham-and-the-wider-urban-region/
Review of Operating Options for The Birmingham Environment Partnership: Lessons for The Green Commission	Sustainability West Midlands	2014	https://www.sustainabilitywestmidlands.org.uk/resources/review-of-operating-options-for-the-birmingham-environment-partnership-lessons-for-the-green-commission/
Birmingham's Green Commission. Carbon Roadmap Update - Autumn 2015	Green Commission	2015	http://www.makingbirminghamgreener.com/useful-information/
Birmingham's Green Commission. Covering Note: Connectivity & Sustainability O&S Committee.	Sustainability West Midlands	2015	http://www.sustainabilitywestmidlands.org.uk/wp-content/uploads/Green-Commission-Covering-Note-final-april15.pdf
A Greater Birmingham For a Greater Britain. Greater Birmingham And Solihull Local Enterprise Partnership Strategic Economic Plan 2016-2030	GBS LEP	2016	https://gbslep.co.uk/resources/reports/strategic-economic-plan-2016-30
MEETING MINUTES			
Birmingham Environmental Partnership, Low Carbon Energy Delivery Group Meeting Minutes	Birmingham Environmental Partnership	13/01/2012	On request from Birmingham City Council
Birmingham Environmental Partnership, Low Carbon Energy Delivery Group Meeting Minutes	Birmingham Environmental Partnership	12/02/2012	On request from Birmingham City Council
Birmingham Environmental Partnership, Low Carbon Energy Delivery Group Meeting Minutes	Birmingham Environmental Partnership	01/05/2012	On request from Birmingham City Council
Birmingham Environmental Partnership, Low Carbon Energy Delivery Group Mapping Workshop Minutes	Birmingham Environmental Partnership	10/07/2012	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	04/09/2012	On request from Birmingham City Council

Notes of Green Commission Meeting	Green Commission	07/11/2012	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	08/05/2013	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	23/07/2013	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	09/10/2013	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	13/12/2013	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	09/04/2014	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	02/07/2014	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	08/10/2014	On request from Birmingham City Council
Notes of Energy & Resources Roundtable Meeting	Green Commission	10/11/2014	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	12/02/2015	On request from Birmingham City Council
Notes of Energy & Resources Roundtable Meeting	Green Commission	10/03/2015	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	10/06/2015	On request from Birmingham City Council
Notes of Energy & Resources Roundtable Meeting	Green Commission	02/07/2015	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	09/09/2015	On request from Birmingham City Council
Notes of Energy & Resources Roundtable Meeting	Green Commission	15/09/2015	On request from Birmingham City Council
Notes of Green Commission Meeting	Green Commission	09/12/2015	On request from Birmingham City Council

FRANKFURT

TITLE	BY	DATE	AVAILABLE FROM
PUBLICATIONS			
Klimaschutz in Frankfurt Am Main. Bericht 1990 – 2007	Frankfurt City Council	2007	https://www.frankfurt.de/sixcms/detail.php?id=3047&_ffmpar[_id_inhalt]=3333159
Energy Action Plan and CO_2 Inventory for Frankfurt Am Main 2008	Frankfurt City Council	2008	https://www.frankfurt.de/sixcms/media.php/738/IFEU_KSK_Frankfurt_summary_en_short_V2.pdf
Strom und Wärme aus Frankfurt am Main	Mainova AG	2011	http://www.ifkomhessen.de/Kraftwerksbroschure.pdf
Every day greener. Frankfurt am Main, Germany	Covenant of Mayors	2012	https://www.covenantofmayors.eu/IMG/pdf/Frankfurt_Case_Study_Covenant_Mayors.pdf
The Power to Change - The Contribution of Municipal Companies. Transforming the Energy Sector - Looking Beyond National Borders.	Mainova AG (Birkner, Peter)	2012	https://www.mainova.de/ueber_uns/presse/Technikvorstand-Peter-Birkner-verlaesst-Mainova.html
The Regional Authority FrankfurtRheinMain. Structure, tasks and services	Regionalverband FrankfurtRheinMain	2013	https://www.region-frankfurt.de/media/custom/2033_731_1.PDF?1495013613

Passiv Houses in Frankfurt/Main – Building the Future	Frankfurt City Council	2013	https://www.frankfurt.de/sixcms/media.php/738/ER_PHT2013_BroENG_DINA4_FINAL.pdf
European Green Capital Award – Frankfurt am Main's application	Frankfurt City Council	2014	http://ec.europa.eu/environment/europeangreencapital/winning-cities/previous-finalists/frankfurt/
Energy management in the city council of Frankfurt	Frankfurt City Council	2014	http://www.energiemanagement.stadt-frankfurt.de/Englisch/Energy-management-in-Frankfurt.pdf
Masterplan 100% Climate Protection. Frankfurt's Systemic Transition Pathway to 100% Renewable Energy Supply.	Frankfurt City Council (Bauer, Alice)	2014	http://www.ilmastokumppanit.fi/files/2014/11/2.-Bauer_climate-protection.pdf
„Masterplan 100 % Climate Protection" – Frankfurt am Main	Frankfurt City Council	2015	https://www.frankfurt.de/sixcms/media.php/738/170124_Masterplan%20Broschu%CC%88re_ENG_bf_pdfua.pdf
Masterplan Industrie für Die Stadt Frankfurt Am Main	Frankfurt City Council	2015	http://frankfurt-business.net/standort-frankfurt/branchenfokus/masterplan-industrie-der-stadt-frankfurt-am-main/
Kommunaler Energiesteckbrief Frankfurt am Main, krsfr. Stadt	Regionalverband FrankfurtRheinMain	2015	http://www.energiewende-frankfurtrheinmain.de/
Unternehmensgruppe Stadtwerke Frankfurt	Stadtwerke Frankfurt AG	2015	https://www.stadtwerke-frankfurt.de/publikationen
Bausteine für den Klimaschutz – Frankfurt am Main. Projekte 2014/15 des Energiereferats der Stadt Frankfurt am Main.	Frankfurt City Council	2016	https://www.frankfurt.de/sixcms/detail.php?id=3081&_ffmpar[_id_inhalt]=30719121
Statusbericht Frankfurt 2030	Frankfurt City Council	2016	https://www.frankfurtdeinestadt.de/frankfurt2030/de/draftbill/48886
MEETING MINUTES			
Resolution of the 15th Meeting of the City Council on 9/6/2007	Frankfurt City Council	2007	http://www.energiemanagement.stadt-frankfurt.de/Englisch/Passive-house-resolution.pdf

BUDAPEST

TITLE	BY	DATE	AVAILABLE FROM
PUBLICATIONS			
Budapest Városfejlesztési Koncepció. Összefoglaló.	Budapest City Council	2003	http://www.urbanisztika.bme.hu/segedlet/bp_fuzet/Urban-Development-Concept-of-Budapest.pdf
Budapest Főváros Fenntartható Energia Akció Programja (SEAP)	Budapest City Council	2011	budapest.hu/Documents/20111118_energia_akcioterv_SEAP.docx
Budapest Főváros Környezeti Programja 2011 – 2016	Budapest City Council	2011	http://budapest.hu/Lapok/Hivatal/Kornyezetvedelem.aspx
Energiahatékonysági Beruházások Önkormányzatoknál. Harmadikfeles finanszírozás - ESCO-k Magyarországon.	Budapest City Council	2012	http://mehi.hu/sites/default/files/tatarne_varga_ivett_eloadasa.pdf

Budapest 2030 Hosszútávú Városfejlesztési Koncepció	Budapest City Council	2013	http://budapest.hu/Lapok/Hivatal/Kornyezetvedelem.aspx
Budapest "Under 2 MOU" melléklet	Budapest City Council	2014	On request from Budapest City Council
Budapest 2020 Integrált Településfejlesztési Stratégia	Budapest City Council	2014	http://budapest.hu/Documents/ITS%20Integralt%20Varosfejlesztesi%20Strategia/BP_ITS_Strategia_Megalapozo.pdf
A budapesti távhőszolgáltatás helyzetképe	FŐTÁV	2014	http://www.fotav.hu/media/downloads/2017/02/20/7015.pdf
Study on the implementation of the ISCO scheme for the Municipality of Budapest Capital City	Ernst & Young	2014	On request from Budapest City Council
Market research regarding the additional development of the ESCO scheme as innovative ISCO for the Municipality of Budapest Capital City	Ernst & Young	2014	On request from Budapest City Council
Budapest Környezeti Állapotértékelése 2014	Budapest City Council	2015	http://budapest.hu/Lapok/Hivatal/Kornyezetvedelem.aspx
Study in the topic of integration of the ISCO construction into the institutional system	GRID Consulting	2015	On request from Budapest City Council
Budapest Környezeti Állapotértékelése 2015	Budapest City Council	2016	http://budapest.hu/Lapok/Hivatal/Kornyezetvedelem.aspx
Budapest Környezeti Állapotértékelése 2016	Budapest City Council	2017	http://budapest.hu/Lapok/Hivatal/Kornyezetvedelem.aspx
MEETING MINUTES			
N/A			

APPENDIX III.

INTERVIEW PARTICIPANT INFORMATION SHEET AND TOPIC GUIDES

Participant Information Sheet

Collaborative governance in sustainable urban energy transitions

We kindly invite you to participate in this PhD research project which analyses the **potential of collaboration** in speeding up sustainable energy transition. It aims to identify the different ways in which collaborative initiatives involving the public sector, business and civil society contribute to the delivery of **urban low carbon transition goals**. Case studies will include Birmingham (UK), Frankfurt (DE) and Budapest (HU).

The study is conducted by **Miss Timea Nochta**, PhD candidate at the Institute of Local Government Studies (INLOGOV), in collaboration with the School of Civil Engineering, **University of Birmingham**, and funded by the **EIT Climate-KIC** partnership.

For a list of **questions** which may come up during the interview, please refer to Page 2 (**Topic Guide for Interviews**).

We kindly ask you to **confirm your availability for the interview via e-mail to the researcher** [redacted]

Please note that taking part in the study is **voluntary**. Interviews will be scheduled according to the respondent's preferences in terms of location, date and time. The duration of the interview will be adjusted to the availability of the interviewee (between 30 minutes and 1 hour). Subject to agreement, the **interviews will be recorded**. No complete transcripts will be produced of the recordings, but a **summary of the discussion may be provided upon request**. Interview data (records, notes, and participant's contact details) will be held securely and confidentially; **compliance with the University's Research Ethics Code will be ensured**. Any quotes or data from interviews used in the research papers **will not identify the individual**, but may give generic contextual description (e.g. senior manager in local authority). None of the secondary data (documents, statistics) relates to individuals or personal circumstances, and will be in the public domain or discoverable via FOI requests. Respondents can **choose to withdraw their contribution** or data provided during the interviews within 14 days **by e-mailing the researcher**; in this case the information they gave would be eliminated from the research, paper documents would be destroyed and electronic files deleted.

We would like to **thank you** for agreeing to take part in the research project. If you have any questions about the study at any stage, please contact the project's PhD researcher, Timea Nochta [redacted] or her supervisors Prof. Chris Skelcher [redacted] and Prof. Peter Braithwaite [redacted]

Topic guide for pilot interviews

Collaborative governance in sustainable urban energy transitions

Please note:

- *This document is a guide to the principal themes and issues to be covered.*
- *Questions can be modified and followed up in more detail; specific examples can be asked where appropriate*

Overview

1. What is the priority of sustainable development in the policy making context in your city?
2. Is there a department/person dedicated to sustainability within the municipality?
3. What is the priority of the low-carbon transition process within the sustainability agenda?
4. What are the key development areas in the city regarding low-carbon transitions, and why?

Autonomy

5. What are the European/national/state/regional policies that shape the local decision making?
6. Are there any development areas that fall under a superior level regulation and the city has no autonomy regarding policy making?

MTH Platform

7. How does the local environmental policy making relate to the priorities of the MTH Platform?
8. Which "Transition Cities" clusters the city focuses on (energy, mobility, housing) particularly?
9. Are there any clusters which are relatively neglected? Why?
10. Are there any projects, which fit the idea of sustainable development, but cannot be associated with any of the clusters above?

Co-operation

11. Does the municipality co-operate with actors from the market or civil sector to achieve sustainability goals? Can you give some examples?
12. Are there any grassroot initiatives in the city involving stakeholders from the market and civil sector where the local government is not present in the decision making process?

Further information

13. Can you give information on what policy documents tackle the institutional background of sustainable development in the city?
14. Can you give any recommendation on who I can talk about this topic within and beyond the municipality?

Topic guide for main interviews

Collaborative governance in sustainable urban energy transitions

Please note:

- *This document is a guide to the principal themes and issues to be covered.*
- *Questions can be modified and followed up in more detail; specific examples can be asked where appropriate*

Overview

1. What is your personal experience in co-operative decision making?
2. Are you or have you been involved in any project which required collaboration with actors from the public/market/civil sector? Can you give some examples?

Goals and the functioning

3. What is/was the purpose of these cooperations? (policy making / implementation)
4. Is/was it a mainly formal or mainly informal co-operation? (legal form, established?)
5. What are/were the objectives of the collaboration? (goals to achieve)
6. What are/were the main reasons for establishing a co-operative working method to achieve these objectives? (interdependencies, complexity, lack of authority, lack of financial / human resources, lack of knowledge etc.)

Roles

7. How would you describe the pattern of decision making in the collaboration? (democratic / leading figure, deliberative / bargaining, consensus / majority, etc.)
8. How would you describe your role and participation in the decision making process?

Interaction

9. What are/were the main channels of interaction between the actors? (meetings, phone calls, e-mails, etc.)
10. Who are/were you mainly in contact with? (personal network map)
11. How frequently do/did you need to interact with the these collegues?

Efficiency

12. Is/was the established cooperation effective in achieving these objectives?
13. In your opinion, is/was the co-operative model more effective than the traditional process would have been to achieve the set-out goals?

Further information

14. Are there any policy documents which could help me improve my understanding of the decision making process regarding these projects?
15. Can you give any recommendation on who I can talk about this topic within and beyond the municipality?

APPENDIX IV.

LISTS OF INTERVIEWEES

BIRMINGHAM

Interview 1.01. Interviewee, Procurement Team, Birmingham City Council (2015). Transition Cities representative. Interview with T. Nochta on 29/10/2015. Birmingham.

Interview 1.02. Interviewee, Sustainability West Midlands (2015). Green Commission member. Interview with T. Nochta on 16/11/2015. Birmingham.

Interview 1.03. Interviewee, Sustainability Team, Birmingham City Council (2015). Interview with T. Nochta on 15/12/2015. Birmingham.

Interview 1.04. Interviewee, Sustainability Team, Sustainability Team, Birmingham City Council (2016). Interview with T. Nochta on 2016/01/06. Birmingham.

Interview 1.05. Interviewee, Climate Change and Environment, Birmingham City Council (2016). Interview with T. Nochta on 12/01/2016. Birmingham.

Interview 1.06. Interviewee, Planning and Regeneration, Birmingham City Council (2016). Green Commission member. Interview with T. Nochta on 19/02/2016. Birmingham.

Interview 1.07. Interviewee, Sustainability West Midlands (2016). Birmingham Science City Low Carbon Working Group Member. Interview with T. Nochta on 12/02/2016. Birmingham.

Interview 1.08. Interviewee, Localise West Midlands and Community Energy Birmingham (2016). Green Commission member. Interview with T. Nochta on 26/02/2016. Birmingham.

Interview 1.09. Interviewee, Energy Technologies Institute (ETI) (2016). Green Commission member. Interview with T. Nochta on 01/03/2016. Loughborough.

Interview 1.10. Interviewee, Birmingham Energy Institute, University of Birmingham (2016). Green Commission member. Interview with T. Nochta on 04/03/2016. Birmingham.

Interview 1.11. Interviewee, Veolia (2016). Green Commission member. Interview with T. Nochta on 11/04/2016. Birmingham.

Interview 1.12. Interviewee, Birmingham City Council and Community Energy Birmingham (2016). Interview with T. Nochta on 29/04/2016. Birmingham.

FRANKFURT

Interview 2.01. Interviewee, Energiereferat, Frankfurt City Council (2016). Former Transition Cities representative. Interview with T. Nochta on 19/05/2016. Frankfurt.

Interview 2.02. Interviewee, Energiereferat, Frankfurt City Council (2016). Interview with T. Nochta on 09/06/2016. Frankfurt.

Interview 2.03. Interviewee, Energiereferat, Frankfurt City Council (2016). Interview with T. Nochta on 13/06/2016. Frankfurt.

Interview 2.04. Interviewee, Sonneninitiative e.V. (2016). Umweltforum and Klimaschutzbeirat member. Interview with T. Nochta on 21/06/2016. Frankfurt.

Interview 2.05. Interviewee, Provadis Hochschule, Industriepark Hoechst (2016). Klimaschutzbeirat member. Interview with T. Nochta on 22/06/2016. Frankfurt.

Interview 2.06. Interviewee, Umweltlernen e.V., Frankfurt City Council (2016). Interview with T. Nochta on 22/06/2016. Frankfurt.

Interview 2.07. Interviewee, Energiereferat, Frankfurt City Council (2016). Interview with T. Nochta on 24/06/2016. Frankfurt.

Interview 2.08. Interviewee, Energiepunkt e.V., Frankfurt City Council (2016). Interview via e-mail with T. Nochta on 15/07/2016. Frankfurt.

Interview 2.07. Interviewee, Energiereferat, Frankfurt City Council (2016). Transition Cities representative. Interview with T. Nochta on 05/07/2016. Frankfurt.

BUDAPEST

Interview 3.01. Interviewee, Project Management, Budapest City Council (2016). Transition Cities Representative. Interview with T. Nochta on 17/08/2016. Budapest.

Interview 3.02. Interviewee, Environmental Protection, Budapest City Council (2016). Interview with T. Nochta on 01/09/2016. Budapest.

Interview 3.03. Interviewee, Energy and Water Management, Budapest City Council (2016). Interview with T. Nochta on 09/09/2016. Budapest.

Interview 3.04. Interviewee, Budapest Zoo (2016). Interview with T. Nochta on 09/09/2016. Budapest.

Interview 3.05. Interviewee, Budapest City Council (2016). Interview with T. Nochta on 20/09/2016. Budapest.

Interview 3.06. Interviewee, Óbuda (District III) District Council (2016). Interview with T. Nochta on 20/09/2016. Budapest.

Interview 3.07. Interviewee, FOTAV Zrt (2016). Interview with T. Nochta on 21/09/2016. Budapest.

Interview 3.08. Interviewee, BFVT Zrt (2016). Interview with T. Nochta on 21/09/2016. Budapest.

Interview 3.09. Interviewee, GRID Consulting (2016). Interview with T. Nochta on 23/09/2016. Budapest.

Interview 3.10. Interviewee, Energiaklub Climate Policy Institute (2016). Interview with T. Nochta on 23/09/2016. Budapest.

Interview 3.11. Interviewee, FKF Zrt (2016). Interview with T. Nochta on 30/09/2016. Budapest.

Interview 3.12. Interviewee, Sustainable Development, Environmental Protection and Quality Control, BERT Zrt (2016). Interview with T. Nochta on 02/10/2016. Budapest.

APPENDIX V.

NETWORK STATISTICS: NODE CENTRALITY SCORES

BIRMINGHAM

Organisations (nodes)	Degree	Betweenness	Closeness
ACIVICO	30	12.257588	0.544444
Borroclub	37	0	0.571984
adi Group	51	0	0.604938
Affordable Warmth Partnership	18	0	0.510417
Amey plc	68	127.217946	0.650442
Arden Estate Partnerships	51	0	0.604938
Arup	37	0	0.571984
Aston University	111	378.094515	0.803279
Atkins	61	85.932003	0.630901
Autogas Ltd	16	0	0.517606
BCC Cabinet	79	350.36199	0.683721
BCC Digital Birmingham	67	140.872487	0.647577
BCC Economy-EU Funding	20	0	0.536496
BCC Education	16	0	0.517606
BCC Employment	20	0	0.536496
BCC Finance	16	0	0.517606
BCC Fleet and Waste	19	0	0.523132
BCC Health	16	0	0.517606
BCC Place	20	0	0.536496
BCC Housing	18	0	0.510417
BCC Parks	16	0	0.517606
BCC Planning and Regeneration	54	104.779555	0.6125
BCC Sustainability	89	349.67425	0.717073
BCC Transport	43	48.097786	0.585657
Bevan Brittan	51	0	0.604938
BECCI	37	0	0.571984
Birmingham & Black Country Local Nature Partnership	33	13.356359	0.563218
Birmingham City University	18	0	0.510417
Birmingham Metropolitan College	27	81.069132	0.550562
Birmingham Energy Savers	18	0	0.510417
Birmingham Municipal Housing Trust	18	0	0.510417
Brit European Transport Ltd	16	0	0.517606
Birmingham Open Spaces Forum	16	0	0.517606
Briar Associates	61	20.602879	0.630901
Black Country Consortium	37	0	0.571984
British Gas	102	460.116075	0.765625
Building Research Establishment	18	0	0.510417

Business in the Community	51	0	0.604938
BVSC Third Sector Assembly	51	44.210877	0.604938
Cenex	96	256.819475	0.742424
Caplor Energy	61	20.602879	0.630901
Caterpillar (UK) Ltd	61	20.602879	0.630901
Carbon3IT	37	0	0.571984
ENGIE	69	121.153329	0.653333
Centro	48	36.138661	0.597561
Cisco	16	0	0.517606
Climate Change Solutions Ltd	51	0	0.604938
Community Energy Birmingham	51	44.210877	0.604938
Cotteridge Park	16	0	0.517606
Concept Advertising & PR Ltd	51	0	0.604938
Coventry City Council	87	121.87542	0.710145
Crestwood Environmental Ltd	51	0	0.604938
Coventry & Warwickshire LEP	25	0	0.532609
East Staffordshire Borough Council	34	37.799813	0.565385
Databuild Consulting Ltd	51	0	0.604938
E4environment Ltd	51	0	0.604938
Ecuity Consulting LLP	51	0	0.604938
DS Smith Plastics	25	0	0.532609
Energy Saving Trust	54	84.114823	0.6125
Energy Technologies Institute	19	0	0.523132
E-ON	40	44.869736	0.57874
Environment Agency	74	126.051283	0.668182
Encraft	94	567.005098	0.735
European Bioenergy Research Institute	51	39.559983	0.604938
Friends of the Earth	19	0	0.523132
Fit for the Future Network	51	0	0.604938
Footsteps	51	0	0.604938
Greater Birmingham Chambers of Commerce	45	66.753639	0.590361
Green Shropshire Xchange	51	0	0.604938
Groundwork West Midlands	25	0	0.532609
Greenwatt Technology	37	0	0.571984
Herefordshire Council	37	0	0.571984
Innovation Birmingham - Climate KIC	98	223.801591	0.75
Institute of Civil Engineers West Midlands	51	0	0.604938
International Synergies	44	33.110376	0.588
Invigour	37	0	0.571984
Keele University	37	0	0.571984
Keepmoat	37	0	0.571984
Knowledge Transfer Network	37	0	0.571984
Localise West Midlands	84	147.300842	0.7
Marketing Birmingham	53	40.043283	0.609959
Lafarge Tarmac	61	20.602879	0.630901
LCMB	51	0	0.604938
Marches Energy Agency	87	121.87542	0.710145
Leading Energy	37	0	0.571984
Lorien Engineering	37	0	0.571984
Midlands Environmental Business Company	93	345.597634	0.731343
Midland Heart	18	0	0.510417
Midlands Energy Consortium	19	0	0.523132
Mott MacDonald Ltd	51	0	0.604938
Northfield Ecocentre	41	30.943067	0.581028
National Grid	19	0	0.523132

National Express	16	0	0.517606
Network Rail	16	0	0.517606
National Farmers Union West Midlands	68	414.426148	0.650442
Neil Wyatt Environmental	25	0	0.532609
Project Dirt	20	0	0.536496
Severn Trent Water	86	231.873681	0.706731
Organic Resource Agency	51	0	0.604938
Ricoh UK Products Ltd	51	0	0.604938
Rooftop Housing Group	51	0	0.604938
Quest Associates	25	0	0.532609
Solihull Metropolitan Borough Council	81	588.650955	0.690141
Skanska	50	44.790035	0.602459
Southern Staffordshire Community Energy	51	0	0.604938
Staffordshire Business & Environment Network	51	0	0.604938
Staffordshire County Council	78	81.586965	0.680556
Staffordshire University	37	0	0.571984
Sustrans	16	0	0.517606
Sustainable Action Housing Partnership	89	225.408649	0.717073
University of Birmingham	111	424.829819	0.803279
The Lunar Society	51	0	0.604938
The Midcounties Co-operative	51	0	0.604938
Truc Technologies	51	0	0.604938
Turley Sustainability	51	0	0.604938
University Hospitals North Midlands NHS Trust	51	0	0.604938
University of Warwick	37	0	0.571984
Veolia	66	78.257398	0.644737
University of Wolverhampton	51	0	0.604938
Utilitywise	51	0	0.604938
URSUS Consulting Ltd	25	0	0.532609
West Midlands Fire Service	37	0	0.571984
West Midlands Integrated Transport Authority	97	254.87528	0.746193
Wildlife Trust for Birmingham and the Black Country	24	0	0.544444
Western Power Distribution	19	0	0.523132
Wolverhampton City Council	51	0	0.604938
Worchestershire LEP	24	0	0.544444
Wyre Forest District Council	37	40.008521	0.571984
Worcestershire County Council	61	20.602879	0.630901
Lichfield District Council	17	0	0.530686
Redditch Borough Council	17	0	0.530686
Tamworth Borough Council	17	0	0.530686
EEF Engineering Employers Federation	17	0	0.530686
Federation of Small Businesses	17	0	0.530686
Herefordshire & Worcestershire Chamber of Commerce	17	0	0.530686
Royal Institution of Chartered Surveyors	17	0	0.530686
KPMG	8	0	0.471154
Deloitte	8	0	0.471154
Performance Birmingham Ltd	8	0	0.471154
Younis Bhatti & Co Ltd	8	0	0.471154
Handelsbanken	8	0	0.471154
Arcadis	8	0	0.471154
Sustainability West Midlands	97	185.75587	0.746193
GBS LEP	77	559.457373	0.677419
Cannock Chase District Council	17	0	0.530686
South and City College	17	0	0.530686

BCC Executive	17	0	0.530686
North Worcestershire Local Authorities	17	0	0.530686

FRANKFURT

Organisations (nodes)	Degree	Betweenness	Closeness
ABGnova GmbH	201	1712.794	0.79822
Agentur fï¿½r Ernï¿½hrungsfragen, Frankfurt	154	0	0.6725
Akzo Nobel Industrial Chemicals GmbH, Werk Frankfurt	154	0	0.6725
Alexander Bracht, Mï¿½rfelden-Walldorf	154	0	0.6725
All Service Gebï¿½udedienst GmbH, Frankfurt	154	0	0.6725
All-in-Media GmbH, Offenbach am Main	154	0	0.6725
Andrea Schweiker, Erlensee	154	0	0.6725
animate Green Entertainment Matthias Graf, Nidderau	154	0	0.6725
Appelt, Sigrid, Frankfurt	154	0	0.6725
Aramark Holdings GmbH & Co. KG, Neu-Isenburg	154	0	0.6725
Arno Arnold GmbH, Obertshausen	154	0	0.6725
Architektur im Dialog, Frankfurt	154	0	0.6725
artichoc, Bad Vilbel	154	0	0.6725
AS-Getrï¿½nkeservice, Schï¿½neck	154	0	0.6725
Ball group, Frankfurt	154	0	0.6725
BanaFair e.V., Gelnhausen	154	0	0.6725
Basic AG, Frankfurt	154	0	0.6725
Berkersheimer Schule, Frankfurt	154	0	0.6725
Berufliche Schule Butzbach	154	0	0.6725
Bibliomania GmbH, Frankfurt	154	0	0.6725
bikuh, Frankfurt	154	0	0.6725
Binding Brauerei AG, Frankfurt	154	0	0.6725
BioBï¿½cker GmbH, Steinbach	154	0	0.6725
Bio Catering Safran	154	0	0.6725
Biokam, Bad Vilbel	154	0	0.6725
Bioland e.V. Landesverband Hessen, Grï¿½nberg	154	0	0.6725
Biometzgerei Spahn, Frankfurt	154	0	0.6725
Bio-Obsthof Schneider, Frankfurt Nieder-Erlenbach	154	0	0.6725
brainshirt, Matthias Hebeler	154	0	0.6725
Brunner, Peter Metaworks, Frankfurt	154	0	0.6725
Bï¿½rger AG fï¿½r Nachhaltiges Wirtschaften FRM	181	815.0429	0.753501
BVMW - Bundesverband mittelstï¿½ndische Wirtschaft e.V., Region Rhein-Main	154	0	0.6725
Cinestar Metropolis GmbH	154	0	0.6725
CityForum ProFrankfurt e.V., Frankfurt	154	0	0.6725
ClearEnergy Mittelhessen GmbH, Mï¿½nzenberg	154	0	0.6725
Commerzbank AG, Frankfurt	154	0	0.6725
Conrec GmbH, Rodgau	154	0	0.6725
Consolar GmbH, Frankfurt	154	0	0.6725
Deka Bank Deutsche Girozentrale, Frankfurt	154	0	0.6725
Denfeld Radsport GmbH, Bad Homburg	154	0	0.6725
Denningers Mï¿½hlenbï¿½ckerei, Frankfurt	154	0	0.6725
Deutscher Wetterdienst, Frankfurt	154	0	0.6725
Deutsche Bï¿½rse AG, Frankfurt	154	0	0.6725
Deutsche Post AG, Frankfurt	154	0	0.6725
Deutscher Olympischer Sportbund, Frankfurt	154	0	0.6725
Diehl Aerospace GmbH, Frankfurt	154	0	0.6725
Druckerei Lokay, Reinheim	154	0	0.6725

Eigenbetrieb fï¿½r kommunale Aufgaben und Dienstleistungen (EAD), Darmstadt	154	0	0.6725
e-mobile-europe, Olaf Menn, Kï¿½nigstein und Frankfurt	154	0	0.6725
Evangelischer Regionalverband, Frankfurt	154	0	0.6725
Frankfurt University of Applied Sciences	199	1992.359	0.79351
FAM Service, Oberursel	154	0	0.6725
FIBL Deutschland e.V., Frankfurt	154	0	0.6725
First Climate Markets AG, Bad Vilbel	154	0	0.6725
firsthand capital management GmbH, Frankfurt	154	0	0.6725
Florian Schï¿½tz, Friedrichsdorf	154	0	0.6725
Frankfurter Entsorgungs- und Service GmbH, Frankfurt	154	0	0.6725
Frankfurter Sparkasse AG	166	392.8343	0.723118
FRAPORT AG, Airport	201	1754.091	0.79822
FSJ Solar GmbH, Bad Soden	154	0	0.6725
Gabal Verlag GmbH, Offenbach	154	0	0.6725
Gesund& Munter e. K. Gerhard Gros, Taunusstein	154	0	0.6725
Gillig, Lenka	154	0	0.6725
GIZ GmbH, Eschborn	154	0	0.6725
GLS Gemeinschaftsbank eG	166	392.8343	0.723118
Goethe-Gymnasium, Frankfurt	154	0	0.6725
Green Business Development GmbH, Kelkheim	154	0	0.6725
Green Origin GmbH & Co KG, Marburg	154	0	0.6725
Gï¿½nther & Co GmbH, Frankfurt	154	0	0.6725
H.O.R.S.T GbR, Frankfurt	154	0	0.6725
Handelshaus Runkel, Weiterstadt-Grï¿½fenhausen	154	0	0.6725
Hedrich Energieberatung, Frankfurt	154	0	0.6725
Henkell & Co Sektkellerei KG, Wiesbaden	154	0	0.6725
Herbert Heinz, Frankfurt	154	0	0.6725
Hessen Design e.V., Darmstadt	154	0	0.6725
Hessenwasser GmbH, Frankfurt	154	0	0.6725
Hilfe zur Selbsthilfe e.V. Krebsmï¿½hle, Oberursel	154	0	0.6725
Hotel Villa Orange, Frankfurt	154	0	0.6725
Hydranten-Betriebs OHG, Frankfurt	154	0	0.6725
ICS IT Consulting Services GmbH	154	0	0.6725
Ingenieurbï¿½ro Peter Grï¿½newald, Hofheim	154	0	0.6725
Ingenieursocietï¿½t Streit, Schmitten	154	0	0.6725
Ingenieursozietï¿½t von Hï¿½lst, Johannesberg	154	0	0.6725
Institut fï¿½r Energie und Umwelt, Bad Homburg	154	0	0.6725
Jï¿½rgen Mï¿½ller, Darmstadt	154	0	0.6725
Kaiser: Die Vollkornbï¿½ckerei GmbH, Mainz-Kastel	154	0	0.6725
Kï¿½mpf + Co Haustechnik GmbH	154	0	0.6725
Kï¿½pplein Bio GmbH, Waghï¿½usel	154	0	0.6725
Karma Konsum, Frankfurt	154	0	0.6725
KCE Marketing GmbH/ Genussakademie, Frankfurt	154	0	0.6725
Landesinnung des Gebï¿½udereinigerhandwerks Hessen, Frankfurt	154	0	0.6725
Landessportbund Hessen e.V.	181	1046.331	0.753501
Landwirtschaftsgemeinschaft Dottenfelderhof KG, Bad Vilbel	154	0	0.6725
Langenfelder Nachhaltigkeitskommunikation, Bad Homburg	154	0	0.6725
LeaseRad GmbH, Frankfurt/ Main	154	0	0.6725
Lufthansa Technik AG, Frankfurt	154	0	0.6725
Mainova AG	215	3192.103	0.832817

Mandausch Containerdienst GmbH, Frankfurt	154	0	0.6725
Marcus Schmitt Architekten, Frankfurt	154	0	0.6725
Marketing of Organic Products, Oberursel	154	0	0.6725
Matthias Nitschke, Niederweimar	154	0	0.6725
Maxlife Coaching, Stefan Maxeiner, Frankfurt	154	0	0.6725
Maye Rechtsanwï¿½lte, Frankfurt	154	0	0.6725
Nord-Micro GmbH & Co. KG, Frankfurt	154	0	0.6725
Nouvelle Energie Europenne, Schï¿½llkrippen	154	0	0.6725
Nowato GmbH, Frankfurt	154	0	0.6725
ï¿½kostromagentur, Frankfurt	154	0	0.6725
opera civil, Feyza Morgï¿½l, Frankfurt	154	0	0.6725
Park & Charge, Frankfurt	154	0	0.6725
organic, Frankfurt	154	0	0.6725
Phï¿½nix Naturprodukte GmbH, Rosbach	154	0	0.6725
Photovoltaik-Reinigung Rhein-Main, Bickenbach	154	0	0.6725
Pix Passion, Hanau	154	0	0.6725
PV5 Solarconzept GmbH, Kleinostheim	154	0	0.6725
Quell Verlag GmbH, Frankfurt	154	0	0.6725
Querbeet GmbH, Reichelsheim	154	0	0.6725
Reisswolf Akten- und Datenvernichtung GmbH, Frankfurt	154	0	0.6725
Ralos GmbH, Michelstadt	154	0	0.6725
Rhein-Main-Heizwerk GmbH, Oberursel	154	0	0.6725
RKW Hessen GmbH	154	0	0.6725
Rupert Fersch, Kleinwallstadt	154	0	0.6725
satis & fy AG Deutschland, Karben	154	0	0.6725
Servicegesellschaft fï¿½r Frankfurt und Grï¿½ngï¿½rtel gGmbH, Frankfurt	154	0	0.6725
Service-Vermittlung-Penzel, Obertshausen	154	0	0.6725
Seitz & Co., Seligenstadt	154	0	0.6725
Shokes GmbH, Frankfurt	154	0	0.6725
SIC Consulting GmbH, Frankfurt	154	0	0.6725
Sonneninitiative e.V.	206	2335.556	0.810241
Solarcenter Hessen, Frankfurt	154	0	0.6725
SolarInvest Main-Taunus eG	166	392.8343	0.723118
Solarverein Frankfurt und Umgebung, Frankfurt	154	0	0.6725
Energiereferat, Stadt Frankfurt	103	716.0704	0.618391
Stadt Maintal	181	1046.331	0.753501
Stadt Michelstadt	154	0	0.6725
Stadtmobil Rhein-Main GmbH	180	1069.13	0.751397
Systemhaus-Energie, Maintal	154	0	0.6725
Tee Fee, Frankfurt	154	0	0.6725
Tomic, Boris, Journalist, Frankfurt	154	0	0.6725
Trifolium - Beratungsgesellschaft mbH, Friedberg	154	0	0.6725
Triodos Bank Deutschland, Frankfurt	154	0	0.6725
Tï¿½V Technische ï¿½berwachung Hessen GmbH, Darmstadt	154	0	0.6725
Ubermut, Offenbach	154	0	0.6725
Uplï¿½nder Bauernmolkerei, Willingen-Usseln	154	0	0.6725
UWS Ingenieurbï¿½ro, Flï¿½rsheim	154	0	0.6725
Velotaxi Frankfurt oHG, Nidderau	154	0	0.6725
Walter Spruck, Florstadt	154	0	0.6725
Weber Networking GmbH, Frankfurt	154	0	0.6725
Weltladen Bornheim, Frankfurt	154	0	0.6725
Wiesenlust Burger-Restaurant, Frankfurt	154	0	0.6725
Wilhelm Schï¿½neberger, Rï¿½dermark	154	0	0.6725

Willi Becker, Frankfurt	154	0	0.6725
Wï¿½hlerschule, Frankfurt	154	0	0.6725
Ziegle Dienstleistungsgruppe Niederlassung Rhein-Main, Bad Vilbel	154	0	0.6725
Ziehenschule, Frankfurt	154	0	0.6725
ZUUM GmbH, Helge Beck, Steinau	154	0	0.6725
Fachstelle fï¿½r Kath. Stadtkirchenarbeit	31	0	0.530572
TraffiQ	31	0	0.530572
Verkehrsclub Deutschland e.V.	53	48.92992	0.554639
Energiepunkt FrankfurtRheinMain e.V.	53	46.8397	0.554639
Handwerkskammer FRM	74	436.3246	0.579741
StaSBEV Stadtbahn	31	0	0.530572
DEHOGA KV Frankfurt e.V.	53	115.2396	0.554639
Evangelisches Stadtdekanat Frankfurt	31	0	0.530572
InfraServ GmbH & Co. Hï¿½chst KG	85	596.6338	0.593819
Hochbauamt, Stadt Frankfurt am Main	31	0	0.530572
Kreislandwirt Frankfurt	46	26.63343	0.546748
Cabinet, Stadt Frankfurt	62	281.5749	0.565126
IHK Chambers of Commerce and Industry	87	603.6813	0.596452
BUND Landesverband Hessen e.V.	64	150.3665	0.567511
Verbraucherzentrale Hessen e.V.	53	46.8397	0.554639
Caritasverband	31	0	0.530572
Umweltlernen	31	0	0.530572
Stï¿½dtebaubeirat	31	0	0.530572
schneider+schumacher Planungsgesellschaft mbH	53	46.8397	0.554639
House of Logistics & Mobility (HOLM) GmbH	53	48.92992	0.554639
Institut fï¿½r Sozial-ï¿½kologische Forschung ISOE GmbH	84	301.2001	0.592511
Guild, Innung Sanitï¿½r Heizung Klima	31	0	0.530572
Provadis School	62	281.5749	0.565126
Regionalverband FRM	117	1444.766	0.638955
FES GmbH	53	115.2396	0.554639
Biodiversitï¿½t und Klima - Forschungszentrum	31	0	0.530572
ABO Wind AG	23	0	0.52233
Gravity Power GmbH	23	0	0.52233
HEAG Sï¿½dhessische Energie AG (HSE)	23	0	0.52233
hessenENERGIE Gesellschaft fï¿½r rationelle Energienutzung mbH	23	0	0.52233
Hessisches Ministerium fï¿½r Wirtschaft, Energie, Verkehr und Landesentwicklung	29	10.39297	0.528487
Climate Alliance	33	28.07985	0.532673
Siemens AG	46	139.709	0.546748
Stadt Eschborn	23	0	0.52233
Stadt Friedrichsdorf	50	106.6082	0.55123
Stadt Mï¿½rfelden-Walldorf	23	0	0.52233
Stadt Rï¿½sselsheim	33	28.07985	0.532673
Stadtwerke Bad Homburg	23	0	0.52233
Stadtwerke Hanau	23	0	0.52233
Stadtwerke Langen GmbH	23	0	0.52233
Stadtwerke Neu-Isenburg GmbH	23	0	0.52233
Sï¿½wag Energie AG	29	10.39297	0.528487
ï¿½berlandwerk Groï¿½-Gerau GmbH	23	0	0.52233
Evangelische Kirche Hessen&Nassau	64	282.5334	0.567511
ADAC Hessen-Thï¿½ringen e. V.	28	0	0.527451
Bundesverband Gï¿½terkraftverkehr Logistik und Entsorgung (BGL) e. V.	28	0	0.527451

Fachverband Fuï¿½verkehr Deutschland ï¿½ FUSS e. V.	28	0	0.527451
Futurecamp GmbH Rethink	28	0	0.527451
Gemeinde Sulzbach	28	0	0.527451
Hochschule Darmstadt	58	152.7071	0.560417
ivm GmbH	28	0	0.527451
Johann Wolfgang Goethe-Universitï¿½t	65	298.0813	0.56871
Mittelhessische Energiegenossenschaft eG	28	0	0.527451
PRO BAHN Landesverband Hessen e. V.	28	0	0.527451
RMV RheinMainVerkehrsverbund	28	0	0.527451
Stadt Aschaffenburg	28	0	0.527451
Stadt Hattersheim	71	317.9887	0.576017
Stadt Neu-Isenburg	59	152.0352	0.561587
Stadt Offenbach am Main	52	64.9108	0.553498
Taunus eMobil	28	0	0.527451
Gespa GmbH	28	0	0.527451
Solarmobil Rhein-Main e. V.	28	0	0.527451
ZIV ï¿½ Zentrum fï¿½r integrierte Verkehrssysteme Gmb	28	0	0.527451
Arbeitsgemeinschaft der Wohnungs- und Immobilienverbï¿½nde Hessen	29	0	0.528487
Architekten- und Stadtplanerkammer Hessen	29	0	0.528487
Bund Deutscher Baumeister Architekten und Ingenieure e. V.	29	0	0.528487
Gemeinde Wï¿½lfersheim	29	0	0.528487
GWH Wohnungsgesellschaft mbH Hessen	29	0	0.528487
Landesinnungsverband des Dachdeckerhandwerks Hessen	29	0	0.528487
Maler- und Lackiererinnung Rhein-Main	29	0	0.528487
MOW Architekten BDA und MOW Generalplanung	29	0	0.528487
Nassauische Heimstï¿½tte Wohnungs- und Entwicklungsgesellschaft mbH	29	0	0.528487
Schornsteinfegerinnung Rhein-Main	29	0	0.528487
Stadt Darmstadt	29	0	0.528487
Stadt Dreieich	29	0	0.528487
Stadt Karben	29	0	0.528487
Stadt Langen	29	0	0.528487
IKEA Deutschland GmbH & Co. KG	12	0	0.402695
Messe Frankfurt VENUE GmbH	12	0	0.402695
RKW Hessen GmBH	12	0	0.402695
Rolls-Royce Deutschland Ltd & Co. KG	12	0	0.402695
bettervest GmbH	15	0	0.505639
Bï¿½rgerEnergieRheinMain eG	15	0	0.505639
ENTEGA GmbH	15	0	0.505639
Labl.Frankfurt	15	0	0.505639
Stadt Heusenstamm	15	0	0.505639
Wetteraukreis	15	0	0.505639
Umweltamt, Stadt Frankfurt	176	982.1253	0.743094
ABG Frankfurt Holding	29	0	0.528487
KfW Bankengruppe	24	0	0.517308
AD Fahrrad-Club Frankfurt	24	0	0.517308
Albert Speer & Partner GmbH	24	0	0.517308
Christoph Mï¿½ckler Architekten	24	0	0.517308
ï¿½ko-Institut e.V.	24	0	0.517308
Senckenberg Forschungsinstitut und Naturmuseum	24	0	0.517308
Verein Arbeits- und Erziehungshilfe e.V	24	0	0.517308

Planung und Wohnen, Stadt Frankfurt	42	110.7382	0.542339
Wirtschaft, Sport, Sicherheit und Feuerwehr, Stadt Frankfurt	42	110.7382	0.542339
Verkehr, Stadt Frankfurt	24	0	0.517308
Stadtwerke Holding Frankfurt	24	0	0.517308
Ferro GmbH	24	0	0.410061
Christian Bollin Armaturenfabrik GmbH	24	0	0.410061
Trade Union, Hospitality Sector NGG	24	0	0.410061
Industrial Union of Metalworkers, IGM	24	0	0.410061
Industrial Union of Mining, Chemical and Energy Industries, IG BCE	29	32.30034	0.528487
Confederation of German Trade Unions, DGB	24	0	0.410061
Continental AG Frankfurt	24	0	0.410061
Glockenbrot Bï¿½ckerei GmbH	24	0	0.410061
Clariant mbH	24	0	0.410061
Nord-Micro GmbH	24	0	0.410061
Allessa GmbH	24	0	0.410061
Industrial Union of Agriculture, IG BAU	24	0	0.410061
FED, Stadt Frankfurt	53	202.3554	0.554639
Samson AG	24	0	0.410061
VhU Association of Hessian Entrepreneurs	29	32.30034	0.528487

BUDAPEST

Organisations (nodes)	Degree	Betweenness	Closeness
ABUD Kft	10	0	0.619048
BFVT Kft	26	70.43333	1
BGYH Zrt.	17	1.6	0.742857
BKK Zrt.	17	1.6	0.742857
BKV Zrt.	17	1.6	0.742857
BME Urban Planning	10	0	0.619048
BTI Zrt.	13	0	0.666667
BuCC Commission	12	5.333333	0.65
BuCC Deputy Mayor/Advisor	22	32.83333	0.866667
BuCC Environment	17	1.6	0.742857
BuCC Planning	20	17.5	0.8125
BuCC Project Management	20	17.5	0.8125
ELMU	13	0	0.666667
Env-in-Cent Kft.	4	0	0.541667
FKF Zrt.	17	1.6	0.742857
FOGAZ	13	0	0.666667
FOKETUSZ Kft.	17	1.6	0.742857
FOTAV Zrt.	17	1.6	0.742857
FTSZV Kft.	17	1.6	0.742857
FV Zrt.	17	1.6	0.742857
KSH	13	0	0.666667
MEKH	13	0	0.666667
MOME Architecture	10	0	0.619048
MuHely Zrt	10	0	0.619048
PESTTERV Kft	10	0	0.619048
Terra Studio	4	0	0.541667
Urban-Lis Studio Kft	10	0	0.619048

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