Knowing climate change. City networks' alternative ways of understanding and acting upon climate change

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Table of contents

ABSTRACT IV

ACCRONYMS AND ABBREVIATIONS V

LIST OF TABLES VII

LIST OF FIGURES VII

1 INTRODUCTION 1

2 HISTORICAL BACKGROUND: CITY NETWORKS AND THE GLOBAL GOVERNANCE OF CLIMATE CHANGE 14

2.1 BRIEF HISTORICAL OVERVIEW: CITIES AND CLIMATE CHANGE GOVERNANCE 14
2.2 CITY NETWORKS AS PARTICULAR ACTORS IN GLOBAL CLIMATE CHANGE GOVERNANCE 16
2.2.1 INTERNAL ASPECTS OF CITY NETWORKS' CLIMATE GOVERNANCE 17
2.2.2 EXTERNAL ASPECTS OF CITY NETWORKS' CLIMATE GOVERNANCE 21
2.3 FOCUSING ON CITY NETWORKS' CLIMATE CHANGE KNOWLEDGE 25

3 CONCEPTUAL BACKGROUND: KNOWING, KNOWLEDGE AND ITS CO-PRODUCTION 27

3.1 KNOWING CLIMATE CHANGE 27
3.2 KNOWLEDGE – A SOCIALLY COINED PRODUCT 34
3.3 KNOWLEDGE AND ITS CO-PRODUCTION 37

4 THEORETICAL APPROACH: KNOWLEDGE FORMS AS CONSTITUENTS OF A WAY OF KNOWING 40

4.1 DIFFERENTIATING FORMS OF KNOWLEDGE 41
4.2 CONCEPTUALIZING FOUR FORMS OF KNOWLEDGE 46
4.2.1 GENERAL BASELINE ASSUMPTIONS 46
4.2.2 A FOUR-FOLD DIFFERENTIATION OF KNOWLEDGE FORMS 48
4.2.2.1 DEFINITIONAL KNOWLEDGE 48
4.2.2.2 CONCEPTUAL KNOWLEDGE 50
4.2.2.3 PROBLEM-SOLVING KNOWLEDGE 52
4.2.2.4 CRITICAL KNOWLEDGE 53
4.2.3 SUMMARY, OR: HOW ARE THESE KNOWLEDGE FORMS INTERACTING? 56

5 METHODOLOGICAL APPROACH AND METHOD 58

5.1 AIMS AND CONSIDERATIONS 58
5.2 WHICH NETWORKS? 61
5.2.1 C40 CITIES CLIMATE LEADERSHIP GROUP 62
5.2.2 CLIMATE ALLIANCE OF EUROPEAN CITIES WITH INDIGENOUS RAINFOREST PEOPLES 64
5.3 DATA GENERATION 66

5.3.1 Consulting material on TMN websites 67
5.3.2 Interviews with TMN staff 68
5.4 Data analysis 69
5.4.1 Content analysis of consultant material 70
5.4.2 Background information from interviews with TMN staff 75
5.4.3 Generating empirical insights 76
5.4.4 Comparative contextualization 77
5.5 Summary 81

6 EMPIRICAL INSIGHTS: ALTERNATIVE WAYS OF KNOWING CLIMATE CHANGE 82

6.1 Climate change as meteorological phenomenon – C40's way of knowing climate change 82
6.1.1 Definitional knowledge: climate change as a meteorological and urban problem 82
6.1.1.1 Defining climate change – a problem of temperatures 83
6.1.1.2 Defining climate change as an urban problem 85
6.1.2 Conceptual knowledge: scientific data for carbon neutrality and green growth 89
6.1.2.1 Significance of (scientific) data 89
6.1.2.2 Concept of 'carbon neutrality' 95
6.1.2.3 Concept of 'green growth' 100
6.1.3 Problem-solving knowledge: Emphasizing benefits, doing research and promoting carbon offsetting technologies 104
6.1.3.1 Climate action as multi-beneficial 105
6.1.3.2 Climate action as financial trade-off 108
6.1.3.3 Research and education 111
6.1.3.4 Carbon offsetting and negative emission technologies 114
6.1.4 Critical knowledge: Accordance with hegemonic knowledge structures 117
6.2 Climate change as a multi-faceted phenomenon – Climate Alliance's way of knowing climate change 119
6.2.1 Definitional knowledge: Climate change being multi-faceted and unjust 120
6.2.1.1 Defining climate change – A problem with many faces 120
6.2.1.2 Climate change as a phenomenon of (un)fairness 122
6.2.2 Conceptual knowledge: personal exchanges for more justice and a good life 126
6.2.2.1 Significance of direct interaction and exchange 126
6.2.2.2 Concept of 'social and climate justice' 131
6.2.2.3 Concept of buen vivir 135
6.2.3 Problem-solving knowledge: local approaches based on cooperation and changes of resource-consuming lifestyle 139
6.2.3.1 Education and joining of forces 139
6.2.3.2 Initiating behavioral change 142
6.2.4 Critical knowledge: Disclosing climate change's root causes, main culprits and listening to silenced voices 143
6.2.4.1 Critique of current perception of climate change's root causes 144
6.2.4.2 Consideration of indigenous concepts and ways of living 146
6.2.4.3 Critique of political and economic actors 148

7 COMPARATIVE CONTEXTUALIZATION OF THE TWO WAYS OF KNOWING CLIMATE CHANGE .. 150

7.1 Two alternative ways of knowing climate change 150
7.1.1 Definitional knowledge: climate change as a meteorological and urban problem vs. climate change as a multi-faceted phenomenon 152
7.1.2 Conceptual knowledge: Scientific data for carbon neutrality and green growth vs. personal exchange for more justice and a good life 154

7.1.3 Problem solving knowledge: co-benefits, research and carbon offsetting technologies vs. local cooperative approaches and changes in lifestyle 156
7.1.4 Critical knowledge: Accordance with hegemonic knowledge structures vs. disclosing discreet root causes, main culprits and listening to silenced voices 158
7.2 Reflections on the provenance of the differences 159
7.2.1 Historical foundations and guiding principles 159
7.2.1.1 C40's historically founded guiding principles 160
7.2.1.2 Climate Alliance's historically founded guiding principles 164
7.2.2 Sociopolitical convictions about the governance of climate change 167
7.2.2.1 C40's way of knowing and underlying sociopolitical convictions 171
7.2.2.2 Climate Alliance's way of knowing and underlying sociopolitical convictions 172
7.2.3 Knowledge production processes as co-producing ways of knowing 175
7.2.3.1 C40's knowledge production process 176
7.2.3.2 Climate Alliance's knowledge production process 178
7.2.4 Summary: differences in knowing co-develop with general orientation of the networks 181
7.3 Different ways forward and imaginaries for the future 182
7.3.1 Different types of green transformations and future visions 184
7.3.2 City networks' future visions and transformation pathways 185
7.3.2.1 C40's vision for the future 185
7.3.2.2 Climate Alliance's vision for the future 186
7.3.2.3 Transformative potential of different imaginaries 187
7.4 Spotting the two ways of knowing beyond the networks 189
7.4.1 C40 member city Copenhagen 189
7.4.2 Climate Alliance member city Munich 197
7.4.3 Summary: Great overlaps between the networks and their exemplary member cities 207
7.5 Summary: Alternative ways of knowing as fostering transition vs. transformation 208

8 CONCLUSION: ON HOW ALTERNATIVE WAYS OF KNOWING FOSTER EPISTEMIC PLURALITY .. 210

9 BIBLIOGRAPHY 225

10 APPENDIX 254

10.1 List of documents analyzed 254
10.1.1 C40 Documents 254
10.1.2 Climate Alliance documents 257
10.1.3 City of Copenhagen documents 261
10.1.4 City of Munich documents 262
10.2 Initial questionnaire for content analysis 263

11 ACKNOWLEDGEMENTS 264

Abstract

Assuming that knowing a phenomenon and acting upon it are inseparably intertwined, this thesis contributes a piece to the puzzle of how we know climate change and what this means for how we deal with it. It does so by focusing on the epistemic actors 'city networks'. Both scholarship, as well as policy-makers acknowledge transnational municipal networks (TMNs) as influential actors in the governance of climate change. This is the case because they serve as knowledge platforms and consultancies. Despite this acknowledgement, an in-depth study of what city networks' climate change knowledge is and what it does, is missing so far. Therefore, this thesis provides an investigation of two city networks' ways of knowing climate change. The networks chosen are C40 Cities and Climate Alliance.

In order to answer the question of how these two city networks know climate change, this thesis develops a theoretical framework proposing a fourfold differentiation of knowledge forms: definitional, conceptual, problem-solving and critical knowledge. The theoretical differentiation of knowledge forms helps to empirically understand how climate change is known in different ways.

This thesis finds that C40 and Climate Alliance know climate change in different, even alternative, ways. To understand where these differences come from, and what their consequences are, the two ways of knowing are contextualized and related to the two networks' respective historical and sociopolitical knowledge environment. This environment is assumed to influence how and which knowledge is produced and passed on to member cities. To get an idea if the respective way of knowledge can also be found in member cities' ways of knowing climate change, this thesis also includes the illustrative analysis of one exemplary member city for each network – Copenhagen and Munich – and its way of knowing.

This thesis concludes that the two networks' alternative ways of knowing are productive for the further development of climate policies. This is because for a wicked problem such as climate change there is no single best way of knowing and acting. This thesis suggests that a wide variety of different ways of knowing are potentially enabling factors for a transition to a more sustainable future. By representing co-existing, though alternative, ways of knowing, TMNs foster a certain epistemic plurality in knowing the epistemic object 'climate change'.

Accronyms and Abbreviations

°C	Degree Celsius
AR	Assessment Report (of the Intergovernmental Panel on Climate Change IPCC)
ARC	Amager Ressource Center (Copenhagen's waste treatment organization)
ASTM	Action solidarité tiers monde (NGO Action Solidarity Third World)
BAU	Business as usual
BECCS	Bioenergy with carbon dioxide capture and storage
BUND	Bund für Umwelt und Naturschutz Deutschland e.V. (Friends of the Earth Germany)
C40	C40 Cities Climate Leadership Group
CBDR	Common but differentiated responsibilities
CCI	Clinton Climate Initiative
CCP	Cities for Climate Protection
CCS	Carbon dioxide capture and storage
CNCA	Carbon Neutral Cities Alliance
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COICA	Coordinadora de las Organizaciones Indígenas de la Cuenca Amazónica (Coordination organization of the indigenous peoples in the Amazon region)
COP	Conference of the Parties (of the UNFCCC)
DACS	Direct air capture and storage
DRR	Disaster risk reduction
EASAC	European Academies' Science Advisory Council
EU	European Union
GCoM	Global Covenant of Mayors for Climate and Energy

GDP	Gross domestic product
GHG	Greenhouse gas
ICLEI	Network 'Local Governments for Sustainability' (founded 1990 as the 'International Council for Local Environmental Initiatives')
INDCs	Intended nationally-determined contributions
IPCC	Intergovernmental Panel on Climate Change
IR	International Relations
MNCs	Multinational companies
NASA	National Aeronautics and Space Administration
NDCs	Nationally determined contributions
NET	Negative emissions technology
OECD	Organization for Economic Cooperation and Development
REDD+	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RFP	Request for proposal
RIA	REDD+ Indígena Amazónico (Amazon Indigenous REDD+)
STS	Science and Technology Studies
TMN	Transnational Municipal Network
UCLG	United Cities and Local Governments
UNFCCC	United Nations Framework Convention on Climate Change

List of tables

TABLE 1: PETER PARK'S CATEGORIES INSPIRED BY HABERMAS' TRIPARTITE DIFFERENTIATION OF KNOWLEDGE FORMS (MODIFIED TABLE ADOPTED FROM PARK 1999: 149) 45
TABLE 2: FOURFOLD CONCEPTUALIZATION OF KNOWLEDGE FORMS 56
TABLE 3: OVERVIEW SELECTED NETWORKS 62
TABLE 4: ILLUSTRATIVE TABLE USED FOR CONTENT ANALYSIS 74
TABLE 5: COMPARATIVE OVERVIEW OF THE TWO WAYS OF KNOWING CLIMATE CHANGE STRUCTURED ALONG THE FOUR FORMS OF KNOWLEDGE 152
TABLE 6: OVERVIEW C40 DOCUMENTS ANALYZED FOR THIS STUDY 256
TABLE 7: OVERVIEW CLIMATE ALLIANCE DOCUMENTS ANALYZED FOR THIS STUDY 260
TABLE 8: OVERVIEW DOCUMENTS PUBLISHED BY THE CITY OF COPENHAGEN ANALYZED FOR THIS STUDY ... 261
TABLE 9: OVERVIEW DOCUMENTS PUBLISHED BY THE CITY OF MUNICH ANALYZED FOR THIS STUDY 262

List of figures

1 Introduction

> Climate change is the defining issue of our time (…) We know what is happening to our planet. We know what we need to do. And we even know how to do it.
> - Antonio Guterres, UN Secretary-General, 10 September 2018

Climate change and knowledge are inseparably intertwined. If we were to take the UN-Secretary General at his word, the situation would be clear: there is unequivocal knowledge about the phenomenon of climate change, we know exactly what it is, how it develops, and also how we can address it. Following this assumption, both rationally grasping as well as acting upon the phenomenon of climate change would become easier, even automatic, the more knowledge we have about it. But here, first doubts arise. Is it not true that already in 1896, Svante Arrhenius, a Swedish scientist, described the influence that the amount of carbon dioxide (CO_2) in the atmosphere has on global temperatures (see Jones and Henderson-Sellers 1990)? A finding that, in 1899, led Nils Eckholm to the conclusion that atmospheric CO_2, as well as emissions from the use of fossil fuels could be a possible future source of climatic change – an assumption that was confirmed by many others in the following years (Christoff and Eckersley 2013: 90ff). Is it not true that – in the face of these findings – already in 1988, the Intergovernmental Panel on Climate Change (IPCC) was founded? An institution whose first report led to the establishment of the United Nations Framework Convention on Climate Change in 1992 (Christoff and Eckersley 2013: 94f) and which, in the meantime, has published five Synthesis Reports and several Special Reports (IPCC 2019). So, apparently yes, we seem to have 'known' climate change for a good number of years. Yet, at the same time, activities which, because of their high amount of Greenhouse Gas (GHG) emissions, are associated with climate destructiveness such as increasing demand for energy, intensified agriculture, the driving of ever bigger cars, air plane travel or luxury crusades are continuously on the rise, and so are CO_2 emissions (Peters et al. 2019; Sarewitz 2011; Welzer 2019). The simple idea that ever more knowledge could solve the issue of climate change hence seems to be short-sighted. But why? How, then, do knowledge and climate change intersect?

Some argue that the hope that more 'knowledge' would lead to more effective climate policy and behavior can be seen as having failed (Grundmann 2019; Hulme 2015). These authors suggest that this might be the case because climate change is a 'wicked' problem. Wicked problems are neither easily understandable from one perspective or discipline, nor solvable with one easy solution as the way how the problem is understood already depends on one's idea of how to solve it (Rittel and Webber 1973: 161). Rather, scholars highlighting the 'wickedness' of climate change suggest that climate change is at heart entangled with "eternal

questions about human meaning, purpose, responsibility and ethics" (Hulme 2020: 2). Tackling a wicked issue such as climate change thus requires the open, democratic discussion of different alternative valid ways of knowing, seeing and acting (Hulme 2020; Machin 2013; Stirling 2015; Swyngedouw 2013). Yet by being presented foremost as a techno-scientific problem, climate change has been extracted from these complex society-nature entanglements (see Rice et al. 2015). Accordingly, climate change tends to be known mainly as a (geophysical) *scientific* problem which has to be addressed by producing ever more (geophysical) *scientific* knowledge (see Allan 2017; Hulme 2015; O'Lear 2016). This is also due to scientists' decisive role in placing climate change on a global agenda (Allan 2017; Christoff and Eckersley 2013; Jasanoff 2015a). However, this has led to a situation in which engagement with the fundamental moral, ethical, social, or economic foundations of climate change is avoided (Swyngedouw 2013). The "dissociation of atmospheric carbon [and other gases, M.K.] from the activities that produce it" (Jasanoff 2015a: 44) leads to consumption habits as the aforementioned examples of huge cars, rising numbers of flight passengers etc. show. Thus, while we indeed know about climate change, what we know seems to be largely limited to one type of knowledge, namely (geophysical) scientific knowledge – in spite of the fact that climate change is a multidimensional phenomenon. Scientific knowledge is expected to tell us how to act upon climate change – however, scientific knowledge is not able to fulfill the expectation of telling us what to do about climate change because it is neither meant to, nor able to do so (Machin 2013: 94; Stehr and Grundmann 2012: 39; Wynne 2010). Therefore, a certain epistemic plurality is needed in order to successfully deal with climate change (Beck et al. 2014; Machin 2013).

How can epistemic plurality be theorized? First of all, the concepts 'knowledge' and 'knowing' need some theoretical clarification. Several different scholars, especially those doing Science and Technology Studies (STS), have conceptualized knowledge – whether characterized as scientific or not – as a social and culturally coined product which cannot be seen and understood as detached from society, location, situation etc. (see Berger and Luckmann 1997 [1966]; Jasanoff and Long Martello 2004a; Jasanoff 2004; Stehr and Meja 2005). In consequence, all knowledge is always the result of the subjective process of getting to know something, influenced by the location, education and social attitude of the knower (F. Fischer 2019: 138). Taken seriously, this means that there is no single 'best' way to know and understand climate change but actually several alternative, in principle equally worthwhile ways. A scientific understanding of climate change is one way of knowing the phenomenon, amongst other ways of knowing. Further, this also means that a clear distinction between science and policy-making has to be seen as problematic (for a discussion of different perspectives on the science-policy interface see Pregernig 2014) and that the linear model of

science policy transfer is overly simplistic (Allan 2017; Jasanoff 1995). Accordingly, Mary Pettenger argues that "the construction of knowledge is fundamental to understanding climate change" (Pettenger 2016: 3). Despite often being presented as a kind of 'neutral' knowledge, science plays an interactive role in socially constructing knowledge about climate change (Bäckstrand 2003; Lahsen 2005). To go even further: "(…) science in many cases *is* the politics of climate change" (Lahsen 2016: 190).

In the understanding of STS scholarship and social constructivist literature not only knowledge about, but also the meaning of climate change itself is manifold and defined in social settings (Jasanoff and Long Martello 2004c; Litfin 1998; Pettenger 2016; H. A. Smith 2016a). To be very clear – this by no means implies a negation of climate change as a phenomenon composed of material facts such as the changing composition of the atmosphere (see W. Steffen et al. 2015: 89), the appearance of ever more severe weather events – droughts, floods, typhoons, wildfires, melting of glaciers, etc. (see EASAC 2018), meteorological changes in seasonality (Sánchez-Cortés and Lazos Chavero 2011) and the continued rise of global mean temperatures (see NASA 2019). Rather, looking at climate change through the lens proposed inter alia by STS means to scrutinize how these material facts are socially absorbed – how are they being described, discussed, interpreted? And which consequences do these social processes have for instance for actor constellations, accountabilities, and knowledge structures (see Pettenger 2007a)? As F. Fischer (2003: 217) puts it: "It is not the objects or their properties per se, but rather the vocabularies and concepts used to know and represent them that are socially constructed by human beings." For my research, this means that while the material challenges that come with climate change are materially present, the answers we give to these challenges (including policies, governance arrangements, knowledge structures etc.) are deeply socially embedded and coined. It is these answers that my research is interested in. These reactions are highly influenced by the way in which climate change is known. To say it differently: "What we do about climate change obviously depends on the stories we tell. As these stories change, the world changes too" (Onuf 2007: xv). In my understanding, these 'stories about climate change' are different ways of knowing climate change. This raises the question: **how is climate change being known?**

City networks as particular knowledge subjects in knowing climate change

This thesis deals with different ways of knowing climate change. It does so by investigating a particular group of knowledge subjects – city networks. This thesis focuses on city networks because both academic literatures, as well as policy-makers, acknowledge them as influential actors in the governance of climate change (Acuto and Rayner 2016; Bansard et al. 2017; C. A. Johnson 2018; Toly 2008). This is especially the case as they serve as knowledge platforms

and consultancies. Despite this acknowledgment, an in-depth study of what city networks' knowledge is and what it does, is missing so far. This is what this thesis provides: an investigation of city networks' ways of knowing climate change.

'Knowing something' encompasses basic epistemological ideas, strategies for acquiring knowledge, requirements for explaining and predicting, standards for inquiry (Hawkesworth 2015), audiences, media types, modes of communication (Berkes 2009), but also the agents, practices and institutions that are influencing what and how something is being known (Cornell et al. 2013: 61). The epistemic object under construction – be it 'war', 'piracy', or 'climate change' – is produced and shaped by all these different sites and practices of knowing (Bueger 2015: 7). Knowledge of the world – respectively, of a specific epistemic object – always involves interpretive constructions and these are created by socially interacting actors in a societal system (F. Fischer 2019: 137). Such actors shaping how an issue is known are thus crucial as they characterize how the epistemic object is designated, translated and problematized (Allan 2017: 139). In global climate change governance, these are various actors ranging from different scientific actors (Beck et al. 2014; Beck 2015), to particular individuals (Boasson and Huitema 2017; Boasson 2018) or urban actors (C. A. Johnson 2018).

The last group, urban actors, has attracted more and more interest in the context of research on climate change and its governance (Acuto 2013b; Bulkeley and Betsill 2003; Bulkeley 2010, 2013; C. A. Johnson 2018; Ljungkvist 2014a; Van der Heijden 2019). Many authors agree that cities are becoming increasingly important international actors (see Acuto 2013c; Angelo and Wachsmuth 2020), some even arguing that they might be compensating the deadlock produced by traditional state diplomacy (Acuto 2013a; Curtis 2014; C. A. Johnson 2018), or that they could contribute to achieving truly just climate policies (Dietzel 2019).

Over the last two decades, a number of scholarly contributions have focused on the role, influence, and power of cities in global climate change governance (Acuto 2013a; Bouteligier 2013; Bulkeley and Betsill 2003; C. A. Johnson 2018; Ljungkvist 2014b; Van der Heijden 2019). They all highlight in this regard – next to some other enabling factors – the importance of transnational municipal networks (TMNs)[1] (Acuto and Rayner 2016; Gordon 2013). These city networks are found to positively influence climate governance on the urban level (Rashidi and Patt 2018) and are even seen "as the primary vehicle through which cities participate in the global response to climate change" (Gordon and Johnson 2018: 35).

[1] Throughout this thesis, I use the terms 'TMNs' and 'city networks' interchangeably. With these terms, I am referring to institutionalized networks focusing on sustainable urban policies such as ICLEI Local Governments for Sustainability, C40 Cities, or the Global Covenant of Mayors for Climate & Energy. Contrarily, these terms do not include more informal networks between cities, such as city-to-city cooperations between twin cities.

TMNs enable cities to raise their voices internationally and therefore contribute to the establishment of urban actors on the global level (Bouteligier 2013; Busch 2015; C. A. Johnson 2018; Toly 2008). However, transnational networks are not only important because of their advocacy. On the contrary, they fulfill various different functions (Busch 2015), one of which is to serve as platforms for the exchange of norms, ideas and knowledge (Bouteligier 2013; Busch et al. 2018; C. A. Johnson 2018). Shaping and diffusing knowledge – understood as comprising norms and ideas – hence lies at the heart of TMNs' activities and one reason why cities join networks is to get information on how to govern climate change locally (see Bulkeley et al. 2003; Haupt et al. 2018; Romero-Lankao et al. 2018). Accordingly, transnational municipal networks are important for cities' engagement with climate change because they offer the possibility to gain knowledge and to learn (Andonova et al. 2009; Bulkeley et al. 2003; James and Verrest 2015) – serving as both a platform for knowledge exchange as well as a consultancy (Busch 2015). In other words, considering the complexity of climate change, cities join networks in order to get knowledge about how to act on climate change and which policies to implement locally, as well as to establish relations with like-minded municipalities. The exchange and production of knowledge hence constitutes a main 'function' of a city network (Bulkeley et al. 2003; Busch 2015).

This knowledge, in turn, is of course shaped by how TMNs themselves know climate change – how they define the problem, which actors they consult to collect information, which solutions they consider worthwhile, etc. Hoffmann (2013) suggests that one of the particularities of transnational climate governance approaches is that they define and understand the problem of climate change differently to the traditional, multilaterally-coined process of climate governance. Hence, it is important to understand how TMNs actually know climate change. At the same time, the aspects of learning and knowledge remain amongst the most under-examined aspects concerning climate city networks (Haupt et al. 2018).

This is all the more surprising when keeping in mind that especially in the context of climate change "how one knows shapes how one governs" (Hulme 2015: 558; see also Uhrqvist and Lövbrand 2014). Networks' knowledge about climate change is hence fundamentally connected to their suggested ways of acting upon it. In turn, different city networks' ways of knowing climate change influences not only what they pass on to their members, but also what they claim in the names of the thousands of cities and millions of city dwellers they represent on a global level.

Therefore, it is essential to engage with city-networks' knowledge and their ways of knowing climate change. This thesis aims at contributing to the question of how climate change is known in general by focusing on the specific actors 'transnational municipal networks' and their knowledge about climate change. Here, my aim is not only to detect what kind of

knowledge city networks provide, but also to understand where this knowledge comes from, how it is produced, and which basic understandings of climate change are at stake in what city networks provide – for short, my aim is to understand how TMNs 'know' climate change. Accordingly, the main question framing my research is the following:

How do TMNs know climate change?

STS scholarship highlights that the conditions of knowledge production are of immense importance and are part of understanding the contextuality of knowledge (Jasanoff and Long Martello 2004a; Jasanoff 2010b, 2015a). If we want to understand how something is known, we have to "understand how processes of producing expertise and policy-relevant knowledge are organized, designed, and work" (Beck et al. 2017: 1067). I argue that through a deeper understanding of city networks' ways of knowing climate change – this knowledge's origins, processing and eventual diffusion – we can understand how city networks produce their expertise and therefore even more precisely define their role in global climate change governance. This assumption builds on International Relations (IR) scholarship having found that non-state actors have particular influence on international politics through their knowledge (Adler and Bernstein 2005; Barnett and Finnemore 2004; Bueger 2015; Haas 1992). In this sense, TMNs are definitely to be seen as actors influencing how climate change is governed – on a local, as well as on a global level. They are shaping both knowledge about climate change and the actions against it based on this knowledge. At the same time, TMNs are part of the relatively new institutions and actors that have grown around the governance of climate change and which are yet to be fully understood (Rashidi and Patt 2018). Focusing on city networks' knowledge is thus a necessary piece of the puzzle of how we know climate change more broadly – a pressing question if we take serious that cultural and social assumptions, as parts of how we know, shape how we collectively understand and behave in face of a changing environment (see Lövbrand et al. 2015: 212).

Theoretical and methodological framework

In order to be able to answer this question, I develop a theoretical framework that proposes a fourfold differentiation of knowledge forms. This theoretical framework is necessary because 'knowledge' – especially in the city network literature, but also in a broader context – is often referred to as a fuzzy, black box term without asking what the substance of this 'knowledge' is. By differentiating forms of knowledge, the black box can be opened up and the various components of what it means to know something become visible. Bueger (2015: 16) argues that also in IR scholarship, there is a certain gap when it comes to understanding knowledge: "We know that knowledge is important, but hardly understand where it comes from, how it is generated and validated in practice". Therefore, my theoretical framework is contributing to IR

scholarship beyond the epistemic object 'climate change', as it can be used for the investigation of other epistemic objects as well. The theoretical framework can shed light on questions such as how exactly a way of knowing is composed, where the respective knowledge comes from, and how and by whom this knowledge gets valued in practice. Hence, this thesis contributes to understanding *how* we know – a question that is only marginally considered in comparison to *what* we know and which therefore needs further attention (Schnegg 2019: 831).

Drawing on differentiations of knowledge forms from different literatures, I distill the following four forms of knowledge: definitional, conceptual, problem-solving and critical knowledge. These knowledge forms represent different dimensions of knowing. Depending on how an issue is known, the aspects forming each dimension can appear very differently. Therefore, the theoretical differentiation of knowledge forms serves as guidance when trying to empirically understand how climate change is known in different ways. The differentiation of knowledge forms thus helps to identify different ways of knowing. If we understand how climate change is known, we can also understand different types of actions to counter it.

Acknowledging different ways of knowing as equally worthwhile, I take the four forms of knowledge as dimensions of knowing where different ways of knowing, their different audiences, knowledge media, communication modes (see Berkes 2009: 154) but also their epistemologies or strategies for acquiring knowledge (Hawkesworth 2015) become particularly salient. Similarly, Hulme (2020: 2) argues that climate change prompts different questions related to "people's identities and values, their attitudes to technology, their attachment to the idea of 'progress' and how they understand their relationships with human and non-human actors". I argue that these aspects in turn, all manifest in different dimensions of knowing – or, forms of knowledge. Accordingly, people's identities and values are reflected in definitional knowledge, their attitudes to technology and their attachment to the idea of progress will influence the problem-solving knowledge they aim for and apply, and their understanding of relationships with other humans and non-humans will factor in their conceptual knowledge. If these ideas, attitudes, beliefs, or understandings are contrasting to a predominant way of knowing, all these aspects could also manifest as critical knowledge. This is because I define critical knowledge as a form of knowledge which questions hegemonic knowledge structures and refers to alternative ways of knowing. What this shows is that the four forms of knowledge are able to depict different ways of knowing and can therefore be used to theoretically grasp how city networks know climate change.

For this thesis, I focus on the two city networks C40 Cities and Climate Alliance and their ways of knowing climate change. Other scholars' work has shown that city networks active in climate change governance differ widely (see Bansard et al. 2017; Keiner and Kim 2007;

Widerberg and Pattberg 2019). Choosing the networks C40 Cities and Climate Alliance means to choose two TMNs that vary a lot with respect to their membership, the partners they work with, but also their own identity. Therefore, it is very interesting to investigate if these differences also manifest in alternative ways of knowing climate change.

In order to analyze how the two networks know climate change, I take inspiration from interpretive research approaches. Interpretive research places intersubjective meanings at the core of research (see Bliesemann de Guevara and Kurowska 2020; Schwartz-Shea and Yanow 2013; Yanow and Schwartz-Shea 2015) and is therefore well suited for an analysis which at its core is concerned with the question of how something is known. Interpretive analyses do not start from the assumption that political problems are objectively given. Rather, they focus on the meaning-laden processes by which these issues become known and problematized (Bliesemann de Guevara and Kurowska 2020). As already mentioned above, I theoretically follow the STS scholarship highlighting that all knowledge is always subjective in the sense of being socially coined – naturally, also a researcher's knowledge. Accordingly, as the question *how do I get to know how city networks know climate change* highlights, throughout my research I am confronted with the so-called 'double hermeneutic' (Giddens 1986; Guzzini 2000). This means that firstly, TMNs' knowledge about climate change is a socially-coined 'first-order' interpretation accumulated in knowledge. In turn, my research about these 'first-order' interpretations consists of likewise socially-coined 'second order' interpretation about how networks are knowing climate change. Therefore, it is all the more important to transparently disclose and reflect upon what I did, how I did it and what I had in mind when I did my research (Barbehön et al. 2019).

I decided to use content analysis as my main methodological tool in a way that was inspired by interpretive scholars (e.g. Ginger 2006). To get to know how networks know climate change, I analyzed 59 documents published on C40's and Climate Alliance's websites. In addition, I spoke to both TMNs' staff and used the information obtained as a supplement to the content analysis, particularly to understand the contextual environment in which TMNs know climate change. To further follow the two ways of knowing beyond each network and to get an idea of where they travel to and from, I chose one member city for each network – Copenhagen and Munich – and analyzed in how far the respective networks' way of knowing is mirrored in their climate policy communication documents.

To return to Antonio Guterres' quote at the beginning of this introduction, knowing what is happening in terms of climate change, what needs to be done and how it should be done are by no means unequivocal undertakings. Rather, when approached through different ways of knowing, these tasks can look very differently (see e.g. Allan 2017: 152ff). Throughout this thesis, I identify how the two city networks C40 Cities and Climate Alliance know climate

change to eventually draw conclusions about what this means for the(ir) governance of climate change, both locally, as well as globally. This thesis therefore makes two major contributions: firstly, it helps to identify the role that different city networks play in governing climate change more clearly; and secondly, by focusing specifically on the knowledge of climate change, it contributes a piece of the puzzle to the question of how the epistemic object 'climate change' is being known.

Outline of this thesis

This thesis is structured as follows: in chapter 2, I introduce the issue area of cities, city networks and climate governance. I firstly outline how cities and their networks have come to be engaged with climate policy. Subsequently, I review the literature that is dealing with TMNs and climate policy. Along the differentiation of an internal focus, investigating TMNs' relation with member cities, versus an external focus, shedding light on TMNs' relation with actors external to their own structures, I summarize that this field of research has found knowledge to be at the heart of city networks' engagement with climate change. I conclude that thus far, research on TMNs has failed to take into account the fact that the knowledge produced and diffused by city networks is shaped by their own way of knowing climate change. Taking up the critique that a sufficient differentiation of TMNs is neglected in most studies dealing with city networks, I end by suggesting that one of the main differences between city networks could be their different ways of knowing climate change.

In the following chapter, chapter 3, I clarify the conceptual background of my study. Assuming that knowing is important for governing climate change, I start out by discussing what 'knowing' actually means. Knowing for me is a socio-material activity that arises from situated practices. In turn, I conclude that a way of knowing can be summarized in the story that is told about an epistemic object. Asking how climate change is predominantly known, I find that scientific ways of knowing climate change have become prevalent and shaped the way how climate change was governed so far. In order to outline the difference between the two concepts of knowing and knowledge, I turn to STS's reflections about knowledge and conclude that knowledge is the resulting product of knowing something. Therefore, I summarize that knowledge has to be seen as a social and situated product which is constantly co-produced with its environment. These conceptual baselines are important because they serve as the starting point for my theoretical framework, differentiating four different forms of knowledge.

In chapter 4, I develop my theoretical approach. I do so by explaining why a differentiation of knowledge forms is a helpful undertaking to understand how something is being known. I argue that this is the case because a way of knowing something is composed of different, interplaying knowledge forms. Therefore, knowledge forms are helpful to illustrate the different aspects of what it means to know something. To find a useful differentiation of knowledge forms, I combine my conceptual baseline assumptions, outlined in chapter 3, with the differentiation of knowledge forms brought forward by Jürgen Habermas. Both frameworks focus on knowledge and its socio-political environment and can therefore be productively combined. This combination shows that both frameworks share some basic assumptions about knowledge. In the remainder of the theory chapter, I use these shared assumptions to establish my own theoretical framework differentiating four knowledge forms. My own four-fold framework of knowledge forms consists of definitional, conceptual, problem-solving, as well as critical knowledge. All these knowledge forms are explained, as well as distinguished to the baseline differentiations throughout the second part of chapter 4.

Chapter 5 serves to explain my methodological approach. I start out with thinking about how to apply my theoretical reflections about knowing and knowledge, as well as my four-fold knowledge form differentiation to an analysis of city networks. In a second step, I elucidate why and how I have chosen C40 and Climate Alliance as the two city networks I want to focus on. Based on my conceptual framework, I assume that knowledge is co-produced with its environment. Therefore, two city networks with a great variety in terms of structure, purposes and partners seem particularly interesting with regards to different ways of knowing climate change. In the remainder of chapter 5, I present the material I consulted for my analysis – 59 online consulting documents published on the two TMNs' websites, as well as interviews with TMN staff serving as background information to better understand the respective knowledge environment. I also discuss in detail how I generated the data to be analyzed, and how I conducted the actual analysis of this material. This analysis was split up in several phases which are all presented throughout chapter 5.

In chapter 6, I outline the ways of how C40 and Climate Alliance know climate change. I start out each networks' chapter with a one-sentence summary of their story about climate change. Distilled from the analyzed documents, this 'main story' captures the different facets of how the two networks know climate change, along the four forms of knowledge identified in chapter 4. In the first part of chapter 6, I trace C40's way of knowing climate change. In terms of definitional knowledge, C40 knows climate change as a matter of scientifically measurable and explainable temperature developments, which is first and foremost an urban problem

caused by and affecting cities and urban areas. Conceptually, C40 bases its knowledge on approaches and data considered scientific. Further, concepts such as ‘carbon neutrality’ and ‘green growth’ play an important role. And, finally, C40 knows solutions to this problem as technological means which are at the same time beneficial for various problems and which are also financially rational. C40’s way of knowing can be summarized with the following sentence:

> Climate change is a meteorological phenomenon, which is to be addressed in particular by cities and urban areas with techno-managerial means which are not only beneficial for climate protection but also other issue areas.

In the second part of chapter 6, I focus on Climate Alliance and its way of knowing climate change. In terms of definitional knowledge, Climate Alliance knows climate change as a phenomenon with ‘many faces’. Accordingly, climate change is also known as a meteorological phenomenon but one that has not only meteorological, but also economic and social origins, as well as consequences. Part of this multifacetedness is, according to Climate Alliance’s knowledge, that climate change is a phenomenon that affects humans and natural environments differently in different places all over the world – and mostly those that contributed the least to it. Climate change is thus known as a problem with unfair consequences and origins. The contribution of ‘unfairness’ to the phenomenon of climate change is an aspect which plays an important role in how Climate Alliance knows climate change. Hence, industrialized countries and their inhabitants, are seen as main culprits of climate change – because of the lifestyle they led over the last 200 years. Climate change is thus also known as a lifestyle problem. In turn, conceptually, Climate Alliance’s knowledge is based both on scientific data and approaches as well as on people’s experiences and empirical expertise. Therefore, direct interaction of people and the exchange of their experiences is seen as significant for the generation of knowledge about climate change. Further, concepts such as ‘social justice’ and ‘climate justice’ play an important role. Climate Alliance’s solutions to this problem (respectively, the multiple problems) are mutual education and exchange as well as a change of currently dominant behaviors and lifestyles. Therefore, climate change is known as a problem that concerns everyone globally (though differently) and which can also be shifted by everyone. Different to C40’s knowledge, I interpret parts of how Climate Alliance knows climate change as ‘critical knowledge’. This critical knowledge is – sometimes more, sometimes less – inherently present in the other three forms of knowledge. Critical aspects of how Climate Alliance knows climate change include its critique of the currently dominant perceptions of climate change’s root causes, the fact that indigenous concepts and ways of living are considered, as well as its explicit critique of political and economic developments and actors. In a single sentence, Climate Alliance’s way of knowing can be summarized as follows:

> Climate change is as much a socio-economic as it is a techno-scientific phenomenon which is to be addressed by everyone by overcoming current unfair socio-economic structures and interdependencies.

Chapter 7 is used to outline the contextual environment in which these two different ways of knowing are produced. I do so to understand possible provenances of the differences in how the two networks know climate change. I start chapter 7 with a short summary of the two ways of knowing, this time in a comparative manner. By summarizing similarities and differences, I put the two ways of knowing in a comparative relation to one another. In particular, I consider the respective presence, absence or rejection of each aspect of each TMN's way of knowing in the other TMN's way of knowing in the beginning of chapter 7. This comparative summary once again highlights that the two networks' ways of knowing constitute two alternative ways of how climate change can be known. After this outline of how differently the two networks know climate change, in the remainder of chapter 7 I focus on possible provenances of these differences. Considering the two networks' historical foundations, general guiding principles, their socio-political convictions and their knowledge production processes, I aim to draw 'plausible conjectures' (Boswell et al. 2019: 30) between the context of each networks' knowledge environment and how these are co-producing TMNs' ways of knowing climate change. Further, I look at the consequences of these differences in knowing. Here, I especially focus on the ways forward that are paved by each way of knowing as these are important for how each networks' member cities can transform and act upon climate change. I conclude that C40 favors a technocentric, marketized and city-led transition towards 'climate-friendliness', whereas Climate Alliance's transformation approach overlaps with a citizen-led one and projects some major shifts in social and economic order. Because of their position and functions, city networks have a certain authority to shape other actors' perception of what is desirable, thinkable and feasible (see e.g. Bouteligier 2014; Gordon and Johnson 2018; Rashidi and Patt 2018). Therefore, how they imagine ways forward might considerably influence how their member cities act upon climate change. In order to get an idea of the 'trajectory' of each way of knowing, as a last step of chapter 7 I investigate in how far the two ways of knowing are mirrored in one particular member city's climate policies. As a C40 member city I choose Copenhagen and as a Climate Alliance member city I choose Munich. The illustrative analysis of four climate policy documents per city shows that in both cases the respective networks' way of knowing is clearly perceivable in how Copenhagen and Munich formulate and present their urban climate policies.

Chapter 8 is the concluding chapter in which I summarize once again how and why Climate Alliance and C40 represent two alternative ways of knowing climate change. I conclude by suggesting that the co-existence of the two very different ways of knowing climate change is,

from a normative and political point of view, both positive and productive. I argue that for a wicked problem such as climate change, it is not possible to find one single best way of knowing and acting. Nevertheless, there is a tendency for particular way(s) of knowing to become dominant, which in turn leads to a de-politicization of highly political and ethical issues. In order to foster the needed democratic debates and contestation, it is necessary to admit different ways of knowing and to openly discuss them. Therefore, my conclusion is that by city networks' representations of alternative ways of knowing climate change at both global and local levels, a certain epistemic plurality in knowing climate change is, if not guaranteed, then at least strongly fostered.

2 Historical background: city networks and the global governance of climate change

My project relies on, and contributes to, the literature on cities, city networks and global climate governance. This scholarship agrees that "(…) climate change represents one arena in which knowledge, ideas, and science circulate within and between cities" (Hughes and Romero-Lankao 2014: 1038). At the same time, city networks are understood as one of the most important vehicles through which cities participate in the global governance of climate change. As such, transnational municipal networks (TMNs) are part of those international institutions shaping global kinds of knowledge about environmental changes. However, there is a disjuncture between the importance attributed to knowledge and its understanding in the city network context. This is the contribution of this thesis to the literature on city networks and global climate governance – it answers the question of how city networks know climate change.

This chapter provides an overview of the existing literature relevant for answering the question of how TMNs know climate change. First of all, I very briefly outline how cities got involved in the global governance of climate change and which role networks play in this relationship. In a next step, I review the literature on city networks and climate governance. I am doing so by splitting up the literature according to their foci: some are rather focusing on the 'internal' governance aspects of city networks, while others are investigating 'external' aspects of city networks' climate governance. Both bodies of literature ultimately illustrate why TMNs are decisive actors in the context of climate change governance and why it is necessary to further shed light on them.

In a last step, I highlight why it is particularly important to focus on the aspects of knowledge in terms of city networks.

2.1 Brief historical overview: cities and climate change governance

The engagement of cities with climate change governance started in the late 1980s with several individual and local mitigation actions (Bulkeley and Betsill 2003). In the following years, some of these cities started to engage in partnerships and networks with the goal of sharing information and good practices on their individual climate actions (Betsill and Bulkeley 2006; Fuhr et al. 2018; Kern and Bulkeley 2009; Toly 2008).

The first international call for an inclusion of urban actors in the global governance of environmental challenges was made by the so-called Brundtland report in 1987. The 'Our Common Future'-report of the *World Commission on Environment and Development* addressed one entire chapter to urban areas and environmental challenges and stated that cities are immensurable in attaining sustainable development (Angelo and Wachsmuth 2020;

T. Hickmann 2016b; United Nations 1987). In 1992, the *Rio Earth Summit* and the *Agenda 21*, again, emphasized cities' role in addressing environmental challenges (Fuhr et al. 2018: 1). Therefore, during the early 1990s, cities started to actively enter the global stage of environmental governance (Gordon and Acuto 2015: 65).

In the specific sub-field of global *climate* governance, it took some more time until the intergovernmental climate regime coined by the United Nations Framework Convention on Climate Change (UNFCCC) officially recognized cities and other urban actors as governance agents. In 2010, at the Conference of the Parties (COP) 16 in Cancún, cities were referred to as governmental stakeholders and therefore officially acknowledged as crucial in the governance of climate change by the UNFCCC secretariat (T. Hickmann 2016b: 85).

Ultimately, the *Paris Agreement* of 2015, the UN Habitat's *New Urban Agenda* and the *2030 Development Agenda* (especially Sustainable Development Goal 11) highlighted the immense role of local governments for finding adequate answers to global environmental issues, including climate change and other pressing sustainability challenges (Fuhr et al. 2018; UNFCCC 2015b; UNGA 2015, 2016).

As a result, cities are perceived as places where not only high environmental degradation is appearing, but also where ideas arise about how these problems could be approached and environmental sustainability realized – both, among policymakers and academics (Angelo and Wachsmuth 2020; Bouteligier 2013).

In order to enhance their environmental policies by exchanging knowledge and expertise, and realizing that "together, cities have a great deal more influence than they would separately" (Toly 2008: 352), cities started to engage in networks – transnational municipal networks, short TMNs (Bouteligier 2013). These early networks of the 1990s – of which ICLEI's Cities for Climate Protection (CCP) is often given as a primary example (Gordon and Acuto 2015: 65) – focused on the creation and exchange of technical possibilities for climate mitigation. However, they suffered from a big divide between a small number of pioneering cities and a large number of members who failed to implement meaningful action (Gordon and Acuto 2015: 66). A 'second wave' (Bulkeley 2010: 232) of municipal action, evolving in the early 2000s, "is characterized by engagement of a more economically and geographically diverse set of cities alongside a shift towards city-led or mayor-driven city networks" (Gordon and Acuto 2015: 67). The C40 Cities Climate Leadership group – which constitutes one of the city networks analyzed in this study – is often taken as a primary example of these 'second-wave' networks.

The importance of such city networks for the governance of global issues (not only climate change) has been highlighted by Saskia Sassen arguing that "our geopolitical future…will be determined in good part through 20 or so strategic urban networks" (cited in Davidson and

Gleeson 2015: 22). Correspondingly, scholars became more and more interested in both cities and their networks in the global climate governance landscape.

2.2 City networks as particular actors in global climate change governance

Over the last twenty years, an ever-growing number of scholars is analyzing transnational city networks in global environmental and especially climate governance (Acuto 2013b, 2013a; Betsill and Bulkeley 2004; Bulkeley 2010; T. Hickmann 2016b; C. A. Johnson 2018; Lee and van de Meene 2012; Toly 2008). This strand of scholarship focuses on networks of local governments which engage in joint actions to address environmental challenges and climate change in particular. Pattberg and Stripple (2008) define these city networks as 'public non-state actor networks' forming "cooperative arrangements to exchange information, learn from best practices and consequently mitigate carbon dioxide emissions independently from national government decisions" (p. 379). Andonova, Betsill and Bulkeley (2009) further specify the *transnational* aspect of these networks and determine that "transnational governance occurs when networks operating in the transnational sphere authoritatively steer constituents towards public goals" (Andonova et al. 2009: 56). TMNs have been defined as organizations which are characterized by forms of self-governance and where decisions are taken within the network and then directly implemented by the members (Kern and Bulkeley 2009). At the same time, TMNs have gained agency through formalizing their status and infrastructure, i.e. through possessing their own staff, offices and headquarters (Busch 2015). This 'institutionalized' form of a TMN, namely with their own staff, offices and a common transnational governance arrangement is the basis for the definition of city networks used throughout this thesis as well. Even though they share some particularities, especially that their main constituents are municipalities, TMNs vary quite significantly. The differences cover aspects such as the overall size of the network, the membership composition (global cities, regions, towns, small villages etc.), organizational structure, administrative capacity, partners, financial means etc. (see Bansard et al. 2017; Haupt and Coppola 2019; Keiner and Kim 2007; Widerberg and Pattberg 2019).

City networks are not the only transnational networks in global climate governance. Scholars have analyzed a number of different transnational networks (Bäckstrand 2006; Bulkeley and Betsill 2003; Cashore et al. 2004) and even diagnosed a transnationalization of environmental governance (Biermann and Pattberg 2008). Nevertheless, networks composed by cities and municipalities are identified as a particularly interesting case of a transnational governance arrangement. This is because they "show how cities can matter beyond their own territories and are one expression of our globalizing world in which norms and practices are shaped and dispersed through networks" (Bouteligier 2013: 2). Therefore, city networks are

seen as emblematic for the shift from government to governance (Acuto and Rayner 2016; Bäckstrand 2008) as they actively created networks through which they could directly govern climate change challenges. Further, it is especially city networks that have provoked great enthusiasm because of the hope that they would be able to overcome persisting short-comings in climate governance (e.g. Acuto 2016; Dietzel 2019). This assumption has been in so far validated as TMNs have been found to be key for the implementation of urban climate governance (Bulkeley and Betsill 2013; C. A. Johnson et al. 2015b; Van der Heijden et al. 2019; Van der Heijden 2019).

At the same time, criticisms are raised against such governance arrangements. The critiques include assertions that politically legitimized states risk to be undermined, neoliberal tendencies reinforced and that therefore climate governance tends to become rapidly privatized (Bäckstrand 2008: 78; see also Van der Heijden 2018).

But what are the particularities of transnational municipal networks? Why are they considered such important actors for the governance of climate change? Scholarship has attempted to answer these questions by focusing on different aspects. When trying to cluster these aspects, it becomes clear that some parts of the literature focus more on 'internal' governance aspects of TMNs, hence the relationship between the networks as actors and their members. Others focus more on 'external' aspects, such as the process by which city networks have successfully established themselves as autonomous and authoritative actors within the global climate governance landscape. 'External' aspects thus cover the relationship between networks and other actors outside their network structure.

2.2.1 Internal aspects of city networks' climate governance

Many of the, foremost early, investigations of city networks and climate change governance focus on and theorize what can be called 'internal aspects' of city networks in climate governance (see e.g. Aylett 2015; Betsill 2001; Betsill and Bulkeley 2004). These internal aspects include questions on how networks secure cities' participation, how they steer their members' actions and which role membership in a climate city network plays for the local governance of climate change. Connected to that is also the question of why cities join networks in the first place. Hence, these are questions that concern the interaction between the networks, as institutionalized organizations, and their members. It is not surprising that the city network scholarship started out with researching 'internal' aspects of city networks' climate governance as this overlaps with TMNs' general development. Accordingly, Gordon and Acuto (2015) highlight that 'first wave' city networks "were configured as hub-and-spoke networks whereby the primary mode of interaction is between the city and the network-as-actor" (p. 66).

The early strand of literature helped to establish city networks as a research object at the international level (see Bulkeley and Betsill 2003; Kern and Alber 2009; Schreurs 2008). The focus in the beginning lay on understanding how the new transnational networks function and how they 'govern' their own members.

In this regard, one important aspect is how city networks secure participation of member cities. Bulkeley and Betsill (2003) find that it is foremost the access to financial and political resources provided by networks that secure the mobilization of members (p.186). However, they also highlight that participation is secured because networks serve as a valuable source of information and as a means to demonstrate environmental leadership (Bulkeley and Betsill 2003: 187). This environmental leadership 'brand' is used by cities to promote themselves as green and sustainable and therefore to attract investments (Bouteligier 2009; Bulkeley and Betsill 2013). These assumptions have been reconfirmed by other scholars highlighting that local climate policies often fit well with other policies aiming at different goals such as infrastructure development, the creation of new jobs etc. (Bouteligier 2013) – an aspect that is discussed for this study in chapter 6.1.3.2. This makes climate change a strategic issue for urban actors (Bulkeley and Betsill 2013). These strategic connections – presented as 'co-benefits' of climate actions (Gordon 2016b; Schreurs 2008; Toly 2008) – are being used to 'sell' climate policies (Gordon 2016b), as also the example of C40 shows (see chapter 6.1.3).

For city networks, it is not only important to secure the participation of their members but also to influence them and their policy decisions – to 'steer' them (see Andonova et al. 2009; Kern and Bulkeley 2009). Accordingly, Bulkeley and Kern (2009) find that city networks steer their members with three different strategies: Firstly, information sharing (exchange of experiences and knowledge); secondly, capacity building and implementation (provision of financial, managerial, and technological resources); and thirdly, self-regulation (rule setting and measuring of performance). The exchange and generation of knowledge is seen as especially central for transnational networks (Andonova et al. 2009: 63; Labaeye and Sauer 2013). Keiner and Kim (2007) even see those transnational networks as an expression of how knowledge-sharing is globalized generally. Accordingly, early city networks are found to have a big influence on the local capacity to deal with climate change through the exchange of knowledge and information (Corfee-Morlot et al. 2009: 81; Feldman 2012).

Most of these aspects have been confirmed by more current scholarship as still being valid. Accordingly, Sofie Bouteligier (2013) finds similar functions – or as she calls them 'goals' – of city networks which are amongst others, to 'exchange information, knowledge and best practices' and to 'increase cities' capacity' (p. 48). Henner Busch (2015: 222ff) refines these functions and finds that networks can serve as 'platforms' for the exchange of information and know-how, as 'consultants' by providing information and supporting members directly, and as

'commitment brokers' by obliging members to commit to certain goals. All of these are functions which cover the relationship between the networks as actors and their member cities. Bouteligier and Busch add other functions which are referring to networks' external aspect and which are therefore explained in chapter 2.2.2.

Additional to the question of how networks try to influence their members' policies, ever more scholars are trying to understand in how far TMNs are actually influencing what their members are doing in terms of climate policies. Accordingly, Betsill and Bulkeley (2007) find that the creation of technical knowledge (in their case emissions inventories and forecasting tools) through networks plays the decisive role "when it comes to making a difference locally" (p. 450f). Interestingly, such impacts of networks on local policies were found to appear in member cities which have already contributed to the development of the network and therefore are 'donators' of best practices (Bulkeley and Betsill 2003: 173). However, this finding seems to be particularly valid for members of 'first wave' city networks. Rashidi and Patt (2018) find that generally TMNs seem to have a positive influence as a city's membership in a city network correlates with the implementation of more urban climate policies. TMNs are found to have a positive impact also in terms of non-quantitative changes. They are identified as being decisive for cities to innovate technically and normatively (Toly 2008), but also for the subsequent scaling of innovative solutions (Kern 2019; Smeds and Acuto 2018) and for other indirect transformation pathways (Gordon and Johnson 2018; Labaeye and Sauer 2013). Busch et al. (2018) highlight that some local policy-makers also use TMN membership as a means to mobilize other urban colleagues for climate policies, an effect that can also be seen as a rather indirect effect of a TMN.

Nevertheless, other scholars are more cautious concerning TMNs' local impacts. They highlight that TMNs have only limited impact on the actions taken by their member cities, especially in cities of the Global South (Barbi and Valente De Macedo 2019; Gore 2019; Stehle et al. 2019). Despite confirming that TMNs indeed have some influence on urban organizational and policy changes, they highlight that a membership in a TMN is not enough for enhancing local climate policies. Rather, this needs to be supported by a change in power relations between cities and other authorities (Barbi and Valente De Macedo 2019; Gore 2019), or strong coalitions of local actors and a change in the domestic policy context (Stehle et al. 2019). Others highlight different aspects to show that TMNs' impact might not be as transformational as hoped for (e.g. Labaeye and Sauer 2013). Focusing especially on C40 as a particular network Heikkinen et al. (2019) find that most measures proposed by C40 are supporting the status quo in cities, while only few are transformational. This adds up on Davidson and Gleeson (2015), who conclude that C40 only promotes solutions embedded in neoliberal urbanism, not allowing for any normative changes amongst their members – a

finding that is reconfirmed by the present study (see especially chapter 7.3.2). Taking the exchange of best-practices as starting point, also Nagorny-Koring (2019) raises doubts that this can enhance transformative change. This is confirmed by Haupt et al. (2020), who find that cities do indeed exchange different kinds of knowledge within networks, but that this cannot be seen as the in-depth learning that would be needed for transformative changes. However, it is important to keep in mind that TMNs are a heterogenous phenomenon, having different purposes, different membership compositions and accordingly different effects (Bach Nielsen and Papin 2020; Bansard et al. 2017; Haupt and Coppola 2019; Kern 2019), and that some might not even want to be transformative (Davidson and Gleeson 2015). Despite these criticisms and calls to caution concerning TMNs' transformative potential, scholarship agrees that city networks indeed enhance local capacities for addressing climate change (Busch et al. 2018; Haupt et al. 2020; C. A. Johnson et al. 2015a; C. A. Johnson 2018; Van der Heijden 2019).

Related to the question of how city networks influence their members, is the question of why cities join networks in the first place (Kern and Bulkeley 2009). Haupt et al. (2020), exploring urban policymakers' intentions in joining city networks, find that gaining knowledge and learning about best practices are the most important reasons for network membership. Next to putting a cities' work in a broader context and gaining recognition at and from other political levels, obtaining knowledge on climate policies, understood as best practices, is the most important reason for joining a network (Haupt et al. 2020: 150f). The rationale behind this is that cities want to draw conclusions from the experiences others have made to create their own 'optimal' solution to the problem (Zevenbergen et al. 2016). However, the practice of presenting 'best practices' is no apolitical but rather a highly powerful one, as Nagorny-Koring (2019) highlights. She describes how the dissemination of best practices has an agenda-setting function, rendering some practices, authorities and knowledges (those presented as 'best') dominant, while they downplay others (Nagorny-Koring 2019: 52f). By providing a platform for the exchange of best practices (Bouteligier 2013; Haupt et al. 2020) and by fulfilling their function as advisors (Busch 2015), TMNs are in the powerful position to decide which examples are good examples and could therefore serve as a blueprint for those seeking advice on what to implement locally (see discussion in chapter 7.3). This agenda-setting function of TMNs is one which does not only play a role 'internally', by influencing their members, but also 'externally'. The next section treats this and other 'external' aspects of city networks' engagement with climate change.

2.2.2 External aspects of city networks' climate governance

Scholars agree that TMNs have already been very successful in what concerns their 'external' effects. These external aspects comprise advocacy, agenda setting, innovation and active participation in global decision-making processes. Because of this broad variety of policy effects, TMNs' involvement in global climate governance was even expected to be a possibility to overcome gridlocks produced by traditional, state-centered policy-making (Bäckstrand 2008; Bulkeley and Betsill 2005; Pattberg and Stripple 2008).

One of the most important aspects of city networks is that they represent their members at the international level and thus fulfill an 'advocacy' function for their members' interests and aspirations (Bouteligier 2013; Busch 2015; Castán Broto 2017; Corfee-Morlot et al. 2009; T. Hickmann 2016b; C. A. Johnson 2018; Kern and Bulkeley 2009). These 'city diplomacy' (Acuto and Rayner 2016) aspirations have been in so far successful as cities have increased their leverage and have become politically empowered at the international level (Bouteligier 2014). The success goes so far that cities are nowadays recognized as central actors in the global climate governance regime (Gordon and Acuto 2015; Gordon 2019; Toly 2016). Through their 'network power' TMNs make cities powerful actors at the international level (C. A. Johnson 2018).

TMNs' advocacy has led to an inclusion of cities and their networks as active participants in the official UNFCCC climate governance processes (Gordon and Acuto 2015; Kern and Bulkeley 2009). In this regard, especially the C40 network is highlighted as an exemplary network with particular importance in establishing city networks as leading actors in global climate governance (Acuto 2013a; Bouteligier 2013; Gordon 2013; Lee and van de Meene 2012). However, there is some disagreement amongst scholars if city networks' involvement in UNFCCC processes is necessary and promising. Some argue that it is indispensable to build and expand linkages with the traditional global regime, and particularly the UNFCCC (Betsill et al. 2015; Chan et al. 2015; K. e. a. Fischer 2015). Others, however, see city networks' potential to establish alternative systems of governance beyond the traditional UNFCCC-centered climate governance regime, potentially even delegitimizing the persisting climate regime (C. A. Johnson 2018; Widerberg and Pattberg 2015). So far, scholars find the UNFCCC-centered regime to remain central (T. Hickmann 2016b), despite highlighting that its character has become more hybrid through the intensified interplay between state and non-state actors (Bäckstrand et al. 2017). This hybridization of the UNFCCC governance processes, amongst others through the inclusion of TMNs, also has its downsides. Therefore, Betsill et al. (2015), as well as Chan et al. (2015) highlight the need to better coordinate the

different actors within the UNFCCC-centered governance regime to be more productive and efficient.

Focusing on the question of how city networks have been successful in establishing cities as central actors, scholars find different answers. One of those answers is that (particular) city networks have been successful in obtaining financial means from third parties, therefore advancing their possibilities as well as their political weight (T. Hickmann 2016b; C. A. Johnson 2018). Accordingly, partnerships with business and private actors, such as multinational companies (MNCs) or foundations play an increasingly decisive role for city networks engagement in climate governance (Bach Nielsen and Papin 2020; Bouteligier 2015; Bulkeley 2010). Many scholars are critical of this aspect as it shows a tendency towards increased hegemony of neo-liberalism and market-based climate governance at the expense of other approaches (Bäckstrand 2008; Davidson and Gleeson 2015; Van der Heijden 2018) – a tendency that is confirmed by the present study for the case of C40's way of knowing climate change (see for example chapter 6.1.2.3).

A second explanation for TMNs' successful advocacy is that they are perceived as norm entrepreneurs in climate governance (C. A. Johnson 2018; Toly 2008). Noah Toly goes so far as to assign a key role to cities and TMNs for realizing the Paris Agreement since they "have kept climate on the agenda even when nations have neglected the issues" (Toly 2016: 2). Johnson rather sees networks' norm entrepreneurship in providing a forum for the diffusion and reinforcement of norms through organizing conferences and workshops (C. A. Johnson 2018: 32).

Another reason for cities' and TMNs' successful establishment as central climate governance actors is attributed to their active search for accountability (Bulkeley 2010; Gordon and Acuto 2015; Gordon 2016b). Accountability is produced by framing climate change as an inherently *urban* problem (Bulkeley 2010). Part of climate change as an urban problem is to identify cities as key source of climate change (Bulkeley 2013). One component of the phenomenon is what Aust (2015: 262) calls the "70% mantra" – suggesting that cities and urban areas are responsible for 70% or more of global total greenhouse gas emissions. By highlighting this 70% claim cities and urban actors actively seek to be held accountable for climate policies without any compulsion or obligation (Gordon 2016b). Gordon highlights that the claim to accountability by highlighting themselves as culprits is used – amongst others – in order to secure recognition from external audiences (Gordon 2016b: 91). However, the framing of climate change as an urban problem also encompasses cities as main victims (Bulkeley 2013; Coaffee and Lee 2016) and as reliable problem-solvers (Barber 2013; C. A. Johnson 2018). Jeroen Van der Heijden (2019) finds that this narrative of 'cities as the saviours of the planet' as he calls it (p. 2) is one that has generally become more and more predominant both

amongst scholars as well as city practitioners. However, at the same time he reveals that there is a relatively big gap between rhetoric, especially focusing on frontrunner cities, and what average cities and citizens can and want to implement (Van der Heijden 2019: 3). Nevertheless, this active search for the accountability of cities by TMNs is seen as decisive for city networks' external recognition (Gordon 2016b). In accordance with these assumptions, both C40 and Climate Alliance (however, to different degrees) do know climate change as an 'urban problem' (see chapters 6.1.1.2 and 7.1.1).

A fourth reason for the successful establishment of TMNs at the international level is their innovative and experimental potential. Accordingly, scholars identify local climate initiatives as 'governance experiments', combining for example niche and grassroots innovations with urban living labs (Bulkeley and Castán Broto 2013; Castán Broto 2017; Gordon 2013; Hoffmann 2011). In such experimental approaches, bottom-up initiatives shift and blur authorities and structures and maybe even replace regional and national policies (Bulkeley and Castán Broto 2013; Fuhr et al. 2018). TMNs themselves are found to provide novel governance instruments (Papin 2020). The hope associated with governance innovations and experimentation is that resulting experiences can be scaled to other levels of governance (Fuhr et al. 2018; Gordon 2013; Sassen 2015). However, scholars highlight that it still remains unclear to which degree cities can implement such experimental policies (C. A. Johnson et al. 2015b). Further, it is argued that a better understanding of which scaling processes are most promising and why is much needed (Van der Heijden 2017, 2018, 2019). Nevertheless, such innovations and experiments play a role in how TMNs are perceived from a global perspective.

To summarize, scholars identify different reasons for why and how TMNs have contributed to establish cities and city networks as decisive actors in global climate governance. This evokes the general question on the consequences of TMNs' rise for the global governance of climate change.

One of the consequences is that TMNs are adding another layer to the global climate change governance system (Pattberg and Stripple 2008). Therefore, some scholars identify cities' and TMNs' international establishment as a symptom of the broader crisis of multilateralism and as emblematic for the shift from government to governance where multiple layers and actors play a role (Acuto and Rayner 2016; Bäckstrand 2008). The former state-centered space is challenged by TMNs entering this space and claiming they must participate. By doing so, they are found to challenge norms about who governs and how (Acuto 2013b; Gordon 2013). By now, scholarship agrees that this challenge has been successful and that the governance of climate change has developed from an intergovernmental system to one in which many different actors play a central role. This governance system is described in different terms and concepts, for example as a 'landscape' comprising different actors (Betsill

et al. 2015), as a 'multilevel' system (Andonova et al. 2009; Betsill and Bulkeley 2006; Bulkeley and Betsill 2005; Gordon 2013), or as 'polycentric' (Jordan et al. 2018; Ostrom 2010). All these concepts have in common that they highlight the presence and influence of diverse actors in the global climate governance system, TMNs being one particular kind of them (Hoffmann 2013). Several studies have confirmed the collaborative character of the climate governance system as they show that TMNs are not able to replace more traditional actors such as states in the global governance of climate change (Bansard et al. 2017). Rather, city networks need to coordinate and cooperate with other actors, such as state or regional institutions, because they lack the capacity to realize change on their own (Barbi and Valente De Macedo 2019; Fuhr et al. 2018; T. Hickmann 2016b; Stehle et al. 2019). However, for example Johnson also sees this dependency and the resulting demand and need for assistance as a considerable form of power (C. A. Johnson 2018: 15).

Despite being dependent on other actors, TMNs' rise to the global sphere has further consequences for the general governance of climate change. Accordingly, city networks have generated an unprecedent 'system of governance from the middle' (Román 2010). One of the features of this governance from the middle is that it combines institutional and market-based elements imported from other fields (Bulkeley and Betsill 2013; Davidson and Gleeson 2015; Haupt and Coppola 2019; Román 2010). This combination is generally seen as one of the most obvious consequences TMNs have for the global governance of climate change: namely, that they blur the separation between public and private (Acuto 2013b; Acuto and Rayner 2016; Andonova et al. 2009; Bach Nielsen and Papin 2020; Bouteligier 2013; Pattberg and Stripple 2008). On the one hand, this is seen as a chance to enhance innovation and therefore to push climate protection forward. On the other, some scholars highlight that it is mainly market-mechanisms that are fostered, in turn reinforcing neoliberal concepts and downplaying other understandings and approaches (Bäckstrand 2008: 78; see also Van der Heijden 2018).

Summarizing, those parts of the literature focusing on the 'external' aspects of TMNs investigate especially the relationship between networks and other actors outside their network structure. The main conclusion is that TMNs have been successful in establishing themselves as indispensable actors in the governance of climate change. As such, they are actively involved in UNFCCC processes and therefore add another layer to the governance system which is coined by multi-level and polycentric structures. Further, it is generally assumed that one of the consequences of TMNs' rise is that the separation between public and private climate governance approaches gets more and more blurred.

Bringing together the results from the literature focusing on internal aspects with that focusing on external aspects, it becomes clear that city networks are central actors for the

governance of climate change. They both influence, internally, their members and their ways of thinking about and acting toward climate change (at least to a certain degree), and, externally, the global climate governance architecture. They are found to positively influence climate governance on the urban level (Rashidi and Patt 2018) and are even seen "as the primary vehicle through which cities participate in the global response to climate change" (Gordon and Johnson 2018: 35). TMNs enable cities to raise their voices internationally and therefore contribute to the establishment of urban actors on the global level (Bouteligier 2013; Busch 2015; C. A. Johnson 2018; Toly 2008).

For both of those aspects, it is decisive how the networks themselves are knowing climate change. However, the specific aspect of knowledge, its production and dissemination, as well as its influence, is one that has been broadly neglected in the city network literature so far.

2.3 Focusing on city networks' climate change knowledge

As the literature has shown, TMNs fulfill various different functions (Andonova et al. 2009; Bouteligier 2013; Busch 2015), one of which is to serve as platforms for the exchange of norms, ideas and knowledge (Bouteligier 2013; Busch et al. 2018; Feldman 2012; Haupt et al. 2020; C. A. Johnson 2018). Shaping and diffusing knowledge thus lies at the heart of TMNs' activities and one reason why cities join networks is to get information on how to govern climate change locally (see Bulkeley et al. 2003; Haupt et al. 2018, 2020; Romero-Lankao et al. 2018). Accordingly, transnational municipal networks are important for cities' engagement with climate change because they offer the possibility to gain knowledge and to learn (Andonova et al. 2009; Bulkeley et al. 2003; James and Verrest 2015) – serving as both a platform for knowledge exchange as well as a consultancy (Busch 2015). In other words, considering the complexity of climate change, cities join networks in order to get knowledge about how to act on climate change and which policies to implement locally, as well as to establish relations with like-minded municipalities. The exchange and production of knowledge hence constitutes a main 'function' of a city network (Bulkeley et al. 2003; Busch 2015).

This knowledge, in turn, is shaped by the way how TMNs themselves know climate change – how they define the problem, which actors they consult to collect information, which solutions they consider worthwhile, etc. However, not only the explicit functions of knowledge provision and enabling knowledge exchange are shaped by how TMNs know climate change. All of the functions that TMNs fulfill are highly influenced by underlying assumptions of what trustworthy knowledge is, how it is to be generated, and how one can provide knowledge. This is an aspect that partially shines through in some of the literature dealing with city networks' climate governance, for example when referring to the particular choice of best-practices (Nagorny-Koring 2019), or when doubting the transformational potential of TMNs because of their

neoliberal orientation (Davidson and Gleeson 2015; Van der Heijden 2018). At the same time, the aspects of learning and knowledge remain amongst the most under-examined concerning climate city networks (Haupt et al. 2018; Süßbauer 2016). Thus far, the focus on how city networks' climate change knowledge looks like is missing.

This is all the more surprising, when keeping in mind that especially in the context of climate change "how one knows shapes how one governs" (Hulme 2015: 558; see also Uhrqvist and Lövbrand 2014). Networks' knowledge about climate change is hence fundamentally connected to their suggested ways of acting upon it. In turn, different city networks' ways of knowing climate change influence not only what they pass on to their members, but also what they claim in the names of thousands of cities and millions of city dwellers they represent on a global level (Acuto 2013a; C. A. Johnson 2018). Despite highlighting that TMNs are a very heterogenous phenomenon and deploring the often missing differentiation (Bach Nielsen and Papin 2020; Bansard et al. 2017; Haupt and Coppola 2019), TMN scholarship thus far has not considered different ways of knowing as one of the possible differences between city networks. However, when considering that how we know has a decisive influence on how we act, this is an aspect we need to focus on. To understand how knowing and acting are intertwined, I refer to the concept of co-production, brought forward in STS scholarship (Jasanoff 2004). In the following chapter, I outline how I understand the concept 'knowing' throughout this thesis, how climate change is being predominantly known, and how this is connected to co-production.

3 Conceptual background: Knowing, knowledge and its co-production

In this chapter, I firstly present how I conceptualize 'knowing' in the framework of this thesis, explain what it means to know climate change, and highlight how climate change has been predominantly known. Focusing on the difference between knowing and knowledge, I draw on premises of STS scholarship in a next step, to better understand the notion of 'knowledge'. Throughout this process, I distill two main premises that are informing my understanding of knowledge: that it is always a social product, and that it is no ready-made product but always tied to its socio-material environment. In a final step, I think further about this tie, and present how knowledge is always co-produced. Finally, I explain how I am making use of the concept of 'co-production' throughout this thesis. These conceptualizations are important because they serve as a conceptual baseline for my research question of how city networks know climate change.

3.1 Knowing climate change

The concept of 'knowing' is used in many different ways – as a method, an empirical object or a particular ontological practice (see e.g. Allan 2018; Schnegg 2019). As such, 'knowing' is differently defined than 'knowledge'. Knowledge in that sense is seen as a product, as a 'resource', whereas knowing is seen as a complex, collective socio-material activity, a process, a practice (Gherardi and Miele 2018; Kuhn 2018). In my understanding, knowledge is resulting from the subjective process of getting to know and knowing something. But how exactly do I understand 'knowing' for my purpose and what does it mean to 'know' climate change?

Law (2017) argues "that knowing and its methods are materially complex and performative webs of practice that imply particular arrays of subjects, objects, expressions or representations, imaginaries, metaphysical assumptions, normativities, and institutions" (p. 47). Therefore, 'knowing' is seen as being a situated activity. 'Situated' here can refer to being situated in social situations or being situated in materiality, thus in bodies, technologies or instruments (Gherardi and Miele 2018). Others have pointed to similar aspects, arguing that knowing encompasses basic epistemological ideas, strategies for acquiring knowledge, requirements for explaining and predicting, standards for inquiry (Hawkesworth 2015), but also audiences, media types, and modes of communication (Berkes 2009). Further, also agents, practices and institutions are part of the process of knowing something (Cornell et al. 2013: 61). Summarizing all these aspects of knowing, Gherardi and Miele (2018) thus see knowing as a collective achievement, as an activity that can be embodied and embedded in practices and which arises from situated practices. The concept of 'knowing' can thus encompass a broad variety of both activities, as well as things.

To grasp what it means to 'know' something for my purposes, I draw on the specific literature that sees knowing as a practice producing particular narratives, similar to 'telling a story' about something (see Forsyth 2020; Hajer 1995). However, this 'telling' can take different forms and does not have to be a spoken word. Forsyth (2020) highlights that different political ecologists and STS scholars have referred to simplified summaries of cause-effect relationships as 'narratives' or 'storylines'. These narratives or storylines are knowledge claims reflecting interests, values and actors (Forsyth 2020: 1045). In that sense, the question of how city networks know climate change, can be seen as the question asking for the respective climate change narrative TMNs are relying on and reproducing through generating and disseminating knowledge.

But in how far can 'knowing' be seen as the story that is told about something? Some scholars have focused on this 'narrativity' of knowledge and knowing (Daniels and Endfield 2009; Marschütz et al. 2020). Daniels and Endfield (2009: 215) respectively argue that different narratives of climate change can be seen as different forms of knowledge. Marschütz et al. (2020) define narratives as cognitive structures (p. 3). As such, narratives depend on the particular times and places in which they are being produced. This reflects one of the central assumptions of STS but also other scholars' concerned with knowledge: that knowledge is always a socially coined product with cannot be separated from society, location, situation etc. (see Berger and Luckmann 1997 [1966]; Jasanoff and Long Martello 2004a; Jasanoff 2004; Stehr and Meja 2005). Accordingly, also knowing is always locally embedded and shaped in so far as it reflects local practices and knowledge-making traditions (see e.g. Hulme 2010: 560).

In how far are narratives, knowing and knowledge related? As Daniels and Endfield (2009) put it, a narrative can be a specific form of knowledge. Or with my own words, a narrative summarizes the way how something is being known. As such, a way of knowing can be visualized by the respective story that is told about the specific epistemic object – because this story can summarize very concisely all different aspects of knowing: the particular arrays of respective subjects and objects, expressions or representations, imaginaries involved, metaphysical assumptions, but also normativities, and institutions.

In turn, the epistemic object under construction – be it 'war', 'piracy', or 'climate change' – is produced and shaped by different sites, practices of knowing, as well as socially interacting actors in the respective societal system (e.g. Bueger 2015: 7; F. Fischer 2019: 137). Accordingly, the way how something is known is shaped by the prevalent structures of the respective societal system. Brand (2010) therefore highlights that knowing – the societal relationship with something, in his example nature, is always highly power-shaped:

> Therefore, the concept of environmental knowledge is used in a broader sense and the distinction of environmental policy knowledge is important because it sheds light on the fact that societal relationships with nature and not only the policy knowledge to deal with its problems are highly power-shaped, i.e. gendered, class-structured, racialized or unevenly distributed regionally and internationally (Brand 2010: 140).

This highlights that knowing is no one-way process. Accordingly, the practices of knowing shape respective narratives, or 'stories' as I want to call them. But the stories themselves also influence how something is being further known – and are therefore powerful in two directions. This happens through the story opening up and limiting how knowledge is generated (Marschütz et al. 2020: 3). This is what Law (2017: 47) refers to when speaking of the 'normativities' and 'imaginaries' of knowing – the way how something is being known determines how it is normatively evaluated, what is seen as imaginable or not, and finally how the epistemic object is governed. This is important to outline because it stresses the importance of knowing. Dependent on how something is being known, people act upon the respective object of knowing – or, do not act at all (see e.g. Allan 2017). Therefore, Gherardi and Miele (2018) highlight the 'mutual constitution' of knowing and practicing, which interact and reproduce each other. Allan (2018) reviewed different contributions to IR literature and shows that the productive power of knowing, i.e. the constitution of epistemic objects, is getting more and more attention in IR scholarship, suggesting a shift of the traditional focus from epistemic subjects to epistemic objects. Such object-centered approaches consider knowledge as being contingent on discourses and practices constituting the world (Allan 2018: 856f). This constituting effect of knowing is highlighted by several scholars from different disciplines: Daniels and Endfield (2009) found that climate change narratives – thus, in my understanding, the way how climate change is being known – powerfully shape "imaginative worlds in the form of past scenarios as well as future prospects" (p. 215). This strong interdependence between knowing and acting lead Felt et al. (2017) to the argument that "knowledge and worlds get made together" (p. 19). Despite depending on prevalent metaphysical assumptions (shaped by the respective context), knowing itself is so powerful that it also influences the reality it is reflecting, i.e. by socially constituting problems:

> The social constitution of problems and the process of dealing with them depend on different forms of knowledge and they take place in a political, economic and cultural context (Brand 2010: 137).

Applied to the case of climate change, Nicholas Onuf therefore argues: "What we do about climate change obviously depends on the stories we tell. As these stories change, the world changes too" (Onuf 2007: xv). In my understanding, these 'stories about climate change' are deeply characterized by different ways of knowing climate change.

As already discussed, knowing always involves interpretive constructions. These interpretations are created by socially interacting actors in a societal system (F. Fischer 2019: 137). Such actors shaping how an issue is known – in their role as the subjects of knowing – are thus crucial (see Allan 2017).

Concerning the epistemic object climate change and its governance, these subjects are various actors ranging from different scientific actors (Beck et al. 2014; Beck 2015; Livingston et al. 2018), to particular individuals (Boasson and Huitema 2017; Boasson 2018) or urban actors (C. A. Johnson 2018). However, the main subjects who have shaped how climate change is known for a long time were (geophysical) scientists, as e.g. Shannon O'Lear summarizes (for an example of how scientific knowledge is priviledged not only in relation to climate change see Yanow 2004):

> Early contributions to climate science shaped the current, scientific understanding of climate change. Some of the key points on the timeline include the identification by early Greeks of climate zones by latitude, John Tyndall's experiments with absorptive properties of atmospheric gasses in 1859, Svante Arrhenius's calculations in the 1890s suggesting that an increase in atmospheric CO_2 could lead to increased average surface air temperature, Wladimir Köppen's climate classification system based on vegetation and precipitation patterns, and Charles David Keeling's measurements in the 1950s at the Mauna Loa Observatory indicating increasing atmospheric CO_2 (O'Lear 2016: 2f).

The influential role of scientists and scientific knowledge in knowing climate change is explained by scientists' decisive role in placing climate change on the global agenda at first (Allan 2017; Jasanoff 2015a). This pioneering role has been reinforced by the implementation and rising importance of the scientific body of the Intergovernmental Panel on Climate Change (IPCC) (see Livingston et al. 2018; Lövbrand 2014: 176ff; Miller 2004; Stehr and Grundmann 2012: 37). As a result, the dominant way of how climate change is known is coined by scientific knowledge, understood as knowledge produced by natural and technical sciences (see e.g. Beck et al. 2017; Lövbrand et al. 2015). Scientific institutions are the most influential institutions in terms of knowing climate change and producing ever more scientific knowledge is seen as the solution to deal with climate change (see Hulme 2015; O'Lear 2016; Sarewitz 2011). Accordingly, scientific representations of climate change became prevalent and influenced how the 'world' of climate change governance has developed (see Allan 2017; Hulme 2015; O'Lear 2016; Turnhout et al. 2012).

However, science is by far not the only way of knowing climate change. It might not even be the best way to know climate change, as Eva Lövbrand highlights: "Since knowledge is never unconditioned, there can be no Archimedean perspective that trumps all others" (Lövbrand 2014: 169; see also: Sarewitz 2011). This means that no way of knowing can be

perceived as being the 'best' way of knowing. Nevertheless, one way of knowing can become (globally) dominant and therefore will be challenged and questioned less. Often, this happens when knowledge is declared as 'expert' knowledge which tends to be accepted as authoritative and to be left unchallenged (Forsyth 2020). The role of science in knowing climate change is an example for how one particular way of knowing has become hegemonic. Assuming that climate change is a 'wicked' (or 'hybrid' (e.g. Allan 2017)) problem, involving various ideational and physical components, it cannot be understood from only one perspective and solved with one solution (Hulme 2009; Wesselink et al. 2013). Knowing it only scientifically is thus highly problematic. This is, because climate change is inherently entangled with political, ethical questions that cannot be decided by referring to science alone (see also e.g. Stehr and Grundmann 2012: 39):

> (…) while climate scientists can and do tell us about the nature of the problem, they cannot tell us about what kind of a problem it is – i.e. what features are important and what we should do. In fact, deciding what kind of problem climate change presents is an inherently political and fraught process (Hoffmann 2013: 3).

Despite the need of a political engagement with climate change, science has dominated the way how we think about climate change. This, in turn, influences what is considered an acceptable response to climate change (Hoffmann 2013; Mahony and Hulme 2018; Okereke et al. 2009). Accordingly, some argue that the predominance of scientific ways of knowing has led to a situation in which engagement with the fundamental moral, ethical, social, or economic foundations of climate change is avoided (Hulme 2020; Swyngedouw 2013), and in which results are dissociated from the activities producing them (Hoffmann 2013; Jasanoff 2015a). This hegemony of one particular way of knowing has consequences, such as the increasing dominance of managerial and technocratic approaches in environmental policies which define nature as something external and manageable, understandable in terms of scientific data and technology (Bäckstrand and Lövbrand 2006; Hajer 1995; Hulme 2015; Litfin 1998; Wesselink et al. 2013). Allan (2017) shows how geophysical determinist understandings of climate have contributed to the understanding of the climate as an understandable, predictable and controllable system which can be manipulated and managed (p. 145ff). Eva Lövbrand et al. (2015) highlight the interconnection of the scientific view of environmental problems and the managerial approach towards them:

> Rooted in a quantitative and positivist research paradigm, the dominant story continues to reproduce nature as an object external to society that is possible to know, monitor and manage from afar (Lövbrand et al. 2015: 216)

Similarly, Ulrich Brand (2010) finds that "elements of and knowledge about nature [are transformed] into marketable products" (p. 137) which in turn fires the fact that "societal

relationships with nature are produced and mediated through techno-sciences" (p. 140). This kind of techno-scientific knowing has become the hegemonic form of knowing in climate governance. And this hegemony, again, has further consequences:

Chris Methmann, for example, argues that 'scientism', thus the scientific way of knowing climate change, builds a part of how 'climate protection' has become an 'empty signifier' (Methmann 2010). This notion refers to the fact that despite overwhelming international agreement that climate protection is needed, not enough, or very controversial, measures to counter climate change are undertaken (see also Sarewitz 2011). Rather, by either arguing that more knowledge is needed, contesting the existing knowledge, or acknowledging the production of knowledge itself as a climate protection measure, actual climate policy changes are obstructed (Methmann 2010).

But also the view that science is neither the only, nor the best way of knowing climate change has its flaws. When arguing for more epistemic plurality in terms of knowing climate change, one is confronted with the question of how far this epistemic plurality reaches and should go. The problem underlying this question is two-fold: firstly, when highlighting that climate change can not only be known from one (scientific) perspective, but also from other (non-scientific) angles, one easily runs the risk of being called out as a 'climate denier', as for example Mike Hulme outlines based on his own experiences (Hulme 2020: 2f), or at least as someone who is fueling climate change denying arguments (F. Fischer 2019: 135f). Secondly, one is confronted with ways of knowing climate change that are brought forward by those people who are actually denying that climate change is even happening, and/or that it is related to human activities. Are those (sometimes even explicitly called 'alternative' (on that discussion see e.g. McIntyre 2018) ways of knowing climate change ways that should still be considered? When researching different ways of knowing climate change, it is necessary to consider these questions, and in my point of view, also to clearly take a position (see also Hulme 2009: xxxiii).

Concerning the first question and the struggle of epistemic plurality being used as an argument denying anthropogenic climate change, it is necessary to locate oneself and to precisely define where this 'plurality' has its boundaries. Arguing that climate change is a wicked problem that cannot be understood, nor solved based on scientific knowledge only, does not mean that scientific ways of knowing climate change are irrelevant – on the contrary. They are necessary and important. The argument rather is that climate change is so complex and involves so many other issues than purely scientific ones, such as the already mentioned moral, ethical and political questions, that it is simply not far-reaching enough to only consider the scientific side of climate change (see Hulme 2020: 2f). Further, Allan (2017), for example, shows that also amongst the sciences there is an imbalance concerning the contribution to how climate change is being known. According to his findings, the geophysical sciences have

contributed much stronger to the predominant understanding of 'climate', whereas other sciences, such as ecology, biology, or complexity sciences have only started to be heard. Allan argues that the inclusion of these sciences and their findings could have altered the understanding of climate and climate change towards including issues such as the fragility of ecosystems, or the importance of biodiversity loss (Allan 2017). Arguing for more epistemic plurality also means to point out such imbalances and to argue for a re-balancing of epistemic power.

Concerning the second issue, in my understanding and for the realization of this study, alternative ways of knowing climate change are acceptable and important to consider to the point that they agree that climate(s) are changing, and that this is happening exceptionally fast since the age of industrialization and can therefore be clearly related to a large extent to human activities. Insofar, the argument for greater epistemic plurality has a clear line: when someone does not agree that natural environments are changing, and that this is happening mainly because of different human activities, this is no way of knowing that needs to be considered. As F. Fischer (2019) highlights, such climate change denying knowledge structures can very well be analyzed as "artifacts of a particular societal system and its culture" (p. 137). However, this does not mean that they are accepted as equally valid knowledge structures contributing to the understanding of the phenomenon we commonly call 'climate change' (see Hulme 2009). The line here is clearly to draw as different forms of knowing – independently of their method of inquiry, their normative evaluation, their expressions etc. – to an overwhelming majority agree on the fact that our 'natural' environments are changing, and that these changes can be related to human activities (FIPLC 2000; IPCC 2014; on that discussion see also ch. 9 in Hulme 2020). There are some scholars, such as Daniel Sarewitz, who would reject even this argument, claiming that a broad acceptance of the consensus on anthropogenic climate change is not necessarily needed in order to take decisive political action (see similarly also Walsh 2019). According to Sarewitz' argument, the focus on scientific knowledge does not lead to progress, but rather causes the contrary, namely a gridlocked situation in which diametrically opposed positions cannot come to a common, acceptable, and effective solution (Sarewitz 2011: 478f). He rather concludes that scientific knowledge should be set aside, in favor of a focus on political 'possibilities for the future':

> Progress waits not on better science, nor on better communication of science to those who are politically alienated from mainstream climate science, but on new approaches that focus first on the articulation of an inclusive and compelling politics built on rich array of possibilities for the future (Sarewitz 2011: 481)

In contrast to Sarewitz, I am convinced that it is important to combine both aspects of knowing climate change: discuss and highlight different policy alternatives and perspectives

on the problem, while at the same time clearly highlighting that there is very broad agreement – overarching over different knowledge systems – that we actually do have a serious problem (or several problems) that we are responsible of, and that we need to find constantly improving and well-discussed ways of acting upon this phenomenon.

What these considerations definitely show is that the way how an issue is known is highly influential and controversial. Therefore, it is of crucial importance to investigate the different aspects of knowing, i.e. the influential subjects, objects, imaginaries, metaphysical assumptions, and resulting normativities. These aspects are especially important to examine when it comes to climate change. This is the case because so far, investigations of these aspects have been rather neglected, Lövbrand et al. (2015) highlight:

> (…) the social sciences need to do more than ask which 'products and services' societal stakeholders need in the transition to sustainability (Future Earth, 2014). A more pressing analytical task lies in exposing and challenging the underlying cultural and social assumptions that inform how we collectively make sense of and respond to a changing environment (Lövbrand et al. 2015: 212).

This quote summarizes quite well what one aims at when investigating how something – in this case climate change – is being known: at outlining underlying assumptions, normativities, imaginaries etc. that shape both knowledge and action.

Accepting these elaborations, some might still wonder what the difference between 'knowing' and 'knowledge' is. For me, knowledge is the result of the subjective process of getting to know and knowing something. As such, knowledge can take very different forms, can be explicit or tacit, can be embodied or objectified. In the following paragraph, I outline the main characteristics of knowledge as I understand it.

3.2 Knowledge – a socially coined product

To grasp knowledge, I draw on premises from Science and Technology Studies: that knowledge – either characterized as scientific or not – is a *sociological and culturally coined product* which *cannot be seen and understood as detached* from society, location, situation etc. (see for example Berger and Luckmann 1997 [1966]; Jasanoff and Long Martello 2004a; Jasanoff 2004; Stehr and Meja 2005). As I discussed before, this product is the result of the process of knowing something.

The specific interdisciplinary field of Science and Technology Studies started to develop in the mid-1960s driven by the aim to better understand the role and development of science in society, approaching science as a social system. It partly followed up on the sociology of science practiced by Robert K. Merton. However, STS researchers criticized his still positivistic

view on science – as formally distinct from culture and society – and aimed at establishing a radical view of scientific knowledge as socially determined and embedded (see Edge 1995: 7). Based on the observation that scientific knowledge is often seen as a mere accumulation of neutral facts, STS scholars argue that the contrary is the case – that there is no knowledge which is neutral and not characterized by its social embedding (Jasanoff 2004). Therefore, STS's aim is to shed light on the very processes producing knowledge (Allan 2018).

To exemplify this social embedding of every knowledge STS scholars such as Jasanoff and Long Martello (2004c) take the often prevailing dichotomy between global ('scientific') and local knowledge as a starting point to outline how actually all knowledge should be seen as a form of 'local' knowledge. Global knowledge in this regard typifies the knowledge that is produced to serve a global audience, thus being constituted of "universally acceptable facts, ideas, and messages about phenomena such as 'species protection', [or] 'biosafety' (…)" (Jasanoff and Long Martello 2004a: 7). According to STS scholars, such 'global' knowledge arises because global actors need a reliable knowledge base to substantiate their administrative and political authority (Jasanoff and Long Martello 2004a: 6). Jasanoff and Long Martello mention as such global actors for example modern states in the 20th century, colonizing states in the 19th century, but also international institutions such as the United Nations with all its bodies (Jasanoff and Long Martello 2004a). The notion of global knowledge therefore describes the ways of knowing that have become globally dominant and accepted as universal knowledge. As scientific knowledge has achieved broad acceptance as a universally understandable kind of knowledge, codified scientific and technical knowledge is often presented as being global knowledge (Jasanoff 2004). Mike Hulme, calling global knowledge 'globalised knowledge' defines this type of knowledge as "knowledge which erases geographical and cultural difference and in which scale collapses to the global" (Hulme 2010: 559).

STS scholars argue that large-scale sociotechnical systems and respective knowledge infrastructures have been established over long time periods to make things (for example 'the atmosphere') knowable on a global scale. Parts of such global knowledge infrastructures are particular practices of knowing such as observation technologies, remote sensing, data standards, global institutions or computer models (Beck et al. 2017: 1062; Mahony and Hulme 2018; Rothe and Shim 2018). Clark A. Miller, for example, highlights how the IPCC has contributed (amongst other things by relying on a scientific knowledge infrastructure) to establishing climate change as a *global* scientific issue which needs scientific answers, instead of knowing it for example as a social problem requiring *local* societal answers (Miller 2004).

Local knowledge on the contrary is referred to as a specific kind of 'situated' knowledge – which means that it is tied to specific contexts. These do not have to be geographical locations

but can also be particular groups of people, histories or institutions. Local knowledge is a collection of observations that have been generated, stored, applied and transferred according to a specific system of concepts, beliefs and perceptions that people of the particular groups share and hold (Jasanoff and Long Martello 2004a: 14; Sillitoe 2007: 3; Warburton and Martin 1999: 13; Yanow 2004). Local knowledge is often seen as incorporating "tacit, historical, cultural, and place-based knowledges" (Jasanoff and Long Martello 2004b: 338) – thus, it is rather based on experiences than on scientifically designed experiments. However, STS scholarship concludes that *all* knowledge – also scientific knowledge – is local knowledge in the sense of being *situated in a specific context*. Accordingly, scientific knowledge is situated in the specific field of science where it is produced, stored, applied and transferred according to scientific standards (Jasanoff and Long Martello 2004a: 16; Lövbrand and Öberg 2005).

The opposition of the two knowledge 'forms' – scientific and local – is used to highlight that the rather positivistic view of global knowledge, understood as scientific knowledge, is misapprehended. Accordingly, even scientific knowledge can never be 'neutrally' accommodated because every knowledge is a social product (Jasanoff 2004) which makes the contrast of scientific versus local knowledge an artificial one (Negev and Teschner 2013). Jens Lachmund (2004), for example, highlights that especially scientific knowledge – which is often proclaimed as universally applicable and understandable – is often connected to contexts that are chaotic and hardly understandable for non-scientists so that it only reaches a very condensed audience (Lachmund 2004; Lövbrand and Öberg 2005). Lahsen (2016) even goes further by arguing that scientific knowledge is not only situated but "a potential vector for hegemonic power" (p. 186) – hence, the contrary of being neutral. Summarizing, STS's main conclusion is that knowledge is always situated in a specific social environment. Therefore, Mahony and Hulme (2018) conclude that „knowledge, of whatever sort, can never arise independently of culture, from human ways of doing things" (p. 410) – on the contrary, knowledge is always tied to its social and material environment. Therefore, some speak of the 'stickiness' of knowledge (Glückler et al. 2017: 2). As knowledge, according to my understanding, is the result of the process of getting to know and knowing something, the same accounts for knowing: knowing, as well, is always situated in a specific context and has to be seen in its social and material environment.

What does that mean for my attempt to better understand knowledge (and knowing)? To answer this question, I distill the two main premises of STS that will inform my study of city networks' way of knowing:

Firstly, that **knowledge** (and knowing) – either declared as scientific or non-scientific **– is always a social product**;

and secondly, that **neither knowing, nor knowledge are ready-made products** that can easily be transferred from one actor/location/situation to another.

Rather, STS scholarship highlights that every type of knowledge, might it be identified as scientific, local, lay, indigenous etc. is always 'co-produced' with its socio-material and technical environments, and as such can never be seen separately from its co-production environment. The notion of 'co-production' is thus essential when engaging with knowing and knowledge from an STS point of view.

3.3 Knowledge and its co-production

In the literature, especially amongst those scholars dealing with climate politics, the notion of 'co-production' is used in several different ways – both as a descriptive, analytical concept, as well as a normative, desirable way of how to organize interactive knowledge production practices (Bremer and Meisch 2017). For my purposes, co-production will be used as an analytical concept. However, it is important to be aware of the other meanings of co-production and I will therefore also present them briefly.

Sheila Jasanoff, the STS scholar having established the concept of co-production in its *analytical* sense, describes co-production in the following way:

> Briefly stated, co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it. Knowledge and its material embodiments are at once products of social work and constitutive of forms of social life; society cannot function without knowledge any more than knowledge can exist without appropriate social supports. Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the social (Jasanoff 2004: 2f).

What this notion of co-production tells us is that knowing and knowledge, and the social (practices, norms, identities, institutions, etc.) can never be seen separately but that they are always ultimately interconnected. STS scholarship uses the term 'co-production' for two purposes: firstly, to describe how current scientific practices affect natural and social orders – arguing that the way we represent the world shapes understandings of how to live in it. And secondly, to challenge the assumption that science can be seen as a field which is separated from society (Bremer and Meisch 2017). This second use of co-production (Bremer and Meisch call it the 'interactional lens of co-production' 2017: 7f) is often perceivable in analyses of climate politics to highlight the processes by which climate science has emerged and claimed more and more authority in producing climate knowledge, and ultimately the epistemic object 'climate' (see Allan 2017; Miller 2004). Hence, 'co-production' is used as a tool to expose and challenge dominant discourses in climate governance and to highlight them not as given forces

but as hegemonic (co-)products of practices and discourses (Bremer and Meisch 2017: 7f; Forsyth 2020).

When used in a *normative* manner, co-production is defined as a desirable way of deliberative collaboration between different actors (Bremer and Meisch 2017). As such, it is seen as a normative concept of deliberative interaction between knowledge providers and users. It seems as if some institutionalized climate city networks share this idea of normative co-production lenses that there is an ideal form of policy making informed by and including scientific research. This becomes particularly obvious through the following examples: the network 'United Cities and Local Governments' (UCLG) states that "(…) climate change science is a critical new tool for the urban practitioner of the 21st century" or "[t]here needs to be a structural dialogue between the scientific community, policy makers and urban practitioners" (for both quotes see UCLG 2018). Another example for such idealized science-practice-cooperations is the IPCCcities conference with the revealing title '*the science we need for the cities we want: working together to implement the global research agenda on cities and climate change*' (see C40 et al. 2018b) – which clearly shows that the co-production between scientific actors and cities is seen as normatively favorable.

This shows that the two manners of use of the notion of 'co-production' are not to be confused: used in an analytical manner, the concept tries to disentangle the mutual making of knowledge and social orders. Used in a normative manner, it can be seen as the name of a specific form of policy making – often in a context of a specific knowledge production process (see Bremer and Meisch 2017; Lövbrand 2011; Prokopy et al. 2017).

Throughout this thesis, I want to make use of co-production as an *analytical* concept. Hence, by applying a critical descriptive co-production lens, I see co-production as a tool for both studying knowledge production practices and interpreting how these knowledge processes affect social, as well as technical and environmental orders (for example by establishing and reproducing specific sociotechnical imaginaries). In this thesis, I call this analytical process 'thinking about the provenances of knowledge' (see chapter 7.2). By doing so, I critically reflect upon how climate change is known by city networks and how this shapes understandings of how different actors (should) react to it.

I use the concept of co-production as a main theoretical baseline assuming that certain problem framings influence specific responses and that these framings themselves are no 'neutral' ones but highly socially coined processes (see Beck et al. 2017: 1066; Jasanoff 2015c: 14). In fact, Eva Lövbrand, for example, argues that such an understanding of co-production is necessary to interrogate concepts of problems and things (such as 'nature' or 'climate change') that are well-established and hegemonic, in order to outline how they are maintained and how they favor specific kinds of solutions, respectively how they are acted

upon at all in social and political life (Lövbrand et al. 2015: 213-215). According to my definition, all these questions are inherent in the way how something is known. Therefore, the investigation of knowing climate change is one that also focuses on the respective co-production of climate change by the two city networks – by asking for example who is considered as an expert by the networks or whose understandings of nature, climate change, human relations to climate etc. they consider (see Lövbrand 2014: 179), but also how they imagine future pathways and ways forward in climate change governance (see Jasanoff 2015c; Scoones et al. 2015).

The three findings of this chapter, namely that a way of knowing something can be summarized in the story that is told about it; that knowledge and knowing is always social and conditioned; and that knowledge and knowing is always co-produced, do serve as the main conceptual baseline for my analysis of how transnational municipal networks know climate change. However, this baseline only serves as a starting point. 'Knowledge' is often seen as an object, a resource which is not further investigated. This definition by far does not cover all aspects of what it means to 'know' something. Therefore, I want to dig deeper into the concept of knowledge and outline different aspects of it. This is done in the following chapter.

4 Theoretical approach: Knowledge forms as constituents of a way of knowing

In most writings on city networks' role in global climate change politics, 'knowledge' is presented as a closed and clear-cut entity without further questioning of its composition. This is exemplarily present in the assumption that city networks are important because they provide 'knowledge' and enable the exchange of 'knowledge' (e.g. Bouteligier 2013; Busch et al. 2018; C. A. Johnson 2018). Hence, different concepts and aspects are squeezed into a single notion without interrogating the substance of the black box term 'knowledge'. This is understandable in the light of the difficulties that one encounters when engaging with knowledge. At the same time, as I have summarized in the last chapter, knowledge is very powerful and decisive for how we act and behave. Felt puts this very clearly: "(…) knowledge plays a central role in the way we understand ourselves, people around us, and our societies" (Felt 2017: 253). This reinforces the need for conceptual clarification. But how to do so? My suggestion is to differentiate several forms of knowledge to open up the black box, and to therefore understand the substance and complexity of city networks' knowledge, respectively their way of knowing climate change. I argue that by differentiating forms of knowledge the various components of a way how something is being known become visible.

To begin, I want to make clear how I understand the relationship of knowledge, knowing, a way of knowing and different forms of knowledge. As discussed before, knowing is a collective, socio-material activity, a practice and a process. This practice of knowing results in the product 'knowledge'. A way of knowing something can be summarized in the story that is told about the respective epistemic object. This way of knowing something is in turn composed of different forms of knowledge interplaying. Therefore, I see different forms of knowledge as illustrating different aspects of what it means to know something.

Summarizing, knowledge is the product of how we know something:

> What we know is a product of socially ordered practices of knowing: the aspects of the world people and institutions choose to observe and theorise, the data they collect, the methods of analysis and reflection and epistemological and ontological assumptions they adopt, and the norms and standards of evidence they apply (Miller 2019: 254).

This quote once again highlights the co-produced character of knowledge and its social environment as outlined in the chapter before. What does that mean for the theoretical conceptualization of knowledge? It means that depending on predominant practices of knowing, including for example assumptions on expertise, knowledge acquirement etc., knowledge can appear very differently. To understand different ways of knowing, it is thus

essential to somehow make visible the different components of the respective way of knowing. And these components of knowing something are different forms of knowledge.

In this chapter, I point out why I think that differentiating forms of knowledge can help to open up the black-box notion of knowledge. In a next step, I am using the baseline assumptions about knowing and knowledge presented in chapter 3, as well as Jürgen Habermas' differentiation of three knowledge forms and adaptations thereof, to find a differentiation that I find useful to understand different ways of knowing. In the remainder of this chapter, I develop my own conceptualization of the four knowledge forms definitional, conceptual, problem-solving, and critical knowledge, and explain how they interact.

4.1 Differentiating forms of knowledge

Many scholars have identified the conceptual differentiation of forms of knowledge – though very different conceptualizations – as a helpful way to capture the broad variety of aspects that 'knowledge' actually contains (see for examples Bourdieu 1973; Crombie 1994; Hacking 1992; B. Johnson et al. 2002; Polanyi 2009). For the analysis of how city networks know climate change, differentiating knowledge forms is a useful way to grasp the respective way each network knows.

By differentiating forms of knowledge we are able to understand the "substance of what is diffused within and across city-networks" (Gordon and Johnson 2018: 38). At the same time, this splitting up allows more precision. Alvesson and Kärreman (2001) rightly warn that "if knowledge means that much, the usage of the word informs us less and less" (p. 999). Therefore, they highlight the same problem that I have identified for the city network literature as well: that knowledge is often used overflowingly, without asking what this knowledge actually is and contains. By clearly differentiating distinct forms of knowledge, the different aspects of what knowing something means are structurally assigned to the respective form and the 'end product' knowledge is split up in these different forms and their particular manifestation. Thereby, I prevent that the notion of 'knowledge' is applied in the same 'black-box' manner that it is often used to.

To start with, I want to stress how broadly knowledge and knowing can be understood. Nullmeier and Rüb (1993), for example, argue that knowledge is everything that can be acquired by learning or cultural deliverance (Nullmeier and Rüb 1993: 25) – encompassing knowledge of the daily life, scientific concepts, competing practical interpretations of different (expert) and (sub-)cultures, as well as ideological knowledge complexes such as philosophical systems or even esotericism (Nullmeier 1993: 183). All of these possibilities are in Nullmeier's argumentation different forms of knowledge. As the definition of knowledge being everything that can be acquired by learning or cultural deliverance overlaps with my baseline assumptions

about knowledge, especially in that it is always socially coined and co-produced, I agree with this broad idea of knowledge comprising not only descriptive and empirical but also normative knowledge (see Davenport and Prusak 1998: 5; Nullmeier and Rüb 1993: 25). Knowledge in Nullmeier's understanding can be seen as a cognitive system made up of different forms of knowledge (Nullmeier 1993: 182). Cognitive system, here, means that 'knowledge' is used for processes of interpretation, whereas the certainty of this knowledge is not the decisive question (Nullmeier 1993: 182). What is decisive is that the respective cognitive system enables an actor to unfold interpretive patterns and to cognitively represent her own experiences (Nullmeier 1993: 177).

I draw from these reflections that such a 'cognitive system' that an actor, or a group of actors, builds for an object can be equated with the way how this object is being known. Such as the cognitive system that is built to cognitively represent and interpret an epistemic object, I argue that a way of knowing is made up of different forms of knowledge as well. These different forms of knowledge are composed of the different aspects that 'knowing' comprises: the particular arrays of respective subjects and objects, expressions or representations, imaginaries involved, metaphysical assumptions, but also normativities, and institutions (see chapter 3.1.).

To be more precise: I understand the way how city networks know climate change as the interplay of different forms of knowledge. Therefore, I align myself with scholars highlighting that knowledge is much more a process than an object (see Nicolini et al. 2003). I see this as being in line with the assumptions of co-production – knowledge as being constantly shaped by its social environment but also the other way around, knowledge constantly shaping its environment. But which forms of knowledge can we differentiate to best reflect the assumptions of what it means to know something?

To find an answer to this question I draw on the three baseline assumptions about knowing and knowledge outlined in chapter 3 and combine them with the knowledge form differentiation brought forward by Jürgen Habermas. Habermas with his differentiation of knowledge-informing interests is trying to understand how knowledge emerges and functions in a world shaped by human beings. As such, his differentiation of knowledge forms can be well combined with an STS approach assuming that knowledge is always socially embedded and co-produced with its environment.

Jürgen Habermas differentiates three knowledge motivating interests and derives corresponding knowledge forms (Habermas 1987). In Habermas' understanding, knowledge constituting interests are means by which humans organize their daily experiences (see Ewert 1991: 347) or to say it differently, the different forms of knowledge are means by which people

relate to the world and to one another (Bryant 2002: 92). The three different knowledge-constituting interests are in Habermas' (1968/1973) view basic human interests: to control nature (= technical interest), to create social harmony (= practical interest), and to generate individual growth (= emancipatory interest) (see Kreber and Cranton 2000). He further postulates that the different interests require and create different forms of knowledge. These are *instrumental*, *practical*, as well as *emancipatory* knowledge (Habermas 1987).

According to Habermas' definition the technical interest is induced by the human will and need to control and manipulate their environment. By following their technical interests, humans satisfy their needs for, for example, food and shelter (Bullough and Goldstein 1984: 144). To meet these needs, humans produce a specific form of knowledge. This form of knowledge comprises knowledge "about the covariance of observable events; (…). Empirical-analytic knowledge is thus possible predictive knowledge" (Habermas 1987: 308). Habermas' calls the form of knowledge that is constituted by the technical interest *instrumental knowledge*. With the production of instrumental knowledge, humans follow the endeavor to manipulate and control the environment, to make predictions about observable social and physical events, to create a reality which is based on empirical knowledge and which can be governed by technical rules, and finally, to find criteria to effectively control this reality (Ewert 1991: 348). This instrumental knowledge is aiming at determining cause-effect relationships and involves learning through task-oriented problem solving (Kreber and Cranton 2000: 483) – in other words, instrumental knowledge aims at "getting things done effectively" (Kemmis 2006: 95).

Habermas' second knowledge-constituting interest – the practical interest – aims at understanding others through communication. It not only includes language but also cultural and social norms (Kreber and Cranton 2000: 483). Language is used to mutually understand individual needs and interests and to organize social actions that satisfy these needs and interests (Ewert 1991: 351). The specific aim of practical interests is to secure the human species' existence "through tradition-bound social life in ordinary-language communication" (Habermas 1987: 313) The practical interest is driven by the aim to find an orientation within everyday social reality by being able to interpret the commonly shared social reality and making oneself understood in this shared reality (Ewert 1991; Kreber and Cranton 2000). The respective knowledge – *practical knowledge* – thus consists of norms that form a common understanding underlying society and which provide knowledge of how actions can be understood and interpreted (Ewert 1991: 351f). The ultimate aim of practical knowledge is to inform "wise and prudent decision-making in practical situations" (Kemmis 2006: 95), as well as commonly defining a social reality that is accepted by all participants. What this implies is that social reality can become objective for participants when they mutually define it as reality and orient themselves towards this reality – in fact, the process that the concept of co-

production refers to (Jasanoff 2004). This also highlights that actions will only be understandable and meaningful to others in a social context when they agree with the respective social reality and share common sets of practical knowledge (see Carr and Kemmis 1986; Ewert 1991).

Habermas finds that there is a third human interest, freeing the individual "from dependence on hypostatized powers" (Habermas 1987: 310) – the emancipatory interest. It arises because the uncritical acceptance of a social reality (manifested through practical, but also technical knowledge) as objective and fixedly defined causes several problems: firstly, it neglects that not all participants in a social reality have the same perspective on this social reality. Secondly, even if all participants shared the same perspective (= have a common normative framework), it could be that this common framework is caused by 'distorted knowledge', in other words, influenced by a certain ideology (Ewert 1991: 364). Hence, the emancipatory interest is to free oneself from coercion and (self-)imposed constraints reflected in social institutions and forces, and finally, to grow and develop (Kreber and Cranton 2000: 484). Hence, knowledge constituted by the emancipatory interest – emancipatory knowledge – leads to an understanding of how the past influences the present and can lead to freedom and relational autonomy (Ewert 1991: 354). Emancipatory knowledge thus constitutes an empowerment of socially dominated and ideologically indoctrinated actors. Summarizing, Habermas' emancipatory knowledge questions social institutions and forces and is generated through thought and action. It makes actors question why they do what they do and empowers them to take alternative action and produce new kinds of knowledge.

Habermas' three knowledge forms are an essential contribution to understanding knowledge itself. He presents in detail that knowledge has different functions: Not only does knowledge help humans to understand and control their environment, but it also serves to establish, define and substantiate a certain reality – thus, he is touching upon what has later been called 'co-production' by Sheila Jasanoff (Jasanoff 2004). With the notion of emancipatory knowledge, he highlights the contestability of dominating knowledge forms. An aspect that can be similarly observed in the argumentation that every knowledge is situated and that there is no knowledge that is universal or globally accessible (Jasanoff and Long Martello 2004c). Despite these overlaps with my conceptual baseline understandings about knowledge and knowing, relying on Habermas' initial knowledge forms for my purpose does not seem very helpful. Why is this the case?

Mingers (1997) highlights that Habermas' theory of knowledge-constituting interests was only intended to be an epistemological device (p. 412). He highlights that Habermas' differentiation is too metaphysical, and only able to differentiate different forms of scientific

knowledge, but not to meaningfully compare them, or to understand the composition of socio-material phenomena (Mingers 1997: 412). As my aim of differentiating knowledge forms is to understand the actual substance of city networks' knowledge to outline the way how they are knowing climate change, relying on a purely epistemological differentiation does not seem to be helpful.

Being confronted with similar problems, other authors have further developed Habermas' initial categories. Park (1999) for example, applying Habermas' three forms of knowledge to his approach of participatory research, refines Habermas' concept by translating practical knowledge into relational knowledge (describing the form of knowledge that enables two persons to be in a relation with each other, or to 'get to know' the other person), emancipatory knowledge into reflective knowledge (a form of cognition committing the owner to action), and instrumental knowledge into representational knowledge (depicting and explaining reality as well as enabling to control it). He further differentiates representational knowledge into functional and interpretative knowledge – functional knowledge enabling an explanation of the experienced reality, while interpretative knowledge enables people to understand reality and give meaning to it (Park 1999: 145ff).

	Representational knowledge		*Relational knowledge*	*Reflective knowledge*
Inspired by	**Instrumental knowledge (Habermas)**		**Practical knowledge (Habermas)**	**Emancipatory knowledge (Habermas)**
Further differentiation (by Park)	Functional knowledge	Interpretative knowledge	No further differentiation	No further differentiation
Content	Explanation	Understanding	Relationship	Values
Use	Control (predict, adapt, prevent, produce)	Give meaning	Create community	Emancipate, Reflect

Table 1: Peter Park's categories inspired by Habermas' tripartite differentiation of knowledge forms (modified table adopted from Park 1999: 149)

As Park applies these categories very practically by using them for his participatory research concept he has shown that a refinement and further differentiation of Habermas' initial categories can be an effective step in order to use Habermas' framework for a practical application. Following this assumption, Habermas' differentiation can eventually serve as a basis for grasping the different components of a way of knowing – when combined with other more practically oriented differentiations and therefore being refined. I am not using the same

forms of knowledge as described and renamed by Park as I do not only want to rely on the reflections of one particular view on knowledge. Rather, for my own knowledge form conceptualization, I also want to draw on the baseline assumptions about knowledge that I have outlined in chapter 3. I thus take Park's refinement as an inspirational starting point to find my own knowledge form differentiation, based on Habermas' reflections, as well as STS's assumptions about knowledge.

4.2 Conceptualizing four forms of knowledge

4.2.1 General baseline assumptions

I combine general assumptions from the two theoretical strands presented above in order to define forms of knowledge which are conceptually differentiable, which can effectively illustrate different aspects of a certain way of knowing something, and which can therefore be used to understand how the two networks know climate change.

The first common feature is that both frameworks highlight that 'knowledge' cannot be seen as one container which can be simply transferred from one location to another. Rather, both Habermas as well as STS scholars (in my case particularly Sheila Jasanoff) agree that we have to investigate the 'knowledge' we are talking about to understand what its content is, where it comes from, how specific contexts are influencing it (and the other way around) and which basic assumptions it relies on – thus, they agree on knowledge being a social product. Hence, both conceptual strands assume that knowledge can, on the one hand, never be 'neutral' and understandable by everybody, and on the other influences and shapes the environment it is produced and used in. Thus, they acknowledge that knowledge has the power to shape and set definitions, norms and behaviors. This is suggested by Habermas' notion of practical knowledge, as well as by the notions of 'co-production' and 'situatedness of knowledge' introduced by STS scholarship. What does this assumption mean for my differentiation of knowledge forms? The conclusion I draw from this is that there must be a form of knowledge which has a high definitional function, understood as the power to shape its environment. This definitional function has two purposes: firstly, it serves in the sense of 'setting the scene' for other forms of knowledge. Accordingly, I am assuming that this form of knowledge is decisive for which other forms of knowledge are being produced. It is somehow the basis for the further social construction of knowledge. Secondly, it serves as a form of knowledge one has to have to be able to cope with a respective situation and environment – both to understand them on the one hand, but also to know how to communicate and act to have a say.

Another lesson learned from the theoretical frameworks presented is that there is a difference between knowledge operating more in the 'background' – such as the just outlined one focusing on norms and definitions – and knowledge forms which are oriented towards achieving a solution to a clear-cut problem. In this sense, knowledge is produced to practically cope with a given situation. According to the specific focus, this can either be a firm wanting to achieve their economic goals, a human seeking to fulfill her need for food, or a community wanting to get access to drinking water – what they all have in common is that they need knowledge of how to achieve these goals. This means that there must be a form of knowledge focusing on perceived problems and possible solutions. This notion of knowledge is reflected in Habermas' instrumental knowledge. But it is also present in STS's notion of 'situated knowledge' understood as knowledge that is being produced for practically coping with a specific situation and problem in a given context. Accordingly, these notions target a form of knowledge focusing on how to get to an aspired outcome. The question of why something is done the way it is does not play a role as long as the outcome is achieved – the knowledge is hence focused on the process of doing something. However, this knowledge focusing on procedures of how to achieve goals further implies another form of knowledge: knowledge building a common ground for how and which processes of acting are being developed. This 'underlying' form of knowledge is reflected in Habermas' instrumental knowledge. Accordingly, Habermas' instrumental knowledge covers two facets: firstly, instrumental knowledge is needed for "getting things done effectively" (Kemmis 2006: 95) – captured by Park's 'functional representational knowledge' (Park 1999: 146ff) – but secondly, instrumental knowledge also covers 'cause-effect relationships' which are in turn used to make predictions about observable social and physical events (Kreber and Cranton 2000: 483) – depicted in Park's 'interpretive representational knowledge' (Park 1999: 147ff). This notion differs from the aforementioned knowledge (aiming at solving a specific problem) in so far as it is not directly task-oriented. What does this mean? It means that there is knowledge establishing a common ground on which further knowledge can be built. However, this knowledge has not as much definitional power as the aforementioned. Rather, it follows up on the definitions which have been set in the first place.

I draw one last general assumption about knowledge from the two theoretical strands. This assumption arises from Habermas' 'emancipatory knowledge' – but the critical notion of STS's co-production also resonates. Both of these aspects highlight that it is possible that some knowledge forms achieve acceptance as being 'universal' and can therefore become globally dominant. What they highlight at the same time, is that it is possible to scrutinize these dominant forms of knowledge – by producing a form of knowledge which is not conform with the hegemonic knowledge forms but rather alternative and querying. As a consequence,

holders of this form of knowledge can question established allocations of roles, institutions, power distributions etc.

Summarizing, the following general baseline assumptions are informing my conceptualization of knowledge forms:

1. Knowledge is a social product tied to and shaped by its environment – and the other way round
2. Knowledge can have different functions – it can operate in the background or be goal-oriented
3. Specific knowledge can become (globally) dominant

Based on these general assumptions, I find that four forms of knowledge can serve as a conceptual basis for understanding the way how city networks are knowing climate change.

4.2.2 A four-fold differentiation of knowledge forms

The four forms of knowledge I differentiate are: ***definitional*** knowledge, ***conceptual*** knowledge, ***problem-solving*** knowledge, as well as ***critical*** knowledge (see Table 2). These four forms are based on the conclusions drawn from the theoretical frameworks brought forward by Habermas and STS scholarship. In the following, I outline which different aspects of knowing something are reflected by the four forms of knowledge that I differentiate conceptually.

4.2.2.1 Definitional knowledge

Definitional knowledge, according to my understanding, is knowledge defining the problem at hand. This includes the definition of what the problem substantially is, in the first place, but also of the actors responsible for finding solutions. This form of knowledge contains underlying norms, assumptions, definitions and epistemological ideas. In this respect, definitional knowledge helps to understand a given situation. It further serves as a more general orientation in the world, in the sense of providing a framework for one's own interpretations. At the same time, it influences how a situation is assessed, which problems are perceived as existing and how they could be potentially solved. By doing so, it serves as a definitional basis for other forms of knowledge which build on the respective definitional knowledge.

This idea of definitional knowledge is inspired by Habermas' notion of practical knowledge, thus knowledge that helps to understand others. Habermas' practical knowledge describes the underlying norms forming society. This kind of knowledge is the product of everyday interpretations of social reality and provides orientation within said reality. However, my understanding of definitional knowledge differs quite significantly from Habermas' 'practical'

knowledge. My conceptualization of *definitional knowledge* adds to Habermas' idea of practical knowledge a constitutive notion of co-production (Bremer and Meisch 2017), saying that knowledge is always a product of a specific representation of the world. This representation shapes the way we choose to live in it and govern it (Jasanoff 2004). Habermas' practical knowledge mainly reflects the human need to understand others (for example through language) by depicting the intersubjective world of a community of actors which share norms, roles, or values (Habermas 1987: 313). However, Habermas' notion of practical knowledge does not include any reflection on how this knowledge is being produced, and what its consequences are. Therefore, my notion of *definitional* knowledge better reflects that this kind of knowledge is not only important for understanding others but that it is also highly influential on how life is being conducted (and therefore how 'problems' are being approached).

Definitional knowledge in my conceptualization is thus in line with Habermas' practical knowledge to the extent that it comprises norms and practices (in the broadest sense) that are forming society. Just as practical knowledge, definitional knowledge is a product of everyday interpretations of social reality. It is needed to know how to behave in specific situations and to know and understand who is responsible for what. However, my notion of definitional knowledge highlights even stronger than Habermas' practical knowledge, that this form of knowledge not only has a practical component but one that very strongly shapes both the social and the material world: as all knowledge, definitional knowledge is socially constructed, and therefore always open for debate. These debates are constant subjacent social struggles. Definitional knowledge has a high tacit component as it is rarely made fully explicit. Polanyi's 'tacit dimension' of knowledge (Polanyi 2009) highlights that you have to know more than the pure content in order to fully understand something – which could be interpreted as the necessity to be aware of underlying norms, definitions etc. – thus, to understand the definitional knowledge base of a respective situation.

How do these abstract theoretical thoughts relate to city networks knowing climate change? As outlined before, it very much depends on the respective definition of climate change which knowledge is being further produced and which solutions suggested. Concerning climate change, it is nowadays accepted that it is as much a scientific phenomenon as it is a political, social or cultural one (Pettenger 2016; Yusoff and Gabrys 2011: 517). The definition of climate change as a cultural phenomenon will produce other answers than its definition as a scientific phenomenon.

I want to give an example to elucidate what this means in the context of knowing climate change: The Hague Declaration of the Second International Forum of Indigenous Peoples and Local Communities on Climate Change states:

> Earth is our Mother. Our special relationship with Earth as stewards, as holders of indigenous knowledge cannot be set aside. Our special relation with her has allowed us to develop for millennia a particular knowledge of the environment that is the foundation of our lifestyles, institutions, spirituality and world view. Therefore, in our philosophies, the Earth is not a commodity, but a sacred space that the Creator has entrusted us to care for her, this home where all beings live (FIPLC 2000).

This statement highlights how differently from prevailing scientific definitions (as outlined in chapter 3.1) the earth as well as environmental changes can be seen and defined. Here, definitional knowledge determines that the earth is the mother of all living beings which in turn have to care for her. Accordingly, knowing the earth in such a way will influence the way people act towards it and how they will try to understand its problems. And these responses will be different to the situation in which the environment is defined as something external to human beings that needs to be managed and controlled (see e.g. Bäckstrand and Lövbrand 2006: 53ff). However, Schnegg (2019) shows that alternative ways of knowing a phenomenon can be multiple but do not need to be mutually exclusive. Therefore, it could very well be that a problem is differently defined and yet, similar solutions suggested.

4.2.2.2 Conceptual knowledge

Conceptual knowledge contains explanations of an observed reality. This form of knowledge aims at figuring out contexts and fundamentals of the respective epistemic object. This form of knowledge includes the main beliefs, ideas and concepts of a way of knowing. At the same time, conceptual knowledge is used to make predictions about observable social and physical events.

My understanding of conceptual knowledge is inspired by what is partly reflected in Habermas' instrumental knowledge. However, it differs from instrumental knowledge by only covering a specific facet of it – namely what Park (1999) has called the 'interpretative' side of instrumental knowledge. It is interpretative insofar as it aims at understanding something and give meaning to it (Park 1999: 146). My notion of 'conceptual knowledge' is further inspired by STS's assumption that all knowledge is situated knowledge building on shared models of interpretation of a shared reality (Jasanoff and Long Martello 2004a).

As already outlined, I understand knowledge as a broad cognitive system encompassing different forms of knowledge – also information. I am aware that many discussions in the knowledge literature focus on the difference between knowledge and information (for that discussion see for example Ackoff 1989; Davenport and Prusak 1998; Liew 2007). For my purposes, I do not need to find a precise separation of knowledge and information. Rather, I understand information as an aspect of conceptual knowledge. Conceptual knowledge comprises information as one form conceptual knowledge can take. Gathering information in

this case is a 'storing system' (Schindler 2006: 114) for knowledge, or a specific epistemic practice of knowing something (see Bueger 2015).

As outlined above, the observed reality which is being explained by conceptual knowledge depends on the definitional knowledge in the first place, but also reinforces this definitional knowledge. To give an example: if a problem – by the successful establishment of a particular definitional knowledge – is presented as a scientific one, scientific concepts, for example formula, theories, or models are being developed in order to conceptualize the identified problem. If a problem is identified differently, for example as religious, the respective conceptual knowledge gets materialized differently, in histories, sayings, legends, beliefs etc. Accordingly, conceptual knowledge can materialize very differently. However, the aim – explaining an observed problem – is always the same. It is easier to highlight this relationship when relating it to climate change knowledge.

As scientific knowledge has become accepted as universally applicable and understandable knowledge (Jasanoff and Long Martello 2004a), much conceptual knowledge in the context of climate change takes the form of scientific theories, formula, data or models. An example for such conceptual knowledge would be a model picturing how and why exactly GHG emissions lead to changes of the global climate system. Such a model is based on the definitional knowledge that climate change is a scientific and technological challenge which can be tackled by scientifically assessing it and finding technological solutions to it. On this knowledge base, scientific models are being developed to explain the causes of the problem – in this case, calculations of GHG emissions which are combined with observable changes in the atmosphere. However, if the respective definitional knowledge is different, a different conceptual knowledge base is established. As already mentioned, a growing body of literature highlights that scientific means are not the only ones to capture and explain climate change (F. Fischer 2000; Hulme 2015; Jasanoff and Long Martello 2004c; Lövbrand 2011). W. D. Smith (2016b), for example, presents a group of indigenous (Huehuetecos) scientists relying on the cosmos – which can be more or less understood as the environment, including climate – to understand and explain their environments with what Smith calls 'presence of mind' (W. D. Smith 2016b: 218). He highlights the sharp contrast between scientific knowledge and the Huehuetecos' knowledge:

> Although a Western view would define presence of mind as a religion-leavened notion of human faculty, Huehuetecos insist that it is an environmental science. The Totonac scientist, although a keen empirical observer, is not the hypothesis formulator and theory builder of the Western scientific paradigm. Rather, he or she possesses a feel for connections among people, environmental elements, and the will of the saints. She or he attunes thinking to the domain of the soil, plants, water, and divinity. And he or she labors on the land accordingly (W. D. Smith 2016b: 218).

Huehuetecos' conceptual knowledge is composed of empirical observations which lead to explanations based on a feel for connections among humans, the environment and spiritual elements. Technological observations, data or formula, in turn, do not play a role for this particular conceptual knowledge. This quote at the same time shows why it is important to acknowledge these ways of knowing as actual forms of knowledge – *Huehuetecos*' ways of knowing, and not to dismiss it out of hand as religious beliefs. This acknowledgement is important to actually follow the paradigm of seeing knowledge as more than the reductionist view of it as Western science (Lahsen 2005; H. A. Smith 2016a; W. D. Smith 2016b).

To summarize, conceptual knowledge is highly influenced by definitional knowledge and in turn also fortifies the respective definitional knowledge. Hence it differs from definitional knowledge in being in a sense the *application* of definitional knowledge. At the same time, it influences how people 'labor on the land' (W. D. Smith 2016b).This is because conceptual knowledge serves as a kind of background knowledge – so to say, setting the stage for further problem-solving knowledge (see below). According to the prevailing conceptual knowledge, respective ways of how to solve problems will be developed.

4.2.2.3 Problem-solving knowledge

Problem-solving knowledge focuses on finding possible solutions to the identified problems. In the process of producing problem-solving knowledge, the explanations and predictions of conceptual knowledge are taken up and plans are being developed for how these explanations can be transformed into concrete steps. Problem-solving knowledge therefore comprises solutions that are considered appropriate, but also knowledge about how to implement these solutions.

This form of knowledge is inspired by the 'functional' facet of Habermas' instrumental knowledge (Park 1999: 146ff), but also Jasanoff and Long Martello's notion of 'situated knowledge', understood as knowledge that is being produced for practically coping with a specific situation and problem in a given context. Problem-solving knowledge is what some authors have called a 'capacity to act' (Stehr 1994) in the sense of a skill or capability to do something. This form of knowledge is present in a wide variety of instances of knowing: from knowing how to ride a bike, knowing how to grow a plant, or knowing how to reduce one's own GHG emissions. What this shows is that problem-solving knowledge is basically about the 'how' – no matter if this 'how' can be described in technical terms, in words or is mainly tacit and therefore rather a status of mind.

What is true for conceptual knowledge, is true for problem-solving knowledge as well: it builds upon the respective definitional (and conceptual) knowledge. Hence, which solutions are seen as appropriate – and therefore ultimately aimed for – highly depends on what is

defined as the problem, and how it is explained. This idea of the high interdependence between different forms of knowledge is also derived from the notion of co-production suggesting that a problem itself (or rather the way how it is known as a problem) is co-produced with the respective way of acting upon it (see Beck et al. 2017; Jasanoff 2004; Lövbrand et al. 2015).

If we take the former example of the Huehuetecos' knowledge, their problem-solving knowledge will be based on their conceptual knowledge of the cosmos. In order to fulfill their need of food production, they refer to the relationship between agriculture and thought (= conceptual knowledge) to know how to generate their food. In their case, this means to rely on a great food crop diversity (= problem-solving knowledge). A variety of food plants according to this conceptual knowledge reflects the "manifoldness of God's presence in the world" and therefore influences how food is to be produced (W. D. Smith 2016b: 228). Hulme (2015) gives a very different example which nevertheless also highlights the interplay of the different knowledge forms very nicely: he finds that climate change has been presented as a scientific phenomenon which can be captured by measuring temperatures. The problem, respectively the goal, has been identified as global climate temperature not rising more than 2°C in comparison to the 19th century level (= definitional knowledge). Accordingly, processes of 'indexing' the climate have been developed, for example in the form of Earth system models, the global carbon budget or the global warming potential (= conceptual knowledge). On this basis, problem-solving knowledge is produced which serves the aim of keeping global temperature rise below 2°C – as the ultimate goal. As the goal is formulated so narrowly around a specific temperature threshold, the respective problem-solving knowledge is narrowly focusing on this goal, without taking into account possible side effects. Accordingly, the problem-solving knowledge in this case ranges from knowledge about reforestation projects and their carbon storage capacities to what Hulme calls "forms of technological adventurism" (Hulme 2015: 559), such as how to inject sulfate aerosols into the stratosphere to stabilize temperatures.

Problem-solving knowledge can thus be seen as the practical application of definitional and conceptual knowledge, containing strategies of how exactly the formerly defined and conceptualized problem is acted upon.

4.2.2.4 Critical knowledge

Next to the three forms of knowledge building on each other, I am including a fourth form of knowledge in my conceptualization: 'Critical knowledge' includes ideas, norms, and beliefs questioning hegemonic knowledge structures. It also contains knowledge about alternatives to these hegemonic knowledge forms and aims at enabling hitherto marginalized actors.

As such, my notion of critical knowledge is inspired by Habermas' emancipatory knowledge form as well as by the interactional notion of co-production as it is used by STS scholars. Habermas states that an emancipatory interest arises when actors seek to free themselves from coercion and self-imposed constraints. This process is characterized by questioning the effects of one's own knowledge. Further, it is shaped by reflecting about assumptions that are previously not being questioned. Emancipatory knowledge in Habermas' definition allows actors to understand why the world is as it is and to see ways of how it could be different (Habermas 1987). Similarly, STS scholars use the concept of 'co-production' as an 'interactional lens' to "challenge established demarcations between science and society and the privileged status of scientific expertise" (Bremer and Meisch 2017: 7). STS's notion of co-production therefore challenges how politics and science often interact, and thereby stabilize a particular global order while neglecting alternative voices (see Kirchhoff et al. 2013). It also contributes to an understanding why the world is as it is and how this has evolved.

The difference between STS' notion of co-production and Habermas' emancipatory knowledge is their focus: Habermas' knowledge form concentrates much more on the individual level by stating that this emancipatory knowledge can lead to an understanding of how the past influences the present and by doing so generates individual growth and relational autonomy (Ewert 1991: 354). The interactional co-production lens on the other hand focuses on how science and society interact and remake each other constantly by highlighting the processes by which science emerges and claims political authority in producing knowledge (Jasanoff 2004; Miller 2004). By doing so it aims at exposing and challenging dominant narratives and knowledge structures (Bremer and Meisch 2017: 7f).

Both frameworks thus highlight that there is knowledge that can challenge established forms of knowledge and critically assess them. I translate these findings in the form of knowledge which I call 'critical knowledge'. It hence includes knowledge which is both aiming at questioning hegemonic knowledge structures, as well as at demonstrating that and which alternatives would be possible or already available. Its production and dissemination is targeted at enabling actors that are hitherto marginalized. Critical knowledge is thus being produced and used to question established structures and actors and to reinforce alternatives. It focuses both on individual as well as on societal structures.

As already mentioned, in the domain of climate politics, we can observe that a specific form of knowledge – techno-scientific knowledge – has been normalized as the 'default' knowledge (Allan 2017; Bäckstrand 2003; Brand 2010; Jasanoff and Long Martello 2004a; Walsh 2019). Producing scientific and technological knowledge thus has become the hegemonic form of knowing, both in climate-, but also more generally in environmental politics (Brand 2010; Negev and Teschner 2013). As outlined in chapter 3.1, this predominance is based on the

positivist assumption that scientific and technical knowledge are 'neutral' and therefore required for formulating the 'best' policy for addressing problems (Negev and Teschner 2013: 51). Nevertheless, scientific knowledge is "a potential vector for hegemonic power" (Lahsen 2016: 186) – hence, the contrary of being neutral. Furthermore, it has been highlighted that climate change, but also other environmental challenges, are 'wicked' and unstructured problems (Hulme 2009; Wesselink et al. 2013). Therefore, 'neutral' descriptions do not exist but are always human, and therefore political, partial and highly power-shaped interpretations (Jasanoff 2004). Hence, science-based knowledge is not only no neutral knowledge, but knowledge which is used to impose and normalize a hegemonic dominance of specific interpretations (Wesselink et al. 2013: 4).

Such a global hegemony of a specific way of knowing can lead to further normalizations of related practices "despite the fact that people die, soil erodes and air is polluted" (Brand 2010: 137). Because of the high power component of such a development, subsequently non-hegemonic forms of knowledge are seen as marginal, peripheral, or local and therefore are being ignored and forgotten (Singer 2005: 215).

How is this connected to the notion of critical knowledge? Critical knowledge according to my conceptualization is knowledge that aims at challenging such established, 'normalized' and therefore hegemonic knowledge. Applied to my research area, critical knowledge is knowledge that questions and establishes alternatives to the supremacy of techno-scientific climate knowledge – in other words, critical knowledge encompasses exactly these forms of knowledge which are being presented as 'marginal', 'peripheral' or 'local'.

As such, critical knowledge implies for me as the researcher a certain 'second-level' analytical component. This is because I do not only have to analyze to which form of knowledge a specific aspect of knowledge 'belongs', but I also have to judge if this aspect is 'critical' and challenging towards hegemonic knowledge structures.

4.2.3 Summary, or: how are these knowledge forms interacting?

The following table summarizes the main characteristics of the four knowledge forms definitional, conceptual, problem-solving, and critical knowledge and highlights the questions these seek to answer.

Form of knowledge	Characteristics	Questions this knowledge seeks to answer
Definitional knowledge	Product of everyday representations and interpretations of social reality/ the world Way of thinking (knowledge about dominant norms and discourses)	What actually is the problem? Who are the responsible actors?
Conceptual knowledge	Models of explanation Aims at making predictions about observable social and physical events 'Materialization' of definitional knowledge, e.g. beliefs, ideas, lifestyles, spirituality, formula, terminology, models	How can we explain the problem we have identified? Which causes and consequences do we attribute to the problem? Which concepts do we use to inform our actions?
Problem-solving knowledge	'Capacity to act' Task-oriented	What are appropriate solutions for the problem? How can we transform our explanations into concrete steps? How can we achieve goals?
Critical knowledge	Reflexivity Critical analysis Enabling empowerment of socially dominated actors	Are current structures the best to solve our problems and where do they come from? Which alternatives could we look for/install? Do we actually need the knowledge we have/produce or would something else be more helpful?

Table 2: Fourfold conceptualization of knowledge forms

It has to be highlighted that these four forms of knowledge are differentiated for analytical reasons. Even though they differ conceptually, they very likely overlap and interdepend on each other empirically. In fact, the complex interplay of the four forms of knowledge constitutes 'the story' that is told about an empirical object and thus the way how it is known. The clear-cut distinction of the knowledge forms thus has to be seen as an artificial one carried out for analytical reasons.

What the differentiation of the four forms of knowledge ultimately highlights is that they are operating at different layers. Accordingly, definitional knowledge is a form of knowledge which serves as a basis for further knowledge production. In turn, it influences which conceptual knowledge is being produced. The respective conceptual knowledge determines how, and which kind of, problem-solving knowledge is generated and disseminated. The other way around, problem-solving and conceptual knowledge reinforce the respective definitional

knowledge. Critical knowledge on the other hand can challenge all of these layers, as well as their interactions. At the same time, it can also be inherently present in all of these forms if they are not part of a hegemonic knowledge structure. As a consequence, the production and dissemination of critical knowledge lead to the establishment of new forms of definitional, conceptual and problem-solving knowledge. The different forms I have conceptually developed are hence connected through a complex interplay, as shown in Figure 1.

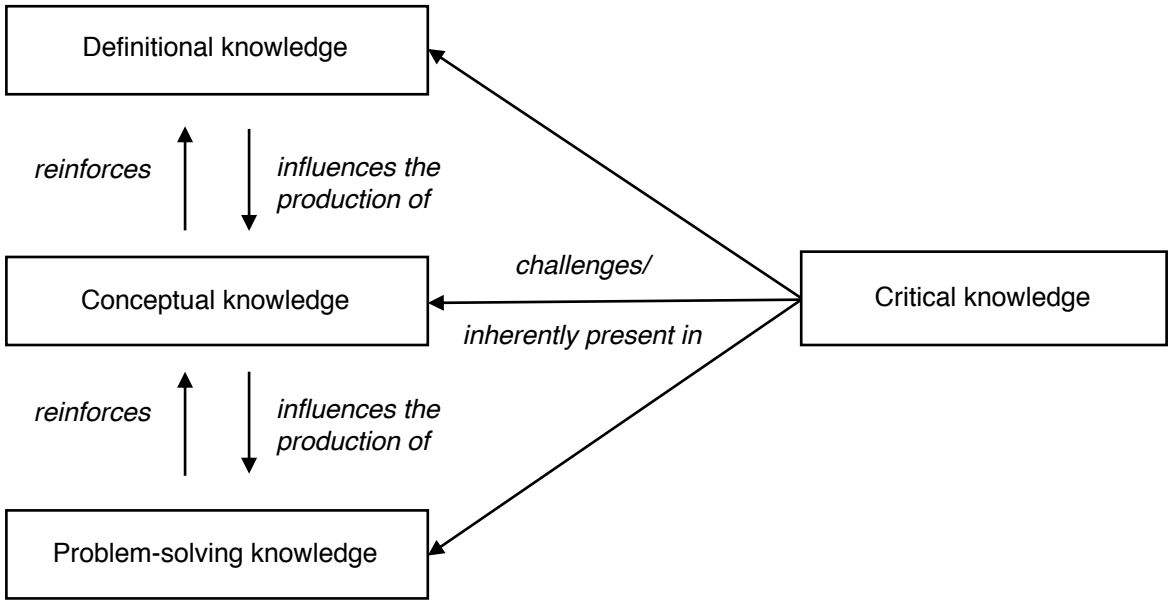

Figure 1: Different layers of the four knowledge forms

It is important to emphasize this interplay of the different knowledge forms as I define them, as this represents a big difference to the knowledge forms established by Habermas. In his reasoning, the different forms of knowledge are tied to different disciplines and media through which they take place (Habermas 1987). His different forms are hence existing rather separated from each other whereas mine are closely connected and supposed to be applicable in every field of study.

So, the remaining question is: where to go from here? How to apply these theoretical reflections about different knowledge forms, knowing something and the constitution of problems to an analysis of city networks active in global climate governance? In the following chapter, I elaborate on these questions with my methodological approach.

5 Methodological approach and method

This chapter explains how I approached my research methodologically. To start, I firstly present the aims and considerations I had in mind when starting out with my research. In a second step, I outline how I decided which city networks I would include in my study and present the two I finally opted for: C40 and Climate Alliance. In a third step, I show how I generated the data I used for my analysis, and which kind of material I used to find out how the two city networks are knowing climate change, namely online publications and background interviews with TMN staff. In a fourth and last step, I explain how exactly I carried out the process of analysis, and how and why I concluded this process with a comparative contextualization of the two ways of knowing.

5.1 Aims and considerations

Before outlining my methodological approach in a step-by-step manner, I want to reflect about what I was asking myself when starting out with my research: why exactly I have chosen the following methodological approach, how and which data I generated and which insights I was hoping for by applying this approach and generating the respective data. Based on preliminary theoretical thoughts, I was wondering:

- Which general research design suits me best for my investigation of how TMNs know climate change?
- How is it possible to analyze the different forms of knowledge?
- How can I observe the production of these knowledge forms?

Answers to these questions could arguably look very differently according to the various ontological and epistemological stances a scholar can have (Harrison and Callan 2013: 80). Therefore, I briefly want to reflect about my own research understanding in the following. This applies to both my understanding of climate change, and the aspect of doing research on how climate change is known by different actors.

As already suggested in the theory chapter, my research speaks to literature assuming that the meaning of climate change is manifold and defined in social settings – in the sense of how it is portrayed, observed and approached (see e.g. Pettenger 2007a: 5). Analyses of different ways of knowing climate change are sometimes misunderstood as denying climate change as such (see discussion outlined in chapter 3.1). However, highlighting different understandings of climate change does by no means imply a negation of climate change as a natural phenomenon or as comprised of material facts e.g. the changing composition of the

atmosphere (see W. Steffen et al. 2015: 89), the appearance of ever more severe weather events – droughts, floods, typhoons, wildfires, melting of glaciers etc. (see EASAC 2018) and the continued rise of global mean temperatures (see NASA 2019). For my *own* understanding of climate change, scientific perspectives on climate change as well as climate change's material facts have and continue to play a major role. I belief that scientific data and observations are a meaningful part of understanding climate change, as well as for understanding the role of human activities for these changes. At the same time, I am aware that different scientific accounts of climate have major consequences, as highlighted especially in chapter 3.1 (see Allan 2017; Bäckstrand and Lövbrand 2006; Hajer 1995; Hulme 2015; Litfin 1998; Wesselink et al. 2013). Politically, a purely scientific understanding of climate change can lead to developments that I personally do not see as a favorable and effective way of dealing with climate change, such as some geoengineering techniques, but also the trading of doubtful offsetting certificates (e.g. Hulme 2015). Although science helps us to grasp climate change, is should not be seen as the only means to do so. Therefore, my focus is on the plurality of ways of understanding, feeling and knowing climate change and on how these enable and constrain how we can individually, and collectively, act upon climate change (see Hulme 2009; Pettenger 2007b).

Approaching climate change as a knowledge object means analyzing how material facts produced by changing climate, and other environmental circumstances, are socially absorbed – how are they being described, discussed, interpreted – short, known. Which consequences do these social processes have for actor constellations, accountabilities, knowledge structures etc. (see Pettenger 2007a)? As F. Fischer (2003: 217) puts it: "It is not the objects or their properties per se, but rather the vocabularies and concepts used to know and represent them that are socially constructed by human beings." For my research, this means that the material challenges that come with climate (and other environmental) changes are not an object of investigation. Rather, I look at how these material effects are being socially absorbed, described, discussed, interpreted, or for short at how they are being known.

These socially embedded answers, in turn, also have an effect on the material trajectories of the Earth System (see W. Steffen et al. 2018: 8253). To say it differently: "What we do about climate change obviously depends on the stories we tell. As these stories change, the world changes too" (Onuf 2007: xv). Tying this to my own research project: what I want to know is how TMNs socially react to the material changes they are observing. To stick with the quote, I am interested in 'the stories they are telling', or how TMNs themselves are knowing climate change.

This meta-theoretical positioning of my research is important as especially in environmental policy research, a lack of reflexivity and transparency about concepts, norms and presumptions frequently causes contestation about the research results (Bornemann et al. 2019). Research without reflexivity, according to this reasoning, is vulnerable because it neglects the subjective role of the researcher and how it impacts the analysis and conclusions. Therefore, I include my own reflections here.

My general research proceeding is inspired by interpretive research approaches. Interpretive research places meanings, comprising values, beliefs, feelings, or sentiments at the core of research (see Bliesemann de Guevara and Kurowska 2020; Schwartz-Shea and Yanow 2013; Yanow and Schwartz-Shea 2015) and is therefore well suited for an analysis with knowledge at its core. Schwartz-Shea and Yanow (2013) highlight that the main interest of interpretive research is to seek "knowledge about how human beings, scholars included, make individual and collective sense of their particular worlds" (p. 46). When asking the question of how city networks know climate change, this is the core of my research question: how do these networks make sense of the 'world of climate change'?

Interpretive approaches are as explicit and conscious about a researchers' stance in research as possible (Schwartz-Shea and Yanow 2013). At the same time, interpretivists reject the assumption of empirical truths that can be directly accessed by researchers (Bliesemann de Guevara and Kurowska 2020: 1222). Rather, interpretive approaches highlight that research is a meaning making activity which is shaped, inter alia, by the researcher herself (Bliesemann de Guevara and Kurowska 2020; Schwartz-Shea and Yanow 2013). This stands in contrast to (amongst others) qualitative research approaches which draw a (more or less intense) line between research objects and the researcher herself, and which are 'classifying' rather than trying to reconstruct and interpret values, beliefs or ways of knowing (Jackson 2016; Reichertz 2016).

These general considerations matter not least because they inform the specific decisions that comprise my research design. Therefore, I want to highlight why I have chosen to analyze two city networks and the ways of how they know climate change, and what I expected from this analysis: Bansard et al. (2017) found TMNs to be a "heterogeneous phenomenon" (p. 242) as they differ strongly concerning for example their targets and the rigidness of their implementation. Therefore, I presumed that by focusing on two very different networks, I could pay tribute to this heterogeneity. However, this choice of two networks is not aimed at structurally comparing these. Rather, I wanted to understand why – despite the importance attributed to knowledge for city networks' role in climate governance – it was not clear at all what exactly this knowledge was, and how it might arguably differ between different TMNs.

Here, based on other scholars' findings concerning the great difference of TMNs (Bansard et al. 2017; Haupt and Coppola 2019), I expected that this diversity would have an influence on the way in which they know climate change. Following this assumption, this influenced my decision to analyze two very different networks and their respective ways of knowing. But what means 'to analyze' in this context? Which data did I generate for this purpose and how did I analyze this data? I answer these questions in the next paragraphs.

5.2 Which networks?

Deciding upon which networks to include in my study was not an easy task: the number of TMNs is vast, as is the range of activities they offer, the topics they focus on, as well as their geographical reach (see Acuto and Rayner 2016; Keiner and Kim 2007). Acuto and Rayner (2016: 1148), analyzing a set of 170 city networks, assume that globally there exist more than 200 formalized city networks. Although the possible universe of cases for my purposes is not quite as large – among the 170 networks analyzed by Acuto and Rayner, 29% topically focus on environmental issues including climate change (Acuto and Rayner 2016: 1153; see also K. e. a. Fischer 2015: 17) – the overall number of networks active in the area of climate change is still considerable.

Most city networks are being described as 'multi-purpose' because they act across at least two policy fields (Acuto and Rayner 2016: 1153). Concerning my own study, I wanted to include TMNs focusing on climate change, either as their main purpose or at least as one of their main topics.

Another restriction to my choice was that I only wanted to investigate institutionalized forms of networks, thus excluding both event-based or ad-hoc networks, but also city-to-city co-operations such as city twinning initiatives. Accordingly, Busch et al. (2018) find as some of the characteristics of a TMN that "a network is more than a city partnership" and "the network has its own staff and physical address" (Busch et al. 2018: 222). These considerations exclude non-institutionalized forms of city networks.

To get an overview of the networks active in urban climate action, I relied on several different listings compiled by other scholars (see Bansard et al. 2017; Keiner and Kim 2007; Widerberg and Pattberg 2019). These listings show that networks differ strongly – concerning the overall size of the network, the composition (global cities, city-regions, regions, towns, small villages etc.), organizational structures, administration, partners etc.

As I have pointed out in the theory chapter, knowledge is never neutral and understood in the same way by everyone. Rather, knowledge is always the product of a specific representation of the world which in turn shapes the ways humans choose to live in it and govern it (Jasanoff 2004). Simultaneously, knowledge influences and shapes the environment

in which it is produced and used in. Hence, differing structures and purposes of the TMNs most probably influence how the respective network knows climate change. Therefore, I wanted to investigate the way how climate change is known by two relatively different networks which are at the same time clearly focusing on climate change as their main issue area.

With these considerations in mind, I re-read the existing literature on climate-related city networks as well as searched on TMNs' webpages which networks could be potentially interesting for my research. After consulting the different existing lists (Bansard et al. 2017; Haupt and Coppola 2019; Keiner and Kim 2007; Widerberg and Pattberg 2019), I decided to include the following two TMNs: **C40 Cities** and **Climate Alliance**. This means that I include two networks which are globally active while having different geographical foci. They further differ concerning the aspects of size, organizational structure, their main purpose and functions (see Table 3). Their knowledge production environment is thus quite different.

Network	**Members**[2]			**Goal**
C40 Cities	96	Global	Megacities and Innovator cities	„addressing climate change" → Zero CO_2 emissions by 2050
Climate Alliance	1734[3]	Europe and Latin America	European local entities	Halving per capita GHG emissions by 2030 from 1990 levels

Table 3: Overview selected networks
(Sources: Widerberg and Pattberg 2019, Widerberg et al. 2016 and Bansard et al. 2017, Haupt and Coppolla 2019; own presentation)

In the following, I introduce the two networks and their history in further detail.

5.2.1 C40 Cities Climate Leadership Group

The 'C40 Cities Climate Leadership Group', short C40, was founded in 2005 by the then-Mayor of London Ken Livingstone and representatives from 18 further metropolises. The network was intended to embody an alternative initiative to the G8 Gleneagles summit on climate change (Bulkeley 2010: 233). It emerged out of a two-days 'World Cities Leadership and Climate Summit' which was convened in cooperation with the network ICLEI and the British NGO 'The Climate Group' and initially was called C20 Partnership (Acuto 2013a: 839). From the beginning, the focus of C40 laid on big cities, the argument being that these major world cities were not "lacking the ability to tackle climate change: rather, these metropolises were already pioneering best practices in this field and the drawback was instead to be found in their limitations in exchanging expertise and coordinating efforts" (Acuto and Steele 2013:

[2] As of January 2019
[3] 1734 members in total, therein 1454 full members, 215 associated municipalities and 65 associated members (see ClimateAlliance 2019d).

840). In 2006, the network started a partnership with the foundation 'Clinton Climate Initiative' and expanded its membership to include 40 of the largest cities worldwide, changing its name to 'C40 Cities Climate Leadership Group' (Bouteligier 2014: 62; Bulkeley 2010: 233). Today, and by now including 96 (mega-)cities, the rationale of vast demographic reach and wanting to impact as many people as possible (Acuto 2013a: 841) continues to play an important role for C40, highlighting that it represents "700+ million citizens and one quarter of the global economy" (C40 2017). The nowadays 96 members are cities on all continents making C40 a network operating globally (see C40 2019a). However, the membership structure is particular: C40 classifies its member cities in three categories: 1. 'Megacities', 2. 'Innovator Cities' and 3. 'Observer Cities'. 'Megacities' are cities with a population of more than 3 million people or a metropolitan area with a population of at least 10 million or one of the 25 global cities ranked by gross domestic product (GDP). 'Innovator Cities' are cities which are not megacities but which are considered to have shown internationally recognized leadership in the field of climate or environmental sustainability. 'Observer Cities' are either new cities applying for C40 membership for up to one year until they meet the membership requirements, or cities which meet membership requirements but are unable to approve their participation within one year (C40 2019a; Gordon 2016a: 13). According to its own statements, C40 counts 24 of the 30 largest megacities worldwide amongst its members (Haupt and Coppola 2019: 12).

The network not only connects its member cities but is characterized by close partnerships with state and private actors (Bulkeley 2010: 233). Private actors range from enterprises such as Microsoft, producing software for GHG emissions accounting (Bulkeley 2010), to philanthropic organizations, such as the Clinton Climate Initiative, the Bloomberg Philanthropies and other wealthy philanthropist donors like Realdania and the Children's Investment Fund Foundation – listed as 'strategic funders' (C40 2019c; K. e. a. Fischer 2015: 19). Other donors are for example the engineering firm Arup, the Citi Foundation, the pharmaceutical company Johnson&Johnson, but also state actors such as the Ministry of Foreign Affairs of Denmark or the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (C40 2019c). Other than that, C40 also collaborates with a range of other TMNs such as the United Cities and Local Governments (UCLG), 100 Resilient Cities, or ICLEI (C40 2019c).

The purpose of C40 is formulated widely as consisting in "addressing climate change" (C40 2017). However, what this concretely means remains unspecified. Accordingly, C40 does not set its members any binding quantified emission reduction targets (Bansard et al. 2017: 238). However, C40 highlights that emission reductions would be necessary to reach this goal of addressing climate change: "Emissions need to peak by 2020 and fall rapidly after that. Average per capita emissions across C40 member cities need to drop from the current level

of 5.3 tonnes CO2 per person to around 2.9 tonnes by 2030 and to zero by 2050" (C40 2018: 8). As it solely addresses urban climate action, C40 can be seen as a single-purpose network.

C40 defines its role in the following way: "C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change" (C40 2017). Accordingly, C40's primary function is described with the keywords 'information and networking' (Widerberg et al. 2016: 16). This means that C40 is primarily providing technical consulting, possibilities for training and capacity-building, shares information and supports local governments (Widerberg et al. 2016: 14). However, the setting of mandatory compliance standards is not part of its activities.

Its structural organization is split up between the Chair, the Board of Directors, a Steering Committee and a management team, led by an Executive Director. The Chair is the elected leader of the C40 network and mainly has a representative, and advocating role. He or she is one of the member cities' mayors and is assisted by eleven Vice-chairs, all of whom are member cities' mayors as well (C40 2017). The Board of Directors "oversees the management and day-to-day activities of the organization" (C40 2018: 45) and is composed of eight members. These are either representatives of member cities or partner organizations' representatives. Accordingly, Bloomberg Philanthropies, the Children's Investment Fund Foundation, Realdania, and the Clinton Foundation are represented in the Board of Directors (C40 2018: 45). One of the main governance bodies is thus composed both of elected member representatives, as well as unelected non-municipal stakeholders (Haupt and Coppola 2019: 8f). The Steering Committee is responsible for the "strategic direction and governance for C40" (C40 2017). It is composed of member city mayors who join the Steering Committee in rotation (C40 2017). The management team is led by an Executive Director and a Deputy Executive Director with their respective own offices. Staff of the management team is responsible for day-to-day organization and management and operates in different locations worldwide (C40 2019b): C40's headquarters are based in New York City yet it also runs five other offices in London, Rio de Janeiro, Copenhagen, Paris, as well as Beijing (C40 2018: 42). In addition, individual staff is based in more than 25 locations worldwide (C40 2019b).

5.2.2 Climate Alliance of European Cities with Indigenous Rainforest Peoples

The network 'Climate Alliance of European Cities with Indigenous Rainforest Peoples' – or Climate Alliance for short – was founded in 1990 as a bottom-up initiative in Germany (Kern and Bulkeley 2009: 316). The founding members are twelve German, Austrian and Swiss municipalities, six indigenous NGOs and representatives from other organizations (e.g. NGOs or Universities) (Busch 2015: 219). Especially in its early years, Climate Alliance was a German-speaking network with ties to German development assistance actors (Busch 2015:

219) and still today a great share of its members are German-speaking municipalities (795 full members from Austria and 488 full members from Germany (see ClimateAlliance (2019d)). However, through the collaboration with COICA (Coordinadora de las Organizaciones Indígenas de la Cuenca Amazónica)[4] the geographical scope of the networks spans both Europe and Latin America. Considering the number of memberships, Climate Alliance presents itself as the largest TMN active in climate governance (ClimateAlliance 2019g). Members are foremost local governments. However, Climate Alliance also accepts other legal entities (Busch 2015: 217), and lists 'cities, municipalities and districts as well as provinces, NGOs and other organisations' as members (ClimateAlliance 2019g). Concerning its partners, Climate Alliance is closely tied to another city network – the Global Covenant of Mayors. Busch (2015: 226) notes that Climate Alliance (along with the networks Energy Cities and Mayors Adapt) shares an office in Brussels and even common staff, as Climate Alliance together with other TMNs coordinates the office of the Covenant of Mayors (ClimateAlliance 2019h). The two closest partners of Climate Alliance are thus COICA, as well as the Global Covenant of Mayors for Climate & Energy. Concerning partnerships, Climate Alliance is a particular case because – next to its collaboration with other TMNs – COICA is the only official partner it is working with (Haupt and Coppola 2019: 10).

Climate Alliance states as its goal "the continuous reduction of (…) greenhouse gas emissions, pledging to cut emissions by 10 percent every 5 years, equivalent to a halving of per capita emissions by 2030 from 1990 levels" (ClimateAlliance 2019e). At the same time, Climate Alliance is particular in its approach. It explicitly addresses not only municipalities in the Global North (on this issue see Bansard et al. (2017)) but also includes indigenous peoples from the Amazon basin and therefore, its aim is not only to cut GHG emissions but to realize both mitigation as well as adaptation in what it considers a holistic approach, following the five principles 'fair', 'nature-based', 'local', 'resource-saving', and 'diverse' (ClimateAlliance 2019f). In line with its principles, Climate Alliance asks its municipal members to enter "into a moral partnership with the inhabitants of the Amazon basin" (Haupt and Coppola 2019: 10). Because of the close partnership with COICA, Climate Alliance not only addresses urban climate action but also issues concerning forests (Widerberg and Pattberg 2019). It is hence a multi-purpose network (see Acuto and Rayner 2016: 1153).

Referring to the clear-cut goals and standards, Climate Alliance's primary function is described with the keywords 'standards and commitments' (Widerberg et al. 2016: 16), meaning that it requires mandatory compliance from its members, sets standards for

[4] COICA holds a seat in the Climate Alliance Executive Board

measurement and reporting, as well as for the quality of projects and asks for voluntary commitments (Widerberg et al. 2016: 14).

Organizationally, Climate Alliance is structured into an Executive Board, the European Secretariat and several Coordination Offices. The Executive Board is composed of 13 representatives from different member municipalities, as well as one COICA representative, which are all elected at the annual General Assembly of the members for a period of two years. The main governance body thus includes only elected member representatives (Haupt and Coppola 2019: 8f). The European Secretariat serves as the coordinating and communicating body and organizes the annual general member assembly. The headquarters are based in Frankfurt am Main in Germany, with a representation office in Brussels. The Coordination Offices serve as coordinators for the members in the respective region they are located in. Climate Alliance has Coordination Offices in Austria, Germany, Hungary, Italy, Luxembourg and Switzerland (ClimateAlliance 2019h).

After having presented the two networks, in the following section I explain the material I consulted for my analysis as well as how exactly I proceeded.

5.3 Data generation

For interpretive research, data is nothing that is to be 'collected' but rather something that is 'generated' (see Schwartz-Shea and Yanow 2013: 147ff). Rather than being 'out there' and waiting to be picked by the researcher, "data […] are made in concrete settings as a result of encounters with humans and non-humans" (Bliesemann de Guevara and Kurowska 2020: 1223). Applied to my approach, this means that I have been thinking about places where to start generating data while at the same time, the actual composition of the data I would finally generate through the process of analysis was not entirely foreseeable from the beginning. So, I started by asking myself: where could I learn about the knowledge of city networks that I wanted to investigate?

As I have outlined in the theory chapter, knowing something according to my definition is a complex interplay of different knowledge forms present in daily-life knowledge, scientific concepts, practical interpretations or philosophical systems. Hence, I see knowledge as a cognitive system made up of definitional knowledge, conceptual knowledge, problem-solving knowledge and critical knowledge, where each of these dimensions can be explicit or implicit. So where can these knowledge forms be identified? Based on my understanding of knowledge, these forms could be identified in everything that TMNs provide to their members. But of course, also in material they use themselves to produce their respective offers. Hence, I thought from the beginning that it would be important to not only gather material TMNs publish

themselves but also to ask where this material comes from and how and by whom it has been produced.

To start, I chose to think about where I would turn to if I would work in a city administration and wanted to find out about what my city network provides in terms of X or Y. The first thing that came to my mind was to go to the networks' webpages and see what they publish online in terms of consulting material. But why do I think that these online documents are not only informative for city staff but are also a possibility to grasp how city networks know climate change? Because documents are "knowledge-made material" (Shankar et al. 2017: 64), and can thus be perfectly used to reproduce how the networks know climate change.

In the following, I describe the different data that I generated as well as the ways of how I did this before turning to the process of analysis. However, I agree that the dichotomy of generating and subsequently analyzing data is a rather artificial one while, in practice, these processes are directly intertwined (Yanow and Schwartz-Shea 2015: 255). Nevertheless, to avoid disrupting the reading flow, I stick to this consecutive structure.

5.3.1 Consulting material on TMN websites

In a first step, I looked at the websites of the two networks to get an idea of what networks are providing to their members. Acuto and Rayner (2016) highlight that city networks are producing "a vast variety of documentation, policy, collaborative pilots and more (…)" (p. 1163). The range of material provided is thus broad. To start, I focused on the consulting material published online. Hereby, I explicitly considered the general and introductory documents and did not take into account the actual tools or platforms suggesting concrete solutions in a step-by-step manner. As I am mainly interested in the way the networks know climate change in general, the detailed investigation of the rather technical tools was not necessary. However, what I actually included in my analysis were documents that have been published online by the networks themselves, but authored by city networks' partners (either exclusively or in collaboration with the respective network). As the networks actively publish these materials, I see them as forming part of their way of knowing and thus wanted to investigate them as well.

I collected the consulting material by browsing each website and downloading the respective documents. While doing so, I only used the material currently available on the website. The range of material analyzed is thus a snapshot in time. Though, as member cities would access the same range of material at the same point in time, relying on the documents available is reasonable enough.

Each network has different sections on its website where consulting material is provided.

C40 has a section called 'Research library' where all kinds of consulting documents as well as links to further consulting websites are published (C40 2019d). As with Climate Alliance, I

concentrated on documents and did not take into further account the websites or interactive tools.

Climate Alliance has two sections containing consulting material: 'Tools and methods' and 'Downloads' (ClimateAlliance 2019b). A further section, called 'Resolutions' was of great interest as these "serve as strong political instruments of change in the association's political work and guide members" (ClimateAlliance 2019c) and as such can be very telling in terms of how climate change is known.

In total, I gathered 105 documents. As of April 30, 2019, Climate Alliance had published 52 documents, including 20 resolutions. The C40 Research library listed 53 documents and websites. However, it has not been necessary to analyze the whole amount of documents gathered. I return to this issue when explaining my process of analysis.

I want to highlight that – in line with my methodological approach, as well as the theoretical background based on STS – I do not assume that the meaning of a document is automatically contained within them and that this meaning is always self-evident and straightforward (Shankar et al. 2017: 60). Rather, "depending on the context and the background knowledge writers and readers bring to bear, the meaning of a document and its power to explicate specific uses may change, whatever the self-explicating intentions of an author might be" (Shankar et al. 2017: 71). Therefore, as a researcher with a specific intention in mind, I might not have selected these documents exactly as a municipality's staff looking for information.

5.3.2 Interviews with TMN staff

In a second step of data generation, I conducted interviews with TMN representatives involved in knowledge production and provision processes. My intention in drawing on interviews as a way to generate data was the following: interviews provide a good opportunity to explore beliefs, motivations and processes of decision-making (Harrison and Callan 2013: 72). I hoped that these interviews would enable me to trace (at least parts of) the processes of knowledge production within the networks. Hence, the interviews served the goal of identifying how the networks themselves have come to hold the knowledge they provide, and which aspects influence their way of knowing climate change.

I did not want my interviews to become standardized situations in which all interview partners are asked the same questions and would answer them similar to a survey. Rather, I thought of questions individually, inspired by questions that emerged while I was analyzing the documents of the respective network. Also, I further developed spontaneous questions adapted to the respective interview situation and partner. Because of this approach, I hoped for my interviews to develop in a more natural and exchanging way – similar to a natural conversation (Yanow and Schwartz-Shea 2015: 149ff). This approach fits perfectly to my aim

of finding out about TMN staff's basic assumptions about knowledge and climate change as co-constitutive of what they produce in the name of their network. Accordingly, it is easier to detect nuances in meaning and normative assumptions of people when listening to them carefully and inquiring them situationally – instead of in a standardized way (Soss 2015). This was an aspect that I was satisfied with after having conducted my interviews. However, there were also some issues concerning interviews as a way to generate information. Accordingly, my initial aim of actually understanding deeply the knowledge production process within the two networks had to be shifted – I realized that these information were hardly accessible for me as an 'outsider'. Further, I could only conduct three interviews in total, one with Climate Alliance staff and two with different C40 staff. Especially because of the pandemic situation throughout the whole year 2020, TMN staff were very busy in trying to position their networks as solution-providers for the 'after-COVID' times. Therefore, many of the people I contacted declined to be interviewed. Nonetheless, the information I received in the interviews I did conduct, was still very interesting and relevant. I used it as background information to my document analysis to reinforce some aspects that would not have been that obvious without the interviews. However, as this information is based on a small number of informants, it should be treated rather cautiously.

5.4 Data analysis

According to my understanding of a research process, there is no strict separation between generating data to analyze and the analysis itself. Rather, these steps are iterative and the researcher starts the process of analysis as soon as she first gets in touch with her research material (see Yanow and Schwartz-Shea 2015: 255ff). So I did already scan some of the documents when downloading them to get a first impression, but without further analyzing the content. For the analysis itself, I followed a clearly defined process after this first and short scanning of the material.

The goal of the analysis was to be able to understand what the different knowledge forms look like for each network. In order to structure this interpretive process, I divided the analysis in two steps: firstly, the analysis of the consulting documents and subsequently, the analysis of the interviews as background to my document analysis.

I want to highlight that these analyses are subjective – because every research is value-laden and embedded (see Leander 2015; Yanow and Schwartz-Shea 2015). However, this does not have to be seen as problematic (Leander 2015). Why am I highlighting this? Because by researching knowledge in climate policies, I am confronted with a multitude of different interpretations on different levels. Hence, I as a researcher, am part of a cumulative process of interpretations as it is highlighted in the following quote:

> For one thing, the action and the inaction of environmentally-oriented civil as well as political actors depends on interpretations. Accordingly, these actors interpret the ecological changes that happen in real-world systems by referring to scientific findings or else to their own everyday observations *as* environmental problems and develop ideas of how to act upon them. These 'first order' interpretations which manifest themselves in social interactions and in different environmental-political phenomena – ranging from conflictual disputes about resources to the cooperative formulation of environmental and sustainability policy strategies – are in turn interpreted and analyzed by environmental policy researchers on the basis of certain theories, concepts, or norms (Bornemann et al. 2019: 2, author's translation).

The 'first order' interpretations outlined in this quote can be tied back to the different forms of knowledge: the interpretation of observable ecological changes as an environmental problem is a form of definitional knowledge which in turn creates but also builds upon conceptual knowledge in the form of scientific findings or one's own daily observations. The ideas of how to react to these problems are in turn a form of problem-solving knowledge. These first order interpretations, which I divide into different 'forms of knowledge' are in turn interpreted by me as a researcher who again, is influenced by my definitional, conceptual, problem-solving, as well as critical knowledge. Hence, my analysis is, again, another form of interpretation, a 'second order' interpretation – a phenomenon which has been called 'double hermeneutic' (Giddens 1986). Therefore, it important to transparently disclose and reflect upon what I did, how I did it and what I had in mind doing it (Barbehön et al. 2019):

Throughout the different steps of analysis, I wanted to outline how the different forms of knowledge are composed and arranged. For this purpose, I wanted to grasp the content of the generated material in the sense of capturing, thus, describing, its content.

Yanow and Schwartz-Shea (2015) describe methods aimed at the interpretation of different material as "(…) reading habits and practices" (p. 255). What I was looking for was thus a way of reading the gathered consulting material and structuring my own interpretations. This structuring aspect is important as Yanow (2003) highlights: "Even though interpretative methods emphasize the centrality of human interpretation and, hence, subjective meaning – that is, meaning to the 'subject,' the actor and/or the researcher – they are, nonetheless, a method: systematic, step-wise, methodical" (p. 241).

I finally realized a content analysis of the documents, combined with an analysis of the interviews.

5.4.1 Content analysis of consultant material

To analyze the content of my documents, I firstly wanted to structure the questions I wanted to answer by analyzing said documents, and secondly, to capture my own interpretations of these to remember and draw upon them later. To start with, I wanted to have a guideline along

which to read the documents. Inspired by the guiding questions presented by Clare Ginger (2006: 346ff), I composed a 'questionnaire' for analysis aiming at identifying the underlying perspectives, identities, values, and ideas, which together decide upon how climate change is being known. Documents actually refer to the different practices, objects, knowledge forms etc. that influenced their production (Shankar et al. 2017: 62). My questionnaire contains different questions which I could answer while reading documents I had saved earlier (for an easier overview of the questionnaire see the appendix). Here, I want to present the questions and elaborate on my considerations for asking them.

The first question is 'what storyline(s) is (are) evident in the document?'. I am asking this question to get a first idea of the overall story the respective city network is telling about climate change. By distilling the main storyline from different documents, I hoped that I would be able to understand if this story is one that is prevailing throughout several documents, or if different storylines are told differently according to the respective document. This question thus targeted especially at identifying the present perspective on climate change. An example for a storyline summarized by me is the following:

> Climate action has to be thought of as a multifaceted problem. Therefore, it has to be seen as a problem affecting all and everything around the world. If the goal is a sustainable future for all, different aspects have to be taken into account: social justice (on a global and local level), the ecological boundaries of the earth and economic development.

This is the storyline that I generated from the Climate Alliance document 'The Future We Want. Bridging Europe and Amazonia' (ClimateAlliance 2017d). Especially for longer documents, it was sometimes hard to compose one overarching storyline. In this case, I formulated several storylines.

The second question is 'what is the communication purpose or message of the document?'. The idea of this question is to summarize the intention laying behind the production of the respective document. By asking this question, I wanted to think about why the network could have published this document. The aim was thus to identify if there was an inherent call to action in the document, and if so which one. I hoped that by thinking about these aspects, it would become easier to identify the respective climate actions that the network is proposing, but also to get an idea of the arguments why climate change should be dealt with.

The third question 'who are the subjects and what is the target group, and what relationships between or among them does the storyline convey?' was targeted at identifying the subjects and objects of climate change and climate action. By answering this question, I thought about who the networks consider to be rightfully placed for doing what, and also who is affected by these actions. But also the broader question of who is 'responsible' for climate change, and who is particularly affected by the effects, plays into this query. The part on the

relationship between subjects and objects was aiming both at thinking about the networks' own identity as governance actors but also about values. I understand values here, for example, as normative questions of responsibility or fairness.

The goal of the fourth question – 'what information is present in (and absent from) the document?' – was to find out what the two TMNs consider relevant (enough) to be part of the documents they publish to advise their members. Therefore, the question could also reveal what the networks see as important for their addressees. When composing the questionnaire, I thought that further questions such as 'how is information presented?', or 'how is selected information related to the storyline?' would add to the initial question. Therefore, I included them as sub-questions and tried to answer them wherever possible. Especially the last sub-question 'which normative positions are reflected in the document?' was important for my aims as I assumed that it would be most telling in terms of identity and values. Here, I also hoped that I would be able to identify what the respective network sees as being at stake in face of climate change. Whereas it was relatively easy to answer this question in most Climate Alliance documents, I sometimes struggled during the analysis of C40 documents. To give an example: in the document 'Benefits of Climate Action. Piloting A Global Approach to Measurement' (C40 2016a), I identified as one of C40's normative positions a belief in 'cost-benefit ratio', in the sense of 'if a measure has an economically validated benefit, it should be implemented'. However, I was struggling if this is really a 'normative' position. I decided for 'yes' in cases where my answer anyways helped me to identify values or specific identities, regardless of the attribution as a 'normative' position.

With the fifth question – 'how are stories and arguments in the document related to broader (policy) contexts?' – I wanted to identify how the network positions itself and its suggested actions in relation to other actors and policies. With this question I thus wanted to especially focus on network-external actors and policies mentioned in the document, to identify the respective relationship with these.

Initially, I included three other questions in my questionnaire: 'who made decisions about the document?', 'who produced the document, and what is the nature of their roles and relationships in the context of the document and the more general policy context?', and 'how was the document produced?'. However, I realized that these questions were nearly impossible to answer only by relying on the documents. Therefore, I mainly focused on the question 'who produced the document', understood as the authors of the document. This was already interesting as I could thereby get an impression if most documents were published by the network itself, or if most were published in cooperation with other actors, or even solely by third parties but published on TMNs' websites.

During the analysis of the first few documents, I realized that there were still some aspects that I found very interesting, but which were not captured by the initial questionnaire. Therefore, I included another, very open question with which I could capture such aspects: 'is there anything else that strikes me as important?' To explicate what this question was getting at, I want to give another example from the document 'Benefits of Climate Action. Piloting A Global Approach to Measurement' (C40 2016a). Here, I filled the question with the following answer:

> Environmental benefits are the last section that is presented (1. Economic 2. Social 3. Environmental) even though it is about climate action (suggesting a little bit that the purpose of implementing climate actions might be different, namely to generate economic gains).

To summarize, the questionnaire helped me understand what the respective documents are about, but also what they are aiming for, and to whom they are addressed. After having understood these aspects, it was then easier to relate (parts of) the documents to the different knowledge forms outlined before (in chapter 4). After having filled in the questionnaire, I associated the content with the four forms of knowledge. As these assignments to one of the four forms of knowledge per se do not tell us anything about the particular characteristic of said form (but just that the marked part is e.g. definitional knowledge), I came up with 'titles' of the specific form, for example 'keeping climate change well below 2°C' or 'climate actions as beneficial for other issue areas', as specific sub-categories of definitional and problem-solving knowledge.

I created an Excel sheet containing the four main categories (= the four forms of knowledge). Within each category, I then clustered the respective titles I had gathered after having filled in the questionnaire for 15 documents (for example 'keeping temperature rise well below 2°C' or 'climate actions are beneficial to other issue areas').

I numbered the documents in the sequence of analysis and analyzed them alternatingly for the two networks. After having analyzed the first 15 documents, I assessed that I had collected enough aspects of each knowledge form. That meant that I didn't fill in the questionnaire for each document to become aware of what I could draw from it for my analysis. From then on, I just read the documents, highlighted interesting parts and annotated them. After having treated each document that way, I went back to the Excel sheet to transfer the aspects I had detected in the latest document. If I had the impression that this aspect was not yet included in my spreadsheet, I added a new characteristic.

After a while, I realized that some characteristics covered similar aspects of knowing. Therefore, I also gathered aspects in the spreadsheet which served at clustering all the different characteristics I found. Examples for such aspects are 'Defining climate change as a problem of temperature', covering titles such as 'Keeping temperature rise well below 2°C' and

'Warming of 1.5°C in comparison to warming of 2°C makes a big difference'; or 'Defining climate action as multi-beneficial' for titles such as 'Climate actions are beneficial for other issue areas' and 'Climate actions should be sold as success stories'. Accordingly, I had collected an overview of the different characteristics of the knowledge forms I found in the documents, related overarching aspects and in which documents I found these characteristics. The following table contains an extract of the respective Excel sheet for better illustration (Table 4):

	C40 'titles'	Climate Alliance 'titles'	'Aspect'
Definitional dimension of knowledge (perspectives, identities, values, norms --> why should climate change be dealt with?)	keeping temperature rise well below 2°C (e.g. Doc. 1; Doc. 3; Doc. 11; Doc. 38; Doc. 40)	keeping global warming to 1.5°C globally (Doc. 14	Defining climate change as problem of temperatures
	Cities leading role (e.g. Doc. 12; Doc. 15; Doc. 16; Doc. 18 (p. 16); Doc. 21; Doc. 26; Doc. 32; Doc. 34; Doc. 38	Cities should lead by example (e.g. Doc. 14)	Defining climate change as an urban problem
	Urban areas as one of the most significant areas where change is needed to reach the global goal of limiting global warming to 1.5°C (e.g. Doc. 11; Doc. 12, Doc. 16; Doc. 18)	Importance of the urban level (however: highlighting that it is not the only one needed and that actions so far and not far-reaching enough) (e.g. Doc. 14; Doc. 17; Doc. 29; Doc. 35; Doc. 39)	Defining climate change as an urban problem

Table 4: Illustrative table used for content analysis

Sometimes it was not easy to clearly relate a title to one of the four knowledge forms. When I started out, I had for example included the title 'climate actions should be told as success story' in the cluster of 'definitional knowledge'. I did so because I assumed that this was a definition of climate actions as multi-beneficial, reflecting a particular perspective. However, when further thinking about it, I realized that the focus of these knowledge parts laid on climate *actions*, and their definition (in the sense of 'how to design climate actions'), rather than on the definition of climate change itself. Therefore, I shifted this aspect to the knowledge form

‘problem-solving knowledge’. Whenever I faced such difficult decisions, I went back to my definition of the four knowledge forms and their attributes (see Table 2) and checked which characteristics were fulfilled by the respective knowledge product. In the given example, this led me to realize that the respective knowledge product explained what was seen as an appropriate solution for dealing with the problem rather than the problem itself.

In parallel to this table, I ran a Word document in which I had introduced an overview of the aspects I had gathered (for example ‘defining climate change as an urban problem’). I copied parts, such as paragraphs or sentences, which were particularly characteristic for the respective aspect from the analyzed documents into the Word document. By doing so, I had gathered a solid basis of examples I could return to while committing my analysis to paper.

Throughout the process of analysis, I reduced the amount of 105 documents gathered in total to be analyzed to a final number of 59 documents. This limitation emerged naturally as I realized for instance that it did not make much sense for my specific research interests to analyze ‘tools’ (hence for example measurement databases or checklists for implementation of a certain policy etc.) because they were not so informative about how the respective network knows climate change. The same goes for annual reports – when analyzing the first annual report, I realized that it was simply a summary of statements, projects, suggestions etc. which were also presented in other documents. Therefore, I finally condensed the original list of 105 documents to a total amount of 59 documents – 27 C40 documents and 32 Climate Alliance documents. Amongst these documents are some documents that do not have the respective network as main author. However, if the network was listed as a co-author or contributor to the respective publication, I still included it in the analysis. For an overview of all documents analyzed see the appendix.

5.4.2 Background information from interviews with TMN staff

In a second step, I conducted and analyzed interviews with TMN staff. With these interviews, I wanted to find out different things: which knowledge do they themselves use for the production of the knowledge they provide and how is the knowledge they provide being produced? Which partner organizations and material do they refer to? How do the knowledge production processes look like? And, which actors play a role in these knowledge production and provision processes?

These questions require background information which cannot be found in documents. Therefore, I needed to talk directly to city network personnel.

Based on the analysis that I had already conducted in a first step, I was able to include my interpretations of the documents in my interview guidelines. As already mentioned above, I wanted the interviews to be as conversation-like as possible. Therefore, I developed particular

guiding questions for every interview and tried to adapt them to the natural flow of the interviews.

For analytical reasons, I decided to record and partly transcribe the interviews. I transcribed those parts of the interviews that seemed most crucial – hence, those parts in which interviewees either talked about the knowledge production process, or the knowledge that their city network provides in their point of view. I summarized and paraphrased the other parts of the interviews in order to be to return to them throughout the process of analysis. This was of particular importance when I reflected upon the differences in how the two networks know climate change. Therefore, the aspect of additional background information on several issues (not only those that I initially was most interested in) became more important than I expected in the beginning.

The interviews thus served the goal of providing background information to my document analysis. This means that I took the most relevant parts from the interviews to draw information from them and included them in my analysis and argumentation. Accordingly, I did not analyze the interviews in detail but rather took interesting aspects from the interviews as background information on how TMNs know climate change. The interviews throughout the analysis turned out to be especially valuable for the contextualization of how the two networks know climate change.

5.4.3 Generating empirical insights

After having generated and gone through my data once, I started the actual process of working with the generated material. By 'working with the generated material' I mean the process of reflecting about what empirical insights I could draw from the material and finally writing up these insights as analytical text. As already mentioned, I assume that data generation and analysis cannot be split up. This also pertains to the processes of analysis and committing them to paper (see e.g. Maynard-Moody and Musheno 2015). Much of the process of analysis already happens while generating data, as well as while explicitly thinking about how to analyze it and even still while writing it down. At the same time, trying to write down an analysis is a form of interpretation, involving new difficulties and further interpretations (Yanow 2014: 146; Yanow and Schwartz-Shea 2015). Therefore, the written presentation of my analysis – and thus the generation of my empirical insights – has again to be seen as an interpretive endeavor throughout which I myself continued to learn more about and make sense of my research topic. What exactly does one learn throughout this process? "Researchers expect to learn, for instance, how situated actors see the matter under investigation and what they consider meaningful in it" (Yanow 2014: 146) – in my case, I

expected to learn how the two different networks know climate change and what they therefore provide to their member cities.

As outlined above, the analysis of different city networks' knowledge did not aim at a structural comparison along predetermined concepts and points of comparison to avoid a "premature closure of inquiry" (Yanow 2014: 147). However, the initial questionnaire and the following procedure of analysis helped me in outlining differences and similarities amongst the two networks without having had to establish too many expectations from the beginning.

In order to do justice to the complexity of both networks' ways of knowing climate change, I present in detail the different aspects of how the respective network knows climate change in chapter 6. Here, I stick to a sequential arrangement based on the four forms of knowledge.

At the end of each section of chapter 6, I contextualized the different knowledge aspects with background information from existing academic literature. These contextualizations are supposed to give an idea of how the respective aspect of knowing can be explained. These explanations have to be seen as rather general contextualizations, asking how the respective knowledge aspects fits into the broader picture of global climate governance.

By committing to paper the data I generated, together with my interpretations thereof as well as general contextualizations, I generated the empirical insights of my research.

5.4.4 Comparative contextualization

As a last step of my empirical analysis, I contextualized the two ways of knowing climate change in a comparative way (see chapter 7.2). As I have already mentioned before, my aim from the beginning was not to structurally compare the two networks and their knowledge along predetermined concepts and points of comparison. Rather, what I aimed at was to make sense of the particularities and also singularities of each system of knowing, its objects and its subjects, etc. (see e.g. Yanow 2014: 145). As Boswell et al. (2019: 4) explain, even though not following an explicitly comparative approach, "interpretive researchers can and do make meaningful comparisons that speak to themes of general significance". As I had decided to analyze two different ways of knowing climate change from two different city networks, I wanted to see them in perspective, without loosing sight of the singularity of each of the two networks and their knowledge with their local and historical specificities. I understand comparison in this sense as an opportunity to outline the alternatives that are possible (see Boswell et al. 2019: 4). These 'alternatives that are possible' can reflect (parts of) the epistemic plurality of the respective knowledge object. In my case, I am reflecting upon alternative ways of how climate change can be known, even if the basis (climate change as an anthropogenic phenomenon) and the goal (limiting climate change as far as possible) seem to be very similar at first sight. Throughout my analysis, I realized that the composition of the two networks'

respective way of knowing is very different and thus embodies two *alternative* ways of knowing climate change.

To reflect these alternative ways of knowing in a comparative chapter (see chapter 7), I firstly summarized very briefly the results of my analysis. In a second step, I reflected upon why these two alternative ways emerge, by contextualizing the ways of knowing of the two networks and thinking about their consequences, in terms of possible imaginaries for the future.

Dvora Yanow (2014) highlights that it is important to try to understand the contextualized perspective of a situational actor. A full 'contextualization' of the knowledge used and produced by the two city networks would have meant to dive deeply into their structures, expose myself to their working processes etc. As the limitations of my research project did not allow for such a 'deep' analysis, I instead based my reflections on the provenances of the differences in particular on the information and points of view that city network staff shared with me during the interviews. Therefore, the contextualization that aimed at thinking about the provenances of the differences in knowing climate change differs from those contextualizations that I had already included in the empirical analysis (in chapter 6). Whereas these first contextualizations are meant to show how the respective knowledge aspects fit into the broader context of global climate governance, the comparative contextualizations are network-specific contextualizations. These focus on the respective knowledge environment. I thus considered the very specific environment in which the two networks know, by asking how this environment is structured and how it has come into being. These knowledge environments are understood as co-producing the respective way of knowing.

To be very clear, the question here is no attempt to actually draw causal relations between two ends. Rather, it is an attempt to understand why particular actors behave in the way they do in particular contexts:

> In our view, methodological interpretivists seek understanding within specific settings: how the actors in them understand their contexts, explicitly and/or tacitly, and why they conduct themselves in particular ways. This 'why' takes the form of 'constitutive' causality, which engages how humans conceive of their worlds, the language they use to describe them, and other elements constituting that social world, which make possible or impossible the interactions they pursue (Schwartz-Shea and Yanow 2013: 52).

The aim of a reflection on provenances of the differences in the ways how climate change is known is thus to understand how the two networks themselves understand the context in which they produce knowledge and in which they act upon climate change. Accordingly, Boswell et al. (2019) argue that if we try to understand how the actors themselves see the choices and questions they face, we can outline their contextual webs. As a consequence, we

are able to think about how it is possible for actors to do what they do. In fact, Boswell et al. (2019) find that "the most obvious misconception about the interpretive approach is that it aims only to understand actions and practices, not explain them" (p. 23). Rather, they argue that also interpretively inspired research can very well assume that people act for reasons, and that the aim of interpretive research is to uncover these reasons (Boswell et al. 2019: 24). However, 'reason' (or 'provenance' as I use it) should not be seen as a law-like, generalizable rule. They are to be seen as 'plausible conjectures', 'plausible' because they rest on good reasons drawn from relevant information (Boswell et al. 2019: 30). My aim in contextualizing the two ways of knowing and thinking about their provenances was thus the attempt to uncover plausible reasons for why the two networks know climate change the way they do.

Further, the contextualization of knowing has to be seen in the theoretical context of knowledge being defined as a co-produced social product constantly shaping and being shaped by its environment (see chapter 3). Thus, the question of the provenance of the two ways of how climate change is known is also an attempt to understand this shaping and shaped environment, respectively to contextualize my preceding analysis.

As a final step of the process I call 'comparative contextualization', I focused on the particular consequences which the two ways of knowing might have, in particular with a view on the future visions they target. I did so, firstly, by generally outlining the respective future vision that each of the two networks project with their respective way of knowing. Visions of the future can have strong en- or disabling effects for social transformations (Jasanoff 2015b: 323). As such, they might strongly influence if and how the networks' member cities are transforming. To outline the two networks' future visions, I presented different pathways for transformation (Scoones et al. 2015), and looked for the commonalities of these pathways with the two TMNs' way of knowing.

To complete the 'comparative contextualization' of the two ways of knowing, I included a last sub-chapter in which I analyzed two exemplary member cities' climate policy (communication) documents to get an idea of how the respective way of knowing has 'traveled' between a network and its member city. The aim of this was to spot the two ways of knowing beyond the network, in its member cities' climate policies. As an encompassing analysis of several different member cities of each network was not possible in the framework of this thesis, I chose one exemplary city for each network. Before doing so, I decided that I wanted to analyze cities which have approximately the same number of inhabitants, are based in a similar geographical region (widely understood as e.g. Europe or Asia), and, most crucially, which are a member in only one of the two TMNs, not in both at the same time. Another restriction to my choice was that I needed to understand the published documents language-wise.

With all these considerations in mind, I chose Copenhagen as an exemplary city for the C40 network and Munich as an exemplary city for Climate Alliance. As of 2020, the Greater Copenhagen area had around 1.8 million inhabitants (RegionH 2020), whereas Munich had around 1.6 million (München 2020a). Further, both cities have agreed on a climate action plan outlining the cities' climate policies for the next couple of years (CPH 2012; München 2018).

I assumed that the respective climate action plan could be a rich source for finding in how far a respective way of knowing is present in a city's climate policy. The reason for this assumption is that these plans both show how the city understands the problem, and what it wants to do about it. I opted for documents instead of interviews as my focus was on the final climate strategy that different urban stakeholders had commonly agreed on, and which consequently serves as a guideline for all actors involved in the respective cities' climate governance. If I had chosen interviews, I would indeed have gotten an insight into how this final strategy had been agreed on. However, for my aim of analyzing the respective *city*'s way of knowing climate change, the focus on the final strategic climate policy documents is more useful than singular opinions on this strategy, or on the production process of these.

To find each cities' climate policy documents, or documents in which they communicate their climate policies, I browsed each cities' websites and downloaded the relevant documents. Accordingly, I found four documents for each city which were of interest for my purposes. These documents are not the whole amount of publications available on each cities' website, however, they are representative for my study as they all deal with the city's climate plan. Other documents, for example, presenting the city's climate managers' work were not of interest for this study and therefore were not taken into account.

To analyze the two cities' documents, I read them in two rounds. In the first round, I wanted to get an idea of what cities present, and highlighted parts seemed particularly interesting with regards to the cities' way of knowing climate change. In a second round, I re-read the highlighted parts to see whether, and if so, how they reflected the particular networks' way of knowing. To relate both the networks' and the cities' way of knowing, I prepared a table in which I had introduced all aspects of knowing identified for the two networks (similar to Table 5 in chapter 7.1), and added quotes which, according to my interpretation, reflected these aspects of knowing climate change.

In Copenhagen's case, the documents were available in Danish and in English, in Munich's case they were only available in German. Therefore, I analyzed Copenhagen's English documents and Munich's German documents. This means that to quote some parts of Munich's documents for this study, I had to translate them into English.

A list of all the documents analyzed for this last step of comparatively contextualizing the two TMNs' ways of knowing climate change, can be found in the appendix.

5.5 Summary

To summarize my methodological approach, I want to go back to the questions that I was asking myself when starting out with my research.

The first question was: which general research design suits me best for my investigation of how TMNs know climate change?

Throughout this chapter I have explained my research approach which was broadly inspired by interpretive research. Interpretive research places meanings and the making of such meanings at the core of research. As I am interested in how transnational city networks make sense of climate change in terms of knowing it, seeking inspiration from interpretive researchers' approaches seemed well-suited to me. I chose to analyze two TMNs and their way of knowing climate change by analyzing their consulting material published online, as well as drawing background information from interviews with TMN staff.

The second question was: how is it possible to analyze the different forms of knowledge?

My approach to this question developed throughout the research process itself. I started out with the idea of analyzing the gathered documents with a guiding questionnaire helping me to relate parts of the documents to my four forms of knowledge. Realizing that this does not suffice to say anything about the differences and similarities in how the two networks know climate change, I switched to an approach where I developed 'titles' for different knowledge parts that fitted into my four knowledge forms. These titles were then, insofar as possible, summarized with an overarching and summarizing 'aspect'. The initial questionnaire helped me to get started whereas I switched to a less strictly organized way of analyzing the documents after the first 15 documents.

And the third question was: how can I observe the production of these knowledge forms?

My idea was to get information on how the networks produce knowledge from the interviews with TMN staff. However, this aim was rather difficult to achieve. The staff members did not inform me in detail about internal processes and I could therefore only gather marginal information about the knowledge production processes themselves. However, the interviews still provided me with valuable background information that I could use to better understand what I analyzed in my first step during the document analysis and to finally contextualize the respective ways of knowing.

6 Empirical insights: alternative ways of knowing climate change

In what follows, I outline in detail the main aspects of how the two networks know climate change. I do so by firstly presenting a sentence summarizing in a nutshell the respective way of knowing, or the 'story' that the two networks are telling about climate change, as Onuf (2007) calls it. As explained in the theoretical part of this thesis, knowing something takes place via different forms of knowledge, which can be captured by the four forms of definitional, conceptual, problem-solving and critical knowledge. Therefore, the chapters analyzing the two ways of knowing are structured along these four forms of knowledge. I firstly present C40's way of knowing climate change, before outlining Climate Alliance's way of knowing in the second part of this chapter.

The result of my empirical analysis is that the two networks have two alternative ways of knowing climate change.

6.1 Climate change as meteorological phenomenon – C40's way of knowing climate change

Condensed to a very short and simplifying sentence, C40's main climate change story can be summarized in the following way:

> Climate change is a meteorological phenomenon, which is to be addressed in particular by cities and urban areas with techno-managerial means which are not only beneficial for climate protection but also other issue areas.

This sentence is based on my findings that C40 – in terms of definitional knowledge – knows climate change as a matter of scientifically measurable and explainable temperature developments, which is foremost an urban problem caused by and strongly hitting cities and urban areas. Conceptually, C40 bases its knowledge on approaches and data considered scientific. Further, concepts such as 'carbon neutrality' and 'green growth' (assessed as part of what is described as 'techno-managerialism' by some authors (see Lövbrand et al. 2015; Swyngedouw 2013)) play an important role. And, finally, C40 suggests as solutions to this problem to rely on technological means which are at the same time beneficial for various problems and which are also financially rational.

6.1.1 Definitional knowledge: climate change as a meteorological and urban problem

Analyzing the definitional dimension of knowing climate change meant for me to work out how the problem – climate change – is defined, which perspectives, identities, values and norms this definition reflects, and how the network argues it should be dealt with.

In C40's case, I found that climate change is defined as a meteorological problem, measurable in temperatures. It is further defined as an urban problem which means that C40 sees it as a problem particularly caused by and affecting urban areas and actors.

6.1.1.1 Defining climate change – a problem of temperatures

The first aspect of definitionally knowing climate change in C40 documents can be called 'climate change as a problem of temperatures' as C40 continuously refers to climate change as a question of rising temperatures – hence, a meteorological phenomenon. Accordingly, the goal of keeping global average temperature rise to well below 2°C with pursuing efforts to limit it to 1.5°C, internationally agreed-upon in the Paris Agreement (UNFCCC 2015a), serves as a guiding principle for climate policy throughout several documents (C40 2016a; C40 et al. 2018c; C40 and NYCSustainability 2019; C40 and Bloomberg n.d.-b).

What does it mean to know climate change as a meteorological phenomenon? It means that 'climate change' is something that is scientifically measurable – in temperatures, combined to a 'global average temperature' – and explainable by combining and comparing numbers picturing temperature measurements all over the world. These numbers then tell us how far climate change has already progressed and how it will likely develop:

> Climate change represents a grave threat to the planet. The world has already warmed by 1.0°C above pre-industrial levels due to human activities and is experiencing the related impacts. Every tenth of a degree matters. At the current rate of warming of 0.2°C per decade, global warming will reach 1.5°C between 2030 and 2052 (C40 et al. 2018c: 7).

Consequently, dealing with climate change for C40 means "to keep global average temperature rise to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C" (C40 and NYCSustainability 2019: 7). If these efforts are not going to be successful, the consequence is described (for example in reference to the IPCC Special Report on Global Warming of 1.5°C) as "a warming between 2.9 and 3.4°C by 2100" (C40 and NYCSustainability 2019: 7). Accordingly, the sheer numbers indicating temperatures are used to describe the phenomenon climate change. What these numbers concretely mean in and for different parts of the planet is not further elaborated on in this context (though, this is done in specific city contexts in other documents, such as '*City Climate Hazard Taxonomy. C40's classification of city-specific climate hazards*' (C40 et al. n.d.)).

In line with the internationally agreed-upon temperature goals[5], C40 in earlier documents (e.g. C40 et al. 2014; C40 and Arup 2016a) presents both 1.5° and 2° as valid goals and thus

[5] The 'Lima Call for Climate Action' as the final document of COP20 which took place in 2014, one year before the Paris COP21 accordingly still contains the two temperature goals as equal options: "(…) holding the increase in global average temperature below 2 °C or 1.5°C above pre-industrial levels" (UNFCCC 2014: 1)

develops and presents respective scenarios for both goals. In later documents – after the ratification of the Paris Agreement – only a 1.5°C temperature rise is both mentioned and presented as being the only 'safe' option (C40 and McKinsey 2017; C40 et al. 2018c; C40 and NYCSustainability 2019).

This fluctuation in what is considered 'dangerous' climate change, respectively 'staying within safe temperature limits' points to the difficulties of climate change being merely known as a matter of temperatures. Especially projected future temperature developments and their classification as 'safe' are in the end numbers which are politically negotiated (see Livingston et al. 2018: 86). The temperatures accordingly serve as "numbers around which the normative goals of international climate diplomacy can be stabilized" (Hulme 2010: 560). Accordingly, the proposition of determining a two degrees warming goal was initially introduced by the European Union (EU) in 1996 and supported by some environmentalists and scientists. Only throughout the 2000s, this number became the globally pertaining object of commitment of international climate governance (Leach 2015: 28f).

It is therefore important to highlight that the notion of climate change as a meteorological problem is far from being a marginalized form of knowing climate change, it is rather one of the most 'globalised' climate change knowledges, as Hulme puts it:

> The clearest example of the globalising instinct in the making of climate change knowledge is the reification of global-mean temperature. This indexed quantity – whether constructed from thermometer measurements, calculated from satellite retrievals, reconstructed from proxies or modelled through computer code – is central to the language of climate change (and, by association, of global environmental change). It has gained iconic status in scientific, policy and public discourse. (…) The story of global climate has in many senses become the story of global temperature (Hulme 2010: 559f).

It is thus not surprising that a city network which is per se 'globalised' and involved in global climate policy-making knows climate change as a matter of temperatures. However, it is important to outline that this definitional basis actually is not the only one possible and has consequences for the other forms of knowledge and thus the full way of how C40 knows climate change. Mahony and Hulme (2018: 406) for example mention radiative forcing or ocean heat content as potential alternatives to global mean temperature measurements.

But why can it be problematic to know climate change as a meteorological phenomenon measurable in temperatures? Besides the danger of just being an impersonal number that does not really tell people what is happening and what could happen in the future (see Jasanoff 2010b), it undermines different experiences and thus pluralist ways of knowing climate change:

> But collapsing human knowledge about climate change into one global signature hides far more than it discloses. It is psychologically sterile: no-one experiences or witnesses global-mean temperature and it requires extraordinary efforts of the

> imagination for it to acquire purchase in the practices of everyday living. It offers an inadequate and one-dimensional guide to policy: the putative international policy goal of two degrees of warming is deeply ambiguous with regard to 'allowable' emissions of greenhouse gases and other forcing agents. (…)
> Through bringing a new kind of knowledge about climate into circulation, 'global temperature' neglects the many other possible regional or local signatures of a changing climate that are of far greater importance for mobilising and constraining society and resources: for example the Asian or African monsoons, El Niño events, Caribbean hurricanes, the French mistral (Hulme 2010: 560).

Especially STS scholars highlight that framings of climate change as a mean of global temperatures are also problematic because they bear the risk that discussions are reduced to the analysis of new temperature statistics and related disagreements about how to interpret them instead of shedding light on normative questions about responsibilities of actors, forms of consumption and the full complexity behind climate change (Beck et al. 2017; Jasanoff 2010a). The interrelationship between the rise of global temperatures and both drivers and effects of human activity thus tends to be overlooked (Hulme 2012; Leach 2015: 29).

What does that mean in application to how a network like C40 knows climate change? This can mean that alternative concepts, such as emotional approaches, or alternative problem-solving options, such as changed consumption patterns, are not considered if the focus solely lies on the outcome of keeping the global mean temperature below a certain threshold (see Beck et al. 2017: 1071). The following paragraphs are revealing which consequences this definitional knowledge base has for how C40 is knowing climate change. However, knowing climate change as a meteorological phenomenon is not the only aspect of C40's definitional knowledge base.

6.1.1.2 Defining climate change as an urban problem

Next to knowing climate change as a matter of temperatures, C40's definitional knowledge base is marked by a second aspect: climate change as an urban problem. Defining climate change as an urban problem includes different aspects: accordingly, cities are seen as being particularly vulnerable towards the effects of climate change; secondly, cities are presented as being among those most responsible for climate change; thirdly, cities are defined as being perfectly placed to take action on climate change; and fourthly, cities are presented as being more ambitious than other actors.

C40 firstly defines cities as being particularly vulnerable because they host a big share of the global population:

> Urban areas are home to more than fifty percent of the world's population and are the site of most of its built assets and economic activity. By 2050, the population in urban areas is expected to increase by 2.5 to 3 billion and comprise two-thirds of the world population. For the next three decades, nearly seventy million residents will move to urban areas every year (C40 et al. 2018c: 7).

This density of population – but also of financial assets – is presented as a risk in face of climate change:

> With cities generating more than 80% of global GDP and housing more than 50% of the global population, the panel's conclusions are undisputed: this density of people and assets increases the concentration of risk from climate change in cities (CDP et al. 2014: 9).

But not only these aspects, also the geographical location of cities and urban areas is used to highlight the particular vulnerability to climate change (C40 et al. n.d.):

> The challenges facing cities include: risk of flooding from sea level rise; tropical cyclones; heavy rainfall events; drought; flooding; landslides; extreme heat events and urban heat island (Arup and C40 2011: 10)

The vulnerability of urban areas is thus used to highlight why climate change ultimately is also an urban problem. However, this definition of climate change as an urban problem implies many more aspects.

Speaking to the argument that climate change is a problem shaped by cities and urban areas, C40 argues:

> Typically, there is a positive correlation between a country's level of urbanisation and its GHG emissions; and many cities have per-capita emission intensities that far exceed that of the country as a whole, or, indeed, of other countries/regions that are among the world's largest per-capita emitters, such as the USA and the EU (Hoornweg et al. 2011; Kennedy et al. 2009). (C40 et al. 2018a: 13)

The shorter version of that statement is the declaration that "cities account for over 70% of global energy-related CO_2 emissions (…)" (C40 et al. 2018b: 1) which is used to exemplify why cities are important actors when it comes to climate change politics. Aust (2015: 262) calls this presentation of cities and urban areas as being responsible for 70% or more of global total greenhouse gas emissions the '70% mantra' and analyses that in doing so, urban actors actively seek to be held accountable for climate policies without any compulsion or obligation (see Gordon 2016b). Gordon highlights that the claim to accountability is used – amongst others – in order to secure recognition from external audiences (Gordon 2016b: 91). This search for recognition is also perceivable in the third aspect of C40's definition of climate change as an urban problem, when C40 presents cities as perfectly placed to address climate change.

Several, very different, reasons are given to show that cities are the right actors to address climate change. The first of these reasons is cities' economic power and their position as "engine of the global economy, accounting for more than 80 percent of world GDP" (C40 and McKinsey 2017: 15; see also C40 et al. 2018c; CDP et al. 2014). The second reason is cities' historic role as hubs for innovation:

> Cities have been the hubs of commerce, culture, and innovation for centuries. More recently, urban centers have emerged as important advocates for global action on climate change (C40 and McKinsey 2017: 15).

The third reason presented is the higher flexibility of cities in implementing policies compared to other actors:

> Many of the world's largest cities also pledged to do their part, recognizing that they can be more agile and responsive than other levels of government, and that local actions, such as land use planning and building retrofits, have long-term implications for global emissions (C40 and McKinsey 2017: 16).

And the fourth reason given to reinforce why cities are rightfully placed to address climate change is that cities have already done a lot in terms of climate policies:

> C40 collects data on the climate actions that cities are taking. At COP21 in Paris, C40 launched the 3rd issue of *Climate Action in Megacities 3.0 (CAM 3.0)*. The report presents a definitive assessment of how mayors of the world's leading cities have taken action on climate change since the COP15 Copenhagen climate talks in 2009. Since then, cities have reported that 11,000 actions are already underway in C40 cities (C40 and Arup 2016a: 39).

The very different examples for why cities are rightfully placed to deal with climate change contribute to C40's whole definition of climate change as an urban problem.

The last aspect of how C40 defines climate change as an urban problem manifests in a demarcation towards other actors where cities are presented as doing more than nation states:

> In 2016, 175 Parties ratified the Paris Agreement. In doing so, they committed to keep global average temperature rise to well below 2°C above pre-industrial levels and to pursue efforts to limit it to 1.5°C. (…) The Preamble to the Paris Agreement recognized the significant role of local governments in tackling climate change. (…) In October 2018 the Intergovernmental Panel on Climate Change (IPCC) released the Special Report on Global Warming of 1.5°C (SR15). This confirmed that current national government commitments are inadequate; projecting a warming between 2.9 and 3.4°C by 2100 (C40 and NYCSustainability 2019: 7).

Cities, in turn, are presented as the 'saviors' (Van der Heijden 2019) which can compensate the inadequate answers of national governments (see also C40 2016d; C40 and Bloomberg n.d.-b):

> There is now widespread recognition in the international community that the commitments made by national governments under the Paris Climate Agreement in 2015 cannot be achieved without concerted action by cities (C40 and McKinsey 2017: 5).

Or even more drastically:

> Nations of the world have agreed to work towards limiting global warming to 2 degrees Celsius. BUT THE COMMITMENTS THEY'VE MADE TO REDUCE THEIR EMISSIONS AREN'T ENOUGH. The good news is that cities can help

> bridge the gap between nations' actions and what's needed to prevent this temperature rise (C40 and Bloomberg n.d.-a: 1, emphasis in the original).

The documents show that, throughout time, the tone has changed. Whereas in earlier documents (such as from 2014), cities are presented as "true partners to nation states and the international community in bridging the global emissions gap" (C40 and Bloomberg n.d.-b), in more recent documents (see e.g. the document cited above from 2019), nation states' commitments are presented as 'inadequate' (C40 and NYCSustainability 2019) and cities as those without whose concerted action the goals of the Paris Agreement will not be reached (C40 and Arup 2016a; C40 and McKinsey 2017).

The definitional knowledge base presenting climate change as an urban problem is thus based on different pillars. Accordingly, cities are presented as originators of the problem, but at the same time also as victims and as powerful solvers of the problem. In order to reinforce this position as 'problem solvers', different arguments are brought forward to distance cities from more traditional actors of climate politics, such as nation states.

This definitional knowledge base defining climate change as an urban problem is not surprising either (such as the definition of climate change as a meteorological phenomenon). Rather, this storyline has to be seen in line with one of the functions that have been identified for TMNs (see Andonova et al. 2009; Bouteligier 2013; Busch 2015) – more specifically the function as 'city advocates'. In their function as *city advocates* networks participate at higher levels of governance such as the national, the European level, or on the international stage (e.g. through participation in COPs). By acting as city advocates, networks represent their members' interests at levels the singular member cities could barely reach themselves. Therefore, networks enable cities worldwide to speak with a common voice and accordingly to enhance their acceptance as considerable actors in climate change governance (Busch 2015: 224; on this discussion see also C. A. Johnson 2018; Kern and Bulkeley 2009; Toly 2008). But in order to be accepted on the international level, networks of course have to justify their participation and leverage. If the problem itself – climate change – is successfully defined as a particular urban problem, the question if cities should be included becomes much less controversial: if cities are held accountable for climate change by external actors, they secure their recognition as important governance actors (Gordon 2016b: 91). Furthermore, the aspects presented above reveal that C40 pursuits this search for accountability on three different bases: on the basis of being one of the *originators* of the problem, on the basis of being one of the *victims* of the problem, and on the basis of being amongst the trustworthy *problem-solvers*. Jeroen Van der Heijden (2019) finds that this narrative of "cities as the saviours of the planet" as he calls it (p. 2) is one that has generally become more and more predominant both amongst scholars as well as city practitioners. However, at the same time

he reveals that there is a relatively big gap between rhetoric, especially focusing on frontrunner cities, and what average cities and citizens can and want to implement (Van der Heijden 2019). Nevertheless, this globally rising definition of cities as climate policy leaders builds the co-constituting context of C40's definitional knowledge defining climate change as an urban problem.

The definition of climate change as being insufficiently dealt with by other actors whereas cities and urban areas are both main victims and perfectly placed to deal with it, also has further influence for how C40 is knowing climate change on a conceptual, a problem-solving and a critical level, which are explained in the following sections.

6.1.2 Conceptual knowledge: scientific data for carbon neutrality and green growth

The dimension of knowing climate change conceptually includes models of explanation used, thus the way how causes and consequences are attributed to climate change. This form of knowledge further mirrors beliefs, ideas and concepts following the predominant definitional basis and building the core for the solutions suggested. In this regard, for me it was not only important to outline the respective prevalent concepts and ideas, but also the way how these are presented. These non-verbal presentations are also aspects of how climate change is known, as they can be seen as materialized knowing (see Gherardi and Miele 2018).

The main models of explanation used by C40 to understand the causes and consequences of climate change are of a scientific nature. The umbrella concept of 'scientific data' serves as a guiding principle in terms of conceptual knowledge (see 6.1.2.1). The belief in scientific data is based on the conviction that climate change, as a scientific phenomenon, can be best understood by generating data. Data is also believed to best picture the consequences of climate change and in turn, to foster climate action. The two main concepts coining C40's conceptual knowledge, and which are well in line with this 'conceptual umbrella', are 'carbon neutrality' (see 6.1.2.2) and 'green growth' (see 6.1.2.3). While outlining the different aspects of conceptual knowledge, I realized that often the boundary between conceptual and problem-solving knowledge is very blurry. This is especially the case when I defined an idea, or a concept, as part of 'conceptual knowledge', e.g. green growth or quantified data, and C40 explicitly suggests this concept as a way of how cities should behave. For this study, it was important for me to highlight the different aspects of knowing, not to precisely attribute these aspects to one particular form of knowledge. In these cases, I decided which form of knowledge was more salient to me and counted the aspect as part of this form.

6.1.2.1 Significance of (scientific) data

One aspect of how C40 knows climate change in terms of conceptual knowledge is the high significance attributed to scientific facts and data. Accordingly, C40 seems to believe that

data are a necessary prerequisite for appropriate climate policies – also on an urban level. However, it states that on a city level, there is often a lack of knowledge or a lack of available data. Fittingly, C40 presents itself – together with its partners – as a provider of 'scientific data' which can also be detected in the way C40's material is composed and presented. Lastly, for C40 it seems to be very important to 'quantify' available facts and findings to make them more reliable.

'High quality (…) data' (C40 et al. 2018c: 11), 'best available existing data' (C40 2016a: 9) or 'the rigor of the science' (C40 et al. 2018c: 7) are presented as the best and necessary basis for urban climate actions. The underlying belief seems to be that without data and scientific background measurements, cities will not be able to appropriately deal with climate change (e.g. C40 2016a: 22). The use of that data is justified by the rationale that if there is a lack of data, there is also a lack of understanding of a particular topic (e.g. C40 2016a: 22). C40 argues that "climate science must be accessible to urban policymakers, because without them, there will be no limiting global warming to 1.5°C" (C40 et al. 2018c). Hence, science is presented as essential for urban policymakers to be able to implement climate action.

At the same time, C40 argues that both scientific knowledge about climate change as well as data about a city's performance in terms of climate impact and actions is often lacking at a city level:

> Many city staff identified that accessing, analysing and managing data about climate change is a fundamental challenge for them. This challenge is experienced in all global regions, but particularly in developing cities (C40 2016c: 23).

In order to fill this gap, C40 is presenting itself as an actor who is producing scientific knowledge – together with partners – that is accessible and useful for urban actors:

> C40, working with Arup, has completed a review of existing approaches to managing and characterising climate hazards used by city practitioners, the Disaster Risk Reduction (DRR) community, and the climate science and policy community (C40 et al. n.d.: 2).

Accordingly, it presents its own undertakings as 'recent research' and itself as an actor producing 'most relevant' scientific research (see C40 and Arup 2016a, 2016b). The following quote highlights that C40 is citing its own publications as 'recent research':

> These measures, impacts and regions were selected based on insights from recent research that highlights the most relevant, high impact and achievable climate actions (ARUP & C40 Cities 2016; McKinsey & C40 2017). (C40 et al. 2018a: 7).

Noticeable in this regard are the partners that C40 chooses in order to do its own research: the actors cited above, ARUP and McKinsey for example, are both no scientific institutions but consulting corporations. In line with presenting themselves as scientific research institutions,

C40 and its partners present their reports in a way for them to appear as 'scientific' as possible: almost all C40 documents analyzed contain not only text but also graphs (e.g. C40 et al. 2018c: 9f), figures (e.g. C40 2016b: 19) or tables (e.g. C40 and NYCSustainability 2019: 37f). Also language-wise, the documents themselves are formulated in a way that suggests that 'scientific' information is seen as particularly trustworthy. One example is the document '*Benefits of Climate Action. Piloting A Global Approach To Measurement. Appendix*' (C40 2016b) in which C40's own approach is called 'research' and 'pilot study' which consists of the phases of 'data collection' and 'data analysis'. The documents hence both in their argumentation and their appearance seem to be created in the style of scientific papers (other, similar examples are C40 et al. (2018a); C40 and NewClimateInstitute (2018)).

Another interesting aspect is the recurrent call for more research that has to be done for cities and urban actors (e.g. C40 et al. 2018b) – which in turn justifies C40's own research undertakings and underlines its importance for cities' engagement with climate change:

> Further research is vital to continue to build the evidence case and to make it more accessible to city-level decision makers. (...) More work is needed to deepen the evidence base for impacts that can be realized through these measures, and for the many other measures that are vital to achieving the necessary emission reductions in cities in the short term, including, but not limited to, decarbonization of the electricity grid, enabling next generation mobility, and improving waste management, which are also measures with considerable potential in cities (C40 et al. 2018a: 110).

Despite the importance attributed to scientific data and knowledge as a basis for urban climate actions, C40 also highlights that scientific data and facts alone might not be enough to convince skeptics that cities should implement climate policies:

> Recent research has demonstrated that immediate action in cities is critical for achieving the goals of the Paris Agreement (ARUP & C40 Cities 2016; Stockholm Environment Institute 2018). Despite this evidence and the urgency for action that it points to, cities may face significant barriers for **establishing and making a robust case** as well as ultimately taking climate action (C40 et al. 2018a: 11, emphasis in the original).

C40 thus suggests that cities should highlight benefits of climate actions for other policy fields to be more convincing for skeptics – in C40's terms to 'make the case for climate action' (see C40 et al. 2018a). However, the importance attributed to data is also perceivable here: these benefits in turn have to be presented in a quantified way to be taken seriously. The importance of quantification is for example reflected in one document's title: '*Quantifying the benefits of climate change mitigation measures in buildings, transport and energy supply*' (C40 et al. 2018a). The reasoning behind quantifying effects of climate actions is that "cities need robust data and standard indicators to measure and monitor the impact of policy actions on co-benefits" (C40 and LSECities 2016: 5), whereas it is criticized that "the benefits are most

often unquantified and uncosted" (C40 and LSECities 2016: 7). Quantification – the production of data in numbers – is hence an important aspect of C40's conceptual knowledge base.

Quantified data is not only produced and provided in areas where it would have seemed quite obvious to me (for example in accounting GHG emissions) but also in areas that seemed surprising to me. Accordingly, all benefits of climate actions are presented as transformed into economic value, for example as "the annual value of saved lives" (C40 2016a: 19), or the "reduction of traffic congestion and improvements in journey ambience" (C40 2016b: 11). The document '*Co-benefits of urban climate action: a framework for cities*' (C40 and LSECities 2016) highlights itself that some aspects are difficult to quantify. Nevertheless, C40, together with its partner, suggests that quantification is always feasible and seemingly suggests that it should therefore be done whenever possible:

> Measurement and quantification is complicated by some of the features of green growth/climate change mitigation and adaptation that go beyond simple economic use functions of environmental assets (e.g., harvesting forests for timber products), though tools do exist. Contingent valuation approaches used to estimate economic values for all kinds of ecosystem and environmental services is an available and established technique within an expanding field of accounting methodologies (C40 and LSECities 2016: 34).

Despite this particular value that is ascribed to quantified data and scientific facts, some documents underline that the reliance on data and science should also be treated cautiously because they could be very opaque for both urban policy actors and citizens:

> While the monetised amount identified may be recognisable to economists and investors, it may be an abstract measurement for many city officials, politicians and – most of all – citizens. It is important to combine this information with other approaches to ensure suitable messages can be generated for each audience (C40 2016b: 12).

Another document also emphasizes that – despite the importance attributed to quantified data for convincing skeptical actors – data alone might still not be persuasive:

> City staff report that **data alone is often not sufficient to get approval for action.** In some instances, the data does not tell the most compelling story for the audience they need to convince. (…) For effective climate action city staff must **engage with a diverse set of stakeholders and develop and deliver messages through a variety of communication channels** (C40 2016c: 30, emphasis in the original).

One document acknowledges that behaviors and beliefs might be much more important for a change towards climate protection, than the simple provision of data on the benefits such actions might have:

> Social norms, the often unspoken values, beliefs and behaviours that are accepted and encouraged within a community, can also impede effective stakeholder engagement. Social norms are often deeply embedded and difficult to shift or

> change. In many instances, city and C40 staff have identified that the existing values, beliefs and behaviours in a city form a barrier to effective climate action. Another aspect of this barrier is ingrained and endorsed behaviour. Research has shown that even if people have changed their values and beliefs they don't always behave in accordance with those beliefs. In fact, some research suggests that the reverse situation is true, and it is changes in behaviour that lead to changes in values. If current endorsed behaviours do not support climate action, it can be difficult to understand how to catalyse change, as Singapore reported; *"Surveys show that awareness [is] high... [but] we have not figured out how to turn this into action*" (C40 2016c: 31, emphasis in the original).

However, these warnings appear mostly at the end of paragraphs or documents and are not elaborated any further than the few words quoted above. Therefore, the aspect of conceptually knowing climate change in a scientific and data-based way seemed to be the more formative component to me. This is especially true because quantification – concrete numbers – is a recurring theme in all C40 documents. Concrete numbers are not only used to figure the benefits of climate actions, but also in other issue areas for example when stating that if cities would implement the actions suggested by C40, they would achieve their CO_2 reduction goals of 2030 to "90-100%", that the investment needed to achieve these goals would be "roughly $50- $200 per metric ton of CO_2 equivalent", but that these "up-front investments are paid back within five to ten years" (C40 and McKinsey 2017: 6).

In light of the high uncertainty of all future projections, these very concrete numbers seem surprising at first sight. However, seen from an STS perspective, the reliance on data and numbers is not that surprising but rather a widespread method by which uncertainty is managed:

> The precision of numbers conveys an aura of definiteness, belying the inevitable choices and judgements involved in translating complex phenomena into mathematical terms. (…) Numbers, in short, are deemed trustworthy in ways that naked human judgement is not, even when the judgement is that of experts (Jasanoff 2015a: 40).

Christian Bueger (2015) also identifies this aspect of 'creating a sense of certainty' in the usage of quantification techniques, such as figures. According to him the process of quantification abstracts local complexities and creates a quantitative entity which in turn "can be known" (Bueger 2015: 10). This creation of a seemingly certain, tangible entity is exactly what is happening when C40 underlines the significance of climate change itself, as well as climate actions and their benefits by referring to (scientific) data. When arguing that scientific data should be accessible and available for mayors to implement climate policies, C40 follows the assumption that without data the phenomenon climate change is not palpable and will therefore not be addressed. In turn, by converting the meaning of climate change, respective actions, as well as their benefits into numbers, C40 creates this sense of certainty and seems

to hope that based on tangible scientific data and numbers, action will follow. Laura Nader, when reflecting on her interaction with energy scientists, described their obsession with models and measurements as the belief to transform the world simply based on the power of numbers (Knox 2014: 411). To me, it seems as if C40 conceptually also believes in such a power of numbers – or, in its own terms 'data' – to change the world.

Such a belief in and reliance on data, numbers, and 'purely scientific' facts can be seen critically in the context of climate change politics. Accordingly, Hulme (2010) highlights that the reduction of "heterodox and incommensurate human values to uniform monetary expressions" (p. 560) erases any differences in how the environment, or the climate gets valued by different people. What this ultimately points to is the loss of 'the human', or, in other terms, rendering invisible human actors and their differing cultural and symbolic valuation schemes, but also their role in both causing the problem and being affected (e.g. Adger et al. 2011; Jasanoff 2010b; Lövbrand et al. 2015). The deeply value-laden discussions about causes and effects of climate change are eliminated with reference to 'science'. The allegedly 'safe' temperature rise of 1.5°C which is underlined by scientific data could thus mean that Sub-Saharan Africa might suffer from ever more severe droughts or that Small Island States might be permanently flooded – effects that are not visible when data and models form the basis for political decisions (Leach 2015: 29).

Similar to the critiques on presenting climate change in terms of temperatures as being something that people cannot really connect to, Jasanoff highlights that scientific facts and data are not necessarily requisite for people to understand what climate (change) is about:

> Science is not the only, nor even the primary, medium through which people experience climate. We need no warrant other than our senses and memories, supplemented by familiar recording devices such as the calendar or the gardeners' almanac, to register the vagaries of the weather, the changing of the seasons, the fertility of the soil, the migration of birds, or the predation of insects (Jasanoff 2010b: 235).

Jasanoff therefore counters the aforementioned conviction that scientific numbers could be the key to convincing skeptics of climate actions and suggests favoring human- and experience-centered approaches to make people understand what climate change is about and consequently, why actions are needed. Accordingly, Elke Weber has found that "(…) beliefs about changes in existing climate variables can also drive individual or household decisions (…)" (Weber 2010: 333). This confirms that it is not necessarily scientific data that convinces people to act upon climate change.

However, the use of data and especially their gathering through emissions assessments, is being denounced for another reason. Mikael Román (2010: 79f) highlights that "quantifying greenhouse gas emissions at the urban or local scale is an exercise fraught with

methodological and technical difficulties (…)" and that "aggregate data miss the large variation between and within cities". In addition, despite potentially increasing transparency and accountability, data are criticized to neglect issues and stakeholders which are not captured by the datasets used (Hughes et al. 2019). There are thus serious concerns to using data as a basis for climate change policies not only because they are hard to access by all those not being involved in their generation.

Nevertheless, the assumption that a quantification of effects and benefits, as well as their recalculation into economic numbers is vital, is widespread within the scientific world (see Adger et al. 2011), but also in the day-to-day practices of cities (Hughes et al. 2019). Accordingly, Hannah Knox reports:

> The day-to-day work that I observed of managing urban climate change was organized around the measurement of carbon emissions, cost savings, and climatic changes – phenomena which were brought together in a range of performative numbers, spreadsheets, charts, graphs, and other forms of visual representation (…) (Knox 2014: 410).

Hence, the high significance attributed to scientific and quantified data by C40 is not surprising. Rather, it fits both in the globally hegemonic story that climate change is a scientific problem which has to be scientifically assessed, and it also fits with C40's definitional knowledge base defining climate change as a meteorological phenomenon, understandable by measuring temperatures and analyzing these temperature *data* over a long term. Nevertheless, this should not be perceived as the only possible option cities and city networks have. Accordingly, Climate Alliance – despite highlighting that data are essential for municipalities, for example in terms of CO_2 monitoring at the community level (e.g. ClimateAlliance 2018b) – suggests that the exchange of experiences and perspectives is at least equally worthwhile (if not more) as a conceptual basis for cities to get to know climate change (see chapter 6.2.2.1).

However, for C40's conceptual knowledge base, scientific and quantified data are much more important than experiences to make sense of climate change. The focus on quantified numbers is also perceivable in the following two concepts that are of great importance for how C40 knows climate change on a conceptual level: 'carbon neutrality' and 'green growth'.

6.1.2.2 Concept of 'carbon neutrality'

A concept that plays an important role in how C40 knows climate change is the concept of carbon neutrality. It is built on the assumption that if GHG and in particular carbon emissions are responsible for rising temperatures, we simply need to get these emissions to 'zero'. In order to achieve this goal, technological measures to capture and store carbon are deemed

unavoidable. A further aspect of the concept is the conviction that every city still has a 'remaining carbon budget' to spend in the next couple of years.

The concept of carbon neutrality is one that is present (more or less explicitly) throughout almost all C40 documents – although with different names such as 'decarbonization' (e.g. C40 and McKinsey 2017; C40 et al. 2018c) or 'target emissions trajectories' (e.g. C40 and Arup 2016b). But the idea is always the same: it is presented as the goal to reach at a certain point in time in order to achieve the goal of limiting global average temperature rise to 1.5°C (e.g. C40 2016d; C40 et al. 2018c; C40 and NYCSustainability 2019). Hence, the underlying rationale is built on the connection of rising global mean temperature with the emission of GHG, respectively carbon emissions. As the problem – climate change – is defined as a problem of rising temperatures which is caused by the emission of too many carbon (and other GHG) emissions, the idea is that a radical reduction of these emissions would solve the problem. Such a reduction would then lead to the goal of keeping the rise of the global mean temperature to 1.5°C:

> To remain within a 1.5 degree temperature rise, average per capita emissions across C40 cities need to drop from over 5tCO2e per capita today to around 2.9tCO2e per capita by 2030 (C40 and Arup 2016a: 7).

'Carbon neutrality' is not only present as a goal but C40 also clearly defines when a city is 'carbon neutral':

> What is Carbon Neutrality for Cities? This guidance proposes the definition of a 'carbon neutral' city, also referred to as an 'emissions neutral' city, as a city that has achieved and demonstrated in a given year:
> - Net-zero greenhouse gas emissions from fuel use in buildings, transport, and industry (scope 1);
> - Net-zero greenhouse gas emissions from the use of grid-supplied energy (scope 2);
> - Net-zero greenhouse gas emissions from the treatment of waste generated within the city boundary (scope 1 and 3), and
> - Where a city accounts for additional sectoral emissions in their GHG accounting boundary, net zero greenhouse gas emissions from all additional sectors in the GHG accounting boundary.
>
> Alternatively, for cities that solely account for emissions using a consumption-based approach, a 'carbon neutral city' will have achieved and demonstrated net-zero greenhouse gas emissions from all sectors in the GHG accounting boundary (C40 and NYCSustainability 2019: 11).

To summarize, C40 assumes that there can be a state when a city emits 'net-zero' GHG emissions – which in turn would mean that it is 'carbon neutral' (e.g. C40 et al. 2018c). It is interesting to highlight here that this definition does not necessarily imply that the respective city itself has to come to a state where it emits no carbon anymore at all. Rather, it has to reach a state of '*net-zero*' – which in turn means that ultimately this relies on a calculation of

‘expenses’ and ‘revenues’ which can have the outcome ‘zero’. Hence, the former quote shows that the concept of carbon neutrality itself in turn relies on other concepts. The most important concept to understand ‘carbon neutrality’ here is ‘net-zero emissions’. Again, C40 states itself how it understands the concept:

> A state where annual residual GHG emissions are completely cancelled out through offsetting or removed through carbon dioxide removal (CDR) or emissions removal measures. The achievement of net-zero emissions is also referred to as carbon neutrality (C40 and NYCSustainability 2019: 14).

The concept of carbon neutrality and the referent concept of ‘net-zero emissions’ as used by C40 hence show that C40 seems to see emissions as a kind of economic good which are produced somewhere, and which can then be sold and bought elsewhere.

The concept of carbon neutrality as used by C40 relies on the belief that there needs to be a balance of emissions emitted somewhere and measures undertaken to either avoid the same amount of emissions elsewhere or of actions undertaken to take back the emitted emissions from the atmosphere. A total reduction of emissions is not unavoidably necessary as long as it is ‘compensated’ or ‘neutralized’ with a ‘carbon credit’ elsewhere (C40 et al. 2018c; C40 and NYCSustainability 2019).

Therefore, carbon sequestration and other carbon capture technologies are an unavoidable part of the concept of ‘carbon neutrality’ and ultimately of achieving the goal of keeping global temperature rise to 1.5°C (see chapter 6.1.3.4 for further discussion of that aspect):

> Even with all required actions taken as per city trajectories, substantial carbon sequestration will also be required by national governments if cities are to stay on a 1.5 degree trajectory post 2050 (C40 and Arup 2016a: 8).

Despite the acknowledgment that already now carbon capture technologies are necessary to achieve the goal of keeping global mean temperature rise to 1.5°C, C40 claims that cities (as well as other actors) still have a ‘remaining carbon budget’ which is in line with the concept of ‘carbon neutrality’. The idea behind the ‘remaining carbon budget’ is that we – as humanity – still have a certain range of emissions we can produce, and which would still allow to stay in line with the agreed-upon temperature goals (see e.g. Rogelj et al. 2019). C40 applies this idea to its member cities and accordingly calculates the remaining budgets for different groups of member cities (see also C40 and Arup 2016b):

> With an overall budget established for C40, each member city was assigned to one of four trajectory groups defined by specific city characteristics (...). Combined with each city’s projected population growth out to 2100, these trajectories create an overall C40 carbon trajectory that member cities need to follow to secure their

> contribution to limiting global temperature rises to 1.5 degrees (C40 and Arup 2016a: 29-30).

Despite highlighting that all cities should reduce their emissions as soon as possible (C40 and Arup 2016a: 35), granting a remaining carbon budget seemed counterproductive to the goal of carbon neutrality at first sight to me. However, if combined with the idea of carbon removal, also the remaining budget makes sense again. If it is possible to remove emitted carbon and other GHG emissions from the atmosphere, it is possible to be 'carbon neutral' while still continuing to produce these emissions. This shows that in the end 'carbon neutrality' is the sum of an arithmetical calculation – a fact that is also criticized by Climate Alliance which clearly shows its opposition to the concept of carbon neutrality:

> Every activity influences the climate when emitted greenhouse gas reaches the atmosphere. Due to that fact the term 'climate neutrality' is misleading because it suggests that compensation neutralises emissions. In fact, the CO_2 balance is neutral but the emitted CO_2 is still in the atmosphere (ClimateAlliance 2008: 1).

As highlighted in the upper part of this paragraph, the concept of carbon neutrality as it is used by C40 is one that directly follows up on the definitional knowledge base defining climate change as a matter of temperatures caused by the ever-increasing emission of GHGs. Again, this aspect of knowing climate change is not an exceptional one. Rather, both the definition of climate change as a matter of rising temperatures and its connection to the emission of GHGs is globally hegemonic (see also chapter 6.1.1.1). Hoffmann (2013) highlights that climate change has been traditionally defined as an 'emissions problem' (p. 8). He further argues that this definition on the one hand, indeed is right, but on the other only focuses on proximate causes. Emissions are hence rather 'symptoms' of a problem lying more deeply – a global economy relying on the burning of fossil fuels (Hoffmann 2013: 13). Connected to this perception is the idea of the need to 'decarbonize', respectively reaching a state of 'carbon neutrality'. Carbon neutrality, understood as a stabilized CO_2 content in the atmosphere, is very pervasive within the global climate regime:

> There is a virtually unchallenged consensus over the need to be more 'environmentally' sustainable if disaster is to be avoided; a climatic sustainability that centers on reducing and stabilizing the CO_2 content in the atmosphere to some sort of mythical point that represents the 'right' climate (1989?) (…) (Swyngedouw 2013: 3).

The balance between emissions and their removal, their 'neutrality', also made it into the Paris Agreement which states as a goal "(…) to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century (…)" (UNFCCC 2015a: 4.1). However, this does not make this connection any less problematic.

Despite its popularity and political prevalence the concept of carbon neutrality is criticized – because it focuses on CO_2 as the culprit and suggests that the problem will be solved if we just manage to 'neutralize' this culprit (see for example Hulme 2015). In particular Swyngedouw denounces this focusing on a single entity – CO_2 – as a way to 'externalize' the problem and therefore a way of trying to cope with the problem within the very system that has caused it. According to him, this 'fetishizing' of CO_2 hinders solutions to the problem which are to be found outside the problematic system:

> Pollution, 'environmental degradation' or 'CO_2' stand here as the classic examples of a fetishized and externalized foe that require dealing with if sustainable urban futures are to be attained. Problems, therefore, are not the result of the 'system', of unevenly distributed power relations, of the networks of control and influence, of rampant injustices and inequalities, of the police order and its non-egalitarian distribution of functions and places or of a fatal flow inscribed in the system, but are blamed on an outsider (Swyngedouw 2009: 612).

By raising this strand of criticism, I do not intend to question the interdependence of globally rising temperatures and rising GHG emissions, not at all – rather, I want to highlight that seeing this as the only way to know climate change can be problematic in face of the criticisms mentioned above.

Nevertheless, the use of 'carbon neutrality' and therefore knowing climate change as a problem that can be tackled by the massive reduction of CO_2 and other GHG emissions is also seen as a productive concept especially in the city context – because it shows the possibility of non-classical actors to act upon climate change independently from nation-states:

> (…) carbon neutrality and the ensuing practices of carbon offsetting can be viewed as a policy instrument not just 'beyond the state', but within a transnational public sphere with the potential to mitigate climate change largely independent of state action (Pattberg and Stripple 2008: 378).

Some authors also find that the criticized flexibility of either reducing emissions oneself or offsetting them through other means can have rather positive effects. Accordingly, Tozer and Klenk (2018) find that the interpretative flexibility of the goal of being carbon neutral allows different cities to achieve this goal whereby for some this means switching to 100% renewable energy, and for others including carbon offsets for emissions they can not immediately reduce themselves (see also Karhunmaa 2019 for an analysis of how the concept 'carbon neutrality' is flexibly interpreted at different scales of governance).

As I have already briefly addressed in the former paragraph, the concept of carbon neutrality has to be seen as in line with the significance C40 attributes to quantified data: in order to achieve carbon neutrality, one needs to have data about the current state of affairs. Further, as already highlighted, the state of being 'carbon neutral' as C40 proclaims it is the result of a calculation – based on data and numbers. The importance of the concept 'carbon

neutrality' is thus to be seen as perfectly in line with the previously presented aspects of how C40 knows climate change.

6.1.2.3 Concept of 'green growth'

The second concept which is of great importance for how C40 knows climate change is 'green growth'. C40 presents green growth as a vital strategy to cope with climate change and as an answer to the challenges accompanying climate change. Accordingly, green growth is defined as the decoupling of economic growth from GHG emissions. Another aspect of the concept of green growth is the assumption that switching to climate protection policies opens up new economic opportunities.

C40 presents green growth as one element of how cities need to react facing climate change: "The world's cities face an immediate need to drive green growth, economic development, and build infrastructure that mitigates the causes and risks of climate change" (C40 and CDP 2013: 6). Green growth is thus presented as a strategy to mitigate climate change. Therefore, this aspect of knowing exemplifies one where it was difficult for me to decide whether it is better conceptualized as 'conceptual' or as 'problem-solving' knowledge. As I already mentioned, for me, it was more important to point out the different components of knowing than to precisely attribute them to one particular form of knowledge. In the case of 'green growth', I opted for the inclusion in 'conceptual' knowledge as it is commonly referred to as a 'concept', reflecting particular believes, more than as a strategy.

'Green growth' as used by C40 reflects its belief that if cities achieve a reduction of GHG emissions, this means a mitigation of climate change. At first sight this collides with the goal of growing economically. This is due to the fact that historically, a growing economy has always involved a growth of GHG, in particular CO_2, emissions (Aye and Edoja 2017; Holtz-Eakin and Selden 1995). The concept of 'green growth' – as it is also used by C40 – tries to counter the fear resulting from this historical 'coupling' of economic growth and climate impact – that the economy or economic development more broadly would be 'damaged' by climate policies:

> It is sometimes perceived that the pursuance of climate change mitigation action represents a burden which may conflict with the development agenda. These concerns are often drawn from the observation that greenhouse gas (GHG) emissions were historically coupled to economic development. However, recent trends have proven that further economic development did not depend on increasing GHG emissions: global trends for GHG emissions and GDP growth were decoupled from one another in 2015 (Olivier et al. 2016) and 2016 (IEA 2016a) (C40 and NewClimateInstitute 2018: 18).

Reflecting the definitional knowledge base connecting GHG emissions and climate change, C40 argues that if cities continue to pursue economic growth as they historically did, there will be no chance to stick to the goal of a maximum temperature increase by 1.5°C:

> In the absence of measures to decouple economic activity and emissions, anticipated economic and population growth is likely to drive up emissions significantly over the coming decades. In fact, if the 758 U.S. cities with populations over 50,000 were to halt progress towards decarbonisation, their BAU [business as usual, M.K.] trajectory would see them emit 475 $GtCO_2e$ to 2100, single-handedly using up the global budget for a 1.5°C limit scenario (C40 and Arup 2016b: 9).

Therefore, the concept of green growth suggests that economic growth and the emission of GHGs need to be 'decoupled' (see also C40 and CDP 2013):

> Green growth, or the green economy, is an overarching principle for delivering economic growth and development while reducing the environmental impact, for example: low air pollution and CO_2 emissions; low consumption of natural resources including water, energy and undeveloped land; and the protection of ecological services (Floater et al. 2013, 2014a, 2014b, 2014c; OECD 2013) (C40 and LSECities 2016: 30).

The concept thus mirrors the belief that economic growth is both feasible and desirable while at the same time reducing the economy's climate impact.

At the same time, C40's concept of green growth also suggests that the investments needed to 'decouple' economic growth from GHG emissions are economically worthwhile: "As cities continue to invest in emissions reduction activities, they can expect to wring more wealth out of each tonne of emissions" (C40 and CDP 2013: 6).

This aspect of the green growth concept touches upon another economic rationale: the reduction of GHG emissions is deemed reasonable for cities because it opens up new economic opportunities:

> Moreover, countries and cities are promoting green growth as an explicit economic development strategy by targeting green goods and services as growth sectors that create a virtuous cycle of innovation, new technology development and deployment, jobs and skills, and improved environmental conditions (C40 and LSECities 2016: 30).

Accordingly, by pursuing a strategy of 'green growth' cities are said to become more attractive to new kinds of businesses and investments, which in turn can help to let the city grow economically:

> Emissions reduction activities by cities are pro-business. 62% of actions that cities are taking to reduce GHG emissions at the city-wide level have the potential to attract new business investment and grow the economy (C40 and CDP 2013: 3).

This aspect of ‘green growth’ thus can be seen as a strategic economic rationale that is explicitly used to attract economic actors to cities on the basis of their GHG reductions. The use of the concept ‘green growth’ is thus based on the belief that climate policies have to be economically persuasive to be implemented, as C40 puts it: “A climate action that cannot be justified on economic grounds is one that will struggle to gain traction and provide value” (C40 2016c: 24). Green growth in that sense provides a suggestion of how economic growth is said to be harmonized with climate protection.

As the first concept, carbon neutrality, also green growth is perfectly in line with the other aspects of how C40 knows climate change: the definitional knowledge base of climate change as a temperature problem caused by the emission of greenhouse gases is the necessary prerequisite for the logic of the ‘green growth’ concept: if we succeed in ‘decoupling’ the production of GHG from economic production and performance, we do not need to question inter alia the functioning of the economic system itself (an option that is favored for example by Climate Alliance (see chapter 6.2.4.1)).

C40’s rationale, again, has to be seen against the backdrop of dominant discourses of climate governance (see e.g. Bäckstrand and Lövbrand 2019; Meckling and Allan 2020). Accordingly, the idea of green growth has prominently emerged as a central idea of sustainable development at the Rio+ 20 Conference on Sustainable Development in 2012. Although the basic idea has already been present a long time before, for example through the ‘Brundtland report’ (see Brundtland 1989), the Rio conference of 2012 has given it formal assertion (Hickel and Kallis 2019). The outcome document ‘The future we want’ thus called for the preservation of economic growth while preserving natural resources and ecosystems (UNGA 2012). Other important actors in driving the ‘green growth’ idea forward were the Organisation for Econonomic Cooperation and Development (OECD), the United Nations Environment Program (UNEP), as well as the World Bank which have all published reports stating that “absolute decoupling of GDP growth from resource use and carbon emissions is feasible (e.g. Solow 1973), and at a rate sufficient to prevent dangerous climate change and other dimensions of ecological breakdown” (Hickel and Kallis 2019: 1; see also Meckling and Allan 2020). But also the other aspect that C40 connects to the concept of green growth, namely that it can be pursued as a strategy to attract innovative businesses and investments, is one that can be seen in a broader context. Accordingly, Jacobs (2013) argues that after the financial crisis of 2008, the promise connected to ‘green growth’ was that environmental protection could positively promote economic growth by generating higher outputs and higher living standards (Jacobs 2013: 201; see also Meckling and Allan 2020: 436f). This shows that C40 is by far not alone with attributing high significance to the concept of ‘green growth’.

Also the IPCC has taken up the green growth concept in the development of its different mitigation scenarios – in so far as the scenarios presented all assume that global mean temperature rise can likely be limited to 2°C while global GDP can still rise (Hickel and Kallis 2019). However, this harmonization is based on the deployment of so-called 'BECCS' (bio-energy with carbon dioxide capture and storage) and afforestation, and assumes a 'temporary overshoot' of CO_2 concentrations in the atmosphere (IPCC 2014: 81).

These aspects touch upon some of the main critiques brought forward towards the green growth concept: the idea of the deployment of BECCS is highly controversial and even the 'inventor' of the BECCS idea claims that "(…) the BECCS concept was unfortunately misused for regular (emissions pathway) scenarios and not in a risk management sense" (L. Hickmann 2016a). Despite the skepticism towards and remaining doubts about its actual usability do most 'green growth' mitigation scenarios, presented by the IPCC but also others, rely on BECCS (Hickel and Kallis 2019: 10f). The decoupling of economic growth and GHG emissions insofar is not an actual decoupling in the sense that less or no more GHGs are emitted, but one that is based on the offsetting and removal of GHG emissions which are still produced. Thus, it is only a calculated decoupling (for a discussion of offsetting mechanisms and the critique of them see 6.1.3.4).

However, this is not the only critique towards the green growth concept. Hickel and Kallis (2019) show that the results that some countries already have been able to decouple economic growth from GHG emissions and material consumption are hiding some important factors:

> In a globalised economy, where rich countries have outsourced much of their production to poorer countries, this side of material consumption has been shifted off their balance sheet. If we bring it back in, looking at the total resource impact of consumption by any given nation (what Wiedmann et al refer to as 'material footprint', or MF), the picture changes. Wiedmann et al show that while the USA, UK, Japan, the OECD and EU-27 have achieved relative decoupling of GDP from DMC (including fossil fuels), material footprint has been rising at a rate equal to or greater than GDP, suggesting no decoupling at all; indeed, in most cases re-coupling has occurred (Hickel and Kallis 2019: 3).

But what about the International Energy Agency's finding that also globally emissions and economic growth have been decoupled in 2015 and 2016, which C40 also refers to in one of the quotes above (C40 and NewClimateInstitute 2018: 18)? Hickel and Kallis (2019: 8) point out that this development has reversed again in 2017 and 2018 and that the developments of 2015 and 2016 are to be explained by China's and the US's switch away from coal to (amongst others) natural gas. Once these turns have been completed, their effect has slowed down again. Kallis and Hickel therefore highlight that despite these small 'success years' in terms of decoupling, this development is firstly too slow to reach the Paris Agreements' goals (which C40 definitely acknowledges) and secondly, will not be tenable any more if the full potential of

efficiency is reached – a condition that is determined by physical limits (Hickel and Kallis 2019: 7f, see also Ward et al. (2016)). The 'green growth' hypothesis of decoupling economic growth from resources use and therefore also from the emission of GHG therefore seems to be not tangible in the long term:

> Permanent decoupling (absolute or relative) is impossible for essential, non-substitutable resources because the efficiency gains are ultimately governed by physical limits.
> Our model demonstrates that growth in GDP ultimately cannot plausibly be decoupled from growth in material and energy use, demonstrating categorically that GDP growth cannot be sustained indefinitely. It is therefore misleading to develop growth-oriented policy around the expectation that decoupling is possible (Ward et al. 2016: 10).

Nevertheless, Hickel and Kallis also show that there is a sign of hope (in terms of how C40 knows climate change) that green growth could be possible – however, with GDP growth rates that are much lower than historical and projected pathways: "It is reasonable to expect that green growth could be accomplished at very low GDP rates, i.e. less than 1 per cent per year (…)" (Hickel and Kallis 2019: 7). However, the concept of green growth does not only meet criticism. Some authors (e.g. Meckling and Allan 2020) highlight the positive effects of the green growth concept which has shifted the focus of climate policy away from purely market-based mechanisms towards a discourse of a win-win logic. This logic is even seen as having facilitated global cooperation towards the Paris Agreement (Meckling and Allan 2020: 436f).

Summarizing, the concept of green growth fits into the whole story of how C40 knows climate change – and has to be seen in a context where many other international actors of climate governance also know climate protection as compatible with green growth.

The significance of concepts such as 'green growth' but also 'carbon neutrality' naturally have a big influence on the solutions suggested to cope with climate change. These solutions comprise, inter alia more research undertakings, as well as carbon offsetting mechanisms and are further detailed in the following paragraphs.

6.1.3 Problem-solving knowledge: Emphasizing benefits, doing research and promoting carbon offsetting technologies

The problem-solving dimension of knowing climate change comprises solutions that are considered as appropriate to deal with climate change, the way how they should be implemented, and also the aspect of who should deal with climate change and is thus responsible for coming up with and implementing the respective solutions.

C40 suggests that climate actions have to be justified because they are considered as being expensive and standing in contrast to other political priorities cities might have. One of the possibilities of how to overcome this problem, according to C40, is to emphasize the

multiple benefits that climate actions might have for other issue areas as well (see 6.1.3.1). Another solution suggested by C40 to justify climate actions is to highlight that it is financially more than rational to implement climate actions as soon as possible (see 6.1.3.2). One of the solutions to climate change is to do more research to better understand the phenomenon of climate change and possible solutions to it (see 6.1.3.3). A very concrete solution to climate change is – according to C40 – the employment of carbon offsetting mechanisms and the investment in finding new technologies of how to dispose of CO_2 emissions (see 6.1.3.4).

6.1.3.1 Climate action as multi-beneficial

An important part of how climate change is known by C40 in terms of problem-solving knowledge is made up of descriptions of how climate actions can be best justified. C40 assumes that skeptics of climate actions – might they be political or financial players or citizens – will not be convinced of the necessity of climate actions if only the environmental imperative is highlighted. Rather, it suggests that other co-benefits of climate actions for example for health or economic development should be brought to the spotlight. In line with its conceptual knowledge, C40 stresses the importance of providing concrete (quantified) evidence of these co-benefits to be truly convincing.

The underlying rationale – which is also explicitly expressed – is that climate actions per se are most of the time difficult to justify because they constitute an expense in a cities' budget (Arup and C40 2011: 91ff; C40 2016b: 2) or are said to hamper development (C40 et al. 2018a: 15):

> Climate change is often seen as competing with a range of more immediate and tangible issues, such as lack of affordable housing, poverty, unemployment, and poor health. Without a holistic and persuasive case that articulates how climate action contributes to these priorities, it is challenging to attract the support required (C40 2016a: 7).

Furthermore, C40 highlights that according to its findings, climate change is simply no priority topic for many cities:

> Interviews with C40 and city staff identified that for some cities, particularly in the Global South, climate action is not a high priority, or it comes second to delivery of basic services and economic development (C40 2016c: 23).

C40's suggested problem solution is thus that if climate actions can be proven to be beneficial not only for climate change mitigation and adaption but also for other areas a city has to deal with, opponents might be convinced:

> Cities made the point that making the case for climate action is most effective when linked to the direct impact on the life and work of citizens, combined with the impact on basic services, security and employment (C40 and LSECities 2016: 28).

This strategy of convincing skeptics that climate actions are indeed beneficial for many issue areas is termed 'making the case for climate action' (C40 2016a, 2016c; C40 et al. 2018a). Climate change is thus known as an issue area where supporters of climate action have to convince skeptics – which can be successful if enough benefits of suggested actions are presented. The aspect of climate protection itself seems to play only a marginal role in this context:

> Data from these 110 cities shows that cities' actions to reduce GHG emissions also benefit the bottom line. In many places, these savings will provide a much more persuasive message than reductions in GHG emissions (C40 and CDP 2013: 5).

The environmental necessity or a focus on climate protection as a stand-alone and worthwhile topic is rather neglected and the focus on other benefits suggested ("(…) climate action is about more than just climate" (C40 et al. 2018a: 9)):

> Climate change action by city governments can yield strong and clear advantages for their citizens and businesses beyond simply being good for the planet (C40 and CDP 2013: 15).

C40 also highlights that focusing on the co-benefits of climate actions can raise more acceptance and agreement than only the environmental benefits:

> The evidence suggests that citizens are more likely to take action on climate change, or more likely to support governments that take action on climate change, if the wider co-benefits of those actions are emphasized (C40 and LSECities 2016: 4).

But what are these co-benefits that C40 identified? Drawing on a literature review realized in the document '*Co-benefits of urban climate action: A framework for cities*' (C40 and LSECities 2016), C40 suggests that there are five strategic sectors where co-benefits of climate actions can be perceived: health, mobility, resources, buildings, and economy (C40 and LSECities 2016: 10). These are more or less reflected in the concrete benefits that C40 is suggesting: "from reduced congestion, better public health, and greater productivity to improved quality of life and increased resilience" (C40 and McKinsey 2017: 10). Other benefits highlighted are reduced poverty or more enjoyable ways of commuting (C40 2016a), but also economic benefits are stressed:

> Emissions reduction activities by cities are pro-business. 62% of actions that cities are taking to reduce GHG emissions at the city-wide level have the potential to attract new business investment and grow the economy (C40 and CDP 2013: 3).

C40 commonly splits up the benefits in 'economic', 'social' and 'environmental' benefits (see e.g. C40 2016a; C40 and LSECities 2016; C40 2016c; C40 et al. 2018a). This splitting is

based on the assumption that climate actions are per se clear environmental policies and no socio-economic ones:

> First, the classification uses the term benefits rather than co-benefits. Second, the classification is based on a standard sustainable development classification of economic, social and environmental net benefits. Third, this type of classification goes back to the traditional theoretical framework commonly used before the Stern Review, which defined climate action as an environmental policy, rather than a socio-economic policy. From a C40 perspective, the advantage of this approach is that as per above (i) it reflects the reality in cities, i.e. that climate change is not their top priority, and (ii) it encourages integrated decision making based on overall net benefit (C40 and LSECities 2016: 18)

Climate goals in this understanding could also be seen as a co-benefit of other goals to achieve, such as better health conditions or economic development. C40 itself highlights that this strategy bares the risk that "climate change is not prioritized as clearly or strongly" (C40 and LSECities 2016: 18), however sticks to this division.

In line with the importance attributed to quantified data (see 6.1.2.1), C40 highlights that also co-benefits should be quantified to be 'more accessible' and finally more convincing to different kinds of stakeholders (see also e.g. C40 2016c; C40 et al. 2018a):

> Even when the case is established, another major barrier persists which is **making the case**, ensuring the buy-in of the necessary urban and national stakeholders, being able to communicate these benefits in a way that reaches citizens and all other stakeholders. The purpose of this project is to directly address some of the key barriers for the integration of wider impacts and benefits into sector-level planning in cities, by clearly identifying the links between the climate agenda and various development agendas, demonstrating the scale of significance through the quantitative assessment of various measures in several regions, and further developing the methodologies for the evaluation of these impacts, expanding it for the global level and making the results accessible to the general public (C40 and NewClimateInstitute 2018: 13, emphasis in the original).

The 'quantitative assessment' of both the measures themselves and their impacts are hence stressed as enabling cities to communicate the benefits of climate actions. At the same time, C40 also argues that these benefits are particularly interesting at the city-level because they are not only measurable in numbers but can be actually perceived directly by citizens: "At the city level, the potential of co-benefits is particularly great as citizens can often witness the results of policy actions more directly on their daily lives. One example is urban air quality" (C40 and LSECities 2016: 7). However, C40 continues to argue that it is important for cities to provide "concrete evidence on how climate action reduces emissions while also delivering positive outcomes for health and prosperity" (C40 et al. 2018a: 11) – the direct experience of citizens breathing better air is not perceived as such a 'concrete evidence'.

Summarizing, C40's rationale here is that climate change should be dealt with by highlighting the several other benefits that come along with actions initially directed at climate

change. C40 thus assumes that climate protection in itself has not enough value for cities to be implemented without adding other benefits. However, in combination with these other benefits, climate action is worth spending money on – a declaration that C40 also states openly itself:

> Without a strong economic case for action, it is difficult to justify spending money on climate actions – whether from the government's own treasury, national government, or national or international development banks (C40 2016c: 24).

This knowledge aspect overlaps with a general finding for cities dealing with climate change: that actions are usually framed in a context of other (non-environmental) co-benefits in order to back up local environmental action (Gordon 2016b; Schreurs 2008; Toly 2008) – a strategy which has been called a 'no-regret' strategy (Süßbauer 2016: 206). Accordingly, some TMN scholars outline that local climate policies often fit well with other urban policy goals such as infrastructure development, creation of new jobs etc. (Bouteligier 2013). Therefore climate change is often perceived as a strategic issue for urban actors (Bulkeley and Betsill 2013). These strategic connections – presented as 'co-benefits' of climate actions (Gordon 2016b; Schreurs 2008; Toly 2008) – are being used to 'sell' climate policies (Gordon 2016b). This finding can be confirmed with regards to C40's approach: the network actively encourages its member cities to 'make the case' for climate policies by highlighting their co-beneficial effects for other issue areas.

6.1.3.2 Climate action as financial trade-off

Another aspect of how C40 suggests that climate actions can be justified and therefore realized, is the solution to see them as a 'financial trade-off'. According to this argument, climate actions are economically rational for three reasons: firstly, because in case of inaction the costs of climate change will get ever more expensive. Costs here are not only understood in monetary terms but also in terms of economic competitiveness. The second reason to see climate actions as a financial trade-off is that climate change is seen as a threat to the economy in general. Climate actions are thus measures to protect the stable operation of the economy. And thirdly, climate actions are said to be worthwhile investments because they can make a city economically more attractive and stimulate investments.

Suggesting to see climate actions as financial trade-off reflects C40's rationale that in case of inactivity towards climate change, the problem will progressively get more expensive: "Without action, the economic costs of climate change are significant. By 2030, as much as $4 trillion in accumulated costs is at risk from climate change around the world" (CDP et al. 2014: 9). However, the costs are not only understood in monetary terms but also in the sense of

loosing businesses which might be harmed by climate change: “Consensus by cities is clear – climate change poses a threat to businesses within their municipality” (CDP et al. 2014: 11).

The argument of climate action becoming more expensive is used to underline the importance of immediate action:

> Cities must act immediately and decisively on climate change. The longer cities wait, the more expensive and difficult it will be to reduce emissions and, as a result, more natural and human systems will be exposed to significant risk (C40 and NYCSustainability 2019: 9).

This quote is particularly interesting because it shows that climate action is firstly defined as a matter of economic rationality before highlighting that it is also important because climate change constitutes a danger for natural and human systems.

However, the financial trade-off not only manifests itself as future higher costs but also in terms of a threat to the economy in general:

> The cost of inaction on climate change will be extremely high. Major impacts for cities and communities will include business interruption, failure in supply chains, temporary or permanent loss of household incomes, as well as losses of life and property. If U.S. mayors do not act to protect their cities, they risk impacts today and a loss of competitiveness on the international stage in the eyes of investors (C40 and Arup 2016b: 6).

C40 highlights that different elements which are important for the functioning of the current economy are threatened by climate change:

> The impacts that cities expect businesses to encounter as a result of climate change are far-ranging. Damage to property, capital and non-transport infrastructure are commonly identified. Other reported impacts reveal a more complex challenge. For example, social impacts within the community, including impacts to public health, affect companies’ workforce and customers. Changes to the natural environment and available resources have impacts on production, particularly for food industries (CDP et al. 2014: 11).

Accordingly, climate actions are financially rational because they ensure the stable operation of the economy.

The third reason why climate actions are known as a financial trade-off is that they in turn not only help to protect a city’s current economic activity as it is but can even make them economically more attractive:

> CDP’s review of city responses suggests that tackling climate change—through actions that both reduce GHG emissions and protect the city from the expected effects of climate change—is also helping cities to attract and retain business investment (C40 and CDP 2013: 7).

Accordingly, C40 suggests that cities should commit to GHG reductions – also as an economic strategy: “GHG reduction commitments matter because they drive action and further

investment in cites [sic]" (C40 and Arup n.d.: 2). As a consequence, according to this point of view, climate actions can even constitute a local advantage for a city:

> While most cities report that rising global temperatures will lead to negative economic impacts, 79% of cities recognize that climate change creates new economic opportunities as well. Improvements in transport infrastructure, for example, can reduce greenhouse gas emissions and improve resilience to climate change. Research by Siemens suggests that the economic opportunity major cities could gain from upgrading their public transport infrastructure alone is around $800 billion per year, due to productivity gains and the development of new economic activities (CDP et al. 2014: 12).

And also on a global scale, C40 states that climate actions are very well economically attractive:

> The New Climate Economy estimates that low-carbon urban actions present a global economic opportunity of $17 trillion by 2050. The creation of new jobs will naturally be a part of this opportunity (C40 and McKinsey 2017: 57).

To summarize, C40 suggests that climate change should be dealt with by stressing climate actions' financial rationality in so far as not taking them would mean accumulating future costs, destabilizing the current economic functioning and foregoing immense economic opportunities. Using all of these arguments is described as 'speaking the language of business' (C40 2016c: 36), which is key to getting support from the economy in C40's terms. This goes in line with one of C40's conceptual knowledge rationales – that climate change can be solved by implementing a 'green economy' and following the concept of 'green growth':

> To facilitate **the green economy,** city administrations need to be able to inspire and enable the private sector. City staff need to 'speak the language' of business in the relevant sectors, and build skills in presenting policies in ways that showcase the business opportunity (C40 2016c: 36, emphasis in original).

The context of this solution suggested by C40 is firstly the network's conceptual knowledge characterized by the concept of 'green growth', mirroring the belief that economic growth is both feasible and desirable while reducing the economy's climate impact. At the same time, there is another important contextual factor of suggesting the financial rationality of climate protection policies: the so-called Stern Report and its influence on the perception of climate change as a future financial burden. The Stern Report has suggested that early investments in climate protection would by far outweigh the costs that would await humanity if no climate protection measures are undertaken in the near future (Jacobs 2013; Stern 2006; von Lucke 2017) – in the meantime, this argument is even called the 'standard' green growth argument (Jacobs 2013: 209). The Stern Report and its conclusions are perceivable in C40's argument that in case of inaction the costs of climate change will increase progressively. Furthermore,

the argument that climate actions are said to be worthwhile investments because they in turn can make a city economically more attractive and stimulate investments are part of the broader, and widespread, green growth context (Jacobs 2013) (see also 6.1.2.3).

6.1.3.3 Research and education

Next to C40's suggestions of how cities and urban actors can justify climate policies at the local level, the network also provides knowledge about which concrete steps can be taken to solve the problem of climate change. One of these concrete problem solutions is doing research and, on that basis, educate others. These others can be either citizens of the respective city or, if a city has done its own 'research', other cities. The research is both to be done by C40 itself in cooperation with its member cities, but also by the member cities in cooperation with local private sector companies.

C40 argues that in order to solve the problem of climate change it is necessary to do more research, especially on the benefits of urban climate actions:

> In response to this critical barrier, C40 has launched an enabling research programme on the benefits of inclusive climate action. This programme recognises the enormity of the challenge but also the scale of the opportunity; climate action has a wide range of benefits for health and prosperity and offers the potential to create not only low- carbon cities but more liveable cities where everybody has an opportunity for a better quality of life. (…) This focus on inclusive action and overall benefits not only better reflects the reality of cities but furthermore encourages integrated decisionmaking and encompasses all citizens – vital to enabling the scale and scope of action. The research programme will focus on enabling the priority, high impact actions. By providing evidence of the full range of benefits from climate action, cities can avoid making false trade-offs and can drive urban development that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens (C40 2016a: 8)

The reasoning suggests that if cities have access to research results they will be enabled to contribute their part to the achievement of the goals as agreed in the Paris Agreement. Further, by doing research themselves, they can contribute to the better understanding of climate changes:

> There are impacts at 2.0°C compared with 1.5°C about which we still have significant knowledge gaps. These include effects at the local level, as well as linkages between climate risks, poverty, equity, and well-being. The scientific community and local, regional and national levels of government could help fill these gaps and enable local action through research and better access to high-quality, relevant data (C40 et al. 2018c: 11).

At the same time, it is C40 presenting itself as the actor who is realizing this much-needed research:

> C40 has undertaken cutting-edge research to demonstrate the air quality and health benefits of climate action - working with 26 cities to date to measure potential health gains and use this to make a stronger case for action (C40 and Johnson&Johnson n.d.: 1).

But research is not only understood in terms of calculations etc. but also in terms of informing oneself about what others have already done in the area of climate actions:

> Cities that build a world-class tool kit to capture these opportunities, including streamlined procurement, access to capital, relationships with other cities to learn from their best-practice experiences, and partnerships with the private sector and government, will be well positioned to tackle the next set of emissions reduction opportunities (C40 and McKinsey 2017: 10).

Exemplary actors for such learning undertakings can be either other cities, especially C40 leadership cities, or business actors. Concerning leadership cities, C40 suggests that it is worth for other cities to check what they have already done in different fields of climate action:

> Closer review of the data reveals that there are a number of cities implementing actions across most these initiatives. These cities are true leaders in the climate finance field, and have much in the way of innovative programmes to share with the rest of the C40 network (Arup and C40 2011: 92).

To find solutions to the problem of climate change, C40 also suggests that cities should research what business actors have already found and tested as solutions:

> An increasing number of companies are already working toward goals of 100 percent renewable energy and can use what they have learned to partner with cities and utilities to make this goal a reality across the global urban landscape. (C40 and McKinsey 2017: 65).

The research results are then to be transformed into educational measures to foster climate action at different levels. ‘Education’ thus constitutes another component of how C40 suggests the problem of climate change could be solved on an urban level.

One target group of such educational undertakings are the citizens of a respective city:

> Many cities are taking informal and formal action to reduce vulnerability of their populations to the adverse affects of climate change. These include the increased possibility of transmitting diseases through infecting organisms who can survive in the warmer climates associated with climate change. They also include preparing populations for heat waves and ensuring that water systems are not toxic.
> In Mexico City, the mayor has helped to create conferences to address mothers of children who have increased exposure to disease, due to a generally warmer climate and increased vector transmission. These conferences address the need to take care of children affected by dehydration and diarrhoea. Mexico City has also developed a virtual centre of information for climate change, as a resource for the community to understand their potential vulnerabilities (Arup and C40 2011: 102).

Education and awareness programs targeted at citizens are a component of what C40 suggests cities as solutions to climate change (see e.g. C40 and Arup 2015a; C40 2016d).

Another aspect of education, and maybe the more important for C40, is the education of cities by cities more experienced climate policy-wise: "Additionally, opportunities for cities to share best practices and lessons learned can play a role in driving action and improving implementation efforts through 2050" (C40 and Bloomberg n.d.-b: 5).

C40 presents especially its own member cities as being capable of educating other cities worldwide:

> While C40's 86 cities influence 20% of global carbon emissions, the world's urban areas already account for more than 70% of global carbon emissions. C40 is a leadership group of some of the world's largest, most empowered and most ambitious cities. C40 cities are able to introduce innovative technologies, test financing mechanisms and pioneer more ambitious actions in a way that other smaller, fast growing cities cannot. These lessons and newly developed best practices can then be shared with the rest of the world's cities. As pioneering leaders across the world, the C40 cities can amplify the impact of breakthroughs and successes within the C40 network (C40 and Arup 2016a: 92).

To summarize, C40 suggests that these activities of doing research and educating others will ultimately lead to 'effective action on climate change':

> As this evidence shows, cities have experimented, shared, piloted, learned, collaborated, invested, and are now moving forward with delivering an unprecedented, truly global wave of effective action on climate change (C40 and Arup 2016a: 39).

This solution has to be seen against the backdrop of C40's conceptual knowledge. As outlined in chapter 6.1.2.1, C40 believes that data and scientific information are a necessary prerequisite for appropriate climate politics, also on the city level. Assuming that there is often a lack of the same, it seems only logical that C40 knows research and education as a solution to persisting climate change problems.

Another context to this problem-solving knowledge is part of the process which has made climate protection an 'empty signifier' as Methmann (2010) suggests, namely that the production of scientific knowledge has achieved a status of a climate protection measure without actually changing any policies (see also Lövbrand 2014):

> (…) the endless demand for knowledge makes providing information an act of climate protection in itself because it contributes to governing the climate. (…) In this sense, no policy change as such is necessary: already by providing crucial *expertise* those organisations become part of the climate protection discourse (Methmann 2010: 364, emphasis in the original).

C40's suggestion to do research and educate as a solution to climate change can actually be seen against this backdrop as C40 also presents the production of expertise as a climate protection measure itself.

6.1.3.4 Carbon offsetting and negative emission technologies

Another solution to climate change that C40 suggests is the implementation of carbon offsetting projects relying on negative emissions technologies. In line with the concept of 'carbon neutrality' (see 6.1.2.2) C40 suggests that the deployment of negative emissions technologies is almost unavoidable to reach internationally agreed goals. Carbon offsetting is presented as a possibility to reach the goal of being 'carbon neutral'. Carbon emissions accordingly can be either offset through 'carbon credits' which are presented as 'natural' ways of capturing carbon from the atmosphere, or by 'negative emission technologies', thus 'technological' means of capturing carbon. While suggesting the necessity of these offsetting mechanisms, C40 also highlights possible problems with these approaches as a solution to climate change.

C40 argues that carbon offsetting – or in C40's terms the production of negative emissions – is a necessity to reach the temperature goals recorded in the Paris Agreement:

> This research shows that a climate-safe future may now rely on CO_2 removal technologies, sometimes known as "negative-emissions" technologies. This is the case for both 1.5 and 2 degree scenarios, where CO_2 removal from the atmosphere must at least compensate for the continued emissions of other greenhouse gases (from agriculture and fossil fuel extraction, for example), which may be far more difficult to eliminate (C40 and Arup 2016a: 88).

At the same time, C40 highlights that the deployment of carbon offsetting projects depends on the rapidity of GHG reductions by other means (those that are understood as 'climate actions' taken on an urban level):

> Negative emissions technologies (such as bio-energy carbon capture and storage) are likely to be required to ensure that the 53 $GtCO_2e$ emitted by 2050 in the 1.5 degree scenario is reduced in line with the 22 GtCO e budget by 2100. A total of 31 GtCO e must be removed from the atmosphere during this time period. Since carbon capture and storage is not yet widely employed, there is an enormous amount of work to be done to make this trajectory a reality. Without negative emissions, our calculations suggest that zero net emissions would need to be reached in C40 cities as early as 2030 (C40 and Arup 2016a: 31).

C40 also highlights the enormous potential that offsetting technologies might have because "while many carbon offset project protocols and standards have been launched recently, few cities have offset their residual emissions" (C40 and NYCSustainability 2019: 8). Accordingly, carbon offsetting is presented as an almost equal option to reduce GHG emissions as the

expansion of renewable energies or energy efficiency improvements (see C40 and NYCSustainability 2019: 16).

How does C40 understand 'negative emissions', thus the result of 'carbon offsetting'? Negative emissions are understood as emissions being captured by different additional human activities:

> **Negative emissions**: Removal of greenhouse gases (GHGs) from the atmosphere by deliberate human activities, i.e. in addition to the removal that would occur via natural carbon cycle processes. For CO_2, negative emissions can be achieved with direct capture of CO_2 from ambient air, bioenergy with carbon capture and sequestration (BECCS), afforestation, reforestation, biochar, ocean alkalinisation, among others (C40 and NYCSustainability 2019: 51, emphasis in the original).

C40 further suggests that cities have two different options to 'offset' their emissions. The first being the employment of 'carbon credit projects' and the second 'negative emissions technologies'. 'Carbon credit projects' are presented as activities that are indeed additionally realized by humans but nevertheless based on natural processes: "Traditional projects that can generate carbon credits include afforestation, reforestation, improved forest management, avoided conversion, and urban forestry" (C40 and NYCSustainability 2019: 16). The second option, 'negative emissions technologies' are in turn technological means invented by humans and not naturally occurring phenomena:

> Employ negative emissions technologies, taking deliberate action to remove GHGs from the atmosphere beyond those removals that would occur via natural carbon cycle processes. For example, direct capture of CO2 from ambient air (DACS), and bioenergy with carbon capture (C40 and NYCSustainability 2019: 16).

Other such technologies include adding biochar to the soil (in contrast to extracting and burning it as fuel), geoengineering technologies such as 'enhanced weathering' (an attempt to improve CO_2 removal from the atmosphere by injecting silicate and carbonate particles in soils, coasts or oceans), or plant engineering technologies modifying a plant's traits to increase CO_2 storage (C40 and NYCSustainability 2019: 43).

Despite highlighting the importance and necessity of negative emissions and carbon offsetting (e.g. through stating that 35 GtCO2e in negative emissions are required between 2050 and 2100 (C40 and NYCSustainability 2019: 11)), C40 also problematizes the deployment of such technologies as competing with other important aspects: "BECCS [Bioenergy with carbon capture and storage, M.K.] also presents challenges for land-use, with its bio-energy feedstock potentially competing with food crops" (C40 and Arup 2016a: 88).

It further stresses that most of these technologies are "yet to be tested and proven, non have been adopted at large scale" (C40 and NYCSustainability 2019: 43) and that therefore cities should be careful in relying on them:

> Cities should consider any and all potential ecological and ethical side effects resulting from the adoption of NETs [negative emissions technologies, M.K.] based on the best available information at the time. For example, direct air capture and storage (DACS) requires a lot of energy which would have to come from renewable sources in order to be deployed on a large scale (C40 and NYCSustainability 2019: 43)

However, C40 still knows carbon offsetting and negative emission technologies as valuable and indispensable solutions to the problem of climate change. This stands in clear contrast to Climate Alliance's reluctant attitude towards these technologies which it considers as no real mitigation measures, as the following statement shows: "There is the danger that this instrument, which promises the consumer an easy course of action in the field of climate protection, will be used more and more instead of real mitigation activities (ClimateAlliance 2008: 2)".

To summarize, C40 suggests carbon offsetting as one of the solutions to climate change, based on the goal that carbon neutrality must be reached at a certain point in time. It suggests different possibilities how cities can make use of carbon offsetting technologies but at the same time underlines that these are not unproblematic.

This solution suggested by C40 perfectly fits in the network's climate change knowledge. Accordingly, carbon offsetting is described as market-based climate governance mechanism (see Pattberg and Stripple 2008) which is in line with the green growth paradigm and the negation of the need to immediately and rapidly reduce emissions (see Hickel and Kallis 2019). As such, carbon offsetting and the accompanying negative emissions technologies have faced much criticism (Bäckstrand and Lövbrand 2006; Lohmann 2009). Amongst the major points of critique are the arguments that by relying on (future) negative emissions, difficult political decisions are simply postponed and the ongoing combustion of fossil fuels is licensed (Anderson and Peters 2016: 183). But also the high technical uncertainty about the feasibility and reliability of such techniques play an important role (Anderson and Peters 2016; Hickel and Kallis 2019; Williamson 2016).

However, the reliance on carbon offsetting is in line with the general development of the climate regime – Pattberg and Stripple for example highlight that "[w]ith the successful negotiation and entry into force of the Kyoto Protocol, market mechanisms have become a cornerstone of the current climate governance architecture" (Pattberg and Stripple 2008: 374, see also Lohmann 2009). And also specific technologies such as the BECCS are globally dominant aspects of climate governance: "Although BECCS, like all negative-emission technologies, is subject to scientific and political uncertainties, it dominates the scenario landscape" (Anderson and Peters 2016: 183).

Hickel and Kallis (2019) highlight that this is the case because otherwise, the idea that green growth is possible without radical changes would have to be dropped:

> It is not clear that we can justifiably rely on BECCS, an unproven technology, to underwrite green growth theory. If we accept this point, then we must return to asking whether it is possible to maintain growth without relying on BECCS to stay within the carbon budgets consistent with the Paris Agreement. Without BECCS, global emissions need to fall to net zero by 2050 for 1.5°C, or by 2075 for 2°C (Hickel and Kallis 2019: 10).

This shows that firstly, C40's problem solution knowledge is very well in line with much of the globally dominant strategy in knowing climate change and potential solutions. Secondly, it is smoothly building upon the other levels of C40's climate change knowledge. If other problem solutions (such as a radical change of lifestyles as Climate Alliance suggests it) would be favored, the conceptual knowledge dominated by concepts such as 'carbon neutrality' and 'green growth' would no longer be tangible.

6.1.4 Critical knowledge: Accordance with hegemonic knowledge structures

Critical knowledge as I define it, is knowledge which aims at questioning hegemonic knowledge structures, as well as at demonstrating that and which alternatives would be possible or already available. As has become clear already throughout the former paragraphs, C40's way of knowing climate change is very much in line with what can be seen as the 'hegemonic' way of knowing climate change (for this discussion see also chapter 3.1). Indeed, all forms of knowledge that I identified in the documents published by C40 were in line with this 'mainstream' way of knowing climate change.

In this vein, Chris Methmann (2010) has extensively outlined how the global governance of climate change is built on four pillars. These are firstly 'globalism', presenting climate change as an inherently global problem which requires international solutions and which favours global managerial and multilateral approaches (Methmann 2010: 357ff; see also Jasanoff and Long Martello 2004; Hoffmann 2013). Secondly, 'scientism' arguing that scientific data, such as global surveys, satellite data etc. are necessary to successfully act upon climate change and that the pure production of scientific knowledge is counted as a climate protection measures, despite not implementing any policy change as such (Methmann 2010: 363f; see also Hulme 2010, Walsh 2019). Thirdly, a 'growth' ethic, justifying climate protection with the means of economic calculations, and seeing climate change as something external to the economy, instead of inherently intertwined (Methmann 2010: 364ff, see also Hickel and Kallis 2019). And finally, 'efficiency', arguing that climate change can be addressed with more efficient technology, therefore privileging technocratic solutions to fundamental political (and economic) changes (Methmann 2010: 366ff; see also Rice et al. 2015; Swyngedouw 2013). As clearly

outlined in the former sections, all of these pillars are, to varying degrees, perceivable in C40's way of knowing climate change, confirming the assumption that C40 "promotes technocratic, economically positioned programs as the conceptual framework to combat climate change" (Davidson and Gleeson 2015: 33).

Because of this strong agreement with the dominant way of knowing and acting upon climate change, I could not interpret any part of C40's knowledge as 'critical knowledge' – an aspect that is in contrast to how Climate Alliance knows climate change (see especially chapter 6.2.4).

6.2 Climate change as a multi-faceted phenomenon – Climate Alliance's way of knowing climate change

In a short and summarizing sentence, Climate Alliance's way of knowing climate change is the following:

> Climate change is as much a socio-economic as it is a techno-scientific phenomenon which is to be addressed by everyone by overcoming current unfair socio-economic structures and interdependencies.

This sentence is based on findings that Climate Alliance – in terms of definitional knowledge – knows climate change as a phenomenon with 'many faces'. Accordingly, climate change is very well also known as a meteorological phenomenon but one that has not only meteorological, but also economic and social consequences (as well as origins). Part of this multifacetedness is, according to Climate Alliance's knowledge, that climate change is a phenomenon that affects humans and natural environments differently in different places all over the world – and it affects those most that contributed least to it. Climate change is thus known as being 'unfair'. The contribution of 'unfairness' to the phenomenon of climate change is an aspect which plays an important role in how Climate Alliance knows climate change. Hence, industrialized countries and the people living therein, are seen as main culprits of climate change – because of the lifestyle they led over the last 200 years. Climate change is thus also known as a lifestyle problem. In turn, conceptually, Climate Alliance's knowledge is based both on scientific data and approaches, as well as on people's experiences and empirical expertise. Therefore, direct interaction of people and the exchange of their experiences is seen as significant for the generation of knowledge about climate change. Further, concepts such as 'social justice' and 'climate justice' play an important role. Climate Alliance knows solutions to this problem (respectively, the multiple problems) being mutual education and exchange, as well as a change of currently dominant behaviors and lifestyles. Therefore, climate change is known as a problem that concerns everyone globally (though differently) and which can also be addressed by everyone.

Different to C40's knowledge, I interpreted parts of how Climate Alliance knows climate change as 'critical knowledge'. This critical knowledge is – sometimes more, sometimes less – inherently present in the other three forms of knowledge. It is thus idealized to present the following aspects as part of a particular form of critical knowledge. I distilled as critical aspects of how Climate Alliance is knowing climate change its critique of the currently dominant perceptions of climate change's root causes, the fact that indigenous concepts and ways of living are considered, as well as its explicit critique of political and economic developments and actors.

All these aspects of how Climate Alliance knows climate change are presented in further detail below.

6.2.1 Definitional knowledge: Climate change being multi-faceted and unjust

Climate Alliance defines climate change as a problem with many faces, measurable in temperatures, but also perceivable with one's own senses. It is defined as a problem which can appear very differently in different places globally. Climate change is further defined as unjust because it is both unequally distributed and, the problem itself is unequally caused.

6.2.1.1 Defining climate change – A problem with many faces

The first aspect of how Climate Alliance knows climate change is its definition as a problem with many faces and facets. What do these facets look like? Climate change is indeed in accordance with the Paris Agreement also seen as a problem capturable in temperature measurements (e.g. ClimateAlliance 2017e, 2019a). Accordingly, Climate Alliance – just as C40 – uses the projected increase in global mean temperature and the respective goal of keeping this increase well below 2°C to describe the seriousness of climate change:

> Recent analysis of the IPCC 1.5 science d [sic] by major cities noted that '2°C of heating has long been cited as the threshold to avoid dangerous levels of climate change. We now know that even 2°C of heating is dangerous. The projected impacts of 2°C versus 1.5°C of heating include half a billion more people struggling to get enough to eat, double the number of people suffering from water scarcity, and dramatic increases in ecosystem loss' (ClimateAlliance 2019a: 3).

But the reference to temperature developments is not used exclusively to define climate change. Rather, climate change is defined as something that is affecting all and everything around the world in similar and yet different ways (e.g. ClimateAlliance and ASTM 2013a; ClimateAlliance 2015a; ClimateAlliance 2017a: 14-26). Exemplary for this definition of climate change as a phenomenon with many different faces and facets is the document '*We Are All Witnesses. People in a changing climate*' (ClimateAlliance and ASTM 2013a), in which "(…) personal testimonies and natural phenomena, all of which are in line with the 2007 IPCC projections and the new findings of 2013" (ClimateAlliance and ASTM 2013a: 3) are put together and in which people from countries ranging from Greenland, Peru, Burkina Faso, to Luxembourg, Hungary or Denmark, are showcasing how they think they already experience climate change in their daily life and in which ways. Also, other documents provide examples for what climate change means for different people and mention for example the changing habits of migrating fish or rising numbers of skin burns (ClimateAlliance 2015a: 27).

In line with this definition of climate change as a problem manifesting in various different ways, different origins of climate change, such as current social and economic systems are enumerated:

> Our current social and economic system does not have any answers to climate change. Indeed, it is in fact part of the problem, as it promotes the production and accumulation of goods in some regions of the world at the expense of the natural resources, health and living spaces of others (ClimateAlliance 2017a: 14).

By stating that the current social and economic system is part of the origin of the problem, climate change is not only defined as a meteorological phenomenon but also a social, economic, or cultural challenge. Climate Alliance provides an example in the document '*UNREDDY*' for how climate change can be a cultural challenge (see Adger et al. 2013) in the form of an interview with two indigenous women representing the Ashánika people who traditionally do not have any privately owned, but only community-owned land (ClimateAlliance 2015a):

> The forest is our only asset. It allows us to be independent. We are able to grow food on our chakras (small forest gardens); the forest is home to the animals and plants we use as medicine. In the cities, we need money for everything. My grandparents taught me that the earth is our mother. The sun, the rain, the animals are all living creatures belonging to one big family. (...) One of the problems that we have in Satipo is the increased migration of smallholder farmers from the Andes region. They often receive their individual land titles faster than our indigenous brothers. Because they are not familiar with the local conditions, they clear large swathes of land. In contrast, we do not claim land titles individually but rather as a community. The authorities take their time to issue these titles though (ClimateAlliance 2015a: 26f).

Knowing climate change as an issue that manifests differently and includes various aspects, in Climate Alliance's definition does also imply that it cannot be seen as a stand-alone problem but instead as one that is interconnected with other problems: "Human rights, governance issues, environment, and economic and social development are to be recognised as interrelated on a global level (…)" (ClimateAlliance 2015b: 1).

The perspective identifiable for me in this aspect of Climate Alliance's definitional knowledge is that climate change is known as a problem which has different roots and different consequences. Therefore, the definitional rationale is that it can not only be captured by rising temperatures but also by for example the observation that fish are changing their migration habits.

If we think back to the critique mentioned before that climate change being merely known as a matter of temperatures, is too unrelated to peoples' actual experiences and too far away from the many possible local implications climate change can have (Hulme 2010; Jasanoff 2010b), the way of knowing climate change as a multi-faceted problem seems to do better justice to the phenomenon. With its drawing back on different experiences and observations that people made and make, Climate Alliance can be seen as trying to render the manifold meanings of climate change (see Jasanoff and Long Martello 2004c; Pettenger 2007b)

accessible. However, as already mentioned above, this is far from the globally dominant way of knowing climate change – which can definitely be seen as a "story of global temperature" (Hulme 2010: 560). Accordingly, Livingston et al. (2018) highlight how reoccurring calls for more diverse and geographically-sensitive accounts of climate change were rejected throughout the drafting process of the IPCC's Fifth Assessment Report (AR5), while scientific representations of climate change were favored over experiences of involved government representatives (p. 88f). Further, they recall that this is not doing justice to the different aspects and accounts of climate change which should always be taken into account: "(…) it is important that what is written about it [= climate change, M.K.] should make evident the culturally and socially specific complexities that climate change implies" (Livingston et al. 2018: 89). Insofar, Climate Alliance's definitional knowledge can be seen as standing in contrast of how climate change is generally known within the global climate change regime.

6.2.1.2 Climate change as a phenomenon of (un)fairness

I have called the second aspect of Climate Alliance's definitional knowledge base 'climate change as a phenomenon of (un)fairness'. The 'unfairness' of climate change here comprises two facets: firstly, that the effects of climate change are unequally distributed and secondly, that the problem itself is unfairly caused in so far as that not all humans on earth have the same share of responsibility for the existence of the problem.

The unequal distribution of the effects of climate change, according to Climate Alliance, is particularly visible when looking at indigenous peoples because they are "among those most affected by climate change despite the fact that they barely contribute to it themselves" (ClimateAlliance 2017d: 2). Climate Alliance argues that this vulnerability is caused by indigenous peoples' dependency on endangered habitats:

> Like many other communities whose ways of life depend directly on some of the world's most fragile ecosystems, indigenous peoples are bearing the brunt of the climate crisis while having contributed little to it. In looking at the injustice faced by these peoples, the fact that climate change is just as much a social and economic problem as it is an environmental one becomes painfully clear (ClimateAlliance 2016b: 4).

But not only indigenous peoples – no matter where they live on earth – also the Global South in general is presented as particularly affected by the effects of climate change:

> Climate change aggravates the living conditions of many people in the Global South to such an extent that they cannot adapt anymore and are subject to an ever-increasing pressure to leave their homes (ClimateAlliance 2017b: 2).

The aspect of unfairness, however, is not only identified on a global scale. This becomes clear when Climate Alliance highlights that also in developed countries climate actions are not

the top priority of people living in deprived neighborhoods but potentially extremely grave for exactly these people (ClimateAlliance n.a.: 5). Therefore, actions targeted at climate change are not only defined as environmental actions but also as actions aiming at increasing equality, reducing energy poverty and supporting deprived neighborhoods – on a local and on a global scale (ClimateAlliance 2015a, 2017a, n.a.). This again mirrors the first aspect of Climate Alliance's definitional knowledge of climate change being a multifaceted problem and bridges to the other part of climate change as a problem of (un)fairness: the unequal responsibility for its very existence.

One of the quotes above (ClimateAlliance 2016b: 4) already points to this aspect when stating that indigenous people have only contributed very little to the problem. The producers of the problem are defined as people living in developed countries – on the basis of the here-prevailing resource-intensive and therefore climate (respectively environmentally) destructive lifestyle model (ClimateAlliance 2012a, 2015a, 2017d, 2017a, 2017e):

> Burgers and steaks, sausages and ham - our consumption of meat leads to the destruction of rainforests. Why is this? Our consumption of meat has quadrupled in the last 150 years to 91 kg per year on average, in Europe, and meat production has become a global industry - with global consequences. The biomass of the global livestock population now exceeds that of all other land vertebrates by a factor of 20. The increase in breeding of and feed required for livestock is the main factor driving worldwide deforestation. Just one example: Where 40 years ago there was rainforest, now 73 million head of cattle graze in the Brazilian Amazon alone. With the cattle, pig and chicken meat we eat in Europe, which is fed soya from Brazil, and the roughly 58,000 tonnes of beef we import every year, also, from Brazil, we create the incentives to continue to clear rainforest for animals to feed (ClimateAlliance and ASTM 2013b: 3).

Accordingly, the "differential use of resources" (ClimateAlliance 2017c: 2) and the consequent impact on the environment is unfairly distributed on a global scale. Assuming that "Greenhouse gas emissions are a good indicator of this unequal consumption of resources" (ClimateAlliance et al. 2014: 21) Climate Alliance very clearly states that "(t)he countries that bear the greatest responsibility for climate change are industrialized countries and the most vulnerable ones are developing countries" (ClimateAlliance and ASTM 2013a: 28).

One of the many examples that clearly reflects this divide of responsibility and impact is given in the document '*The Land We Grab*' (ClimateAlliance and ASTM 2013a), where different people's experiences with changing natural circumstances are presented while at the same time, the per capita CO_2 emissions of the respective country are compared to per capita CO_2 emissions from the (then) EU27, as well as global average per capita CO_2 emissions. Below these data, the vulnerability of the respective country according to the WorldRiskIndex 2012 is demonstrated on a scale ranging from 'very low' to 'very high'. This graph for example shows that Denmark, with 12.1 tons/capita CO_2 emissions lies both above the EU27 (10.0), as well

as the global per capita average (7.3) but ranges only between 'very low' and 'low' on the risk index scale. In contrast, Burkina Faso, with only 1.4 tons CO_2 emissions/capita ranges between 'high' and 'very high' on the risk index scale (ClimateAlliance and ASTM 2013a: 6 & 16). Such illustrations, in combination with the other quotes presented above, show that Climate Alliance also defines climate change as a lifestyle problem – more specifically, as a phenomenon characterized by inequality. This problem is due to a questionable, though hegemonic, Western- and consumption-based lifestyle (see chapter 6.2.4.1).

Normatively, Climate Alliance seems to assume that it would be 'fairer' if those who contribute most to climate change would also be those carrying the burdens of it (or at least they should help avoiding that those that least contributed to it are hit the hardest). Further, I interpret that Climate Alliance – because of it being aware of the 'unfair' distribution of climate change consequences – sees enough value in mitigating and adapting to climate change as such, without recurring to financial trade-offs, in the sense of 'acting now is cheaper than acting later' (as C40 partially does it, as explained in chapter 6.1.3.2).

This definitional baseline is to be seen against the backdrop of two principles that have long been at the center of the international climate regime because they highlight some of the key dilemmas of climate change and its governance (see von Lucke 2017): the 'polluter pays' principle and the principle of 'common but differentiated responsibilities' (to which Climate Alliance also explicitly refers (e.g. ClimateAlliance and ASTM 2013a: 28)).

The aspect of defining climate change as unfair touches upon one of the core issues of climate change: different parts of the world have contributed to the emergence of the problem to different degrees, whereas at the same time some are disproportionately affected by its consequences (Harris 2006; von Lucke 2017). The 'common but differentiated responsibility' (CBDR) principle was therefore introduced within the UNFCCC context to clarify that global climate policies have to be based on the different responsibilities and capabilities of the parties. The principle of this rule is based on the assumption that developed countries have a stronger historical responsibility for emissions and are at the same time better prepared to face the consequences (Harris 2006: 314-315). On this basis, countries have been divided into 'Annex I' (developed) and 'Non-Annex I' (developing) parties to which the Kyoto Protocol has attributed different obligations and scopes for actions (UNFCCC 1997) – a division that was upheld until the adoption of the Paris Agreement in 2015. This agreement does not prescribe (or better, attempt to prescribe) any binding targets for specific groups of countries but rather encourages all participants to develop their own 'nationally determined contributions' (NDCs) (UNFCCC 2015a).

The 'polluter pays' principle goes a little bit further than the CBDR in so far as it not only answers the question of who is responsible in general, but also practically, who should pay for

the actions taken considering climate change. It has a “considerable intuitive appeal” in so far as it follows the assumption that “if someone has produced a harm (they have spilled rubbish on the streets, say) then they should rectify that situation” (Caney 2005: 752). Applied to climate politics, the ‘polluter pays principle’ was introduced by the OECD in 1972 and became a guiding principle of international environmental law as well as for the OECD’s and the EU’s environmental policy (Caney 2005; De Lucia 2008). It suggests that those causing pollution are responsible to bear the costs, including pollution prevention, control of pollution as well as ‘clean-up costs’ (De Lucia 2008).

Although the two principles have been (and to a certain degree still are) widespread within the climate regime (at least until the adoption of the Paris Agreement (Dröge 2016; von Lucke 2017)) they are being questioned and criticized for several reasons. The points of critique include that it has been mostly states which have been taken as the relevant unit to answer the question of who are to be seen as ‘the polluters’. Other relevant units, such as particular individuals, economic corporations, or international regimes and institutions are not considered in turn (Caney 2005: 754f). Other points of critique are that the dichotomy between developed and developing countries firstly deepens the already existing rift between these and secondly, is no longer tangible with once developing countries such as India or China becoming part of the biggest emitter countries (von Lucke 2017: 6). Further, the divide between different circumstances and responsibilities is also said to having long hindered the establishment of a universal climate agreement (Pauw et al. 2014).

Nevertheless, Dröge (2016) highlights that the CBDR is still an important part of the climate regime and serves as inspiration for the strategy of the NDCs as agreed upon in the Paris Agreement. Accordingly, even though the split between different actors’ responsibilities is no longer made that explicit, the CBDR principle and its idea of equitable contributions to climate politics still has to resonate when countries are designing their NDCs (Dröge 2016: 30).

Climate Alliance’s definitional knowledge base is thus not surprising but can be seen as in line with much of the international climate change debate. As such, the ‘unfair’ character of climate change is also acknowledged by C40 underlining the effects of climate change are most probably going to hit those who are the poorest, the hardest (see C40 et al. 2018a: 110). It further asks for a ‘fair’ distribution of the remaining carbon budgets keeping in mind historical responsibility and capacities (C40 and Arup 2016a: 102). However, this aspect is much more pronounced in Climate Alliance’s way of knowing climate change than in C40’s.

What is definitely clearly perceivable in terms of how Climate Alliance knows climate change is that its definition as a phenomenon marked by unfairness has consequences for the conceptual knowledge, for example in the widespread use of concepts of social and climate justice, but also on the problem-solving, and even more on the critical level.

6.2.2 Conceptual knowledge: personal exchanges for more justice and a good life

Climate Alliance's conceptual knowledge level is coined by the 'umbrella' belief that climate change is a phenomenon which can be best understood if different experiences with and understandings of climate change are exchanged between different groups of people (as outlined in chapter 6.2.2.1). These accounts of climate change can be either scientific or based on everyday observations. Accordingly, Climate Alliance seems to believe that climate change can be best known if it is 'experienced'. These experiences – made either by people themselves or being passed on by people who made them – are in turn believed to foster climate action. The two main concepts characterizing Climate Alliance's conceptual knowledge are 'social and climate justice' (see 6.2.2.2) and 'buen vivir' (see 6.2.2.3).

6.2.2.1 Significance of direct interaction and exchange

The first aspect of how Climate Alliance knows climate change on a conceptual level is the belief that direct exchange between different (groups of) people is significant both for fostering climate action but also for building a valid basis of information about the phenomenon climate change itself. Hereby, the concept of 'experiencing' climate change plays an important role. The argument goes that people, also within city and regional administrations, will only understand the phenomenon climate change – and therefore act upon it – if they either experience it themselves or if they directly interact with other people experiencing already occurring changes. Thus, Climate Alliance sees itself in the role of enabling such exchanges and therefore fostering action upon climate change.

Accordingly, Climate Alliance argues:

> Experiencing other realities first hand and interacting with local communities supports intercultural exchange and understanding while strengthening connections. Climate Alliance thus organizes opportunities for direct exchange between representatives of European municipalities and indigenous peoples, regularly bringing local politicians and civil society representatives to South America as well as indigenous representatives to Europe. These tours provide opportunities for mutual learning, vividly underlining the challenges faced by both sides and motivating needed action (ClimateAlliance 2017a: 2).

Direct exchange and interaction are thus presented as a valid basis for understanding what climate change actually means, hence what the challenges are that different people around the world face in terms of climate change as well as other environmental challenges (e.g. ClimateAlliance 2016b; ClimateAlliance 2017d, 2017c). The direct interactions and exchange between people are thus known as a way to transmit experiences that different people make with environmental challenges. Therefore, Climate Alliance presents in its material experiences of people faced with environmental changes (so called 'eyewitnesses') and builds

its own information on their personal expertise (see also ClimateAlliance and ASTM 2013b; ClimateAlliance et al. 2014; ClimateAlliance 2015a):

> Drawing on the experiences gained during the delegation trips, Climate Alliance and its project partners have formulated recommendations to support 'sustainable development for all'. We have based these recommendations on findings and suggestions made throughout the project as well as Climate Alliance's vast experience in its over 25 years of cooperation with COICA, the coordination body of the indigenous organisations of the Amazon Basin (ClimateAlliance 2017d: 2-3).

As a reason for relying on peoples' experiences instead of for example economic data, Climate Alliance argues that many aspects of climate change are (almost) inaccessible with numbers: "(…) the effects on human health and the environment, which are difficult to measure in terms of footprints or rucksacks, in tons, hectares or cubic metres" (ClimateAlliance et al. 2014: 4).

However, despite not being the primary source for understanding climate change, scientific knowledge also plays a role in Climate Alliance's conceptual knowledge base – often being combined with experiences that people have made. Correspondingly, the document called '*We Are All Witnesses'* (ClimateAlliance and ASTM 2013a) presents quotes from people experiencing changes of the natural circumstances surrounding them (similar example given in ClimateAlliance et al. 2014). These are combined with a 'scientific background' to underline their proofability and explain the background of these changes:

> "Well, up there the Yanacocha and the Chaquishkacocha lagoons used to be the watering place for the cattle of Tambohuasha community. Now, they have disappeared because it is less raining and becoming much warmer. To have water for their cattle, the community must bring it through pipes from the neighbouring Carihuayrazo mountain. During the last decade, the cattle has been grazing every time higher up in the Chimborazo Fauna Reserve in order to have more access to water and to pastures depending on it. (…)
> In the past, ice used to be extracted upstream the lagoons from the Chimborazo by indigenous inhabitants for being sold to urban dwellers. Presently there is only one "hielero" left, Don Baltasar Ushca. He told me that before the Chimborazo was quite cold, there was enough rain, and the snow used to remain even where the communities are settled, being even 40 cm high at 4,000 m above sea level. Now however, the ice starts at 5.500 m, and there is no snow anymore."
> SCIENTIFIC BACKGROUND
> The smallest glaciers in the Andes, such as those in Carihuayrazo, located below 5100 m height are irremediably in unbalance with current climate: From 1939 to 2006, temperature in the tropical Andes increased by 0,7° C. It is the level of frost and the relation between rain and snowfall that determine how much a glacier is melting at its surface. Actually, the glaciers are losing mass, and if the current conditions prevail, residual glaciers will disappear in a few years or in up to two decades (ClimateAlliance and ASTM 2013a: 10).

However, Climate Alliance seems to assume that direct interactions between (groups of) people will more likely foster climate action – also on an urban level – than the mere presentation of scientific information. Arguing that "seeing is understanding" (ClimateAlliance 2016b: 11), Climate Alliance sees the organization and enabling of such opportunities for exchange as its primary task: "Learning from one another is a large part of what networks like Climate Alliance are all about" (ClimateAlliance 2018b: 53).

The exchange of experiences is – according to Climate Alliance – not only important to help people understand the problem, but also to encourage action (see ClimateAlliance 2016b, 2017a). This action can be triggered through experiences making people truly understand what is at stake (see above) or by the exchange of possibilities of how to deal with the problem:

> Meeting with representatives from indigenous organisations of the Amazon basin and exchanging opinions resulted in conclusions of high political significance: some Greek municipalities and regions face problems similar to those of indigenous communities, with human exploitation of the environment leading to disastrous degradation. The exchange of experience provided the opportunity to discuss ways and means to avoid such activities and their consequences (ClimateAlliance 2017a: 22).

To proof that the direct interaction with others actually changes the stance towards urban climate policies, Climate Alliance quotes several urban actors who have already been involved in such an opportunity for exchange, for example.:

> 'This experience has prompted me, in my role as Environment Manager of the City of Luxembourg, to push even harder to make our society aware of its global responsibility while recognizing that saving resources also helps improve quality of life.' Pierre Schmitt, Environment Manager of the City of Luxembourg (ClimateAlliance 2017a: 2).

This example, again, shows how conceptual and problem-solving knowledge do overlap empirically. Although I classify the significance of direct interaction and exchange as conceptual knowledge because it exemplifies a belief and an idea, Climate Alliance also suggests this very concept as a concrete action in light of climate change. However, there are some differences between the belief and the concrete suggestions, which is why I also consider education and the joining of forces as a particular aspect belonging to problem-solving knowledge (see chapter 6.2.3.1).

Knowing climate change as a phenomenon which can be captured by experiences and by passing on these experiences through direct interactions is very much in line with Climate Alliance's definitional knowledge base. If climate change is defined as a multifaceted phenomenon it is consequential that it can not only be understood by scientific data, but in several different ways – for example by listening to people and their experiences with changes already occurring. Further, by defining it as unjust, Climate Alliance highlights that climate

change is affecting some more than others – it is thus understandable that it also assumes that those more affected should at least be lent an ear.

By basing its documents both on scientific data and findings (examples are ClimateAlliance and ASTM 2013a; ClimateAlliance 2019a), as well as experiences of different people and attributing high significance to direct exchanges, Climate Alliance complies with some scholars' recommendations of "relinking larger scales of scientific representation with smaller scales of social meaning" (Jasanoff 2010b: 238). This need to relink scientific representations with social meaning, for example through falling back on people's experiences, is caused by the tendency to clearly separate scientific facts from traditional, locally-rooted ways of understanding and interacting with nature:

> Climate change, on this account, is problematic because it tends to separate the epistemic from the normative, divorcing is from ought. Crudely put, it detaches global fact from local value, projecting a new, totalizing image of the world as it is, without regard for the layered investments that societies have made in worlds as they wish them to be. It therefore destabilizes knowledge at the same time as it seeks to stabilize it. To know climate change as science wishes it to be known, societies must let go of their familiar, comfortable modes of living with nature (Jasanoff 2010b: 236).

Seemingly, Climate Alliance avoids this compulsion to let go familiar ways of relating to nature for the sake of science by using both scientific knowledge, as well as personal experiences.

Drawing on experiences as an alternative to numerical data to make people understand what is at stake in terms of climate change follows the assumption that "(…) some of the values that should be considered in climate change decision-making cannot be compared meaningfully using any common metric" (Adger et al. 2011: 14). Enabling exchanges to allow urban actors to make their own experiences in order to foster urban climate action accommodates the critique that rational approaches to environmental challenges often do not meet "very personal, mournful and highly emotional experience of witnessing environmental degradation" (Roelvink and Zolkos 2011: 54). It further takes into account that people do not relate to something by rationally evaluating the knowledge they have about a specific situation but by the emotional connection to this situation, respectively to their natural environment etc. (see Adger et al. 2011; Roelvink and Zolkos 2011; Weber 2010). By relying on actual people's experiences, Climate Alliance renders climate change a tangible problem to which people can relate. Behavioral research has found this strategy to be very effective in terms of motivating people for taking action on climate change: "Increasing personal evidence of climate change and its potentially devastating consequences can be counted on to be an extremely effective teacher and motivator (…)" (Weber 2010: 339f). The importance of this aspect also in the city

context has been outlined by Knox (2014) who has observed that the tangibility of a problem helps city administrations to legitimate their own policies:

> Derived, as we have seen, from a population effect that appears as an outcome of climate scientists' projections, it has remained difficult for people working in local authorities or public sector organizations to publicly justify decisions to act on the basis of a projected future effect for which everyone is deemed somewhat responsible, and to which everyone will ultimately be subject. In contrast, fuel poverty has offered a tangible problem, existing in the here and now and affecting a potentially identifiable sector of the population for whom local governments can legitimately be expected to take some responsibility (Knox 2014: 423).

In addition to rendering climate change a problem that is both imaginable and tangible, the exchange of experiences includes another aspect which is important to justify and foster immediate action: the replacement of a phenomenon which may occur some day in the future, with a problem that is happening right here and right now. Accordingly, Roelvink and Zolkos highlight that relying on experiences that are stemming from current times can avoid "that the discourse of climate change is displacing experiences of environmental degradation into the future, that is, a catastrophe that we can still head off if we act now" (Roelvink and Zolkos 2011: 44). Seen from a psychological stance, there is another reason to draw upon personal experiences as people tend to attend to personal experience more than data, as Weber (2010) has found:

> When given the choice between attending to information provided in the form of statistical summaries or to information provided by personal experience, personal experience is far more likely to capture a person's attention, and its impact dominates the often far more reliable and diagnostic statistical information (Weber 2010: 333).

Next to these explanations for the use of experiences as source of information and the respective significance attributed to direct exchanges, there is another contextual factor for Climate Alliance's encouragement of interactions and partnerships: this conceptual knowledge base also can be seen as in line with one of TMNs' functions (see Andonova et al. 2009; Bouteligier 2013; Busch 2015), namely their *'platform'* function. According to Busch's definition, networks fulfill a *platform* function by granting their members a space where they can exchange information and know-how between each other. Networks do so by highlighting lighthouse cities and presenting them as best-practices examples, by organizing best-practice workshops, or by arranging city-to-city co-operations (Busch 2015: 223). In Climate Alliance's case, this function also comprises the organization of partnerships between European municipalities and indigenous communities in the Amazon region (see ClimateAlliance 2015b, 2016b; ClimateAlliance 2017e, 2017c). Busch (2015: 223) finds the platform function to be of 'high' significance in Climate Alliance's case so that it does not surprise that Climate Alliance

highlights direct exchanges and partnerships as being imperative for knowing climate change. I want to highlight that also C40 fulfills this function of a city network enabling partnerships and encouraging learning experiences between different partners (see also chapter 6.1.3.3). However, for C40 it is much more important to connect similarly organized cities sharing common profiles than connecting different kinds of people and municipalities (C40 and Arup 2015a).

This 'umbrella' of highlighting direct exchanges and listening to each other as a conceptual baseline for knowing climate change also becomes obvious in two of Climate Alliance's recurring concepts: the concept of 'social and climate justice', as well as the concept 'buen vivir'.

6.2.2.2 Concept of 'social and climate justice'

The first actual concept of great significance for how Climate Alliance knows climate change is 'social and climate justice'. In fact, these could also be treated as two different concepts – 'social justice' and 'climate justice'. However, as they are often mentioned in a combined manner, I decided to see them as belonging to the same over-arching concept. 'Social and climate justice' is presented as a political approach to climate change, as an answer to the challenges of climate change but also as a goal to achieve. The specific aspect of social justice is brought into the concept as the addressing of social inequalities and the consideration of intergenerational justice issues.

Climate Alliance puts more emphasis on the aspect of *climate* justice (somehow unsurprisingly) than on the aspect of *social* justice. One of the documents is even called "*Championing Climate Justice*" (ClimateAlliance 2017a) – putting 'climate justice' at the heart of Climate Alliance's engagement with climate change. However, it remained difficult for me to understand what the concept of climate justice means for Climate Alliance and how it is defined exactly. I had the impression that the concept is used in a way that is (at least partly) overlapping with what others would call 'climate protection', 'climate action' or sometimes simply 'climate policy' (see also in ClimateAlliance (2017d: 6, 8):

> Direct partnerships with indigenous peoples, the exchange of experiences between municipalities, fair products in local administration, municipal awareness-raising weeks and the support of selected projects in Amazonia – countless member municipalities are already active in the field of global climate justice today (ClimateAlliance 2015b: 3).

However, there are hints to how climate justice could be understood by Climate Alliance, for example the statement that "the challenges of climate change require global perspectives and local solutions" (ClimateAlliance 2017d: 8) or that climate action is ultimately about finding "answers to the question of how a good life can be guaranteed for all" (ClimateAlliance 2017a:

2). In Climate Alliance's perception "climate action and climate justice go hand in hand" (ClimateAlliance 2018b: 77) and are thus two separate things.

'Social and climate justice' is used in several different ways: Firstly, it is presented as a way to cope with climate change: "If we are to truly tackle the climate challenge, we must reframe the issue as one of climate justice" (ClimateAlliance 2016b: 4)). Secondly, it is seen as an answer to the challenges coming with climate change:

> The consequences of climate change and even some of the 'mitigation measures' (e.g. the expansion of palm oil plantations for the production of biofuels) mostly affect the poor as well as indigenous peoples, who have not contributed to the emissions. Climate justice must therefore form an integral part of climate and energy policies at all levels (ClimateAlliance 2014: 2).

And thirdly, it is also used as a goal to achieve through climate policies: "(…) our recommendations and demands for the transformation of our world towards climate justice" (ClimateAlliance 2017c: 2). All of these statements also reflect the social aspect of the concept, for example through highlighting that some people are or will be more affected by climate change's consequences than others. However, these social aspects are also made even more explicit. Accordingly, climate policies are presented as addressing social inequalities (both globally and locally) and respecting social equity:

> A sustainable future for all will only be possible if we reconcile social justice, the ecological boundaries of the earth and economic development. The overuse of natural resources globally is having a dramatic impact on the environment and leading to social problems (ClimateAlliance 2017d: 2).

Following this logic, if the environmental problems are addressed, the social problems will (or at least should be in Climate Alliance's point of view) be addressed at the same time (see also ClimateAlliance 2019a). At the same time, climate justice is presented as raising global equity through establishing fairer structures globally: "Climate justice means assuming responsibility together. It means fairness and sustainability instead of injustice and overexploitation" (ClimateAlliance 2017e: 2). But the social aspect of climate justice is also presented as a matter of intergenerational justice, thus to guarantee that following generations still have the same resources, chances and environmental conditions at their disposal as current generations have:

> A sustainable approach to all kinds of soils to conserve and nurture all soil functions as well as their resources and the natural and cultural heritage must be striven for the current and future generations. This includes socially fair soil and land usage (cf. European Land and Soil Alliance, ELSA) (ClimateAlliance 2012a: 2).

Hence, the social aspect of climate change – both concerning its causes and its consequences – in general seems to be an important aspect of conceptually knowing climate

change for Climate Alliance. This is both perceivable in the argumentation but also in the way the documents are visually designed. They all contain large pictures of people, often showing indigenous people and their living environment but also representatives of seemingly European municipalities, or groups of different people meeting. I interpreted these pictures as wanting to highlight the aspects of climate and social justice also in the layout of the documents (on the importance of 'visual imagery' especially in the context of indigenous peoples' representativeness of climate change see for example Long Martello (2008)).

Considering these various aspects, it is hard to find a clear definition of the concept of 'social and climate justice' as it is used by Climate Alliance. Taking into account the different ways of how it is used, I found it best defined as 'the state of having a global perspective on climate change, while favoring local ways of dealing with it' (see ClimateAlliance 2017d: 8), or as Climate Alliance puts it: "At its best, thinking in terms of climate justice engages us in coming up with real, locally-led solutions that actively contribute to a good life for all the world's peoples" (ClimateAlliance 2016b: 4).

The concept is used to reinforce Climate Alliance's definitional baseline that climate change is not only a meteorological phenomenon but a social and economic issue as well:

> Like many other communities whose ways of life depend directly on some of the world's most fragile ecosystems, indigenous peoples are bearing the brunt of the climate crisis while having contributed little to it. In looking at the injustice faced by these peoples, the fact that climate change is just as much a social and economic problem as it is an environmental one becomes painfully clear (ClimateAlliance 2016b: 4).

This quote again highlights the interconnectedness of the concept of 'social and climate justice' with the definitional knowledge base and also the baseline it lays for knowing climate change both on the level of problem-solving and critical knowledge.

Similar to Climate Alliance's definitional knowledge base, the use of the concept 'social and climate justice' can be filed in a broader discussion around justice issues in the global climate regime (Bäckstrand and Lövbrand 2019; Dietzel 2019) – which ultimately centers around different questions of justice (von Lucke 2017).

The root of the frame 'climate justice' lays in the broader discussion around 'environmental justice' which emerged in the 1980s in the United States around two main issues: practices of environmental racism against African American communities and the disproportionate exposition to toxic waste of poor white communities (Ottinger et al. 2017: 1030f). These initial aspects of environmental justice are still present today in the notion of both environmental and climate justice. Accordingly, Ottinger et al. (2017) highlight that environmental justice debates comprise different levels: the rather local level (as in the initial cases in the US) in which different communities are treated unequally and being marginalized "due to their social

positionality along the lines of indigeneity, race, class, and gender *within* a given country (…)" (Ottinger et al. 2017: 1031, emphasis in the original), and the global level which encompasses especially "the economic marginalization and environmental despoliation of developing countries (…)" (Ottinger et al. 2017: 1031). In the specific case of climate justice, another level comes to play: that of future times in the form of questions about intergenerational equity (Ottinger et al. 2017; von Lucke 2017). Climate justice can thus be seen as a kind of subcategory of environmental justice in that it focuses on the effects of climate change. However, Schlosberg and Collins (2014) highlight that different understandings of 'climate justice' have emerged out of which only one – the 'grassroot' understanding of climate justice – can be directly tied to the historical understanding of environmental justice. According to this classification 'climate justice' is differently used and understood by academic literature, elite NGOs and grassroot movements and it is therefore difficult to find one definition of climate justice (Schlosberg and Collins 2014: 364f). According to Schlosberg and Collin's review, the academic use of the notion of climate justice is "an attempt at applied philosophy – the use of more or less ideal notions of justice to provide a normative justification for global climate change policy" (Schlosberg and Collins 2014: 365). 'Elite' NGOs in turn are said to focus on different climate justice positions which are not aiming at building a movement on their own: "the development rights approach, a related right or need to industrialize, a negotiated north/south approach, a human rights approach, and a commitment to carbon markets" (Schlosberg and Collins 2014: 365f). Further, they argue, that 'grassroots networks' such as the 'Climate Justice Action network', the 'Klimaforum', but also the 'World People's Conference on Climate Change and the Rights of Mother Earth' focus their definition of climate justice on "historical responsibility, reparations, and a variety of individual and collective rights including participation, the rights of Indigenous peoples, labor, women, and nature" (Schlosberg and Collins 2014: 367), and that further, grassroot understandings of climate justice also put the notion in the position of a goal in the sense of "moving to a post-carbon energy system, paying for the ecological and social damage of climate change, and protecting the voice and sovereignty of the must vulnerable" (Schlosberg and Collins 2014: 367).

Against this backdrop, it is no more surprising that also Climate Alliance's use and understanding of the concept of 'social and climate justice' is manifold and difficult to bring down to one definition. Schlosberg and Collin's classification however clearly suggests that Climate Alliance's use of the concept is very much in line with what they understand as the 'origin story' of climate justice:

> Broadly put, the movement idea of climate justice originated with a focus on removing the causes of climate change, as well as addressing the inequitable impacts of the oil industry at all stages (from production and distribution through to

> climate impacts). But it also addressed fostering a 'just transition' to a post-carbon economy and providing assistance to vulnerable communities (Schlosberg and Collins 2014: 366).

The way how Climate Alliance uses the concept 'social and climate justice' as a political approach to climate change, as an answer to the challenges of climate change but also as a goal to achieve is in principle following the 'grassroot' understanding of 'climate justice' and is also in line with the general shift that Schlosberg and Collins draw from environmental to climate justice:

> This is one of the major shifts in the environmental justice discourse itself—climate change has helped move the understanding of environmental justice from one where environmental risk is seen as a symptom of social justice, to one where functioning environment is seen as necessary for any form of justice—environmental, climate, or social (Schlosberg and Collins 2014: 370).

This aspect of preserving a functioning environment to ensure and enable social justice and equity is clearly perceivable in the 'social' aspect of Climate Alliance's notion of 'social and climate justice'.

Summarizing, conceptually knowing climate change for Climate Alliance means to recurrently refer to 'social and climate justice' in a way that has been classified as the 'grassroot' take on climate justice. This, again, reflects Climate Alliance's definitional knowledge base and is also closely connected to the second major concept in knowing climate change: 'buen vivir'.

6.2.2.3 Concept of buen vivir

The second concept playing an important role for how Climate Alliance knows climate change on a conceptual level is called 'buen vivir'. However, the concept does not always appear under this name – applied to Western contexts it is often transformed into the concept of 'good life' which plays an important role for Climate Alliance's climate policy formulation (ClimateAlliance 2017a, n.d.-b). With the use of the concept, Climate Alliance takes up indigenous conceptions of a good life and uses it to show that a different lifestyle would be a solution to climate change while at the same time bearing the possibility to make people happier.

The concept 'buen vivir' as Climate Alliance refers to it, is initially an indigenous concept (also called 'Sumak Kawsay' or 'Good Living' (ClimateAlliance 2015a: 22)) which in turn is based on another concept called 'Kawsak Sacha' ("The Living Forest") (ClimateAlliance 2015a: 22; 2017a: 30). 'Kawsak Sacha' is defined as "a proposal for living together with the natural world" (ClimateAlliance 2015a: 22):

The initial concept of 'buen vivir' or 'Sumak Kawsay' is based on the assumption that the natural world is made up of living selves which can communicate and establish constant

relational webs between each other. If one leads a good life, he or she will live in harmony with the other living beings and contribute to the possibility that all and everything can continue to live also in the future (ClimateAlliance 2015a: 22).

Climate Alliance takes some parts of this initial idea of 'buen vivir or 'a good life' as inspiration to formulate the main question driving Climate Alliance's climate policy strategy: "how a good life can be guaranteed for all" (ClimateAlliance 2017d: 2; 2017e, 2018a, n.d.-b). A 'good life' in that sense is one that is not doing any harm to other living beings (also the environment as such) and which also does not postpone any conflict or problems to the future. The concept is used as a strategy to formulate climate policy goals but also as a way to understand the full scope of challenges driving climate change:

> All the screen and monitors, the running motors, the assembly lines churning out brand new, cheap stuff – we need to dial back. Many of the things that are supposed to improve our lives only seem to make them more complex. There are countries that do without this extra stuff – we often call them underdeveloped, but wouldn't that make us overdeveloped? The truth is, all any of us really wants is a good life. This may mean rethinking our habits. Jumping on our bikes, for example, rather than sitting in a traffic jam. It's better for us and better for the climate...(ClimateAlliance 2016a: 21).

The challenge here would be that in order to lead a 'good life' many people must change their habits. Climate Alliance with the use of the concept 'buen vivir', respectively the 'good life', suggests that a 'good life' would be much simpler (ClimateAlliance 2015c), could make people happier (ClimateAlliance 2016a: 21) and would address many of the causes leading to climate change (ClimateAlliance et al. 2014). Climate Alliance further seems to aim at diversifying the conceptual perception of climate change at a global level by drawing on a concept such as 'buen vivir':

> The world is looking for solutions to address global challenges such as climate change and the overuse of natural resources. These are mostly developed from a Western-dominated and supposedly objective, scientific perspective. Alternative solutions and concepts from the Global South are often not taken seriously or simply forgotten (ClimateAlliance 2017a: 30).

By attributing great significance to the concept 'buen vivir' Climate Alliance highlights its position that knowing climate change is no universal undertaking and that it is worth drawing inspiration from globally marginalized positions to understand and face the problem of climate change:

> The fact that we in the developed countries are the main contributors to climate change along with the outcome of the climate talks gave us no reason to accept that we also have the greatest capacity for climate protection. Rather, we should be happy to be able to take up an initiative from a developing country that originates from the local civil society and is supported by them (ClimateAlliance 2010a: 2).

This quote shows very well that the significance attributed to 'buen vivir' is very much in line with Climate Alliance's understanding of the concept 'social and climate justice' as a position favoring local solutions to global problems. This position therefore also comes to play in Climate Alliance's problem-solving knowledge.

Before outlining different aspects of this problem-solving knowledge, I firstly want to reflect on Climate Alliance's conceptual use of 'buen vivir'.

As Climate Alliance itself outlines, the concept of buen vivir is one that has different indigenous roots, such as the Quechua concept 'Sumak Kawsay', the Mapuche 'Küme Mongen' or the Aymara 'Suma Qamaña'. All of them share the commonality of a main principle which symbolizes how to live in harmony with Mother Earth, the cosmos, life and history while respecting every form of life and living in balance and respect with each of these living beings (Vanhulst and Beling 2014: 56).

The concept 'buen vivir' emerged at the global political level in the late 1990s as an alternative and adversary to neoliberal globalization projects especially in Latin America. As such, it combines some ethical principles of its Andean-Amazonian root cultures, ideas of critical intellectuals and NGOs and political assimilations of these two pools of ideas (Vanhulst and Beling 2014: 56). 'Buen vivir' became especially pertinent as a concept in the global discourse around 'sustainable development'. Sustainable development is being criticized for not having fulfilled its promises of more equality and better planetary health and for being too growth- and neoliberal economy-oriented (e.g. Kothari et al. 2014). 'Buen vivir' (along with other concepts such as 'degrowth' or 'Ecological Swaraj' (see Kothari et al. 2014)) in turn is represented as an alternative concept to sustainable development as it suggests a much more radical change away from the notion of development as the ultimate globally pertinent goal to a radically different socio-environmental future (Kothari et al. 2014: 369). However, Vanhulst and Beling (2014: 57) find that 'buen vivir' where it is translated into actual policies (e.g. in the constitution of Ecuador and Bolivia) has some major overlappings with 'sustainable development'. They further conclude that also on the international level, 'buen vivir' partly fits into the concept of 'sustainable development' insofar as both highlight the interdependencies between human and non-human entities. However, 'sustainable development' – as a western-centric concept – still makes the clear distinction between society, respectively human beings, and nature – a distinction that is not compatible with the indigenous roots of 'buen vivir' (Vanhulst and Beling 2014: 58). Vanhulst and Beling (2014) therefore highlight that the application and uptake of an indigenous concept has to be seen critically because "pouring the indigenous *Sumak kawsay* into the modern clothing of *Buen vivir* unavoidably implies a loss of semantic richness" (Vanhulst and Beling 2014: 60, emphasis in the original) and does not do justice to the original philosophy. The original idea accordingly has been transformed partly

and the concept is used in very diverse ways "indicating that it is being appropriated by diverse social groups as a vision of their own" (Vanhulst and Beling 2014: 58). The overlap with sustainable development and other transformative concepts thus is the aim of transforming social organization and prevailing production and consumption patterns (Vanhulst and Beling 2014: 61). Therefore, Vanhulst und Beling highlight that making use of 'buen vivir' can open up spaces for thinking creatively and out of pre-coined boxes:

> (…) the legitimation and potential of *Buen vivir* rest on the building of a real space for citizen participation and on the emergence of collective learning processes (…) by concrete social groups, thereby expanding the frontiers of what is speakable, of what is deemed desirable or even conceivable. This expansion of collectively shared cultural and cognitive templates is a precondition potentially enabling for the realization of the ideal of harmonious plural and ecologically sustainable societies underlying the ideal of *Buen vivir* (Vanhulst and Beling 2014: 61).

Climate Alliance's use of the concept 'buen vivir' in my point of view is aiming at exactly this: to suggest thinking differently about the problems we face today and about alternative ways of living which could reconcile solutions to many challenges. Climate Alliance, by attributing high significance to an originally indigenous concept, tries to open up the debate about possible ways to find solutions to current challenges and also for questioning current forms of development:

> By asking indigenous representatives for their perspectives on our global challenges, we come closer to answering the question of how a sustainable future and a good life for all can be made possible (ClimateAlliance 2018b: 77).

Climate Alliance also promotes 'sustainable development' as a goal (e.g. ClimateAlliance n.d.-b: 2) but highlights at the same time that this is not to be seen as economic development but rather as a way to ensure 'a good life for all'. By transforming the concept 'buen vivir', respectively 'Sumak Kawsay' into a new concept of a 'good life', Climate Alliance takes the concept to another environment and therefore tries to avoid loosing too much of its original idea – it thus also appropriates the idea to a vision of its own, as it is done by many other actors referring to 'buen vivir' in one way or another (Vanhulst and Beling 2014: 58).

Climate Alliance thus fits into the category of NGOs and social movements with affinity to indigenous concepts having contributed to the political establishment of the concept 'buen vivir' (see Vanhulst and Beling 2014: 56).

The importance attributed to concepts such as 'buen vivir' and 'social and climate justice' has consequences for the level of problem-solving knowledge, and also partly overlaps with this knowledge form, as pointed out before. Climate Alliance suggests education and joining forces, as well as the initiation of behavioral change as solutions to climate change, as I present in more detail in the following section.

6.2.3 Problem-solving knowledge: local approaches based on cooperation and changes of resource-consuming lifestyle

Following the assumption of climate change being a multi-faceted problem, Climate Alliance postulates that climate change should be dealt with in different ways according to the local circumstances. For all of these different ways, different forms of knowledge might be available and useful. Accordingly, Climate Alliance mentions that "indigenous peoples play a decisive role in global climate protection and possess an in-depth knowledge of their environment (…)" (ClimateAlliance 2017d: 2) and that often, indigenous peoples with their traditional knowledge have been way more successful (ClimateAlliance 2015a: 18) in "preserving these ecosystems while also acting as their stewards" (ClimateAlliance 2017d: 3). The way how to deal with climate change in Climate Alliance's definition is thus manifold and follows the assumption that "there is no one size fits all answer" (ClimateAlliance 2017e: 12). More precisely, Climate Alliance suggests as solutions to climate change realizing education projects and joining resistance forces against injustices (chapter 6.2.3.1) as well as shifting to other modes of lifestyle (chapter 6.2.3.2).

6.2.3.1 Education and joining of forces

Climate Alliance suggests that mutual education and the resulting joining of forces against common problems is one of the solutions to the problem of climate change. Education here encompasses both the exchange of perspectives and experiences with others at the city level, as well as the education of citizens by the municipality itself. Resulting from such education endeavors, Climate Alliance suggests that part of the solution to climate change would be to pool these experiences to strengthen the resistance against practices seen as destructive and unfair. Just as on the conceptual level, Climate Alliance highlights the importance of partnerships between indigenous groups and European municipalities for such efforts.

The first aspect of education directly concerns the city-level in so far as Climate Alliance suggests that cities should seek others' experiences with finding solutions to climate change:

> Interacting with other communities and experiencing other realities first-hand fosters understanding for other cultures, provides opportunities for mutual learning and prompts action. It also opens up new perspectives for alternative social structures, ways of life and concepts (ClimateAlliance 2017e: 10).

The experiences to be learnt from here encompass both those from people living far away (i.e. the indigenous partners in the Amazon region) but also other European cities who have already successfully implemented local climate policies (see ClimateAlliance et al. 2017; INTERREG 2018). However, Climate Alliance still highlights that despite the inspirational capacity of other cities' experiences, locally-led and -found solutions are always the best (as

outlined in chapter 6.2.1.1). This stands somewhat in contrast to C40's perception that mutual learning between cities is possible because in the end they are quite similar all over the world:

> It is sometimes the perception that cities are each of a different type; that working with each city will be a new learning process, and that there is always some need to re-invent the wheel when transferring solutions between them. This analysis shows, however, that while cities use a variety of types of power to achieve action, many cities employ the same profile, or combination, of power types across their various assets and functions. The existence of such clusters, or power signatures, demonstrates that groups of cities use similar approaches to deliver action. These commonalities provide a strong platform through which cities can collaborate, much like they do through the C40 network, sharing their knowledge and experiences in exercising power to deliver climate action. (C40 and Arup 2015b: 7)

But not only the cities themselves should seek education opportunities as a solution but they should also educate their citizens, Climate Alliance (see also e.g. ClimateAlliance 2016b; ClimateAlliance n.d.-b) suggests:

> Building broad public support for the rapid change needed to mitigate and adapt to climate change can be done in different ways. Education and awareness raising are very important and effective. If people understand that they will benefit from the changes, then they are more likely to support them and amend their actions (ClimateAlliance 2019a: 11).

This educational aspect is present in many of Climate Alliance's suggested campaigns (e.g. ClimateAlliance 2015c) such as the 'Green Footprints' campaign educating children to serve as role models for sustainable mobility (ClimateAlliance 2018b: 118).

As already outlined before (see chapter 6.2.2.1), Climate Alliance highlights that for education to be successful (i.e. to actually initiate change in peoples' mind and behavior) direct exchanges and partnerships are unavoidable. Education therefore is also presented as a solution because it helps people understand the full scope of challenges, as Climate Alliance points out by drawing on quotes of people having participated in exchanges:

> 'I am very grateful to the indigenous organisations for drawing attention to their current situation. In contrast to us, they are acutely aware of the connection between the destruction of the rainforest, climate change and the western way of life as a threat to their existence. They want to draw attention to the interrelationships around the world and, as those directly affected, are not willing to accept current developments implicitly.' - Andreas Wolter, Mayor of Cologne, Germany (ClimateAlliance 2018b: 87).

Climate Alliance argues that these educational undertakings are the prerequisite for the second part of this solution to climate change: the global joining of forces against structures deemed responsible for the very problem of climate change. Climate Alliance argues that through mutual education and exchange, different people would understand that they face

common challenges and could thus join their forces in overcoming these challenges and problems:

> The delegation trips revealed parallels in the local effects of the global economic system in different regions of the world. The challenges faced by indigenous peoples and developments in Europe are presented below, whereby a great many parallels can be discerned.
> Both acknowledging the existence of common challenges and exchanging on forms of resistance, possible solutions and (technical) innovations inspired and motivated the participants in their search for alternatives.
> Global solidarity and mutual support empower people to combat the effects of (neo-)extractivism and climate change, and to develop alternative concepts. (ClimateAlliance 2017a: 14).

Here, Climate Alliance presents its own role as being the enabling actor for such learning exchanges, for example by organizing delegation visits for municipal stakeholders in other regions of the world:

> For us and our member municipalities, global partnerships are an invaluable opportunity to have a direct impact. We therefore foster the exchange between representatives from European municipalities and indigenous peoples. A direct exchange offers insights into the global challenges that indigenous peoples face to facilitate political support for the SDGs. At the same time, this interaction opens up opportunities for mutual learning and prompts action (ClimateAlliance 2017d: 8).

Particularly interesting here is that Climate Alliance explicitly terms these mutual learning and exchange activities as 'fighting unjust structures' (ClimateAlliance 2017a: 43).

Again, Climate Alliance outlines that partnerships between indigenous groups and European municipalities are important aspects for realizing both education endeavors and the joining of forces in finding effective solutions to climate change:

> Despite all of the differences between Europe and the Amazon region, it was primarily the similarities that left a lasting impression on the delegates. In addition to feeling responsible for the global climate, common challenges at the local government level were also identified. It emerged that, in many respects, indigenous communities work just like municipalities: both are responsible for planning their areas and are confronted with challenges such as the rural exodus and provision of public services. As the local level, they are also best in a position to implement practical climate protection activities in their territories. These similarities helped to dispel prejudice, encourage solidarity and foster mutual appreciation (ClimateAlliance 2017a: 43).

The aspect of education is thus one that is suggested as a solution by both networks and nevertheless is one that is understood very differently.

6.2.3.2 Initiating behavioral change

In line with defining climate change as a multi-faceted problem that also encompasses social and economic aspects (see chapter 6.2.1.1), climate change is defined as the result of the predominant current lifestyle (ClimateAlliance 2012a, 2015a, 2017d, 2017a, 2017e):

> The overuse of natural resources globally is having a dramatic impact on the environment and leading to social problems. Only if the consumption of resources is reduced will we succeed in creating the conditions needed for effective climate protection and sustainable development (ClimateAlliance 2017d: 2).

Therefore, one of the solutions presented by Climate Alliance is the initiation of behavioral change. However, Climate Alliance suggests that not only individual behaviors, such as the use of a different means of transport, are to be encouraged but the whole Western way of life and development (deemed an 'unsustainable' lifestyle (ClimateAlliance 2015a: 27; 2018a)) needs to be changed radically as a solution to climate change. This is because "[i]t is becoming clear that the Western model of development consumes the earth's resources too quickly (…)" (ClimateAlliance 2017a: 46). Therefore, Climate Alliance urges that the focus must be much more on behaviors and lifestyles when thinking about climate policies than it usually is, as this quote from one of Climate Alliance's position papers shows: "*Recall* focus on sustainable lifestyles, fair and sustainable consumption" (ClimateAlliance 2017d: 3).

Lifestyle here comprises consumption, energy, mobility, and nutrition (ClimateAlliance 2018a: 3). Thus, all areas that not only municipal but also individual actors can have an influence on. Different from C40 which is focusing on a more efficient use of resources, Climate Alliance finds that using less would be the first step of the solution: "Using fewer resources by doing more with less and using less to begin with" (ClimateAlliance 2018b: 8). Again, the individual is called upon for favoring more durable products and using them longer: "We can consume less and more conscientiously, favouring more durable products; we do not always need the newest model when the item we have still serves our purposes" (ClimateAlliance et al. 2014: 23). Another part of this suggested solution is "sharing, swapping and repairing" (ClimateAlliance 2018b: 123).

In order to make this change of behaviors and the whole lifestyle more attractive, Climate Alliance suggests to connect the reduced resource use with an improvement in quality of life (ClimateAlliance 2018b: 80). Therefore, Climate Alliance encourages a new definition of what a 'good life' is like, an aspect made particularly obvious through the campaign "A good life is simple" (ClimateAlliance 2015c):

> This awareness-raising campaign got off the ground in 2015. It gives the public and politicians a deeper understanding of global interdependencies by calling into question European overconsumption of natural resources and showing the way towards more responsible and globally fair consumption habits. The goal: To show

> just how simple leading a more sustainable and fulfilled life in (over)developed Europe can be! (ClimateAlliance 2018b: 73)

The changes of lifestyle are accordingly presented as aiming at the goal of achieving a 'good life for all' (ClimateAlliance 2017d, 2017a, 2017e, 2018a). In consequence, climate actions are defined as 'enabling a good life', not only as preserving ecosystems as we know them right now. By doing this, Climate Alliance suggests a strategy similar to C40's: highlighting other benefits that come with climate policies but are not only good for climate protection but also other issue areas such as health or better air quality. However, Climate Alliance does not make this strategy as explicit as C40 does (see 6.1.3.1) but rather implicit and in a thought-provoking way e.g. with slogans such as "burn calories, not fuel" and "why have a lead foot when you can have buns of steel?" (ClimateAlliance 2015c: 1).

Climate Alliance sees this change of lifestyle not only as a task for every individual citizen but as a process that can and should be initiated by cities and municipalities:

> By setting climate-friendly standards or legal and regulatory measures, municipalities are also able to influence the behaviour of businesses and consumers to the benefit of the climate (ClimateAlliance n.d.-b: 6).

Summarizing, Climate Alliance sees the radical change of the currently predominant lifestyle as one of the solutions to climate change. This change has to be implemented by individuals but can very well be influenced by cities and municipalities.

This aspect of knowing has to be seen in the context of Climate Alliance's definition of climate change as unfair, being mainly caused by the Western, neo-liberal lifestyle and its resource consumption, as well as the conceptual knowledge being based on the concept of 'buen vivir' and promoting simpler, less resource-consuming lifestyle.

6.2.4 Critical knowledge: Disclosing climate change's root causes, main culprits and listening to silenced voices

Different to C40's knowledge, I interpret parts of how Climate Alliance knows climate change as 'critical knowledge'. The critical dimension of knowing climate change encompasses aspects of critical engagement with current structures and the consideration of anti-hegemonic alternatives. This critical knowledge is often inherently present in the other three forms of knowledge and did already shine through in the upper paragraphs. Presenting the following aspects as part of the particular form of critical knowledge thus has to be seen as idealized. Nevertheless, as these aspects clearly constitute particularly critical ways of knowing climate change, it is important to outline them as forming a specific form of knowledge.

The critical aspects of how Climate Alliance knows climate change are composed of its critique of the currently dominant perceptions of climate change's root causes, the fact that

indigenous concepts and ways of living are considered, as well as its explicit critique of political and economic developments and actors.

6.2.4.1 Critique of current perception of climate change's root causes

The first aspect of how Climate Alliance critically knows climate change is that the network explicitly criticizes that currently one of the main root causes of climate change is disregarded: Western lifestyle and the economic development model as the main culprit. This targets the often-prevailing perception that climate change is a purely 'environmental' problem (which is also explicitly pushed forward by C40, see chapter 6.1.3.1). Rather, Climate Alliance suggests that the main root causes of climate change are the market-liberal economic system and the Western lifestyle based on the overconsumption of resources. Therefore, Climate Alliance argues, mechanisms aiming at solving the problem of climate change, but still relying on these ideas, will not be successful.

The critique of the current perception of climate change's root causes aims mainly at its perception as an environmental problem without locating the environmental effects in a wider socio-economic framework. Climate Alliance rather highlights that climate change mainly roots in social and economic structures: "Climate change is, after all, not only an environmental problem – it is a socio-cultural one with roots in social inequality and differential use of resources" (ClimateAlliance 2017c: 2). Here, the network highlights that the main problem related to climate change is the consumption-based social model relying on resource extractivism and disregarding social impacts elsewhere: "Scarce resources and climate change are the result of the same development model that primarily disregards the social impact" (ClimateAlliance 2012a: 2). This critical aspect also shines through in Climate Alliance's use of the concept of 'social and climate justice' (see chapter 6.2.2.2). Climate Alliance further argues that because climate change is perceived as an environmental problem, not a socio-economic one, climate protection strategies are implemented which rely on and maybe even reinforce the very problem, instead of solving it because these strategies "pursue the primacy of the market, and thus support the very structures considered the causes of destructive economic activity" (ClimateAlliance 2015a: Foreword).

Despite highlighting that it is the world's richest people's lifestyle which is impacting the most vulnerable people and places (e.g. ClimateAlliance et al. 2014; ClimateAlliance 2016b: 13), Climate Alliance finds that the impacts of the destructive lifestyle can be found in many places worldwide:

> The consequences of an economic system geared towards growth and profit can be felt everywhere – albeit to varying degrees – be it in illegal deforestation of huge areas of forest for the European timber industry in Romania or the unlawful expansion of palm oil plantations in areas of primary forest in Peru. The outcomes,

> such as deforestation, overuse of resources, violation of (human) rights and land conflicts, will be felt by all of us sooner or later (ClimateAlliance 2017a: 43).

In Climate Alliance's point of view, the culprit of climate change is very clear: over-consumption of resources favored by an economic model aiming for endless growth:

> In recent years, we have witnessed an intensification of climate change impacts, economic inequalities, political imbalances, natural resource depletion, energy consumption, trade and migration. The current economic model of endless growth and resource extraction is a major driver of these developments (ClimateAlliance 2017e: 8).

The network, by relying on quotes from others, criticizes that the main root cause of climate change – too much consumption – is never tackled but rather even forged ahead:

> 'The problem is ... our economic model not only allows for but thrives on what is essentially a collective free ride on the back of natural capital. In the long run ... it boils down to the plundering of global natural resources. This makes the preservation of our livelihood more difficult. So long as the policy makers ... see the world through the lens of economic capital alone ..., the damage done to human, social and natural capital will go unnoticed. A change of course in the right direction is thus ruled out' (from: Chandran Nair, Hong Kong: Die Mutter allen Kapitals, in: Le Monde diplomatique 10457 of 11.07.2014.) (ClimateAlliance et al. 2014: 21).

Climate Alliance further criticizes national governments for ignoring these causal relationships respectively favoring economic interests over climate change impacts: "The states bow to the interests of capital when it comes to the so-called 'mega drivers', which is why the INDCs are only formulated in such a vague and unconvincing manner" (ClimateAlliance 2015a: 17).

Furthermore, Climate Alliance suggests that the currently predominant economic model not only causes the problem of climate change but is also unable to provide fitting answers to it:

> Our current socio-economic system isn't providing any answers. It favours the production of ever more 'stuff' and the accumulation of goods in some areas of the globe at the expense of natural resources, health and livelihoods in others. This destructive pattern cannot be sustained without devastating results (ClimateAlliance 2016b: 4).

Therefore, Climate Alliance proclaims that the only way of successfully dealing with climate change would be to acknowledge the actual root cause embedded in our social and economic model and to break with this model in so far as to drastically reduce the consumption of resources: "Only if the consumption of resources is reduced will we succeed in creating the conditions needed for effective climate protection and sustainable development" (ClimateAlliance n.d.-b: 2).

This knowledge strand is a clear positioning of Climate Alliance against predominant climate strategies trying to combine economic growth and climate protection and therefore has to be seen as 'critical knowledge'. It further stands in stark contrast to C40's take on the predominant economic model relying on consumption. Indeed, C40 acknowledges that the current consumption-based economic system causes an increase of resource needs and expenditure in terms of for example infrastructure or waste: "Rising global consumption levels are increasing demand for products and, in turn freight and waste management infrastructure." (C40 and Bloomberg n.d.-b: 5). However, the network does not take a critical stance towards that fact but rather suggests to 'increase recycling' or 'improvements in freight logistics and vehicle efficiency' (C40 and Bloomberg n.d.-b: 4 & 5) as a solution to these very aspects. In contrast, C40 even justifies some climate protection actions such as the introduction of bike lanes with their ability to increase local consumption (C40 2016b: 25).

6.2.4.2 Consideration of indigenous concepts and ways of living

Critical knowledge can also be critical in so far that it considers ways of knowing that are contrasting established structures and actors. Its production and dissemination is accordingly targeted at enabling actors that are hitherto marginalized (see chapter 4.2.2.4). The following aspect of Climate Alliance's knowledge can be seen as such a case of enabling marginalized peoples and their knowledge. Accordingly, Climate Alliance not only presents indigenous concepts of understanding and influencing their environment but also distills possibilities of how these aspects can be reconciled with more mainstream climate change knowledge.

Correspondingly, one aspect of how Climate Alliance critically knows climate change is that it presents and draws upon ways of knowing the phenomenon which are far away from the 'mainstream' way of knowing climate change. In Climate Alliance's case this means firstly that indigenous concepts and ways of dealing with climate change are considered and promoted. Secondly, Climate Alliance continuously highlights that indigenous peoples and their ideas for dealing with climate change should be better included into the global governance of global problems such as climate change. Climate Alliance argues that this is a promising supplementary (or even alternative) to the hegemonic way of knowing and acting upon climate change because indigenous peoples are more successful in facing the problem(s) of climate change (see also ClimateAlliance 2012b: 2):

> As the guardians of the forest, indigenous peoples are one step ahead of us in many aspects, for example, with regard to their sustainability expertise and regenerative ways of life (ClimateAlliance n.d.-b: 11).

Consequently, Climate Alliance does not only present different concepts and tools of how different indigenous peoples make sense of their natural environment (for example the

seasonal calender of the Tucano people (ClimateAlliance 2017a: 39) or the concept Kawsak Sacha (see chapter 6.2.2.3) but also lets them directly report how they see nature themselves:

> We see nature as our mother, who cares for us. It is even more important than our own mother, because she will leave us at some point in our lives. But Mother Earth will always be there and even takes us into herself after our death. Everything we own and consume in our world but also in the Western world ultimately comes from the earth (ClimateAlliance and ASTM 2013b: 6).

To highlight that it wants to take these perceptions and ideas seriously, Climate Alliance presents indigenous representatives as experts with valid knowledge and calls them 'counsellors' (ClimateAlliance 2018b: 79). At the same time, it criticizes that often the contrary is done and that it is almost only Western people – despite having initially caused the problem – who are presented as experts and as knowledgeable providers of solutions and suggests that much more attention should be paid to indigenous ideas:

> The fact that we in the developed countries are the main contributors to climate change along with the outcome of the climate talks gave us no reason to accept that we also have the greatest capacity for climate protection. Rather, we should be happy to be able to take up an initiative from a developing country that originates from the local civil society and is supported by them (ClimateAlliance 2010a: 2).

In line with this, Climate Alliance also promotes indigenous approaches of dealing with climate change (for example the RIA 'REDD+ Indígena Amazónico) as alternatives to internationally established ways of dealing with climate changes (for example through measures such as REDD+) (see also ClimateAlliance 2015a; ClimateAlliance 2016b):

> This alternative is called 'Amazonian Indigenous REDD+' and proposes more effectiveness, efficiency and simplicity, correcting problems found in 'Conventional REDD+' with its reductionist approach to carbon, the confusion regarding emission compensation, the dependency on the uncertain 'Offset' or carbon credit markets, and the conflicts caused by 'carbon cowboys' or 'carbon pirates' (ClimateAlliance 2012b: 1).

Climate Alliance suggests that just by considering very different ways of knowing and perceiving global problems, such as climate change, it will be possible to find solutions and answers to it: "By asking indigenous representatives for their perspectives on our global challenges, we come closer to answering the question of how a sustainable future and a good life for all can be made possible" (ClimateAlliance 2018b: 77).

However, Climate Alliance not only considers these alternative ways of knowing climate change as valid options but also highlights that indigenous peoples – as being part of those who will and are most affected by climate change – both have to suffer from global problems and are much too infrequently included in the processes of finding solutions to these problems:

> Indigenous communities often find themselves in a constant struggle to protect their lands from the resource extraction that feeds our lifestyles as well as monocultures, mega-dams and offset schemes – supposed 'solutions' to climate change implemented without regard to indigenous livelihoods (ClimateAlliance 2016b: 3).

Rather, it highlights that climate change and indigenous rights are part of the same problem and that it is therefore essential to include affected actors in decisive processes to ensure their self-determination. Climate Alliance therefore knows climate change as a phenomenon which can be understood with different perspectives and which is ideally addressed if ideas that are considered 'mainstream' are complemented with alternative, i.e. indigenous ways of dealing with it.

6.2.4.3 Critique of political and economic actors

The third aspect of how Climate Alliance critically knows climate change is coined by the questioning of established structures and actors. This aspect does not highlight any alternative actors or ways of knowing but rather sharply carves out in detail who exactly is considered particularly responsible for the consisting problems. Accordingly, Climate Alliance is relatively open about its political stance towards particular actors and clearly names those that are deemed accountable for bad developments. In doing so, Climate Alliance aligns itself openly with environmental and human rights activists trying to oppose these actors. Part of this aspect is also the critiquing of many of current climate actions as hypocritical and not far-reaching enough.

Climate Alliance is very explicit in its political stance towards particular actors that it presents as being amongst the main culprits for problematic developments. Accordingly, it names those that are considered as causing environmental and human rights issues in different parts of the world, for example the World Bank (ClimateAlliance and ASTM 2013b: 13), Agribusinesses and Mennonite settlers (ClimateAlliance and ASTM 2013b: 11), some state funds such as the Swedish AP2 or the Danish PCA, Deutsche Bank, the insurance company AXA (ClimateAlliance and ASTM 2013b: 23) or the oil company Chevron (ClimateAlliance et al. 2014: 18). Climate Alliance not only accuses these actors of causing manifold problems but also calls for more regulations of their activities:

> As we have seen, neither the invisible hand of the market nor the profit motive give rise to a sustainable use of natural resources, the global commons and respect of human rights. The most influential actors are multinational corporations, and therefore they need political rules and guidelines to be set.
> In most cases, they give back very little money to the mining regions and the host country, but they leave a lot of poison and waste – and the extracted wealth is exported. They know how to avoid taxes in the exporting country and to shift profits to tax havens (ClimateAlliance et al. 2014: 22).

In line with these accusations and criticisms, which resemble those that are brought forward by environmental activists and NGOs, Climate Alliance aligns itself with these actors, thus those who are trying to oppose the criticized actors and developments. The alignment becomes visible for example by legal aid funds that Climate Alliance provides (ClimateAlliance 2018b: 83, 87). Climate Alliance presents this engagement as the common "fight for climate justice" (ClimateAlliance 2018b: 83). Accordingly, Climate Alliance suggests that climate protection projects should always be implemented in cooperation with and co-guided by the local population: "Climate Alliance also supports a variety of community-led projects in the Amazon River basin. Importantly, these projects are built on ideas coming directly from the people rather than on ideas imposed externally (ClimateAlliance 2016b: 6)."

Another part of this critical knowledge is that implemented climate actions are criticized as hypocritical and not far-reaching enough. This accounts for economic actors, as well as for nation states' commitments to climate protection (for example with the statement "With this resolution of our General Assembly 2010 in Perugia, we urge the European Commission to practice what it preaches (...)" (ClimateAlliance 2010b: 1)). Accordingly, Climate Alliance accuses companies for just implementing climate actions to 'greenwash' their image:

> Nowadays, many companies have voluntarily committed to environmentally and socially responsible actions. However, in practice, such obligations are of use to the company's image, but produce only the minimum mandatory benefits (ClimateAlliance et al. 2014: 22).

Also, the in the Paris Agreement internationally agreed-upon way of dealing with climate change through the means of 'nationally determined contributions' is criticized as bearing the risk that emissions are not factually reduced but only arithmetically reduced:

> Yet these national goals, known in technical jargon as Nationally Determined Contributions (NDCs), have their share of issues. Not binding under international law, the goals themselves and the plethora of paths towards them are completely up to each individual country. Whether they are to be achieved via actual energy savings or via offsets with the help of the international carbon market is a national decision. A major risk herein is that real reductions may actually be diluted at a time when they must be boosted: current commitments would allow for a warming of three to four degrees Celcius – a long way off from the Paris target of significantly less than two degrees (ClimateAlliance 2018b: 22).

To summarize, Climate Alliance critically knows climate change also in so far that it clearly sheds light on those actors and practices that it considers accountable for the very problem of climate change. In line with this, Climate Alliance aligns itself with environmental activists opposed to big and influential economic actors. This constitutes a significant difference to C40 which presents companies and private economic actors as inspirational and providers of valuable solutions to climate change (e.g. C40 and McKinsey 2017: 65).

7 Comparative contextualization of the two ways of knowing climate change

In this chapter, I bring together the results of the empirical analysis. I do so to highlight the differences between how the two networks know climate change. To better contextualize these differences, I reflect on both the probable provenance and the consequences these differences might involve.

7.1 Two alternative ways of knowing climate change

In the empirical chapter, using the four forms of knowledge, I have already shown that the ways of how Climate Alliance and C40 know climate change are composed very differently. However, I have realized this analysis separately for the two networks and only included some comparative bits in chapter 6. At the same time, I have consciously decided to investigate two different city networks and their way of knowing climate change. Therefore, I also want to put the two ways of knowing in a comparative relation to each other. In this chapter, I do so by summarizing very briefly every aspect of the respective way of knowing. At the same time, I reflect about the presence of this aspect in the alternative way of knowing – does this knowledge aspect overlap with the other networks' way of knowing? Is it partly present but understood differently? Is it maybe even explicitly rejected by the other way of knowing? These are questions that I want to answer by juxtaposing the two ways of knowing climate change represented by C40 and Climate Alliance.

Table 5 provides a first overview of all aspects forming the respective way of knowing that I have presented in detail before (see chapter 6). These aspects forming the respective ways of knowing are written in bold letters. In italics, I have included in the table in how far this aspect is present or rejected in the other way of knowing. In addition to this table, all aspects are explained in detail in the following paragraphs.

Form of knowledge	C40 Cities	Climate Alliance
Definitional knowledge	**Defining climate change as a meteorological phenomenon measurable in temperatures**	*Temperature measurements as one possibility to understand climate change but not the only one*
	No definition of the problem as multi-dimensional but climate actions as multi-beneficial (solving several problems)	**Defining climate change as a multidimensional phenomenon**
	Defining climate change as an urban problem	*Urban and communal actors as important actors but not the only ones needed → climate change as a problem affecting all and everything around the world*
	Effects of climate change might be unfairly distributed but unfairness not used as the main defining feature of climate change	**Defining climate change as unfair**
Conceptual knowledge	**Climate change as ascertainable by scientific data**	*Climate change is ascertainable by scientific data (e.g. emissions inventories) but also by listening to testimonials of change for example*
	Climate change itself as not ascertainable by direct exchanges but exchanges are very important to find solutions to the problem of climate change	**Climate change as ascertainable by direct interactions and exchanges**
	Concept of 'carbon neutrality'	*Term and concept of 'carbon neutrality' as misleading*
	Justice plays a role but differently understood: *Inclusivity = inclusion of all relevant stakeholders* *Equity = fair distribution of negative and positive impact across different population groups*	**Concept of 'social and climate justice'**
	Concept of 'green growth'	*Green growth as an illusion because indeterminate growth is not compatible with limited natural resources*
	Climate actions as enabling a better life defined by more jobs, better health and more prosperity (in terms of economic performance)	**Concept of 'buen vivir'**
Problem-solving knowledge	**Solution 1: Highlight co-benefits of climate actions (incl. financial reasonability)**	*Solution to some extent present: Climate actions as having multiple benefits because they always address several*

		problems at once (because climate change itself is multi-dimensional)
	Solution present but: education as either cities educating each other, being educated by C40 or educating their citizens; joining of forces rather understood as city-to-city peer learning	**Solution 1: education and joining of (local) forces**
	Solution 2: research and education	*Solution present but: exchanging experiences as a necessary complementary to research findings*
	Solution to some extent present: Some behaviors need to change, e.g. people's mobility behaviors, but also industries' or energy generation behaviors	**Solution 2: Change of behavior**
	Solution 3: Carbon offsetting and negative emission technologies	*Solution rejected: highlighting danger of carbon offsetting promising easy way out instead of actual mitigation activities and negative emission technologies as insecure and hindering the actual reduction of emissions produced*
Critical knowledge	*Not detectable according to my definition → accordance with hegemonic knowledge structures*	**Critique of current perception of climate change's root causes**
		Consideration of indigenous concepts and ways of living
		Critique of political and economic actors

Table 5: Comparative overview of the two ways of knowing climate change structured along the four forms of knowledge

7.1.1 Definitional knowledge: climate change as a meteorological and urban problem vs. climate change as a multi-faceted phenomenon

As I have outlined in detail in chapter 6.1.1, C40 definitionally knows climate change as a meteorological phenomenon in so far as it refers to it as a question of rising temperatures. This definition of the problem as a matter of temperatures is co-developed with the suggested solution to the problem, namely to keep global average temperature rise to well below 2°C with pursuing efforts to limit it to 1.5°C.

Climate Alliance, on the other hand, as described in chapter 6.2.1, definitionally knows climate change as a problem with many faces, facets and dimensions. Rising global mean temperature indeed is one of these dimensions of climate change but it is just one amongst several different ones. Rather, Climate Alliance's knowledge focuses on the globally very

different ways and consequences of climate change in different regions and circumstances. According to this logic, climate change is also a phenomenon coined by questions of fairness because it hits some regions but also parts of the population harder than others (see chapter 6.2.1.2). This juxtaposition of both networks' definitional knowledge shows that climate change is defined quite differently by the two networks. Nevertheless, aspects of both definitions can be found in each networks' way of knowing climate change definitionally.

C40 also acknowledges and highlights that the effects of climate change might be unfairly distributed – both locally as well as globally – because they are most probably going to hit those who are poorest the hardest. C40 draws different consequences from this acknowledgement. Firstly, referring to a local perspective, it argues for the mainstreaming of climate policies as being co-beneficial for other issue areas, such as social cohesion, poverty reduction and economic equity (e.g. C40 2016a; C40 and LSECities 2016; C40 et al. 2018a). And secondly, put in a more global perspective, it highlights that the 'remaining global carbon budgets' need to be fairly distributed (e.g. C40 and Arup 2016a). Despite being present to some extent, C40's understanding of climate change as 'unfair' is nevertheless very different to Climate Alliance's understanding of what 'fair' or 'unfair' means in the context of climate change (see chapter 6.2.1.2 for a more detailed description of how Climate Alliance defines climate change as being unfair).

Concerning the definitional knowledge coining climate change as a problem of changing meteorological circumstances, I found that this aspect is also strongly present in Climate Alliances' way of knowing. Accordingly, the goal of keeping global mean temperature rise under a certain internationally-agreed upon threshold is accepted and taken as a valid goal which needs to be achieved (e.g. ClimateAlliance 2019a: 2). Nevertheless, meteorological events and circumstances tend to be connected with other, accumulating problems such as the economic and social consequences of such events (e.g. ClimateAlliance 2017b: 1).

C40 further defines climate change very strongly as an urban problem (see chapter 6.1.1.2). The definition as an urban problem is justified by several reasons, for example that cities are both particularly responsible for climate change but also particularly prone to its consequences. Further, cities are presented as particularly responsible and well adjusted to the tasks posed by climate change. All of these aspects can be found to a certain degree in Climate Alliance's way of knowing as well (e.g. ClimateAlliance 2014, 2017b; ClimateAlliance et al. 2017: 4). However, Climate Alliance does not go as far as C40 in defining climate change as an urban problem, first and foremost. Rather, it highlights that many other actors, such as indigenous peoples, are crucial for climate protection (ClimateAlliance 2018b: 4). It also highlights much more than C40 does, that a coordinated approach and the cooperation with

other levels of governance is unavoidable and much needed (e.g. ClimateAlliance 2014, 2017e).

To summarize, all aspects of definitional knowledge of one network are to some degree also present in the other networks' definitional knowledge. Some aspects overlap, such as the definition of climate change as a meteorological phenomenon, whereas other aspects are understood very differently. This is the case for example for climate change's definition as unfair. Despite being present in both ways of knowing, the respective definition of 'fair' and 'unfair' differ widely. This is similar with regards to the definition of climate change as a multi-dimensional phenomenon. This aspect is to a certain degree present in both ways of knowing, however, for Climate Alliance the problem itself is multi-dimensional. For C40, in turn, it is rather the solutions to the problem which are multi-dimensional, respectively multi-beneficial.

7.1.2 Conceptual knowledge: Scientific data for carbon neutrality and green growth vs. personal exchange for more justice and a good life

As I have outlined in detail in chapter 6.1.2.1, the main models of explanation used by C40 to understand the causes and consequences of climate change are of a scientific nature. Accordingly, C40 defines that climate change is best ascertainable by data and quantified scientific facts. In turn, if there is a lack of data (e.g. on the urban level), the problem of climate change can not be sufficiently understood. C40 thus knows climate change as a problem that will only be successfully tackled if the relevant actors – in this case mayors – have access to scientific and quantified data (e.g. C40 2016a: 22; C40 et al. 2018c). Climate Alliance, on the contrary, promotes that climate change can be best understood through direct interactions and exchanges (e.g. ClimateAlliance 2016b; ClimateAlliance 2017d, 2017c). Climate change is thus known as a problem that can only be successfully tackled if people, also within city and municipal administrations, actually get a feeling for what climate change means or could mean (see chapter 6.2.2.1) – which they do if they have direct interactions and exchanges with people experiencing already occurring changes, according to Climate Alliance's way of knowing. Nevertheless, to get a full picture of the causes and consequences of climate change, Climate Alliance's way of knowing climate change also relies on scientific data and quantified data, e.g. in the form of emission inventories (e.g. ClimateAlliance and ASTM 2013b; ClimateAlliance 2018b, 2019a, n.d.-a). However, the scientific stance is seen as equally important to other means for understanding climate change. Also for C40, direct exchanges and interactions between different people play an important role. However, these exchanges do rather not serve to understand climate change as a phenomenon but to find solutions, together with other actors sharing a common profile (e.g. C40 and Arup 2015b).

Conceptual knowledge serves to finding explanations for an observed reality. At the same time, it is used to make predictions about observable social and physical events. To do so, particular concepts, beliefs and ideas are considered and used to build a core for dealing with the observed reality. The concepts the two networks draw upon differ widely.

For C40's way of knowing climate change, the two concepts of 'carbon neutrality' and 'green growth' are decisive. Carbon neutrality is understood as the status when a city (or any other actor) has net-zero greenhouse gas emissions (e.g. C40 et al. 2018c; C40 and NYCSustainability 2019). To reach this state of carbon neutrality, cities can either stop emitting carbon dioxide at all, offset the remaining emissions or remove them through carbon dioxide removal measures (e.g. C40 and NYCSustainability 2019: 14). Climate Alliance, in turn, rejects the concept of carbon neutrality and calls it misleading, arguing that it suggests that emissions would be finally neutralized after having been emitted, which de facto is not the case (ClimateAlliance 2008: 1).

The other concept guiding C40 in finding solutions to climate change is 'green growth'. This concept contains the conviction that the historical connection of economic growth and GHG emissions can be 'decoupled' and that new, climate-friendly businesses will generate a new area of economic growth (e.g. C40 and CDP 2013; C40 and LSECities 2016). Again, Climate Alliance clearly rejects this concept arguing that economic growth is not part of the solution to climate change, but has to be seen as its main driver (e.g. ClimateAlliance et al. 2014; ClimateAlliance 2016b). Climate Alliance rather highlights that natural resources are limited and already being overused by some parts of the global population nowadays (e.g. ClimateAlliance et al. 2014; ClimateAlliance 2018b: 82). The network therefore suggests moving away from the idea of unlimited growth towards relying more on material cycles (ClimateAlliance et al. 2014: 23).

Climate Alliance's conceptual knowledge is coined by the concept of 'social and climate justice', as well as 'buen vivir'. The concept of 'social and climate justice', as drawn upon by Climate Alliance, suggests that climate change should be seen as a global challenge, but that it requires local solutions, considering different circumstances and ways of life which would in turn address persisting inequalities (e.g. ClimateAlliance 2017d: 8; 2019a). In C40's way of knowing climate change, the concept of 'justice' plays a role as well. However, it is understood differently. For example, C40 defines just climate policies as being inclusive and equal. Inclusiveness in this case is understood as the inclusion of all relevant stakeholders, whereas equity is understood as the fair distribution of negative and positive impacts of climate policies across different population groups (e.g. C40 and Johnson&Johnson n.d.: 4). Despite the difference in the ways of understanding it, the concept is partly present in both ways of knowing.

The second concept shaping Climate Alliance's way of knowing is the concept of 'buen vivir'. The concept is used to show that a different lifestyle could be a solution to climate change while at the same time bearing the possibility to make people happier (e.g. ClimateAlliance 2017a, n.d.-b). C40's way of knowing contains some parts that suggest the presence of the main idea of the concept 'buen vivir', namely a good (or better) life for all. However, again, this idea is conceptualized differently. Accordingly, the idea of a 'good life' in C40's way of knowing is one where more jobs are created, better health guaranteed, and more economic prosperity generated (C40 and CDP 2013; C40 2016b; C40 and NewClimateInstitute 2018).

Summarizing, the conceptual bases of the two ways of knowing can be seen as sharing important aspects, such as the reliance on scientific data and the importance attributed to exchanges. However, the degree of importance varies. The explicit concepts which are used to build a core for dealing with climate change differ widely. The two main concepts C40 draws upon, are even explicitly rejected by Climate Alliance. In turn, C40's way of knowing indeed contains some parts of the main concepts used by Climate Alliance, however, they are understood differently.

7.1.3 Problem solving knowledge: co-benefits, research and carbon offsetting technologies vs. local cooperative approaches and changes in lifestyle

Problem-solving knowledge comprises solutions that are considered appropriate for dealing with climate change, as well as the way how they should be implemented. I have summarized C40's suggestions in three broader solutions, and Climate Alliance's in two general solutions.

C40 suggests that climate change is best dealt with when policies addressed at climate change are connected to other fields of policy. By doing so, the co-benefits of climate policies can be highlighted. Co-benefits of climate actions can be positive impacts of climate actions on other issue areas, or their financial rationality (see for a detailed explanation chapters 6.1.3.1 and 6.1.3.2). This suggestion of highlighting climate actions' co-benefits is to some extent also present in Climate Alliance's problem-solving knowledge. Based on the definitional knowledge seeing climate change as a multi-faceted problem, Climate Alliance proposes that climate policies always have multiple benefits. This is because these policies – by addressing climate change – always cover several problems at once (e.g. ClimateAlliance 2015c, 2017b). However, the recommendation to use these co-benefits explicitly to convince skeptics as a climate policy solution is much less present (for an exception see ClimateAlliance et al. 2017: 11).

Rather, Climate Alliance suggests to foster education and to join forces with similar actors elsewhere. Education in this case encompasses the exchange of perspectives and

experiences between different municipal actors but also the education of citizens by these urban actors (see ClimateAlliance 2016b; ClimateAlliance et al. 2017; ClimateAlliance n.d.-b; INTERREG 2018). Climate Alliance further sees as part of the solution to climate change the global joining of forces against those structures deemed responsible for the very problem of climate change (e.g. ClimateAlliance 2017a: 14; 2018b). These are expected to arise from mutual education endeavors which make people understand that they face similar challenges (e.g. ClimateAlliance 2017a: 43). C40 partly shares this problem-solving knowledge, especially the importance attributed to education. Education in C40's way of knowing refers mainly to the mutual education of cities (C40 2016d; C40 and Bloomberg n.d.-b: 5), but also to city administrations educating their citizens (e.g. C40 and Arup 2015a; C40 2016d), as well as city administrations educating themselves by working with external partners, such as companies (e.g. C40 and McKinsey 2017: 10). The difference in the aspect of education between the two networks is the content of what actors are educated about. In Climate Alliance's case, education refers to the experiences others make (see chapter 6.2.3.1), whereas C40 rather refers to education about research findings or experiences that have been scientifically gathered (see chapter 6.1.3.3).

Another part of Climate Alliance's suggestion of how to deal with climate change is the initiation of behavioral change. This problem-solving knowledge builds upon the definition of climate change as a multi-faceted problem, resulting from the currently predominant lifestyle (see chapter 6.2.3.2). C40 agrees with this recommendation in so far that it acknowledges that some behaviors must be changed, for example in terms of mobility behaviors or industrial production standards. However, it emphasizes more the improved efficiency in the use of resources (e.g. C40 and Bloomberg n.d.-b: 4 & 5) than the actual change of the lifestyle, respectively the economic logic as a whole.

C40 suggests thirdly, the offsetting of carbon emissions and the use of negative emission technologies. According to this solution, existing carbon emissions can be either offset through the acquisition of 'carbon credits', or by deploying 'negative emission technologies' (see chapter 6.1.3.4). Climate Alliance clearly rejects this advice, highlighting that it might promise an 'easy way out' and therefore postponing real mitigation activities, as well as increasing pressure on fragile eco-systems, such as rainforests and their inhabitants (ClimateAlliance 2008: 2; 2009, 2017c).

To summarize, in terms of problem-solving knowledge, again, there is some overlap of the two ways of knowing. This concerns especially the idea that education could lead to meaningful action addressing climate change. Both ways of knowing agree that changes in current behaviors are essential parts of dealing with climate change. However, the degree of change, as well as where to realize these changes are aspects that do not fully match. C40's problem

solution of deploying carbon offsetting practices and negative emission technologies, in turn, is clearly rejected by Climate Alliance. The two ways of knowing thus represent alternatives with regards to problem-solving knowledge.

7.1.4 Critical knowledge: Accordance with hegemonic knowledge structures vs. disclosing discreet root causes, main culprits and listening to silenced voices

Critical knowledge comprises aspects of critical engagement with current structures and the consultation and establishment of alternatives. In contrast to C40's way of knowing, Climate Alliance's way of knowing climate change contains different critical knowledge aspects.

The first aspect of Climate Alliance's critical knowledge is that it emphasizes that one of the main drivers of climate change is the Western lifestyle based on the rationale of ever-growing economic development – and criticizes that this root cause is often disregarded. At the same time, Climate Alliance suggests that the only way of dealing with the problem of climate change would be to acknowledge this root cause and to drastically reduce the economic model relying on the overuse of resources (see detailed description in chapter 6.2.3.2). C40, though, acknowledges that the current consumption-based economic system causes an increase of resource needs (e.g. C40 and Bloomberg n.d.-b: 5). However, it does not have a critical stance towards that fact but rather suggests increasing recycling or improving efficiency (e.g. C40 and Bloomberg n.d.-b: 4 & 5). Therefore, C40's perception is to be seen as in line with the globally hegemonic way of knowing climate change (see chapter 6.1.4).

The second aspect of Climate Alliance's critical knowledge is that it takes into account anti-hegemonic structures and actors. In this case, this means that Climate Alliance presents indigenous concepts of understanding and acting and tries to adapt these to the global and local governance of climate change (see chapter 6.2.4.2). Climate Alliance knows climate change as a problem which can be understood from different perspectives and which is to be addressed by interweaving hegemonic and alternative ideas of acting. This is a knowledge aspect which is not present in C40's way of knowing climate change at all.

The third aspect of how Climate Alliance knows critically is that it openly questions established governance structures and actors. By doing so, Climate Alliance highlights whom it considers particularly responsible for the consisting problems. Further, it also criticizes global climate actions as being hypocritical and not far-reaching enough (see chapter 6.2.4.3). As is the case for the consideration of indigenous concepts and problem-solutions, the open critique of established actors and structures is absent in C40's way of knowing climate change.

Critical knowledge is thus the form of knowledge where the differences between the two ways of knowing are particularly obvious.

7.2 Reflections on the provenance of the differences

After having outlined the facets of how differently the two networks know climate change but also where they overlap, I want to reflect on the question: why is this case? Where do the broad differences in how climate change is being known come from while at the same time there seems to be significant agreement? In order to answer these questions, I try to understand the knowledge environment coining the two networks' ways of knowing climate change. To do so, I consider historical foundations and general guiding principles, sociopolitical convictions, as well as their knowledge production processes. This way, I build on the rather general contextualizations of the different forms of knowledge which I have already included in the different paragraphs of chapter 6. These first contextualizations were meant to highlight the broader context in which the respective knowledge forms can be put. The contexts I outline in the following paragraphs explicitly focus on the respective particular knowledge environment of the two networks, and are thus network-specific contextualizations.

The aim of a reflection on provenances of the differences in the ways how climate change is known is to comprehend how the two networks themselves understand the context in which they produce knowledge and in which they act upon climate change. In the framework of this thesis, 'provenances' are understood as co-constitutive of ways of knowing. Thinking about the 'provenances' thus has to be seen in the theoretical context of knowledge being defined as a co-produced social product constantly shaping and being shaped by its environment (see chapter 3). Thus, thinking about the provenance of the two ways of knowing climate change is an attempt to understand this shaping and shaped environment and to outline 'plausible conjectures' (Boswell et al. 2019: 30) of the two different ways of knowing climate change.

7.2.1 Historical foundations and guiding principles

One aspect of the environment shaping knowledge is the historical development of the city networks, understood as their historical specificity (Yanow 2014: 145). As I have outlined in chapter 3, knowledge is a socially-tied and -constituted product. Accordingly, the historical development of the two city networks influences the way how and which knowledge is produced. This knowledge, in turn, influences in which direction the respective network develops. Therefore, the historical backgrounds and the founding principles for both networks are important factors for their knowledge environment. To get an idea of what these principles and backgrounds are, I primarily draw on the interviews I have conducted with city network staff. As my aim is to understand how the two networks themselves understand the

environment in which they produce knowledge and in which they act towards climate change, this approach is the logical consequence.

7.2.1.1 C40's historically founded guiding principles

In my interviews with C40 it became quite obvious that the network understands itself as a network of leading cities, for leading cities. The orientation towards cities that are at the same time big population-wise and ambitious in terms of climate policies is very much present:

> So C40 is a leadership organization. So the organization, our title I think says it all, it's a cities' leadership, cities climate leadership group. So we're the world's, you know, we're megacities, so we kind of describe ourselves as the world's greatest cities which are taking the leading, leading climate action (C40 2020b).

In this regard, 'great' is both understood in terms of population size, as well as in economic performance. Accordingly, one of the selection criteria for membership in C40 is the international ranking of a city according to GDP (C40 2019a; Gordon 2016a: 13). Economic performance is thus equated with success and influence. This assumption becomes visible when C40 underlines its importance and the need to be integrated in climate governance arguing that it represents 'one quarter of the economy' (C40 2017) (see chapter 5.2.1). Economic rationales, such as the belief in infinite economic growth and the financial rationality of climate protection (see Methmann 2010) can thus be seen as one of the guiding principles that characterize C40 since its foundation.

In parallel, the conviction that traditional climate policy actors, i.e. nation states, were not doing enough in terms of climate protection, and that therefore cities needed to take the lead is another of C40's founding principles but is still present today as a main guideline:

> It [C40, M.K.] was set up (…) by Ken Livingstone with the idea that national governments weren't doing enough and that cities could work together to do more. (…)
> And that leadership looks different at different times, so you know after the Paris Agreement when most nation states had signed up to that, it was a different story as to when you've got completely stalled national negotiations. So you know when you've got completely stalled national negotiations the city role is even more important because we're saying, right, we're almost leading nation states at that point, especially when you look at the situation in the US, and the response of US mayors is really powerful. So what that leadership looks like varies at different times. (…)
> And I think that, very boldly speaking, our aim is that all 96 cities have a 1.5° compliant action plan by the end of this year. Half emissions by 2030 and are carbon-neutral by 2050. And that that helps the world be on track for it. Because we represent, you know, 700 million citizens, over 25% of the global GDP, hopefully it's the leadership part where it's kind of important. Well, it's not only our cities that gets over, that meaning that there's a global shift (…) (C40 2020b).

This interview quote shows that one of the rationales guiding how C40 approaches climate policy is that if C40 member cities with their size and their economic power are able to show that effective climate policies are realizable, this will serve as an inspiration for other actors and initiate policy adjustment elsewhere.

The other part of C40's founding rationale, as highlighted by the upper quote, is that by working together and learning from each other, cities could be more successful with the implementation of climate policies. This conviction is another guiding principle for how C40 approaches climate change and the solutions to it. Accordingly, one of my interviewees highlighted:

> (…) you know the whole of the network is based on sharing ideas and best practice (…). And so one thing we talk about is that cities face the same challenges and that they can share solutions. So a huge part of the networks' premises is cities' peer-to-peer learning (C40 2020b).

C40's guiding principle here is that learning from other cities' experiences, educating others about what has been implemented elsewhere and informing cities about current research and scientific findings is decisive for cities' capability to implement successful urban climate policies. An interesting finding from my interviews in this regard is that C40 now expands this guiding principle from its member cities to a wider audience of cities. Initially, C40 was rather focusing on its own member cities which present a rather particular sort of cities, namely megacities respectively cities that are recognized as top performers in terms of climate policy. Nevertheless, nowadays C40 expands its will to educate cities especially with an online platform called 'knowledge hub' where cities from all over the world can access information both on best-practice cases and on data that has been gathered on urban climate policies more broadly:

> So the knowledge hub was launched in October [2019, M.K.] and it reflects an increasing desire by C40 sort of strategically, to support and share best practice with all cities not just 96 of them. (…) It's any city could come, well not any city because it depends on what we've got the data for but we've got a set of 3.000 or 10.000 cities so. But that's based on well, A, the general principle of best practice sharing. But it's also based on the fact that if all C40 cities achieve 1.5 degrees that's scarcely enough. We need every city and beyond. (…) Increasingly, strategically, we are wanting to have some way of engaging with and sharing and supporting cities more broadly than our 96 network. And the knowledge hub is probably the first and biggest way of how we've done that. So the aim and the vision of the hub was to be a kind of one-stop-shop to engage the cities, providing all the kind of information they might need (C40 2020b).

Both the conviction that firstly cities are decisive climate actors which can secondly be most effective if they learn from each other are identity-shaping factors and guiding principles for how C40 knows climate change and how it approaches answers to it. Accordingly, one

important principle is that cities' challenges are generally very similar and that they therefore can and should share their experiences amongst each other. This guiding principle is supplemented by the idea that cities need to be supported with data and information in order to perform well in terms of climate action. Therefore, this guiding principle reproduces and is co-produced with the general tendency to rely on data and numbers to deal with uncertainty and to create quantitative understandings of complex situations (Bueger 2015; Jasanoff 2015a). Producing and relying on data has become hegemonic in the sense of being acknowledged as a necessary precondition for any successful climate policy (Adger et al. 2011; Methmann 2010).

These aspects are historically rooted principles that seem to make up a big part of how C40 sees itself and its role, and which are decisive for C40's knowledge creation environment. They can thus be seen as having co-developed especially with several aspects of how C40 knows climate change. Firstly, with the definitional knowledge that climate change is an urban problem (see chapter 6.1.1.2); secondly, with the conceptual knowledge based on 'green growth' (see chapter 6.1.2.3) and thirdly, with the problem-solving knowledge that climate change needs to be addressed by research and education (see chapter 6.1.3.3):

Being aware of the historical foundation of C40 as an urban-led alternative to existing state-led climate politics, it does not come as a surprise that C40's knowledge environment is coined by the definition of climate change as an urban problem. Accordingly, C40 highlights that climate change has to be seen as an urban problem for several reasons. C40's knowledge environment is structured along the convictions that cities are firstly particularly vulnerable through climatic changes; that they are secondly amongst those that are most responsible because of their historical emissions; thirdly that they are perfectly placed to take action; and fourthly, that they are more ambitious than other actors. Especially the last two points are often contrasted with nation states' (missing) activities and therefore highlight the co-development with C40's historical foundation as an alternative political forum. This founding rationale therefore influences how C40 perceives climate change and acts upon it.

Since its foundation, economic rationality plays an important role for C40's knowing and acting. This aspect has co-developed with C40 focusing on economically well-performing cities and cooperating with private companies and other well-situated economic actors, such as philanthropies (Bouteligier 2014; Bulkeley 2010; Haupt and Coppola 2019). In line with how other economic actors and institutions know climate change (see Methmann 2010), namely that climate protection is compatible with economic growth, C40 attributes great importance to the concept of 'green growth'. Based on this concept, climate policies are justified by the logic of economic calculation, and are presented as being favorable for economic development. Accordingly, climate actions that do not negatively affect economic growth are favored. In

C40's case, these suggested actions are not only presented as not being bad for economic growth, but on the contrary, as being multi-beneficial – also for economic growth.

C40's suggested action towards climate change is characterized by the idea that the phenomenon is to be captured by (scientific) data and that therefore cities' solutions need to be based on research and education. This aspect of highlighting the importance of information and data is one that is indeed rooted in C40's historical foundation when arguing that cities should work together to share their experiences and knowledge to be more successful. However, the focus on peer-to-peer learning, despite still being very important as the former quote has shown, has been supplemented with the idea that C40 as a network could help spread more information and better process scientific findings for urban actors. This supporting role of how C40 sees itself is highlighted by the following quote:

> If you consider C40 as the mayors, we're led by mayors, for mayors. So then what C40 is, is a leadership organization of the world's greatest cities and most ambitious mayors who are prepared to kind of taking leading climate action. If you think about C40 as the 250 sorts of staff, what's our role. To support those mayors. To take bold, ambitious climate action. To be able to kind of lead (C40 2020b).

Another interviewee also told me that this direct, and very technically-oriented support is what distinguishes C40 from other networks:

> But I think what makes C40 slightly different is that we kind of tell cities what to do but then we're just immediately there offering support. (…) But we, basically, especially in my team, I would say, we spend most of our capacity and money in actually producing resources and tools and make them so that they use it (C40 2020a)

C40's self-understanding thus seems to be coined by the conviction that it is the network's role to support cities technically, scientifically, but also practically to implement urban actions locally.

Despite the importance attributed to data and scientific information, the interviews have highlighted an aspect that has not become clear throughout the analysis of the online documents. Namely that C40, just as Climate Alliance, attributes great importance to direct interactions and exchanges as part of the solution, as the following quote shows:

> But (…) we try and have one in-person workshop a year over the course of two to three days where the agenda would be agreed with the cities. (…) You'll get some very hands-on study tour element by the host city and then there's a series of presentations and sharing and workshopping that happens between the cities where they all talk about what they are doing. And of course the very important chats over lunch, chats over dinner where they get to know each other and then after that they can pick up the phone and say you know that procurement you were talking about, can you just send me that? I'm trying to do something and I'm not quite sure. So, C40 facilitates it. So by bringing the cities together, so that they actually know each other. We then build the relation right. We build relationships

> between those people so that they can pick up the phone to each other. (…) When we have asked cities what's important that's really important (C40 2020b).

Interestingly, my interviewee highlighted that these direct exchanges and contacts are not only important for getting more useful, direct information but also in terms of emotional support and maybe also emotional motivation:

> For two reasons, one is information and secondly, support. You know, these big things we're trying to achieve and we're all fighting the same battle. So being someone who is responsible for sustainable stuff can be isolating and hard. And so having a network of other people who are just like you is really important. Not just for information but definitely for that kind of peer-support and elements (C40 2020b).

Despite being different from the emotional importance that Climate Alliance attributes to direct exchanges – understanding what climate change can mean for people, their environment and lifestyles – the significance of direct interactions and relationships is nevertheless one that seems to be influencing C40's knowledge environment. This aspect is reflected in C40's problem-solving knowledge highlighting that education can be a solution to the climate problem (see chapter 6.1.3.3).

The outlined aspects of C40's historical development and guiding principles, namely the assumption that cities can outperform nation states, that climate policies are economically rational and that data gathering and information exchange are essential, can be seen as having co-developed with its way of knowing climate change. These rationales coin the knowledge environment in which C40 produces its knowledge about climate change.

Despite already having underlined some of the differences to Climate Alliance's way of knowing, the two networks' variations in the knowledge environment become particularly obvious when C40's guiding principles are contrasted with those of Climate Alliance.

7.2.1.2 Climate Alliance's historically founded guiding principles

In my interview with Climate Alliance staff I found out that the network identifies itself strongly as a 'bottom-up' network, or rather -initiative, once founded by some communities in cooperation with local civil society organizations and NGOs, active in the fields of environmental protection as well as North-South co-operations (ClimateAlliance 2020). This aspect is one that is still deeply rooted in how Climate Alliance sees itself, and also in how far it distances itself from other networks, especially C40 (which – on the basis of it not having been established in a bottom-up way – is even questioned as being a 'real' city network by the interviewee):

> There are opinions that C40 is not to be seen as a city network, for the very reason that it doesn't have a bottom-up approach, being that it is founded by communities themselves. The Climate Alliance was founded by the communities themselves

> whereas C40 has a totally different approach. It is financed by Bloomberg, Michael Bloomberg, who used to be mayor of New York (…) and who has through his Bloomberg Philanthropies a totally different approach and a totally different interest in a city network. (…) Whereas the Climate Alliance also based on its history and its approach and also with regards to our understanding of local climate protection through the partnership with indigenous peoples and the relation to Amazonia, which was decisive upon the foundation, maybe even more decisive than it is today, naturally has a completely different basis, a different principle (…) (ClimateAlliance 2020, author's translation).

The interviewee thus clearly highlights that Climate Alliances founding principle is one that is based on the idea that local communities and actors should, independently from a globally-steering institution, connect with each other and share their approaches to find solutions to climate change. The relationship of the nowadays institutionalized network *Climate Alliance* to both its small member communities as well as to environmental and social civil society organizations is an aspect that is important to Climate Alliance still today and therefore strongly influences the way how the network approaches both climate change, as well as how it acts upon it:

> (…) Climate Alliance is different to other networks because it not only has a certain range of communities as members as in this case extremely C40 which is exclusively focused on megacities (…). And therefore this diversity is rather a potential for us and shows explicitly our approach of local energy supply, decentral, so this has also an effect eventually on our political self-conception, with regard to potential solutions (ClimateAlliance 2020, author's translation).

This quote shows that for Climate Alliance, the distinctiveness of being a network that accumulates a broad variety of members is an identity-shaping factor and a guiding principle for what the network is doing and how it approaches questions. Further, it shows that the network is explicitly aware that this distinctiveness influences the way how it is acting upon climate change and maybe even uses it as a rationale for decisions.

This historical foundation as a bottom-up network and the high diversity of members is co-developing with some specific aspects of how Climate Alliances approaches climate change knowledge. Accordingly, Climate Alliance intensively highlights that climate change is a multi-faceted problem and might manifest very differently in differing places globally as part of its definitional knowledge (see chapter 6.2.1.1). The diversity of members therefore influences Climate Alliance's perception of climate change also being a diverse phenomenon in terms of its manifestations. Further, in terms of conceptual knowledge, Climate Alliance emphasizes the importance of direct exchanges and interactions of very different actors to both understanding the problem of climate change, as well as to finding solutions to it (see chapter 6.2.2.1). This aspect of appreciating the diversity of members and valuing local responsibility and autonomy, according to what the interviewee told me, is one that is deeply rooted in

Climate Alliance's self-conception and therefore surely influences how climate change is approached and conceptualized.

Concerning problem-solving knowledge, Climate Alliance suggests amongst other things, that an important climate action is to initiate behavioral change. This starting off of changes both in behaviors but also in societal structures is an aspect that seems to have become more and more important for Climate Alliance throughout its engagement with climate change. Accordingly, my interviewee told me that nowadays, Climate Alliance wants to be rather action-inspiring than debating theoretical agreements and goals such as specific CO_2 reduction commitments:

> This instrument [= 'Klimaschutzplaner', M.K.] reflects the development of climate protection so to say. Whilst in the beginning, it was a technical or measuring instrument for CO_2 emissions because they have been and still are today seen as the central element for climate protection. (…) That means, our vision today is for example rather 100% renewables. (…) Our approach currently, that is still up to discussion, is rather a 100% renewables vision which is not CO_2-based but is supposed to be rather guiding actions. And 100% renewables in fact is not only concerned with CO_2 but also with transformation processes which are not only located in the energy sector but which also involve social and other transformation processes (ClimateAlliance 2020, author's translation).

What this quote further shows is that for Climate Alliance, it is important to see climate change not only as a matter of CO_2 emissions and their reduction at any cost but also as a matter of projecting realizable and easily understandable visions for the future. This aspect is co-constituting with Climate Alliance's critique of concepts such as 'climate neutrality' and related carbon-offsetting technologies, but also with the focus on behavioral changes as solutions.

This short overview has shown that there are some historical, but also current, differences between the two networks which guide their way of knowing and acting upon climate change. Thinking about them as co-constituents of the respective way of knowing means to see those aspects as influential. This is the case because they apparently coin the environment in which the two networks produce knowledge of how to act towards climate change. Accordingly, C40's historical conviction that states were not doing enough in terms of climate protection can be seen as having co-developed with the definition of climate change as an urban problem. Climate Alliance's historical foundation shares this conviction that climate or more broadly environmental protection needs to be realized (also) at the municipal level (ClimateAlliance 2020). However, it lacks the conviction that it is first and foremost cities and municipal areas which need to take care of the problem. Rather, Climate Alliance's historical development is based on the diversity of its members which is reflected by the definition of climate change as

a diverse problem. Further, its historic rationale of a partnership organization connecting municipalities, NGOs and indigenous peoples still influences its understanding of climate change to a great part.

However, the historical foundations and prevailing guiding principles are not the only aspects shaping the environment in which networks produce knowledge.

7.2.2 Sociopolitical convictions about the governance of climate change

Next to differences in the historical foundations and guiding principles of the two networks, there is another contextual aspect which can be seen as part of the respective environment in which the two networks know climate change: the stance towards sociopolitical questions related to climate change. These sociopolitical stances represent differing positions concerning the value of nature and ecosystems and their relation to human purposes (Leach 2015; A. Steffen 2009). These beliefs and values are important because they resonate in the respective knowledge about climate and climate change (Mahony and Hulme 2018: 410). Frank Fischer even sees a relationship between these specific sociopolitical stances and the respective (dis)agreement to environmental science: “disagreement about environmental facts is also caused by deeper and more difficult sociopolitical questions attached to the respective facts” (F. Fischer 2019: 235). Although the two networks might not disagree about environmental facts (at least this is not discernible from my study), they still disagree about the way of how to reach a ‘climate-safe’ and ‘sustainable’ future. This might be explainable by their differing sociopolitical stances, their worldviews for short, their beliefs about how the world works. These sociopolitical stances intensively influence the way how we know and to which ends we know. Standring formulates this very cleary: “The way we view the world as human subjects has logical implications for our subsequent beliefs about what we can hope to understand about it” (Standring 2017: 228).

This points to a discussion that several scholars interested in global environmental and climate governance have been dealing with – that the perception of how to understand these environmental issues and also how to act in the face of them – is highly influenced by the respective worldview of someone. Accordingly, different scholars have differentiated various positions to understand these differing worldviews (Bäckstrand and Lövbrand 2006; Clapp and Dauvergne 2011; Leach 2015; Standring 2017). Despite a variation in the names given to the different worldviews and also the number of different ones identified, they nevertheless point to the same differences. It has to be highlighted that all these positions share the assumption that some kind of environmental issues are present, which need to be tackled by humanity. They do not include worldviews which reject the presence of environmental problems that could be dealt with by humans (as for example F. Fischer 2019 deals with).

Clapp and Dauvergne (2011) differentiate four worldviews they call ‘market liberals’, ‘institutionalists’, ‘bioenvironmentalists’, and ‘social greens’. Bäckstrand and Lövbrand (2006, 2019) identify three key positions, called ‘ecological modernization’, ‘green governmentality’ and ‘civic environmentalism’. Melissa Leach (2015) finally differentiates two ‘green’ positions, namely ‘light green’ and ‘dark green’. All of these differentiations overlap to some extent and can therefore be productively combined.

The first sociopolitical stance, ‘market liberalism’, is found to believe that economic growth and high per capita incomes are essential for human welfare (as a precondition to environmental concern) and the maintenance of sustainable development. Globalization is identified as a positive force, enabling the development of science and technology, as well as self-regulating free trade. Market liberals identify the lack of economic growth and performance, poverty, and market failures as the main drivers of environmental problems. Therefore, they suggest that good policies to ensure economic growth are key to improve environmental problems. They further put great faith in the ability of modern science and technology to help humanity overcome persisting problems (Clapp and Dauvergne 2011: 4ff). This broadly overlaps with the ‘ecological modernization’ position identified by Bäckstrand and Lövbrand (2006). Accordingly, the worldview of ‘ecological modernization’ is found to believe in the compatibility of economic growth and environmental protection, if only capitalism and industrialization are made more environmentally friendly. This can be achieved by technocratic means, ‘ecological modernization’ representatives argue. Therefore, people with an ‘ecological modernization’ worldview often deploy a ‘win-win storyline’, highlighting benefits for the environment as well as the economy (Bäckstrand and Lövbrand 2006: 52f). Melissa Leach’s notion of the ‘light green’ position can also be seen as overlapping with the former definitions. Accordingly, she finds that the ‘light green’ position perceives the environment as being relatively robust and assumes that green goals are “achievable by relatively modest economic shifts to price nature correctly, substitute for non-renewable resources, or redirect personal consumption and lifestyle choices” (Leach 2015: 25f). She further highlights that many positions assuming that green growth is possible follow this view and represent ‘light green’ positions (Leach 2015: 26). As part of the ‘light green’ position, Leach highlights that lately ‘bright green’ has been added to distinguish approaches that mainly rely on technology and social innovations to achieve green transformations (Leach 2015: 26). A. Steffen (2009) defines ‘bright green environmentalism’ as the belief that through innovations, design, urban restructuring and entrepreneurial creativity, social and economic systems can be transformed in such a way that they are sustainable and at the same time prospering. Therefore, the notion of the ‘bright green’ worldview maybe even fits better to the notions of the ‘market liberal’ and ‘ecological modernization’ positions.

Clapp and Dauvergne (2011) call people with the second environmental worldview 'institutionalists'. This is because they argue for stronger global institutions and norms, as well as sufficient state and local capacities to protect the common good 'environment'. Institutionalists are also found to believe in the value of economic growth, globalization, trade, foreign investment, and technology. They identify the lack of global cooperation as key source of environmental degradation. Therefore, as a solution to environmental problems, they suggest building and strengthening global and local institutions. These would in turn have to promote state adherence to collective goals and norms. Further, these institutions should also enable the transfer of knowledge, finances and technology, tackling persisting environmental problems (Clapp and Dauvergne 2011: 7ff). Again, this overlaps (at least to some extent) with the second position identified by Bäckstrand and Lövbrand (2006), called 'green governmentality'. According to this position, nature and life itself need to be managed and administrated, preferably by the state. Standardization and scientific precision could help to identify the exact environmental risks, but also to establish a worldwide techno-scientific infrastructure aiming to solve persisting problems (Bäckstrand and Lövbrand 2006: 53ff). Despite not highlighting the importance of institutions, this position nevertheless reflects the importance attributed to the management of environmental problems, preferably by techno-scientific means. This position, however, also shares some important features with the third worldview identified by Clapp and Dauvergne (2011) – 'bioenvironmentalism'.

This commonality consists of bioenvironmentalists' call for the control of worldwide population growth. This call can be seen as speaking to green governmentalists' idea of managing nature and life itself. 'Bioenvironmentalists' see the need for a control of population growth because they stress the biological limits of the earth to support life. They find humanity, as a species, to consume too much of the earth's resources. This overconsumption is caused by the massive growth of population, but also the need for an ever-growing economy. Therefore, they argue for a reduction in economic and population growth (Clapp and Dauvergne 2011: 9ff).

The last worldview identified is called 'social greens' by Clapp and Dauvergne (2011), 'civic environmentalism' by Bäckstrand and Lövbrand (2006), and 'dark green' by Leach (2015). 'Social greens' are found to see social and environmental problems as inseparably intertwined. They argue that the main problems in terms of environmental degradation are capitalism leading to overconsumption of resources, and neocolonial relations between rich and poor countries. These unequal relations lead to both unequal access to resources and unequal exposure to environmental harms. Therefore, economic globalization is seen as a thread and is being opposed. However, different from bioenvironmentalists, social greens do not aim at controlling population growth because this is seen as a threat to the self-determination of

women and poor people. Rather, what they suggest are major economic reforms in favor of local community autonomy, streamlining the voices of those marginalized by economic globalization. Further, they argue that effective solutions to environmental problems need to include the voices of women, indigenous peoples, and poor people to integrate both social and environmental justice, and to respect local specificities (Clapp and Dauvergne 2011: 12ff). This definition more or less overlaps widely with what Bäckstrand and Lövbrand call 'civic environmentalism', respectively the 'climate justice discourse' as they re-frame it in their review article of 2019 (Bäckstrand and Lövbrand 2019). Accordingly, Bäckstrand and Lövbrand (2006) identify 'carbon-colonialism', 'North-South equity' and 'local participation' as the key concepts of civic environmentalism and climate justice accounts (Bäckstrand and Lövbrand 2006, 2019). They find civic environmentalism to favor solutions which are found on the basis of multilateral discussions including those actors which are most affected by problems (Bäckstrand and Lövbrand 2006: 55f). This overlaps with Leach's definition of a 'dark green', respectively 'green socialist and Marxist' worldview. Leach (2015) finds the 'dark green' or 'deep green' position to see nature and its ecosystems as "much more vulnerable, interconnected and prone to damage (…)" (Leach 2015: 26). People with such a sociopolitical stance towards nature accordingly tend to argue that nature needs to be conserved and precautionarily approached. To do so, they argue, structural changes have to be realized (Leach 2015: 26). Further, Leach distinguishes a 'green socialist and Marxist' position aiming at a fundamental restructuring of current capitalist social and economic structures. According to her findings, this position often overlaps with the view that a strong local community and ways of life as having co-developed and being interdependent with ecosystems and nature, should be better valued. She finds such positions to be exemplarily present in indigenous people's movements, or ecofeminist movements which emphasize the connection of gender equality and ecological sustainability (Leach 2015: 26). This overlaps with the 'radical resistance' strand of civic environmentalism identified by Bäckstrand and Lövbrand (2006), which goes further than the 'reform oriented' strand by challenging and resisting inequitable power structures (p. 56).

This overview shows that despite some small differences in the definition of different worldviews connected to environmental and climate issues, there are major agreements. The authors identify a continuum of sociopolitical convictions, ranging from 'light green' and market-oriented positions to 'deep green' positions, aiming at a complete restructuring of social and economic relations. In line with these convictions, different solutions and ways forward are suggested, ranging from promoting growth and encouraging technological 'fixes', to rejecting industrialism and reversing economic globalization (Clapp and Dauvergne 2011: 16f).

Relating this summary to the two ways of knowing climate change represented by the two networks investigated, I suggest that the two city networks represent such differing 'green' worldviews, and seem to have varying sociopolitical convictions. These worldviews can be seen as co-producing with the way of how an issue is known as they influence in the first place the understanding of what it is we can actually hope to understand (Standring 2017: 228).

7.2.2.1 C40's way of knowing and underlying sociopolitical convictions

C40 can be seen as representing the so-called 'light green', but also 'bright green' position. Further, elements of the 'ecological modernization' and 'green governmentality', as well as 'market liberal' sociopolitical convictions are perceivable in C40's way of knowing.

All of these worldviews argue that a sustainable future can be achieved by slight economic and social shifts, supported by scientific and technological innovations. This the very reason why 'bright greens' argue that the future will be bright – because of groundbreaking and life-improving innovations (A. Steffen 2009). This overlaps with C40's conviction that climate change is first and foremost a meteorological phenomenon, which can be 'fixed' when switching to a 'carbon-neutral' and 'green growing' economy. The aspect of a 'bright' green position is in so far present as C40 argues for climate action being multi-beneficial, financially reasonable and therefore enabling a positive future. This also reflects the worldview of market liberals/ ecological modernization, believing that economic growth and climate protection are compatible, further, that climate policies are even win-win projects.

Interesting in this regard is that C40's way of knowing clearly co-produces these sociopolitical convictions, however, that they are also used as a strategic argument. Both the documents (e.g. C40 2016a; C40 and LSECities 2016; C40 et al. 2018a) and my interviews have shown that in C40's case this 'bright green' orientation highlighting the multiple benefits that would come with more climate protection has to be seen as a planned strategy. Accordingly, C40's argument of climate action being reasonable, and rewarding is actively raised to 'mainstream' climate action and to ensure that those actions will not be taken back as soon as the (local) government changes, as one of my interviewees highlighted:

> But then they [= the mayors, M.K.] leave, you know. Then there's elections and then they leave and then the technical team is left there with all these promises and normally those teams never change. So they kind of have to navigate through this political nightmare. (…) And that's also why a big part of our program is to make sure that climate action is mainstreamed within the city. It is true that sometimes it is the climate team sitting in a corner, completely isolated and the rest of the team isn't really caring what they are doing and they don't realize that it's actually the same thing (C40 2020a).

In C40's case it thus seems as if the conviction of 'bright greens' of a positive and better future seems to be intentionally called upon. I can thus not clearly say that C40 is convinced

of these beliefs. What indeed is sure is that it clearly co-produces them, and that they influence C40's knowledge environment.

Another characteristic of the bright green/ecological modernization/ market liberal spectrum is perceivable in C40's way of knowing: the belief in technological innovation. More explicitly, in the arguments for carbon offsetting and negative emission technologies. C40 argues for 'more work to be done' in terms of CCS technologies: "Since carbon capture and storage is not yet widely employed, there is an enormous amount of work to be done to make this trajectory a reality" (C40 and Arup 2016a: 31). This reflects the belief in the ability of modern science and technology to solve persisting problems.

However, also the managerial approach which is present both in ecological modernization/ market liberal worldviews, as well as green governmentality and institutionalism, is present in C40's way of knowing. These worldviews share the opinion that measures to counter environmental threats should be expert-driven and technocratic (Bäckstrand and Lövbrand 2006: 57). C40 shares these convictions in so far as it knows climate change as an issue that is ascertainable by scientific data provided by experts (e.g. C40 2016a: 22; C40 et al. 2018c). Further, it believes that on the basis of these data, humans will be able to act upon, to 'manage', the problem of climate change, especially by managing their CO_2 emissions. C40's problem-solving knowledge promoting both research and carbon offsetting as solutions to climate change is also in line with these technocratic convictions. But C40 also shares these worldviews' convictions that environmental problems need to be better managed because they are simply the result of bad policies and market failures (explicitely stated in C40 and LSECities 2016). In C40's case it is especially nation-states which are accused of having produced bad climate policies. This argument is used to justify that cities are in a better position to manage climate change (e.g. C40 and McKinsey 2017; C40 and NYCSustainability 2019)

Hence, I draw the conclusion that C40's way of knowing is co-producing with sociopolitical convictions valuing nature in terms of its economic value, seeing humanities' role in managing nature and the life with environmental problems, and putting faith in the innovative power of science and technology to solve persisting problems, thus creating win-win situations.

7.2.2.2 Climate Alliance's way of knowing and underlying sociopolitical convictions

In turn, Climate Alliance rather represents the 'dark green'/ civic environmentalism/ social greens position seeing nature and its ecosystems at stake by human activities, social inequalities reinforced and therefore aiming for deeper structural changes. Climate Alliance's stance towards climate change as a problem of (un)fairness which needs to be addressed by valuing 'social and climate justice' and by aiming for a 'good life' with changing behavior patterns clearly reflects these positions. As outlined before, these worldviews value sound

ecosystems and prioritize social and justice concerns when thinking about appropriate climate actions. Their critical stance towards the perceived root causes of climate change in preference of seeing the current economic system as the main reason overlaps with the so-called 'green socialist' position. It maybe even overlaps with the 'radical resistance' strand of civic environmentalism favoring a radical restructuring of the capitalist economic system. This worldview is mirrored in Climate Alliance's belief that climate change is not only an environmental problem but rather a structural problem caused and influenced by many aspects. Accordingly, the same idea is visible in social greens' conviction that social and environmental problems are inseparable and intertwined with global inequalities. I have outlined this reasoning of Climate Alliance in chapter 6.2.1.1 already, but the following interview quote again shows how important and influential the aspect of the inseparability of climate change from other inequality problems is for how Climate Alliance approaches climate change:

> (…) the conception of climate change being an environmental topic is for us not right, not correct. Nevertheless, it is mostly treated as an environmental issue. (…) This still shows, you know, a missing realization of the primary role of the topic of climate change and that, in fact, maybe the effects are visible in the environment but that in fact the reasons for climate change are to be traced back to unfair and wrong aspects of resource use (ClimateAlliance 2020, author's translation).

Further, the aspect of valuing cultures that have co-developed with nature is present in Climate Alliance's approach of considering indigenous concepts and ways of living, as outlined in chapter 6.2.4.2 but also as highlighted several times by my interview partner during our conversation:

> So, to show that if we are developing climate protection plans for the local level, we have to consider these global aspects in certain regards, or at least to not ignore them. (…) And because of our collaboration with indigenous peoples in Amazonia we bring along this perspective (ClimateAlliance 2020, author's translation).

It is especially environmental activist movements such as indigenous peoples' or ecofeminist movements in which such convictions are predominant (Leach 2015: 26). A city network is maybe not the first institution one would think of when hearing about deep or social green transformational actors. However, having realized that Climate Alliance often refers to environmental activists and particularly their exposure in fighting for environmental protection (e.g. ClimateAlliance and ASTM 2013b; ClimateAlliance 2017a, 2018b), I have asked in my interview with Climate Alliance staff if the network sees itself as an environmental activist group. And the answer suggests that Climate Alliance at least does not object to this suggestion:

> That is also part of the development of our self-conception. Surely, in the initial phase of the Climate Alliance, you can also see that in the founding documents, there were many NGOs involved. Non-governmental organizations, environmental organizations. I already mentioned BUND but also others who brought up this idea of environmental protection at the municipal level. Based on that, in the last 10, 15 years, a tightening of the conviction that we are a city network has arisen. But maybe the Climate Alliance is particularly because of that history, there is, say, also this component which is maybe in the field of North-South cooperation (…). And there we are of course or maybe we are better comparable with environment or activist organizations. Also with regard to the topics maybe more than the municipal level. So, we also try of course, to develop the municipal coop-, the connection here as well (ClimateAlliance 2020, author's translation).

This strong connection to environmental and North-South cooperation NGOs is an aspect which can be seen as influencing both predominant sociopolitical convictions of the network, and therefore also the way how climate change is known. According to my analysis, the 'environmental activist' background of Climate Alliance becomes particularly obvious in terms of its critical knowledge (see chapter 6.2.4), by arguing for an inclusion of marginalized voices or by highlighting perceived social and economic inequalities. The sociopolitical convictions of civic environmentalism and social greens are hence co-produced by Climate Alliance's way of knowing. Bioenvironmentalists' worldview is in so far represented by Climate Alliance's way of knowing as it also highlights the drive for an ever-growing economy as key source of environmental degradation and inequality (e.g. ClimateAlliance 2017e: 8). However, bioenvironmentalists' key conviction that population growth needs to be limited is not part of Climate Alliance's knowledge.

Summarizing, we can see that Climate Alliance's way of knowing is co-producing with sociopolitical convictions seeing environmental and social problems as inseparable, therefore arguing for a change in social and economic structures in favor of more local participation, and putting faith in solutions found on the basis of inclusive processes, involving those affected by persisting problems.

These differences in C40's and Climate Alliance's sociopolitical position towards nature, ecosystems, climate change and humans' interdependence and interconnection form part of the knowledge environment of the two networks. Therefore, they surely shape the way how climate change is known by the networks and can thus be seen as something as a 'constitutive causality' of each networks' knowledge.

These positions have to be seen as interacting with other aspects influencing which and whose knowledge is valued, i.e. who is seen as an expert, what is defined as a 'good' and 'sustainable' future, how we might get there etc. (Jasanoff 2015c; Leach 2015; Lövbrand

2014). Therefore, the way how the two networks produce knowledge, respectively where they get it from, is another very interesting aspect I shed light on in the next section.

7.2.3 Knowledge production processes as co-producing ways of knowing

All knowledge processes are always highly selective and competitive because they involve different actors with diverging views, interests, unequal resource capacities who are all striving to ensure the success of their own perspective throughout these processes (Nay 2014: 212). Hence, the question of how knowledge is being produced touches upon profound social struggles and power politics (Bracken and Oughton 2012; Buchanan 2013). These struggles are about whose knowledge is considered truthful and trustworthy. Hence, the production of knowledge has to be seen as a dynamic and interpretative process which is deeply interwoven with ideas about what the problem is and how it might be addressed (Wesselink et al. 2013: 4). Depending on how these questions are answered, different actors and ideas will be included into the process of knowledge production. In turn, these knowledge production processes again, co-produce the respective ideas and concepts. The previously presented historical roots, guiding principles and socio-political convictions are thus co-producing with the two networks' respective ways of knowing climate change.

But how does this manifest itself in the two city networks' knowledge production processes?

Similar to international organizations (Nay 2014: 213), city networks define policies and programs after having selected, internalized and reframed ideas promoted by partners involved in the knowledge production process. This process of producing knowledge is highly influential on how the issue itself is known. However, so far we do not know anything about the knowledge production processes within TMNs and the role different partners play throughout these processes (Haupt and Coppola 2019: 16). Against the backdrop of Haupt and Coppola (2019), stating that TMNs increasingly collaborate with different actors, such as private companies or NGOs acting as "participants and providers of solutions" (p. 10), we can assume that different ways of knowing are co-produced in collaboration with different actors and types of knowledge. At the same time, we still know very little especially about non-city actors and their role within city networks (Bach Nielsen and Papin 2020). In order to understand which actors' concepts and ideas, and which types of knowledge are co-produced through TMNs' knowledge production processes, I draw on information I have obtained during my interviews with city network staff. I want to highlight that this is giving me first insights into the knowledge production processes of the two networks. Nevertheless, as the number of interviews is very small, this insight has to be interpreted with caution. For the sake of this thesis, these first insights are providing a good impression. However, for an extensive

understanding of the knowledge production processes, it would be important to draw on more, and more diverse data.

7.2.3.1 C40's knowledge production process

The interviewees at C40 highlight that the network is collaborating with 'experts' to produce the knowledge resources that are then offered to cities (C40 2020b, 2020a). However, C40 does not only outsource the knowledge production process to 'experts' to then adopt their suggestions. Rather, the network – in form of the staff working for C40 in different departments – seemingly plays an active role in the knowledge production itself, despite favoring the collaboration with 'experts':

> It's a mix. So we would commission it, sometimes we do it and then sometimes it's a kind of mix in between. So the piece that we're working on at the moment, we're doing some of the modelling ourselves and we are commissioning other stuff, and then were getting a bunch of external experts in to review all of it. So it's a real mix. We tend to do, not to do research just ourselves. I think there's so much to be gained by working in partnership with people and one of the most important things we can do at C40 Research, it depends on the question we're looking at but sometimes we're needing to answer questions for cities that other people have spent decades thinking about (…)
> We don't commission something and then say come back to us with what you find. We're engaged the whole way through. We usually try and involve some of our cities in sort of an advisory function. We often do pilots and testing with the cities and that's part of the research project so that we know that it's relevant to them. So it's very rare that we commission something and then sort of receive a (…) presentation at the end. We're happily involved. But it totally varies to who does most of the action, of the research legwork. (C40 2020b).

This quote hints to the fact that C40's knowledge production processes is mostly designed as a commissioning process. External experts are chosen to do work that the network cannot realize itself. However, also member cities seem to be involved in the knowledge production process, adding their point of view, and their specific position about which knowledge is to be produced. C40 actively wants to provide knowledge to its members. However, the network does not seem to assume that the knowledge production process should not be a purely top-down one but one that also includes the opinions of those involved:

> But, you know, fabulously our cities will often come to us and say we're looking at this. We think C40 should be doing more on this. We want more help on this. Who else is doing something, you know, whatever, however you wanna phrase the question. We work with leading cities and they push us. And that's great. And then, the other way round, we'll go to cities as part of, you know, as part of research. (…), anyways, that was us going out and asking them in terms of research to then generate knowledge to say okay, these are the six main barriers that cities face. (…). So those are two ends of the spectrum and then I think in between (C40 2020b).

What this inclusion of the member cities also shows is that these member cities' perceptions of climate change, according norms and imaginaries are, again, co-produced through C40's knowledge production process. As C40's membership structure is rather particular, representing especially economically well-performing, big cities, the positions and views which are co-produced are particular in the same way.

The following quote again exemplifies C40's commissioning process. The actors chosen to participate in the knowledge production process are thus those who made the best offer, with regards to a cost-performance calculation. It further suggests that C40 sees those as experts who are representing research institutions or consultancies dealing with the particular topic of interest:

> We try and go to these that got the expertise in the area that we're looking at. So I could give you a couple of examples. So we've done our program and our research around the wider benefits of climate action, which most people call co-benefits. And two sort of projects within that program, one was looking at air quality and one was looking at the benefits of building retrofit. And so for the air quality stuff we worked with the London School of Hygiene and Tropical Medicine and a couple of folk there, that's their specialism. We went out to tender because we, yeah, just a general procurement, if we spend over x amount of money we need to get three proposals and so part of the process would be asking people what expertise they've got. And for that we wanted a Consortium, yeah, I think we wanted a consortium so a generalist consultant with the academic experts. So, we have a kind of mix of the practical delivery and a more sort of that academic expertise. And we ended up working with a consortium, yeah Bureau Happelt as the consultant, the air quality health experts, you know the epidemiologists from the London School of Hygiene and Tropical Medicine and then air quality modelling experts, Cambridge environmental research consultants. So we put the tender out there, saying what we wanted and we got various bids in and kind of and then we decided kind of who fitted the expertise the best. And I guess, yeah, that's how we would normally do it (C40 2020b)

Generally, consultancies seem to play an important role throughout both the knowledge production and the 'implementation' processes:

> Everything that has been developed in the last say two years there's always consultancies involved. We manage the relationships with the consultants, we brief them, we connect them with cities, we gather the information for them, we do interviews with cities for them sometimes. But at the end of the day, it's mostly consultants delivering the work because we don't have the capacity and probably we don't have the knowledge as well in many cases because it is so regional. So we're mostly going consultancies that are big in that region and know what they are doing. (…) And we also have consultancies delivering the work for cities. So cities do not have the capacity to do an inventory so they hire a consultancy to do it for them. The budget that we have also kind of covers the find of support that the city seeks from the consultancies (C40 2020a).

This quote shows that consultancies seem to be influential actors in C40's knowledge production process. They seem to be involved in all knowledge processes, from the initiation

of a particular offer, through to the realization of climate policies within a city. From these insights gained through my interviews, I assume that C40 privileges scientific, respectively academic knowledge and respective actors. At the same time, economic actors, consultancies but also companies, are included in the knowledge production process as well. Based on other authors' findings (Clapp and Dauvergne 2011; Methmann 2010), I assume that these actors represent a techno-scientific, respectively market liberal view on climate change. Thus, their inclusion into C40's knowledge production process very likely co-produces C40's way of knowing climate change. Therefore, also the knowledge production process can be seen as one of the provenances of C40's way of knowing climate change.

The valuation of specific expert knowledge and the tendency to neglect other, unknown knowledge sources is one that C40 seems to be aware of and supposedly wants to change in the future:

> And I guess we might have an idea of who we might want to work with. We send out the requested proposals to sort of a set of people we think have the right kind of expertise. (…) So it's basically the kind of, I guess the feel is out for who are the right experts. One problem with that is when you're doing that in that kind of word in the mouth way is that you, you tend to bend, pool within a certain network and so we really wanted to expand that much more globally. So we're drawing on kind of more institutions across the globe and more kind of forms and perspectives of the kind of knowledge I suppose. So the plan for the future is to kind of identify a number of leading academic organizations as well as probably, they don't have to be, leading research organizations I should say, and just have kind of conversations with them, so that we know them and then we get the RFPs coming up with less of the usual suspects and then becoming European or North American focused (C40 2020b).

Interesting in this regard is that, despite wanting to expand the range of expertise drawn upon to a globally more widespread one, the focus on *research* institutions as the ones with the expertise remains. This is a clear difference to Climate Alliance's take seeing lay and indigenous people as experts to talk to and to include in knowledge generation processes.

7.2.3.2 Climate Alliance's knowledge production process

Climate Alliance states in several of its documents that indigenous and other suppressed communities should be considered as experts in terms of climate protection with valid knowledge and calls them 'counsellors' (e.g. ClimateAlliance 2018b: 79). Unfortunately, during my interview with Climate Alliance staff I did not get as many general information about different knowledge production processes and was therefore not able to confirm or decline the inclusion of indigenous representatives in Climate Alliance's knowledge production processes. However, I assume that already the acknowledgement of indigenous and lay peoples' expertise stated in many of the analyzed documents points to the valuation of their knowledge. My Climate Alliance interviewee explained the knowledge production process along one

particular instrument, the 'Klimaschutz-Planer' (climate protection planner). This explanation shows that Climate Alliance is also working with external companies as consultants to develop tools to offer to its members. It also shows that both Climate Alliance's staff and its members play important roles throughout knowledge production processes. However, in addition state institutions, as in this case the German Federal Ministry for the Environment, are part of the process:

> In this case, one can comprehend this relatively clearly. So the starting point was at a general meeting, I don't know how many years ago, the members have just wished, have said, we need our own monitoring instrument. Starting with their commitment. So that's the starting point. (...) We then looked, researched, okay there's something like that or we have to do everything ourselves. There was already such a set of instruments in Switzerland, with which we then negotiated. To adapt what was there, eco-regio instrument, for the Climate Alliance. This, of course, costs money, then we asked the members for special contributions, so to speak, and then adapted this set of instruments. (...) We then formed an internal working group, Climate alliance internal, with members who dealt with the issue of CO_2 monitoring, from a technical and political point of view, that is, what are, what do we need, what are the criteria, what are the standards, how can we have comparable data, where do we get the data from and so on. (…) And then the climate protection planner has just been developed, with the involvement of the Ministry of the Environment (…) (ClimateAlliance 2020; author's translation).

At the same time, my interviewee also highlighted that the partnership with the Swiss company was ended by Climate Alliance as the network realized that the companies' expectations and views, described as 'profit-oriented', did not fit with those of Climate Alliance:

> Meanwhile, we have also separated from this company. That's just such a difficulty, let me say, our approach as being driven by content with an approach that is only economically driven or profit-oriented just doesn't always fit together and that's where we just split up and we just said we need something broader (ClimateAlliance 2020; author's translation).

Climate Alliance thus seems to actively consider whom to involve into its knowledge production processes. The basis for such considerations seems to be the conformity with the networks' norms and interests. This confirms the assumption that according to one's own ideas about what the problem is and how it might be addressed, different actors and ideas are included into the process of knowledge production. In this case, this could be Climate Alliance's belief that climate change is also a social issue, and not one primarily concerned with making profit and seeing economic benefits.

Nevertheless, the interview also showed that Climate Alliance adjusts its own knowledge to the demands of the broader political environment. As outlined before, Climate Alliance's documents attributed as much significance to direct exchanges as to data gathering. However, in the hegemonic way of knowing and acting upon climate change, data are an essential part of the solution. This seems to have influenced Climate Alliance's view to prioritize data as a

necessity for taking political decisions and therefore also influences which types of knowledge are being produced:

> And that's why, I keep mentioning it, for us, we're always trying to consider the whole chain, I say. In other words, the formation of political will is linked to a set of instruments of measurability. Which, in turn, provides me with data for the further political decision. (…)
> Meanwhile, in the process of this development, let me say, the world has also changed. This monitoring has also become increasingly important from a political point of view, because in all processes, be it international, national is actually always connected to each other, that is, I make a political statement and I have to look at how I measure it and prove it. This means monitoring and commitment are inextricably linked (ClimateAlliance 2020; author's translation)

As in Climate Alliance's case I could only draw on one interview, it is even more difficult to make general statements about the knowledge production process. However, some actors and their respective ways of knowing seem to be privileged knowledge production actors. These are Climate Alliance staff, members and other political institutions working at other political levels (such as the nation state). Climate Alliance also seems to include what C40 calls 'experts'. However, the network seems to be willing to end such cooperations if the ideas and beliefs no longer correspond. I assume that these actors represent more institutionalist or even social green views on climate change and that their inclusion therefore also co-produces Climate Alliance's way of knowing climate change.

These two very short insights into the two networks' knowledge production processes confirm that depending on their own points of view, their norms, imaginaries and ideas, the networks favor different actors for cooperation. In turn, these knowledge production processes together with the respective actors, co-produce the ideas and concepts prevailing in a network. Obviously, we have to be cautious with all too easily drawing conclusions and correlations. Accordingly, Leach (2015) highlights that the valuation of particular 'green' positions does not have to go in line with a particular type of knowledge. However, there is a tendency that the respective position clusters around 'fitting' knowledge and the other way around:

> Different ways of knowing are often associated with different ways of being, including different ways of living with and valuing 'nature'. People, institutions and knowledges often interact and combine in actor-networks (Latour, 2005) or discourse coalitions (Hajer, 1995) that can serve to represent or promote particular views, values or interests. There is no necessary affinity between any particular meaning of green and particular type of knowledge. Yet in practice, powerful actor-networks and discourse coalitions often converge strongly around certain green meanings and goals, while marginalizing or crowding out others (Leach 2015: 26)

In the case of the two city networks, we can see that different experts and their knowledge are valued, different ways of how to reach the overall goal are projected and different outlines

of the problem fostered. As shown in the previous section, Climate Alliance can be seen as following the 'dark green' position and at the same time values local, indigenous and lay people's knowledge, local approaches and criticizes ways of how climate change is known predominantly. C40 can be classified as following 'light and bright green' positions and simultaneously values expert knowledge and scientific data, urban but globally coordinated approaches and technological means in reaching these.

7.2.4 Summary: differences in knowing co-develop with general orientation of the networks

These explanations of the probable provenance of differences, respectively the environment in which the two networks know climate change, show well that the two networks' knowledge environments differ concerning influential aspects. These aspects are their general historical development and founding principles, but also their respective sociopolitical location and the corresponding experts they draw upon in their knowledge production processes. In line with the STS ideas of co-production, differing environments actually co-produce with differing ways of knowing and knowledge. Thus, I conclude that the differences in the historical development, the guiding rationales, the differing sociopolitical convictions, their knowledge production approaches and especially the fact that the networks (here in form of the interviewed staff) themselves consider these aspects to be important for what they do, allow 'plausible conjectures' (Boswell et al. 2019: 30) about the provenance of the differences in knowing climate change.

Despite being a simplification, the comparative contextualization reveals that the two networks do converge around specific ways of knowing and types of knowledge, whereas they rather crowd out differing ones. At the same time, this shows that alternative ways of how climate change is known, are both possible, and represented by city networks in the global governance of climate change.

The co-production aspect, however, does not only concern the production of knowledge. Obviously, it also influences the strategies and actions that networks envisage and suggest to their members. And these can vary greatly even if the goal is the same. Exemplarily, Hulme (2012) finds that the two degree warming goal can be seen as being purely an 'output index' which is compatible with a whole range of 'input scenarios'. Input scenarios in this case refers to the strategies and actions that are undertaken to reach the agreed-upon goal. Similar to this example, city networks' 'input scenarios', thus their strategies and actions in view of climate change, vary as I have outlined before. This has consequences, especially for their member cities. In the following paragraph I reflect on these consequences.

7.3 Different ways forward and imaginaries for the future

The former paragraphs have summarized that the ways how C40 and Climate Alliance know climate change – despite some overlaps and similarities – differ quite significantly. And these different ways of knowing have consequences which I reflect about in this section.

Different ways of knowing climate change always have 'material' effects. These effects might be political decisions but could also influence the built environment of a city for example. This is the case as knowing and acting are inseparably intertwined as Mahony and Hulme clarify:

> Acting in the world may be a corollary of knowing the world, but *how* one acts is already bound up with *how* one knows. Different knowledges lead to different actions (Mahony and Hulme 2018: 411, emphasis in the original).

This interdependence between knowing and acting lead Felt et al. (2017) to the argument that "knowledge and worlds get made together" (p. 19). Applied to climate change policies this means that the way of how climate change is known has decisive consequences for how it is acted upon (Allan 2017; Hoffmann 2013).

Different knowledge forms do not only influence decisions that are immediately pending but also far-reaching visions of the past and for the future. Accordingly, Daniels and Endfield (2009) found that climate change narratives – forming part of the way how climate change is being known – powerfully shape "imaginative worlds in the form of past scenarios as well as future prospects" (p. 215). Therefore, one of the consequences of different ways of knowing is that they project specific visions for the future and accordingly pave different ways forward.

Scoones et al. (2015) found that understandings of ways forward are decisive (in their case for 'green transformations') in so far as they suggest for example who can use which resources, or which processes should be addressed in order to push transformations forward. This en- or disabling aspect of future imaginaries for social transformations is also highlighted by Sheila Jasanoff (2015b: 323). City networks' different ways of knowing climate change and the resulting projections about desirable futures and how to get there will accordingly influence how their member cities transform.

But how are these 'ways forward' being constituted and in how far are they intertwined with different ways of knowing? As I have shown before, particular aspects of knowing are decisive for who is accepted as an expert, who is considered vulnerable and responsible, how change should be initiated and in which direction this change should develop. Besides the aspects that I have already outlined above, one aspect of 'knowing' – according to Law (2017: 47)'s

definition[6] – is particularly influential for future visions of ways forward: the so-called 'socio-technical imaginaries'.

According to Sheila Jasanoff, who has coined the term 'socio-technical imaginaries', these are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff 2015c: 4).

As visions of desirable futures, socio-technical imaginaries enable, but also restrict the scope for individual and collective action. Thus, they determine what is considered as thinkable and feasible. Jasanoff therefore argues that socio-technical imaginaries are at the same time ontologically (which kind of threats exist in the world?), and politically decisive (how should these threats be dealt with?) (Jasanoff 2015c: 6). As such, aspects of socio-technical imaginaries are inherently present in all four knowledge forms that I have conceptually separated. However, because of its future-orientation it is worth concentrating on the specific 'imaginary' aspect of knowing when thinking about the consequences that different ways of knowing might have. Accordingly, socio-technical imaginaries focus on why societies or specific societal groups opt for particular directions of choice and hereby also include a very strong normative component: "Imaginaries, moreover, encode not only visions of what is attainable through science and technology but also of how life ought, or ought not, to be lived; in this respect they express a society's shared understandings of good and evil" (Jasanoff 2015c: 4). The respective socio-technical imaginary thus influences what is aimed for and what is perceived as desirable. Applied to city networks and climate change policies, the questions that imaginaries are concentrating on are for example what ought cities to protect, what should they change, in how far should they change it, which role can and should science and technologies play to support them in that process, and what does it mean to be 'climate-friendly'? The answers to these questions would change according to the respective imaginary. However, social order and its interplay with science and technology are not the only aspects of an imaginary that influence which futures are envisaged. Another important question influencing how the way forward is being projected is who is deemed responsible for initiating changes and how?

Scoones et al. (2015) have looked at specific ways forward, namely ways of green transformations, and found four broad streams "each reflecting different framings of problem and solution, and different versions of sustainability" (p. 15). These four streams represent different pathways for 'green transformations' including different actors and strategies to reach

[6] According to this definition knowing something is constituted by different facets, namely by "particular arrays of subjects, objects, expressions or representations, imaginaries, metaphysical assumptions, normativities, and institutions" (Law 2017: 47).

a certain desirable future. They identify ‘technocentric’, ‘marketized’, ‘state-led’ and ‘citizen-led’ transformations. These types of pathway partly overlap with the different worldviews that have been identified as shaping environmental governance approaches (see chapter 7.2.2). I understand a transformation here as a development towards a desired future. Therefore, Scoones et al. (2015)’s classification of green transformations is also valid for me when thinking about future imaginaries for urban climate policies.

7.3.1 Different types of green transformations and future visions

The first stream, ‘technocentric transformations’ assumes that the main challenge to a more sustainable future is to find the right technologies to reduce ecological impacts without changing the current system fundamentally. These technological ideas are expected to arise from hi-tech laboratories and because of business-led demands and rather not from grassroots initiatives or through a wider mobilization of citizens (Scoones et al. 2015: 10ff).

The second stream ‘marketized transformations’ clearly positions the market as the main actor fostering transformations. It assumes that environmental, social, economic etc. problems can be seen as market failures. It further supposes that these failures can be tackled by pricing mechanisms, creating new markets or property rights regimes, and thereby financially valuing for example nature and ecosystems (Scoones et al. 2015: 12ff). Scoones et al. (2015) further highlight that this pricing-approach often tends to overlook other, for example social and cultural values that are not easily transferable into financial value (p. 13f).

The third transformational stream, ‘state-led transformations’ assumes that markets that are not steered by state institutions need to be re-embedded in stronger frameworks of social and economic control. Those highlighting the potential of state-led transformations further emphasize the importance of state-led decisions in former waves of innovation (Scoones et al. 2015: 14).

The fourth, and final, stream aiming for a green transformation does so by emphasizing that this would need to be ‘citizen-led’. The main rationale in this stream is that state-capital elites have not been able and show no interest in profound and far-reaching green transformations and that therefore these have to be controlled by ordinary citizens. Emphasis is being put on ideas of degrowth and bottom-up transitions to economies that are solidarity-based. Further, the idea that alternative ways of ‘living well’ are possible and desirable is predominant. Innovation is expected to arise from initiatives based on citizen science and grassroots innovation (Scoones et al. 2015: 15).

This short summary shows that the transformation streams both envisage different futures and see different actors as responsible for achieving these futures.

Based on my findings that the two networks represent two different climate change worldviews (see chapter 7.2.2), I suggest that the two networks have two different imaginaries and therefore visions for the future. Further, they also have different expectations about the political strategies of how to achieve them. In turn, this means that for a city to become a part of a city network also means to join an environment in which a specific socio-technical imaginary is predominant. This might again have consequences for how this city imagines the future and what it implements in terms of climate policy.

But how do the future visions of the two networks look like and what does that mean for their member cities?

7.3.2 City networks' future visions and transformation pathways

First of all, both networks share the vision of a climate-friendly future. When seeing this vision as an 'output index' with different possible 'input scenarios' (Hulme 2012: 124), the 'input scenarios' to achieve this common goal differ amongst the two networks studied. Accordingly, the vision of a desirable future is marked by different understandings of how social life and order should look like and in how far these are to be supported by advances in science and technologies.

7.3.2.1 C40's vision for the future

C40 projects a future imaginary in which the social order is relatively similar to the current one. Social life is in so far differently envisaged as more people are projected to live in prosperity, which is mainly understood as economic welfare. C40 suggests that some relatively small social changes are needed to reach the overall goal of a 'climate-friendly' future, such as changes in people's eating habits (e.g. Arup and C40 2011; C40 et al. 2014), less private ownership and more sharing of products (e.g. C40 et al. 2014), or changed mobility habits in favor of walking and cycling (e.g. C40 et al. 2018a; C40 and Bloomberg n.d.-b). New technologies and technological advances in different areas such as buildings, industrial production, transport or waste management play an important role in C40's future vision. Therefore, the role that C40 attributes to advances in both science and technology in its imaginary of the future is immense. The solutions and advances are expected to arise from research institutions or business companies. In this vein, cities are encouraged to collaborate with these as innovative partners (e.g. C40 and McKinsey 2017). From these findings, I conclude that C40 rather favors a transformation process that is 'technocentric' and 'marketized'. This is because C40 attributes high significance to technologies reducing ecological impacts which it expects to arise from scientific or from business undertakings. The network further believes in pricing approaches and the creation of new markets as enabling factors for a transformation towards a more sustainable future. This overlaps with the

classification of C40's worldview on climate change (see chapter 7.2.2.1.). In addition to these pathways identified by Scoones et al. (2015), I would supplement that C40 also sees the transformation process as one that is 'city-led'.

In fact, according to Stirling's definition (2015: 54), C40's transformation process rather resembles a 'transition', than a 'transformation' as it follows an actively managed process, in which technological innovation plays a major role and in which the goal of the process is clearly formulated and actively managed (see Stirling 2015: 62).

7.3.2.2 Climate Alliance's vision for the future

Climate Alliance, in turn, aims for an open transformation of the social order and life. Its future vision includes a transformed economic system in which consumption is reduced and factors other than economic performance are valued. The idea of a 'good life' as being in line with a climate-friendly future implies major political and individual changes. All in all, the needed changes touch upon the same areas as those suggested by C40: changing eating habits (e.g. ClimateAlliance and ASTM 2013b; ClimateAlliance 2019a), favoring a sharing economy (e.g. ClimateAlliance 2018b: 123), and changing the current system of mobility (ClimateAlliance 2011, 2015c). However, in contrast to C40's conviction that smaller changes in these habits can be complemented by major shifts in technologies that make the use of resources more efficient, Climate Alliance clearly favors a drastic reduction of the overall use of resources (e.g. ClimateAlliance 2018b). The social order is envisaged to change in so far as Climate Alliance highlights that the current (Western) one does harm to both the environment and people (e.g. ClimateAlliance and ASTM 2013b). It further suggests that Western communities could very well seek inspiration in other lifestyles, such as those by indigenous peoples (e.g. ClimateAlliance 2010a, 2018b).

Implementing these inspirations would mean a rather sharp transformation of the current predominant social order. The transformation envisaged by Climate Alliance is also supported by advances in science and technology. Accordingly, Climate Alliance envisages the goal of getting energy from 100% renewable resources (ClimateAlliance 2020), as well as ameliorated energy efficiency, and cleaner ways of transport and buildings (e.g. ClimateAlliance 2019a; ClimateAlliance n.a.) which ultimately have to be supported by technological innovations. However, Climate Alliance underlines that the development and implementation of new technologies, e.g. enabling energy production from 100% renewable resources is thought to go hand in hand with broader societal transformations, as this quote from my Climate Alliance interview shows:

> That means, our vision today is for example rather 100% renewables. (…) Our approach currently, that is still up to discussion, is rather a 100% renewables vision which is not CO_2-based but is supposed to be rather guiding actions. And 100%

> renewables in fact is not only concerned with CO_2 but also with transformation processes which are not only located in the energy sector but which also involve social and other transformation processes (ClimateAlliance 2020, author's translation).

In line with the aim of a 'holistic' societal transformation, some technologies (such as some carbon offsetting technologies (e.g. ClimateAlliance 2008, 2017c)) are clearly opposed. The transformation process itself is expected to be led by the local level in partnership with citizen initiatives, grassroots organizations, NGOs, but also local businesses. According to Scoones et al. (2015)'s classification, Climate Alliance's transformation pathway overlaps mostly with the 'citizen-led' one which is characterized by the conviction that neither state, nor business leaders have been able to start a green transformation – or are not willing to do so. 'Citizen-led' transformation pathways often put emphasis on alternative ideas of a good life and expect innovations to arise bottom-up (Scoones et al. 2015: 15).

7.3.2.3 Transformative potential of different imaginaries

But in how far is it decisive which transformation pathway or imaginary for the future city networks have? Scoones et al. (2015) highlight that the respective pathway envisaged has decisive consequences for political, social, and economic decisions:

> Whether transformations should be technology-led, marketized, state-led or citizen-led has huge implications for the processes, institutions and instruments deployed. Should the entry point be individual behaviour change, pricing of environmental externalities and ecosystem services, state restructuring and support of 'green' industrial sectors, or green technological innovation? All have different implications for who should be involved on what terms and who wins and who loses. Such choices about 'green' directions therefore inevitably have implications for social justice and social inequality (Scoones et al. 2015: 23).

Bearing in mind that city networks are considered decisive actors in global climate change governance because of their guiding potential (through information and knowledge) for cities on how to face climate change (Bouteligier 2013; Busch et al. 2018; C. A. Johnson 2018), and that one of the reasons why cities join networks is because they actively seek to get information on how to govern climate change locally (see Bulkeley et al. 2003; Haupt et al. 2018, 2020; Romero-Lankao et al. 2018), the influence of the pathways suggested by networks on the actions their member cities might take might be immense. Accordingly, Hughes and Romero-Lankao (2014) propose that cities' climate policy choices are indeed shaped by their broader perception of climate change but also depend on the tasks and solutions they receive from their network. And these tasks and solutions – for example if they need to set up a local emissions inventory, forecast their GHG emissions, or assess their climate vulnerability – in turn influence which knowledge cities use and produce (Hughes and Romero-Lankao 2014: 1025f). By setting targets and tasks, TMNs thus directly influence their member cities' climate

policies. And these targets are in turn characterized by their respective vision for the future. Because of their position and functions, city networks are actors who have a certain authority to shape others' perception of what is desirable, thinkable and feasible (see e.g. Bouteligier 2014; Gordon and Johnson 2018; Rashidi and Patt 2018). Their suggested ways forward might therefore indeed have consequences for the built, social, and economic environment of their member cities.

At the same time, the respective future imaginary also has to be seen against the backdrop of the two networks' historical development, their general membership structure and their sociopolitical convictions. This means that the imaginaries are of course also co-produced (as all parts of city networks' knowledge) with the general knowledge environment. Similarly, Scoones et al. (2015) conclude for their identified four transformation pathways that

> (…) some types of transformation politics are more likely around some issues in some parts of the world than others. This depends, among other things, on the degree of democratic space that exists, available technological capacity, the development and functioning of markets, the power and commitment of the state, and the influence of citizen mobilization and action (Scoones et al. 2015: 20).

The respective aspects influencing the preferred pathways are different ones for cities and city networks than for states. Nevertheless, the scope of action is both set by the aspects Sconnes et al mention, and the networks' general set-up. The fact that Climate Alliance represents small cities and towns in particular in rather wealthy European countries, and at the same time Amazonian indigenous peoples, whereas C40 represents global metropolises with other capacities and demands, surely plays a role for the prevailing future imaginary and influences the likelihood of the implementation of the pathways they are suggesting, as well.

To summarize, the future vision, as a part of how climate change is being known, again, has a decisive influence on the way of acting upon it. Andy Stirling highlights this interconnected and even inseparable relationship between knowing and acting with regards to sustainability topics:

> In all these areas[7], understandings supposedly *informing* practice are typically at least as much *formed* by it. In other words, knowing and doing are not so much distinct as inseparable – especially when it comes to transformation (Stirling 2015: 60, emphasis in the original).

What this means applied to TMNs is that city networks' knowledge environment is inseparably intertwined with their way of knowing, their suggested climate policies, their future imaginaries, but also their membership structure. And these member cities are in turn also influenced by the respective way of knowing. In the framework of this study, I am not able to

[7] examples given by Stirling are 'sustainability', 'Anthropocence', or 'planetary boundaries' (Stirling 2015: 60).

answer this precise question – how are member cities influenced by and influencing their networks' way of knowing – in an encompassing way. To nevertheless get an idea if and how the two alternative ways of knowing have 'traveled' to and from the networks' member cities, I illustratively examine two exemplary network cities in the next chapter: Copenhagen as a C40 member city, and Munich, as a Climate Alliance member city.

7.4 Spotting the two ways of knowing beyond the networks

As outlined in the previous chapter, city networks' ways of knowing are co-producing with their member cities' ways of knowing. This happens in two directions: each networks' way of knowing is co-constituted by its member cities' ways of knowing, and in turn member cities' ways of knowing are influenced by the respective city network. In this section, I spot the two alternative ways of knowing climate change beyond the two city networks to see if I can actually perceive this assumed co-constitutiveness. To do so, I analyze climate policy documents of one exemplary member city of each network to see if I can retrieve the two ways of knowing in these documents.

However, I also want to highlight that both cities, Copenhagen, as well as Munich, are part of not only one network, but actually several different ones. All of them could and will be decisive for how the cities themselves know climate change, and how they constitute their policies. Also, it could be the case the other way around: that the respective city chooses particular networks because they overlap with its own way of knowing. However, this subject lays beyond the scope of this study.

Copenhagen is a member not only of the C40 Cities network, but also of Carbon Neutral Cities Alliance, Big Buyers Initiative, ICLEI and some others (CPH 2020: 55; ICLEI 2019). Munich is not only a member of Climate Alliance but also of Energy Cities, European Land and Soil Alliance, Healthy Cities Networks and others (München 2020b). Therefore, I once again want to highlight that the 'spotting' of the two ways of knowing is not to be understood as a form of correlation, but rather as a way of following the journey a way of knowing travels along. And interestingly, the analysis of Copenhagen's and Munich's climate policy documents shows that each networks' way of knowing can be perceived in the respective urban policy documents.

7.4.1 C40 member city Copenhagen

In the documents that are published by the City of Copenhagen and in which Copenhagen's climate policy strategy is explained, I could find many overlappings with C40's way of knowing climate change.

Accordingly, both aspects of C40's definitional knowledge can be found in Copenhagen's climate policy documents, namely that climate change is defined as a meteorological phenomenon which is measurable in temperatures, and that it is further defined as an urban problem (see chapter 6.1.1). The definition of climate change as a meteorological phenomenon is in so far present as the Paris Agreement's goal of keeping global average temperature rise to well below 2°C (UNFCCC 2015a) serves as the ultimate guiding principle and rationale for Copenhagen's climate policies (see also CPH 2016: 8):

> The Paris Agreement of December 2015, places an obligation on 171 countries, including Denmark, to keep the global temperature rise well below 2°C, and to pursue efforts to limit the temperature increase even further to 1.5°C (CPH 2020: 10).

Copenhagen, therefore, on the one hand repeats the climate policy goal that nation states have set themselves in the UNFCCC framework and on the other hand highlights that also for its own policies, this goal forms the core guiding principle. However, it combines this general objective with the second definitional knowledge aspect that is also highlighted by C40, namely that climate change is particularly an urban issue. Accordingly, Copenhagen adds right after the definition of climate protection as limiting global temperature increase to maximum 2°C: "The battle will be won in towns and cities" (CPH 2016: 8). Here, different aspects of C40's definition of climate change as an urban problem can be perceived in Copenhagen's climate policy documents. Accordingly, C40 defines climate change as an urban problem on the basis of cities' vulnerability, cities' responsibility, cities' possibilities for action and cities' ambition (see chapter 6.1.1.2). Copenhagen covers the aspects of cities' responsibility in terms of their carbon emissions, as well as cities' ambitions in climate protection, as the following two quotes show:

> Urbanisation means that almost two-thirds of the world population are expected to be living in cities by 2050, compared to just over half today. Cities are already responsible for a large share of the world's total carbon emissions, so in light of the rising population, it will only be possible to achieve the climate targets if cities grow and develop according to sustainability principles (CPH 2020: 10).

Copenhagen also uses the highlighting of cities' ambitions in terms of climate protection to outline the accompanying role of city networks, such as C40:

> The picture in a number of towns and cities all over the world is already positive and many international organisations support the trend, e.g. C40 (Climate Cities Leadership Group), Carbon Neutral Cities Alliance (CNCA) and International Council for Local Environmental Initiatives (ICLEI) (CPH 2016: 8).

Cities' vulnerability and cities' possibilities for action, in turn, have not been part of Copenhagen's definition of climate change as an urban phenomenon in the documents analyzed for this study.

In terms of conceptual knowledge, there are significant overlaps between C40's and Copenhagen's way of knowing climate change, as well. For C40, data, preferably quantified, are a necessary prerequisite for successful climate policies. Similarly, Copenhagen suggests that (quantified) data can serve as a 'motivator' for urban dwellers to behave in a more climate-friendly way (CPH 2018: 17). As an example, Copenhagen suggests that data could animate Copenhageners to better sort their waste:

> Strategic work on waste data is to be launched and a system is to be established for automatic registration of quantities in the waste containers when emptied. For example, it may be in the form of development of methods giving feedback to Copenhageners about how much is sorted in their neighbourhood, and which effect this has on the environment. It may be feedback at the same level as what we get from our power company: *"You have sorted xx kg of plastics, thereby saving xx kg of CO2".*
> This information can be supplemented with data on sorting progress, rating compared with the average, and similar information that Copenhageners are interested in having about themselves. Precisely which data will have the largest relevance to Copenhageners must be studied in more detail and in collaboration with Copenhageners. Data may be disseminated on a digital self-service solution or other methods and channels that prove relevant in the planning period. The target is that Copenhageners can follow their contribution and maintain the motivation for sorting (CPH 2018: 19, emphasis in the original).

Similar to C40, which presents itself as actively involved in research processes, also Copenhagen wants to generate some of the scientific data and research findings itself. Just as for C40 (see chapter 6.1.2.1), Copenhagen here seems to be convinced that an approach which is designed as scientifically as possible is particularly trustworthy and needed, as the following quote suggests:

> During the first period which includes 2016 there is great emphasis on pre-analysis and strategy development. There is a need to define the framework for future initiatives. Various solution models are analysed and evaluated, strategies and methodologies are drafted and attempts will be made at influencing national legislation. (...) A number of the initiatives will be accompanied by demonstration projects, which, on a small scale will provide Copenhagen with knowledge and experience relating to the strengths and challenges of each individual solution model. The City of Copenhagen will use the demonstration projects to accumulate knowledge in each specific area and to initiate joint ventures and provide a wider world with a glimpse of the initiatives and solutions which form part of green cities of the future (CPH 2012: 15).

Further aspects of C40's conceptual knowledge are the concepts 'carbon neutrality' and 'green growth'. 'Carbon neutrality' is built on the conviction that GHG and especially carbon emissions are responsible for climate change and therefore need to get to 'zero' to stop climate

change. This can be achieved by different measures capturing and storing carbon emissions (see chapter 6.1.2.2). 'Green growth' is a concept that C40 beliefs to be an answer to the challenges related to climate change. The concept of 'green growth' suggests that a decoupling of GHG emissions from economic growth is possible, and that climate protection measures can open up new economic opportunities (see chapter 6.1.2.3). Both of them also appear to be very important for the City of Copenhagen's climate policy, as well. The City of Copenhagen, thus, has 'carbon neutrality' as the explicit goal of its climate policy: "Copenhagen wants to be the world's first carbon neutral capital in 2025" (CPH 2012: 4). Further, it also defines what carbon neutrality means for the city:

> The City of Copenhagen will be carbon neutral if the carbon emissions from the city are offset by activities that reduce emissions, such as renewable energy production or the planting of trees. (CPH 2020: 7)

Just as for C40, for Copenhagen, the state of 'carbon neutrality' is based on the assumption that through a calculation, a city can reach 'net zero emissions' because emissions from one sector allow for offsetting the emissions of another sector:

> The City of Copenhagen will be carbon neutral when the city's residual carbon emissions are offset by activities that reduce emissions, such as through establishing carbon sinks (e.g. forests) or renewable energy production. For example, Copenhagen's electricity consumption is carbon neutral when the amount of electricity generated by renewable energy sources equals the electricity consumed by the city. If more electricity is produced from renewable energy sources than Copenhageners use, this compensates for carbon emissions from other sources of emissions such as car traffic (CPH 2020: 54).

Therefore, Copenhagen's perception of the concept 'carbon neutrality' overlaps with C40's insofar as they both build on the assumption that there needs to be a balance of emissions emitted and offset, which means that the total reduction of CO_2 is not necessary as long as it is compensated by savings in another sector or place (see chapter 6.1.2.2).

The second concept, 'green growth', is also very prominently present in how Copenhagen perceives climate change, and how it acts upon it. The goal of becoming carbon neutral is accompanied by the goal of generating green growth, and to therefore demonstrate the feasibility of 'decoupling' GHG emissions from economic growth (see also CPH 2020: 9).

> Copenhagen sees an opportunity to become carbon neutral while at the same time generating green growth. Since 1990, CO_2 emissions have been reduced by more than 40% and during the same period, there has been a real volume growth of around 50%. (...)With its initiatives up to 2025, the City of Copenhagen is actively contributing to green growth. The investments in retrofitting, urban renewal and an improved public transport system and cycle lanes create new jobs and opportunities for innovation in Copenhagen (CPH 2012: 11).

The quote not only shows that Copenhagen, like C40, believes that a decoupling of emissions and economic growth is possible, but that the investments needed to realize this decoupling are also economically worthwhile, as they create new economic opportunities (see chapter 6.1.2.3). Interesting in this regard is also that Copenhagen clearly states that growth is a necessary requirement for its local businesses to be successful on the international level (see also CPH 2016: 6): "The green businesses – those already here, newcomers and those about to emerge – all require growth in order to mature and, in time, find their way into the export markets" (CPH 2012: 10). This clearly overlaps with C40's reasoning that the reduction of GHG emissions is seen as being reasonable because it opens up new economic opportunities (see chapter 6.1.2.3).

Considering the problem-solving knowledge, C40 suggests emphasizing the multiple benefits of climate policies, as well as their financial rationality as potential ways of how to act upon climate change. Further, it suggests that more research, as well as the employment of carbon offsetting mechanisms could be solutions in face of climate change (see chapter 6.1.3). All these aspects can also be found in Copenhagen's approach.

Accordingly, Copenhagen often enumerates the multiple benefits of its climate policies, especially to justify investments in them (see also CPH 2016: 6; 2020: 56):

> The plan requires investments. But the climate plan documents that they will pay for themselves both with regard to the climate, the environment and the health of Copenhageners as well as the economy. Several of the investments will result in savings on the power and heating bills while others will form the basis for the jobs of the future (CPH 2012: 4).

In line with the conviction that 'green growth' is a possibility to also generate new economic opportunities, Copenhagen also highlights the financial rationality of climate policies, understood as a possibility to foster internal business opportunities, but also as a way to open new markets abroad for local companies (see also CPH 2016: 6 & 19):

> A carbon neutral Copenhagen will provide Danish businesses with a common platform and a showcase for demonstrating green Danish technology. Not just as small-scale embryonic projects and demonstration facilities, but in a full-scale metropolis where technologies and solutions form a symbiotic relationship, simultaneously showing their strengths individually and collectively, aptly illustrated by the development of remote cooling.
> Internationally, Copenhagen is very conspicuous. Copenhagen is known worldwide as a green and ambitious city with ideas for future green solutions. The green sector in Copenhagen is growing. In 2009, the green sector employed 11,000 people and turnover rose to KK 24 bn. Green sector exports also rose significantly in the same period reaching DKK 10.5 bn. In 2010, the economic growth rate of the Capital Region was 3% compared with the national rate of 1.3%. This supports the role of the region as a growth locomotive and its potential to attract new business activities (CPH 2012: 11).

Further, also C40's suggested solutions of doing more research and employing carbon offsetting technologies can be found in Copenhagen's climate strategy. Copenhagen wants to initiate more research by collaborating with different actors (see also CPH 2016: 6):

> Several solutions are based on known technology just waiting to be implemented. In other areas, we will focus on the need for developing new technology. A cornerstone in the climate plan is, therefore, initiatives for collaboration with the business community, the Government, organisations and research institutions (CPH 2012: 4).

With regards to research, this quote shows that Copenhagen seems to see research in the field of technology as the most important focus. The City of Copenhagen sees itself as a relevant actor in doing research itself, but also wants to collaborate with other public and private actors, as also C40 suggests it:

> The City of Copenhagen will conduct many of these analyses itself, but often they will be done in collaboration with stakeholders such as knowledge institutions, companies and other interested parties, so that the analyses are as valid as possible and provide a good basis for decisions on specific initiatives (CPH 2016: 35).

Another part of Copenhagen's way of dealing with climate change is to focus on research and education. It explicitly wants to educate other cities internationally with its own experiences:

> Copenhagen is conscious of its role as an international pioneer in developing solutions to urban climate challenges. The capital is already widely recognised abroad for its climate initiatives, and a large number of delegations visit the city every year to study its solutions. During the next programme period, the City of Copenhagen will open a proper showroom, which will describe the city's path toward carbon neutrality in the Copenhagen Narrative (CPH 2016: 31).

However, it further also sees the education of its own employees as an important part of acting in light of climate change:

> Additionally, the City of Copenhagen wants to collaborate with knowledge institutions and public/private players about the creation and dissemination of new knowledge. The collaborative effort will secure green growth through the development of new technology, services and competencies on aspects of climate and the environment. Through communication, education and behavioural campaigns, the City Administration seeks to inspire its 45,000 employees to climate-friendly conduct (CPH 2012: 51).

But Copenhagen also highlights that it wants to educate its dwellers to foster more climate-friendly behavior. It particularly wants to focus on children and young people. Interesting in this regard is that Copenhagen wants the climate education to focus on technical climate knowledge and skill for the labor market – thus, the wished-for education can also be seen as a kind of 'education for green growth':

> The City of Copenhagen must instil [sic] far better understanding and acceptance of and involvement in the city's green transformation among city residents, and future generations. Children and young people must be trained in climate issues through an interconnected, three-tiered effort:
> - the Climate Training Programme in Copenhagen must ensure that all Copenhagen children and young people can receive climate training that provides a high level of technical climate knowledge, skill-sets for the labour market of the future and contributes to democratic formation and resource-fulness (...) (CPH 2020: 51).

Hence, Copenhagen also sees education as a means to change people's behavior. The problem-solving knowledge of changing behavior is thus present, as the following quote highlights:

> A carbon neutral city requires everyone to take a long look at their habits. When we move about the city, a bike and public transport must be our preferred means of transport. Increased waste separation will mean new ways of arranging our kitchens and backyards. We must be willing to invest in having our homes energy retrofitted (CPH 2012: 4).

However, just as for C40 (see chapter 7.1.3), the changes in behavior are presented as being rather small, and not aiming for e.g. a reduction of consumption, but rather at enhancing the recycling of used resources (see also CPH 2016: 20):

> This means that we use enormous amounts of raw materials and energy to produce a lot of products that end up as waste far too fast. (…) This is not sustainable. All of us – businesses, the City, Copenhageners – must change attitudes in terms of what we discard. Or rather, how we discard it. (...) In brief, behind this Plan [= Copenhagen's Resource and Waste Management Plan 2024, M.K.] stands a comprehensive vision. A vision of a future in which we get more out of what we produce and consume, and where waste is not just waste. The circular economy is not just a buzzword. It is the way forward to a really sustainable society in which we do not just incinerate all sorts of waste, but where we keep materials and resources in the loop. This is common sense, and it is the pathway to a better Copenhagen, a better Denmark, and a better world (CPH 2018: 5).

Again, the overlap between C40's problem-solving knowledge and Copenhagen's strategy is great. The last aspect of C40's problem-solving knowledge is the suggested offsetting of carbon emissions and the use of negative emission technologies. According to this problem-solving knowledge, carbon emissions can be either offset through the acquisition of 'carbon credits', or by deploying 'negative emission technologies' (see chapter 6.1.3.4). The City of Copenhagen considers this a valuable solution, too, and invests in the research on possible carbon offsetting technologies within its own boarders, as the following quote exemplifies:

> The City of Copenhagen has just completed an investigation project on carbon capture and the part it can play in making cities carbon neutral. The project was carried out with support from the Carbon Neutral Cities Alliance (CNCA) in cooperation with NIRAS, Bellona (Norwegian NGO), as well as Amsterdam, Helsinki, Oslo and Stockholm. The lessons learnt from the project have been

> passed on in the partnership with ARC [= Amager Ressource Center, M.K.] concerning the establishment of a carbon-capture facility at the Amager Bakke facility (CPH 2020: 32).

However, Copenhagen also highlights that it does not see carbon capture as an alternative to other climate protection measures and therefore acknowledges the overall need to generate less carbon emissions: "The carbon-capture efforts at the incineration plant are not deemed an alternative to existing actions to remove fossil waste fractions, but a supplement to them" (CPH 2020: 33). In my document analysis, I interpret that C40 sees carbon offsetting as an almost equal option to reducing GHG emissions (see chapter 6.1.3.4). Thus, Copenhagen's clear positioning of carbon capture as a supplement only can be seen as a small difference to C40's problem-solving knowledge.

Lastly, I found that C40's way of knowing – in contrast to Climate Alliance – is in line with the hegemonic way of knowing climate change and therefore does not include any critical knowledge. The same can be concluded for Copenhagen's way of knowing and acting upon climate change. However, what I found to be right for C40, namely that it indeed acknowledges the consumption-based economic system as a cause for ever-increasing resource needs and accompanying problems (see chapter 7.1.4), is also true for Copenhagen. Accordingly, the City of Copenhagen highlights that ever-growing consumption globally leads to pressure on the environment and pushes climate change further (see e.g. CPH 2012: 10; 2018: 25). Further, it also acknowledges that some parts of the world are particularly responsible for this environmental pressure, amongst them Denmark and Copenhagen:

> For we do discard a lot. According to Eurostat, Denmark and Copenhagen are ranked twice as high as the EU average when it comes to resource consumption per capita. This means that we use enormous amounts of raw materials and energy to produce a lot of products that end up as waste far too fast. It also means that in reality we take more from the Earth than most people (CPH 2018: 5).

In line with C40's approach, Copenhagen does not propose a drastic reduction of consumption (for an exception see CPH 2018: 9) but suggests that a higher level of recycling and reuse in form of a circular economy can make up for the high demand of consumption goods:

> Circular economy moves away from the linear economy, which rests on a production-consumption-throwaway culture. A fully implemented circular economy has evident environmental and economic advantages: materials can circulate for decades and centuries – and thanks to renewable energy this can happen without emitting more CO2 (CPH 2018: 6).

Copenhagen accordingly indeed acknowledges that the consumption-based economy is a driver of climate change and needs to be tackled, but still wants to address this issue only after having optimized all other sources of emissions, as the following quote suggests:

> Achieving the goal of carbon neutrality by 2025 will make Copenhagen a city with cleaner air, less noise, energy- efficient dwellings and greener mobility. Yet even if Copenhagen does achieve carbon neutrality by 2025, the green transition will not be over. (…)Carbon emissions in Copenhagen will derive from the consumption of goods and services that is beyond the scope of the Climate Plan, and there may be a need to determine how scarce resources should be sustainably consumed (CPH 2020: 14).

As for C40, I thus conclude that Copenhagen acts mostly in line with globally hegemonic knowledge structures and I can not detect any critical knowledge in its climate policies.

To summarize, Copenhagen's way of knowing climate change and the respectively suggested policies to act upon climate change mirror C40's way of knowing climate change very well. Therefore, the assumption that ways of knowing travel and co-produce between city networks and their member cities is obvious in the case of Copenhagen and C40. This assumption is being reinforced by the fact that Copenhagen actually refers to C40 several times in its climate policy documents (e.g. CPH 2016: 8). However, the way in which Copenhagen mentions the network rather suggests that it sees the network as an opportunity to 'export' its own ideas and solutions to other cities, than that it would take up ideas provided by C40, as the following quote exemplifies:

> The City of Copenhagen is in the process of planning pilot experiments involving energy monitoring and controls in Beijing in collaboration with C40 and in Buenos Aires. The vision is to disseminate Copenhagen solutions and show that the potential savings achieved in the city's properties have international format (CPH 2020: 47).

7.4.2 Climate Alliance member city Munich

For Munich, I find a similar picture concerning the overlap with its networks' way of knowing as for Copenhagen. Accordingly, I could detect most aspects of Climate Alliance's way of knowing climate change in Munich's climate policy documents.

In terms of definitional knowledge, Climate Alliance knows climate change as multi-faceted, as well as to be unfair. The multifacetedness expresses itself in the fact that climate change is acknowledged as a problem capturable in temperature changes, but also as something that can have different faces than temperature increases. This definitional aspect is present in Munich's definition of climate change when highlighting that climate change is caused by ever-increasing GHG emissions, which can have different consequences:

> The concentration of greenhouse gases in the atmosphere has increased sharply since the beginning of industrialization. The climate is already changing today and will continue to change in the future. A large part of the observed and predicted changes are directly associated with the emission of greenhouse gases by humans. Climate change manifests itself both in long-term climate changes such as slowly rising average temperatures, as well as in a changed climate variability,

> i.e. more severe climate fluctuations and more frequent extreme weather events such as storms, droughts or heat summers (München 2018: 51f, author's translation).

The consequences of climate change that are highlighted in Munich's policy documents cover a great variety of aspects from food and water scarcity, over newly-generated migration flows (München 2014: 5), to severe threats to the performance of the ecological system, or even its complete collapse (München 2015a: 20). Interesting in this regard is that Munich has set itself the goal of becoming climate-neutral until 2050 (München 2018: 3), a condition that is rejected by Climate Alliance because of its potential for delusion (see chapter 7.1.1). This fact is interesting because Munich sticks to the definition of climate change as multi-faceted, and broadens this definition to 'climate neutrality' as also being multi-faceted, when explaining its goal of becoming climate-neutral:

> There is no general definition of the term 'climate neutrality' for municipalities. The term is often considered purely from the point of view of the reduction of greenhouse gas emissions. This approach, however, misappropriates the factual dimension that the term 'climate' and thus also the term 'climate neutrality' covers. The issue of climate is a very far-reaching and complex field. Therefore, the term 'climate neutrality' will be understood in a more comprehensive and integrated way in the future, in order to do more justice to this complexity. Climate neutrality does not only refer to global climate protection but is at least as important with regards to the local urban climate. This includes not only the aspects of climate protection but also air quality. In addition, measures within the framework of Munich's climate protection always address aspects of the social climate, such as health, quality of stay and recreation, education and housing conditions (…). All these aspects are associated with the term 'climate neutrality'. This makes it clear that climate neutrality is not only the reduction of abstract greenhouse gas emissions, but can also be experienced directly by all people living in Munich (München 2018: 21, author's translation).

Therefore, I find Munich's definition of climate change as a multi-faceted phenomenon to overlap with Climate Alliance's definition. Climate Alliance further defines climate change as a problem affecting all and everything around the world – thus cities, but also other actors and areas. This aspect can also be found in Munich's definition of the problem. Accordingly, it highlights the importance of cities:

> Cities are significant drivers of climate change and have a special responsibility. After all, 80% of the greenhouse gases emitted globally come from cities. As a major city, the state capital of Munich must think globally and act locally (München 2014: 5, author's translation).

But it also highlights that very particular aspects of the social life, such as the health care system, and also every single individual will be affected by climate change: "The health care system, as well as each and every individual, must prepare for the consequences of climate change" (München 2014: 29). The city of Munich therefore has a similar approach as Climate

Alliance in trying to make people understand what climate change means, on a more personal than on a rather abstract and number-based ground.

The second aspect of Climate Alliance's definitional knowledge is that climate change is defined as being 'unfair'. This unfairness consists of the fact that the effects of climate change are globally unfairly distributed, and that the problem of climate change is unfairly caused (see chapter 6.2.1.2). Munich shares this definition of climate change as being unfair insofar that it highlights that some parts of the global population have a higher responsibility for the problem than others, but also that existing problems are already unfairly distributed. The city accordingly states: "In Germany, we belong to the 20 per cent of the world's population who consume 80 per cent of the world's resources due to their lavish lifestyles" (München 2015b: 40, author's translation). At the same time, it highlights that this very lifestyle impacts the life of others, even if they live in other places: "We all live in one world, our lifestyle definitely has an impact on the lives of others" (München 2017: 4, author's translation).

The unfair distribution of climate change and other environmental degradation problems is exemplified by the City of Munich with reference to its climate partner – the Asháninka people living in the Peruvian Amazon region – which are considered as experiencing problems Munich is not confronted with (see also München 2015b: 4):

> The Asháninka people in the Amazon rainforest, Munich's climate partner in Peru, are confronted with the problems of growth and hunger for resources on a daily basis: (Illegal) deforestation of the rainforest, exploitation of natural resources such as oil and gas production lead to enormous ecological damage in their habitat (München 2017: 4, author's translation).

In terms of conceptual knowledge, Climate Alliance suggests that climate change can be best understood through direct interactions and exchanges, which are supposed to give people a better feeling for what climate change actually means. At the same time, Climate Alliance also acknowledges that climate change can only be fully understood if also scientific data of knowing climate change are considered (see chapter 6.2.2.1). Further, the concepts of 'social and climate justice', as well as 'buen vivir' are of great importance for Climate Alliance's way of knowing climate change. Munich, again, has a very similar conception of climate change, in terms of conceptual knowledge.

Direct exchanges and interactions with other people are therefore considered very important in order to better grasp climate change. Accordingly, Munich makes use of its climate partnership with the Asháninka to inform people living in Munich about the consequences of climate change:

> It is particularly important to organise information trips from Asháninka delegates to Munich and from Munich residents to Peru. So far, there have been four, mainly privately financed trips from Munich to the rainforest to get to know the situation

> there and to talk in direct exchange about the best possible measures for rainforest conservation and possible support. In addition, some people from Munich completed an internship or a study visit with the Asháninka. Conversely, Asháninka were guests in Munich on several information trips. During their two- to three-week stays, they had very intensive work programmes in day-care centres, nurseries and schools, at public events, as well as at specialist meetings, expert discussions and conferences. They gave first-hand information about the immediate effects of climate change, about the destruction of the Amazon rainforest – but also their views and concepts of life, as well as their determination to fight for the preservation of the forest. The conversations were and are always also about the question: What do we in Europe have to do with this situation and what sustainable options for action can we develop here? (München 2017: 14f, author's translation)

The importance attributed to 'feeling' what climate change means, is also exemplified by Munich's statement that many people do not take climate change seriously because they do not experience what it is like: "The consequences of climate change are currently still underestimated in Europe, as they are still barely perceptible for many people in their own everyday lives" (München 2014: 5, author's translation). This statement implies the conviction that people must experience climate change, or at least exchange with people experiencing it, to understand the importance of acting upon it. However, Munich also considers the monitoring of climate change with scientific data as equally important and therefore also takes part in the generation of scientific data, as the following quote shows:

> In order to be able to better estimate climate change and its effects, the state capital is cooperating with the German Weather Service. In a joint project, forecasts are being developed for the development of the climate in Munich over the next 50 to 100 years (München 2014: 9, author's translation).

Nevertheless, just as Climate Alliance, the City of Munich also beliefs that quantitative data are not the only basis for climate policy decisions as they cannot measure all aspects of climate change and related actions:

> It should be noted that almost 50% of all climate protection measures are non-quantifiable and come from the strategic planning area as well as from the field of action awareness raising and behavioral change. However, these measures are indispensable for climate protection and the achievement of objectives, as they are basic measures for future CO_2 savings and/or are aimed at activating the important actor of the urban society. Furthermore, climate protection measures have many positive side effects, such as health promotion, improvement of air quality, etc., which make these measures valuable (München 2018: 26, author's translation).

Another part of Climate Alliance's conceptual knowledge are the concepts of 'social and climate justice' and 'buen vivir'. Relying on the concept of 'social and climate justice', Climate Alliance suggests seeing climate change as a global challenge, requiring local solutions. According to the concept as used by Climate Alliance, solutions should consider different circumstances, ways of life and persisting global inequalities. This concept is to some extent

also present in Munich's climate policy documents. Munich claims that it wants to 'think globally and act locally' (München 2014: 5), and that it wants to achieve a "climate-just urban redevelopment" (München 2018: 31, author's translation). The concept is also present insofar as Munich highlights that climate policies are necessary to prevent social inequality when prices rise as a result of climate change, as the following quote exemplifies: "Dwindling resources and rising prices in the energy sector, with the corresponding consequences, can accelerate the process of social polarisation and thus endanger social peace" (München 2014: 29, author's translation). The aspect of taking into account different ways of life and being aware of global inequalities is especially present when it comes to Munich's climate partnership with the Asháninka people. Explaining how this partnership looks like, Munich highlights that it does not aim to 'implement' solutions in the Amazon region but that it wants to cooperate and enable the local people to put in place their own ideas and solutions: "Support for concrete projects of the Asháninka in the Peruvian rainforest – according to their priorities" (München 2017: 14). Therefore, I conclude that the rationale of the concept is inherently present in Munich's way of knowing climate change, even though it does not mention the concept clearly as a guiding principle.

The second concept of Climate Alliance's conceptual knowledge is 'buen vivir'. This concept is used to exemplify that a different lifestyle could be a solution to climate change, and at the same time could make people happier – and this concept is also explicitly mentioned in Munich's climate policy documents. It is explained as a concept according to which indigenous peoples conduct their life, but also as a concept which is being more and more discussed as an alternative for a life in Europe (see München 2017: 4):

> This concept is called 'Buen Vivir' – 'the good life' – in other parts of Latin America. With it, the indigenous population in the Andes and in the rainforest is looking for their own ways to live well together. They see their concept as a way out of the Western-influenced neoliberal economic concept that is bringing the earth's reproductive capacity to the brink of the abyss. An important basic philosophical understanding with concrete effects on everyday life is that of 'Mother Nature'. Behind this is the idea that humans are not the 'crown of creation'. It is the insight that we humans are part of nature and must treat it with respect (München 2017: 15).

Therefore, Munich clearly states that it sees 'buen vivir' as a valid alternative of how to conceive of and approach climate change. Consequently, I interpret that the concept of 'buen vivir' forms a part of how Munich knows climate change conceptually.

Climate Alliance, based on its definitional and conceptual knowledge, suggests as solutions to climate change the fostering of education and joining of forces with similar actors, as well as the changing of current behavioral structures. At the same time, it also acknowledges C40's preferred solutions of highlighting climate policies' co-benefits and of doing research, insofar

as they are present in addition to the other suggested solutions. Munich's projected problem-solving strategy overlaps to a great extent with Climate Alliance's problem-solving knowledge. Munich states that it considers education and awareness raising a central element of the pathway to becoming climate neutral:

> In other words, a continuation of the measures at the same level will not lead to the achievement of the climate protection goals of the City of Munich. A shift to the path of climate neutrality therefore requires significantly greater efforts and the development of awareness in the city's society (München 2018: 20, author's translation).

The City of Munich hereby sees itself in a position to educate its dwellers and to raise awareness among them (see also e.g. München 2018: 23):

> The city provides information about the risks of climate change, for example health risks, and describes the possibilities for action for each and every individual. It shows the population measures for climate protection, but also for adaptation to climate change. It motivates people to contribute to climate protection by changing their behavior (München 2014: 29, author's translation).

This overlaps with Climate Alliance's suggestion that municipal actors could and should educate their citizens. Climate Alliance further suggests that education should encompass different perspectives and experiences and should therefore be coined by the exchange with various actors. This suggestion is also taken up by Munich which aims to foster the exchange with other cities and regions (see also München 2014: 29): "Munich makes a solidarity-based contribution to overcoming global challenges and to this end seeks cooperation and exchange with cities and regions at home and abroad" (München 2015a: 6, author's translation). However, as already mentioned before, for Munich, another partner for exchange and education is also its Amazonian partner of the Asháninka people (e.g. München 2017: 14). In addition to education about facts and experiences that are already existing, Munich also sees the scientific accompaniment of the transformation process to a climate-neutral city as very important (see also e.g. München 2018: 7f):

> Against this background, the individual sectoral targets must become part of a learning process and be continuously reviewed with regard to technical and economic possibilities, their interactions and their consistency with the overall goal. For the reasons mentioned above, monitoring must be further developed in order to be able to steer the measures in a target-oriented manner (München 2018: 20, author's translation).

At the same time, it also highlights that this scientific support and information must be communicated in such a way that it is understandable for all and that it accordingly paves the way to climate neutrality:

> The municipality expands and structures its existing knowledge. It communicates this in a good, comprehensible and clear manner. In this way, it creates a basis for credible assistance in tackling the upcoming challenges and tasks in climate protection (München 2014: 29, author's translation).

Based on the definition of climate change as a problem resulting from the predominant resource-intensive current lifestyle, Climate Alliance suggests as another solution to initiative a change of this lifestyle and related behaviors. This solution is also taken up by the City of Munich. Accordingly, Munich highlights the potential of its citizens to change consumption behaviors as a part of reaching climate protection goals:

> There is a potential for savings for each and everyone. Whether as a consumer, investor, real estate owner or entrepreneur. In order to achieve the necessary climate protection goals, this potential must be mobilised in the coming decades. However, this can only be achieved if every CO_2 polluter can be motivated to make a contribution to climate protection in relation to his or her lifestyle (München 2014: 29, author's translation).

Munich further highlights that it wants to establish climate-friendly behavior as the "new lifestyle" in Munich's society (München 2014: 31). Accordinlgy, it presents different opportunities of how citizens can change their behaviors to more climate-friendliness in a very detailed way:

> It is also important to reduce personal greenhouse gas emissions: starting with food (regional products save e.g. transport emissions), through one's own consumption (less meat, products without palm oil, etc. – see Chapter 1) to modernizing a heating system or switching to a provider of renewable energies - there are numerous opportunities. Because a very large share of global greenhouse gas emissions can be attributed to freight and passenger transport, and especially to car and air transport, one's own mobility is a particularly effective way to minimize one's own greenhouse gas emissions: Anyone who considers whether a journey really has to be made by car or whether it can also be made on foot, by bicycle, by public transport or at least in carpools is already contributing a great deal to climate protection, because one third of all greenhouse gases come from the transport sector. The following applies to holiday trips: every avoided flight reduces one's own ecological footprint enormously (München 2015b: 22, author's translation).

This shows that Munich, just as Climate Alliance, considers the change of behaviors an important aspect of how the problem of climate change needs to be acted upon.

As a last aspect concerning problem-solving knowledge, Climate Alliance clearly rejects C40's suggestion to make use of and further develop possibilities to offset emissions. Despite not with the same persistence as Climate Alliance, I still find Munich to raise some doubts about the appropriateness of carbon offsetting mechanisms:

> It is often criticized that both emissions trading and greenhouse gas offsetting are a modern form of selling indulgences, because one can buy a good conscience

> with a corresponding payment instead of making greater efforts to reduce one's own greenhouse gas emissions (München 2015b: 16, author's translation).

However, the quote shows that Munich raises this critique rather indirectly and does not clearly state this as its own point of critique. It rather presents this critique as the opinion of its indigenous partners, quotes it and then leaves it up to everybody's own interpretation, without commenting it itself, as a city. Nevertheless, Munich seems to be rather in line with Climate Alliance's way of knowing, than C40's. Therefore, I can conclude that in terms of problem-solving knowledge, there is significant overlapping in all aspects.

A similar conclusion applies to the last form of knowledge: critical knowledge. Climate Alliance's critical knowledge encompasses three different aspects: firstly, critique of the disregarding of one of climate change's root causes – Western lifestyle; secondly, considering anti-hegemonic structures and actors, especially indigenous ones; and thirdly, critique of political and economic actors that are considered particularly responsible for current problems. Munich's way of knowing and acting upon climate change overlaps with Climate Alliance's critical knowledge especially insofar, as it is very considerate of its Amazonian partnership and that it very clearly thematizes that current climate protection efforts are not sufficient.

The following quote highlights that missing climate protection results are put in relation with stronger economic growth – which can be interpreted as a critique of the current economic model as threatening climate protection:

> At the end of March 2018, the International Energy Agency (IEA) published new figures on the development of global greenhouse gas emissions. According to the report, energy-related greenhouse gas emissions increased by 1.4% compared to 2016 to a historic record level of 32 gigatonnes of CO_2. This result is all the more painful as it is the first time – after a three-year period of stability in global CO_2 emissions – that a significant increase can be detected. This also confirms the forecast of the Global Carbon Project published a few months ago (…). According to this, in order to achieve the 2°C target, greenhouse gas emissions worldwide must reach their maximum in a few years and then fall continuously. The IEA attributes the increase in global CO_2 emissions to stronger global economic growth and the associated increase in energy demand (München 2018: 14f, author's translation).

Again, Munich quotes another actor's standpoint, however, does not clearly state in the following how Munich as a city evaluates this finding. Nevertheless, I interpret the pure quotation and thus highlighting of economic growth's connection to a growth in emission, as Munich being at least aware of this relation and therefore the current economic model's role for climate change.

This attention to Western lifestyle as a driver of climate change is further present in Munich's documents highlighting several times that "[w]e all live in one world, our lifestyle definitely has an impact on the lives of others" (München 2017: 4, see also e.g. München 2014:

29; München 2015a: 40). Climate Alliance criticizes especially that climate change is often perceived as a purely environmental issue without connecting environmental problems to their socio-economic framework (see chapter 6.2.4.1). Despite not formulating the conclusion that climate change roots in social and economic structures as openly as Climate Alliance, Munich nevertheless highlights that economic, social and ecological developments cannot be seen as separated from each other:

> In the concept of sustainability lies the realization that economic, social, cultural and ecological development must not be split off from each other and played off against each other but must be regarded as a necessary unity. (...)The protection of the environment with its natural resources is the basis of all development, because if an ecological system is stressed beyond a certain level, serious restrictions on its performance, up to and including possible collapse, are to be expected (München 2015a: 20, author's translation).

The second aspect of Climate Alliance's critical knowledge, the consideration of indigenous concepts and ways of living is present in those documents in which the City of Munich specifically addresses its climate partnership with the Asháninka people (München 2015b, 2017). Munich considers indigenous concepts and ways of living insofar as it explains the life realities and beliefs of its indigenous Amazonian partners:

> While Latin American governments have adopted the concept of individual private ownership of land from Europe and North America, indigenous peoples are traditionally characterized by the concept of communal ownership. This concept is based on the traditional indigenous idea of holistic living, which understands humans and animals and the entire cosmos as a unity (cosmovision). The indigenous people worship the soil on which they live as 'Patcha Mama', i.e. 'Mother Earth'. It therefore has not only a purely material value but also a spiritual one. In short: Mother Earth is sacred and what is sacred, no human being can own. Consequently, land cannot belong to anyone (München 2015b: 26, author's translation).

The City of Munich also criticizes that these concepts and related ways of living are often discriminated as 'backwards' and 'underdeveloped' (München 2015b: 6 & 10). Such as Climate Alliance, Munich highlights that indigenous peoples are particularly successful in protecting their surrounding environment and concludes that they should therefore be seen as valuable experts and partners when it comes to climate protection. However, in Munich's case this does not mean that the city is calling for an inclusion of aspects of indigenous life and ways of knowing on the global level (as Climate Alliance does), but rather that it highlights how important city partnerships are with and for indigenous peoples and their causes (and finally also for successful climate protection (on this matter see e.g. München 2017: 6f)):

> Indigenous peoples traditionally live in harmony with nature. In their areas the rainforest is therefore still intact today. (...) Therefore, the goal of the climate partnership with the Asháninka is to jointly protect the rainforest from further

> deforestation, resource exploitation and slash-and-burn agriculture and thus to preserve the habitat of the indigenous peoples (München 2015b: 2, author's translation).

The third, and last, aspect of how Climate Alliance knows climate change critically is that it openly questions hegemonic governance structures and actors. It does so by highlighting whom it considers especially responsible for the persisting problems. Further, it also criticizes global climate actions as being hypocritical and not far-reaching enough (see chapter 6.2.4.3). This aspect is only marginally present in Munich's climate policy documents. Accordingly, it very well highlights that particular actors are especially responsible e.g. for illegal logging in the rainforest, as the following quote shows:

> The greatest threats in Peru's central rainforest include:
> - massive overexploitation by timber companies
> - illegal gold mining with mercury
> - the criminal activities of the drug mafia
> - land grabbing for industrial agriculture (for example, for palm oil plantations)
> - the plans for the construction of large hydroelectric power plants
> - the poisoning of rivers by waste water from mines (München 2017: 10, author's translation)

However, it does not state them as clearly by their names, as Climate Alliance does. Further, I do not identify the aspect of criticizing other actors' climate actions as hypocritical. Therefore, I can conclude that – in terms of critical knowledge – there are fewer overlaps between Climate Alliance and Munich. However, they are still present and therefore can be seen as a great difference to both C40, and the City of Copenhagen as well.

Summarizing, also in Munich's case, the city's way of knowing and suggested policies in face of climate change mirror very well its networks' way of knowing climate change. Also in this case, I conclude that ways of knowing seem to travel between a city network and the respective member city analyzed for the purpose of this thesis. Just as it was the case for Copenhagen, the city of Munich also refers to its climate city network several times in its climate policy documents, as the following example shows:

> The City of Munich joined the network 'Climate Alliance of European Cities with Indigenous Rainforest Peoples' in the 1990s. Like the other more than 1.700 members, it has committed itself to the following goals:
> - Reduce CO_2 emissions by ten per cent every five years.
> - Halving per capita emissions by 2030 at the latest (base year 1990)
> - Protection of tropical rainforests by renouncing the use of tropical timber
> - Supporting projects and initiatives of indigenous partners
> As part of this commitment, Munich has entered into a project partnership with the Peruvian rainforest people of the Asháninka. (München 2017: 13, author's translation).

The quote suggests that the membership in Climate Alliance indeed also serves as a rationale for how climate policies are being developed by the City of Munich (see also München 2014: 30).

7.4.3 Summary: Great overlaps between the networks and their exemplary member cities

The analysis of the two cities and their ways of knowing perceivable in their presentation of their climate policies is in itself very interesting and could be advanced much deeper (see for an example of a detailed investigation of cities and climate change knowledge e.g. Süßbauer 2016). This is to highlight that I am aware that the analysis presented above is rather superficial. However, for the purpose of this thesis, it is only my aim to spot the two ways of knowing that C40 and Climate Alliance embody, beyond the scope of each network. For this endeavor, the rough analysis is sufficient. Accordingly, I could spot the particularities of both ways of knowing in each city networks' member cities' climate policy documents. Copenhagen's climate policies share most aspects of C40's perception of climate change as a meteorological phenomenon, to be addressed in particular by cities and urban areas with techno-managerial means, which are in addition also beneficial for issue areas other than climate policy. Concerning all forms of knowledge, there are significant overlaps and C40's way of knowing climate change is clearly mirrored in Copenhagen's climate policy documents analyzed for this thesis.

The same conclusion can be drawn for Climate Alliance and Munich. All aspects of Climate Alliance's way of knowing climate change can to some extent be found in Munich's different climate policy communication documents. Munich shares the definition of climate change as both a socio-economic, and techno-scientific phenomenon, as well as the concepts used to understand it as such. Further, it also postulates that climate change needs to be and can be addressed by everyone, by helping to overcome current unfair socioeconomic structures and interdependencies. Therefore, I can conclude that also in the case of Climate Alliance there are great overlaps concerning all forms of knowledge. Climate Alliance's way of knowing climate change is thus perceivable in Munich's climate policy documents and can be said to have traveled between the network and its member city.

7.5 Summary: Alternative ways of knowing as fostering transition vs. transformation

The goal of this chapter was to outline the differences between the two networks' ways of knowing climate change and to make sense of their particularities and specificities, hence, to contextualize them by thinking about the provenances and consequences of these differences.

In this chapter, I determine very clearly that the two ways of how C40 and Climate Alliance know climate change present two alternative ways of knowing. Concerning the probable provenance of these differences, I conclude that the variation of influential aspects of the two networks' knowledge environments, such as their historical development, their sociopolitical orientation, as well as their expert consultation co-produce with the differences in the two ways of knowing. Further, the two ways project different pathways of how to achieve the goal that both networks – and their ways of knowing – share: to be 'climate-friendly'. At the same time, these differing projections and suggested pathways are co-produced with the networks' structures, and their knowledge environment, too. The networks' particular members are another important part of their knowledge environment. In parallel, it can be assumed that those differences influence how the two networks' member cities act upon climate change. This assumption is reinforced by the finding that both in C40's, and in Climate Alliance's case, the respective way of knowing is clearly mirrored in the climate policy documents that I exemplarily analyzed for the two member cities Copenhagen and Munich.

In addition to this particular finding, I conclude more generally that the way each networks' member cities will transform will be a different one, if they act according to the pathways suggested by their network. Accordingly, C40 cities are projected to rather undergo a '*transition*' to become 'climate-friendly'. Transition, here, is understood as a change that is actively managed under orderly control, in which technological innovation plays an outstanding role and in which the goal is clear and shared (Stirling 2015: 54). Climate Alliance members, on the other hand, are rather urged to follow a '*transformation*'. The notion of a transformation involves diverse, emergent and unruly political alignments, in which social innovations which challenge incumbent structures are decisive, and where the end of this transformation is not clear yet (Stirling 2015: 54). These two different projections for the future highlight once again that C40 and Climate Alliance represent two alternatives in how climate change can be known and acted upon.

C40's way of knowing hereby reinforces currently prevailing structures of knowing and acting, as the typical elements of climate 'globalism' are strongly present and co-produced by its way of knowing: highlighting international solutions favoring global managerial and multilateral approaches (Methmann 2010: 357ff; see also Jasanoff and Long Martello 2004; Hoffmann 2013), 'scientism' as necessary requirement to successfully act upon climate

change (Methmann 2010: 363f; see also Hulme 2010, Walsh 2019), the 'growth' ethic (Methmann 2010: 364ff, see also Hickel and Kallis 2019) and finally 'efficiency' (Methmann 2010: 366ff; see also Rice et al. 2015; Swyngedouw 2013).

On the other hand, Climate Alliance's way of knowing and suggested acting represents an alternative to the prevailing structures. It can be rather seen as being part of the rising system-critical climate justice thinking which is deeply skeptical of modernization visions, including the idea of a green-growing, low-carbon society and market-based climate governance, and which sees climate change more as a structural problem, caused by the global capitalist and neo-colonial economy (Bäckstrand and Lövbrand 2019: 528).

Whereas Climate Alliance at least potentially fulfills the hope that cities and city networks could "set a course of deep transformation" (Davidson and Gleeson 2015: 35), including in the political economy, C40 can be confirmed as an actor focusing rather "on reformative and not transformative urban action" (Davidson and Gleeson 2015: 35; see also Heikkinen et al. 2019).

8 Conclusion: on how alternative ways of knowing foster epistemic plurality

This thesis started out with the question of how the epistemic object climate change is being known. This particular question emerged from a quote by the UN Secretary-General Antonio Guterres, suggesting that we know exactly what is happening in terms of climate change, that we know what we need to do about the problem of climate change, and that we even know how to do it (see UNSG 2018). At the same time, many scholars argue that yes, we know a lot about climate change but only from one, very particular perspective: a techno-scientific perspective. In parallel, these scholars argue that climate change is a 'wicked' problem which cannot be understood, let alone solved, when only knowing it in a very particular manner. Therefore, it is not obvious at all how and what to do in face of climate change. Rather, scholars convinced of the wickedness of climate change suggest that the way how climate change is being known has a strong influence on how it is acted upon.

In addition to that, I was asking myself, who are these actors who are able to influence how a particular issue, in this case, climate change is being known? Scholarship suggests that these actors can be very different ones. However, one particular group raised my interest: city networks. Why? Because since about two decades, both climate policy practitioners, as well as scholars, highlight that both cities and their networks could be among those actors having the greatest influence on how climate change is being governed. And interestingly, TMNs are, amongst others, highlighted as being influential because they shape and diffuse knowledge about how to understand and govern climate change. Despite this importance attributed to city networks' climate change knowledge, this remained an area which had not been investigated thus far. Combining this finding with the assumption that how climate change is being known is highly influential for how it is acted upon, I came up with the main question guiding this research endeavor: how do transnational municipal networks know climate change?

After having conducted my content analysis of publicly-available online documents and some additional background interviews, I can conclude: different TMNs do know climate change very differently. In terms of the two networks I was investigating, C40 and Climate Alliance, I can even suggest that they represent two alternative ways of knowing climate change. And I conclude that, in terms of epistemic plurality and to deeply engage with the many ethical questions that climate change raises, this is very positive. However, before I want to explain why, I want to summarize again what, and how I have done my research to answer the main research question 'how are TMNs knowing climate change?'.

To conclude that C40 and Climate Alliance represent two alternative ways of knowing climate change, I firstly set a conceptual and theoretical background to my research. I did so by reflecting on what 'knowing' actually means for me and my purposes. I found knowing to be a socio-material activity arising from situated practices (e.g. Gherardi and Miele 2018; Jasanoff and Long Martello 2004a). Knowing thus is a process. As such, knowing encompasses basic epistemological ideas, strategies for acquiring knowledge, requirements for explaining and predicting, standards for inquiry, but also audiences, media types, and modes of communication, agents, practices and institutions are part of the process of knowing something. A 'way of knowing something' can be summarized in the story that is told about an epistemic object. This story, very shortly, visualizes the way of how the epistemic object is being known. It is important to highlight that this way of how something is being known, is being co-produced with its socio-political and material environment. At the same time, a way of knowing opens up or limits how and which further knowledge is generated. It also influences if and how the epistemic object is acted upon.

Asking how climate change has been predominantly known so far, I found that scientific ways of knowing climate change have become prevalent and shaped the way how climate change has been governed (see Hulme 2015; Lövbrand 2014; O'Lear 2016). This has influenced which solutions and governance structures and measures are seen as acceptable responses to climate change (Okereke et al. 2009). In the case of climate change, these accepted responses are often managerial and technocratic solutions, based on data and technology (Bäckstrand and Lövbrand 2006; Hajer 1995; Hulme 2015; Litfin 1998; Wesselink et al. 2013). One of the most prominent examples for such managerial and technocratic solutions are large-scale geoengineering projects, which for example plan to inject aerosols into the stratosphere to lower tropospheric warming (Hulme 2015; Lövbrand et al. 2009). This example shows impressively how deeply knowing and acting are intertwined. This confirmed the idea that it would be urgently necessary to investigate how city networks, as influential governance actors on both the local and the global level, do know climate change.

On knowing, knowledge and forms of knowledge

Before answering this question, I wanted to outline the difference between the two concepts of knowing and knowledge. I turned to STS's reflections about knowledge and concluded from that, that knowledge is the resulting product of the process of knowing something. Therefore, knowledge has to be seen as a social and situated product which is constantly co-produced with its environment. In turn, a way of knowing something is composed of different forms of knowledge. These forms of knowledge are tied to different aspects of knowing. This meant that, to understand the different ways of how C40 and Climate Alliance know climate change,

I had to find a theoretical framework grasping the knowledge forms which together form the two networks' ways of knowing climate change.

To differentiate knowledge forms which meaningfully help to understand how C40 and Climate Alliance know climate change, I combined the baseline assumptions drawn from STS literature with Habermas' differentiation of knowledge-informing interests and respective knowledge forms. I did so because both frameworks try to understand how knowledge emerges and is being shaped in different socio-political environments. Thus, they could be productively combined to derive knowledge forms which help to understand how climate change is being known by different actors.

From this combination of the two conceptual frameworks I drew the following baseline assumptions: firstly, that knowledge is a social product, standing in a co-constitutive relationship with its environment; secondly, that knowledge can have different functions and operate both in the background or be goal-oriented; and thirdly, that specific knowledge can become (globally) dominant.

In turn, these assumptions led me to the conceptual differentiation of four knowledge forms: definitional, conceptual, problem-solving and critical knowledge. Definitional knowledge is knowledge about what the problem at hand actually is, and therefore also defines who the actors are for finding solutions to the defined problem. Therefore, this form of knowledge contains underlying norms, assumptions, definitions or epistemological ideas. It serves as a definitional basis for the other forms of knowledge which are building on definitional knowledge. Conceptual knowledge is knowledge that covers explanations of an observed reality, by figuring out contexts and fundamentals. Therefore, it also encompasses models of explanation. This form of knowledge includes the main beliefs, ideas and concepts of a way of knowing. Problem-solving knowledge is the form of knowledge that covers the possible and envisaged solutions to the identified problems. It comprises solutions that are considered appropriate and also the ways how these solutions should be implemented. Therefore, problem-solving knowledge is the form of knowledge which most clearly shows which consequences the respective way of knowing has in terms of concrete actions. Critical knowledge is the form of knowledge covering ideas, norms, and beliefs questioning hegemonic knowledge structures. It also contains knowledge about alternatives to these hegemonic knowledge forms and aims at enabling hitherto marginalized actors. These four knowledge forms are obviously differentiated for analytical reasons and are therefore idealized. Nevertheless, such a differentiation is necessary to understand in detail the different components of a way of knowing something. Taken together, these four forms of knowledge and their specific characteristics build the respective way of how an epistemic object is being known. Throughout this study, this differentiation has proven to be helpful to understand different ways of knowing

climate change. These knowledge forms can also be used to understand other actors' ways of knowing, or they can also be applied to other epistemic objects. Therefore, this four-fold framework of knowledge forms builds the core theoretical contribution of this thesis. As mentioned in the introduction, IR scholarship is aware that knowledge is important. However, it is not always able to understand where knowledge comes from and how knowledge gets valued in practice and by whom (Bueger 2015). These are questions which my theoretical framework sheds light on. Therefore, the present theoretical framework can be used to better understand knowledge and knowing in different contexts.

Climate change as a clearly definable vs. as a multi-dimensional problem

Back to the initial question of how C40 and Climate Alliance know climate change: My empirical analysis has shown that the two networks represent two alternative ways of knowing climate change. This confirms the assumption that differences in membership, structures and partnerships also manifest in two different ways of knowing. It also suggests that, indeed, one of the main differences between city networks could be their different ways of knowing. What the empirical analysis also showed is that both ways of knowing can and should be seen in a broader socio-political context which is co-producing the respective way of knowing and its characteristic knowledge forms.

In a nutshell, the two ways of knowing climate change can be summarized in the following two sentences:

For C40:

> Climate change is a meteorological phenomenon which is to be addressed in particular by cities and urban areas with techno-managerial means which are not only beneficial for climate protection but also other issue areas.

For Climate Alliance:

> Climate change is as much a socio-economic as it is a techno-scientific phenomenon which is to be addressed by everyone by overcoming current unfair socio-economic structures and interdependencies.

These two sentences each cover the main aspects of what it means to know climate change for the two city networks, according to my analysis. To summarize, I want to present these aspects again very briefly:

C40 – in terms of definitional knowledge – knows climate change as a matter of scientifically measurable and explainable temperature developments. Accordingly, climate change is defined as scientifically measurable in temperatures, which can in turn be used to understand how climate change has already progressed and how it will likely develop. As I already mentioned before, it is important to relate knowledge to its co-constitutive contexts. Therefore,

I considered background information from the broader climate governance and city network literature to understand the general context of every aspect of the two networks' ways of knowing climate change. The context of knowing climate change as a matter of changing temperature developments is accordingly that the global average temperature has become one of the most iconic knowledges about climate change (Hulme 2010: 559f). The other aspect of how C40 knows climate change definitionally covers climate change as an urban problem. According to this definition, climate change is an urban problem for four reasons: cities are seen as particularly vulnerable to the effects to climate change; they are presented as being amongst those most responsible for climate change; cities are defined as being perfectly placed to take climate action; and cities are presented as being more ambitious than other actors. The context of this definitional knowledge is city networks' function as 'city advocates' (see Andonova et al. 2009; Bouteligier 2013; Busch 2015), representing their members' voices on an international level. To get their participation and leverage accepted at the international level, city networks (successfully) defined climate change as an urban problem, making it less controversial if urban areas should be involved in tackling this problem (Gordon 2016b; Van der Heijden 2019). Hence, this context can be seen as co-producing C40's definitional knowledge.

Conceptually, C40 bases its knowledge on approaches and data considered scientific. This belief in scientific data is based on the conviction that climate change can be best understood by generating (quantified) data, which in turn is believed to foster climate action. The contextualization of this aspect has shown that the production of and reliance on data is a phenomenon that is employed to manage uncertainty, by creating a sense of certainty (Bueger 2015; Jasanoff 2015a). Further, data and numbers are often perceived as possessing an inherent power to convince (Knox 2014: 411). It seemed as if C40 conceptually also believes in such a power of numbers. Further, concepts such as 'carbon neutrality' and 'green growth' (assessed as part of what is described as 'techno-managerialism' by some authors (see Lövbrand et al. 2015; Swyngedouw 2013)) play an important role in C40's way of knowing climate change. Both concepts form part of the knowledge structure the current global climate governance system is based on (see Hickel and Kallis 2019; Swyngedouw 2013) and thus can be seen as building the co-constitutive environment of C40's way of knowing.

Finally, C40 suggests solutions to the problem of climate change in the form of technological means which are at the same time beneficial for various problems and which are also financially rational. C40's problem-solving knowledge thus comprises the suggestion to present climate actions as multi-beneficial in order to justify them. This solution can be seen in a more general context which has been identified by TMN scholarship: that local climate policies are commonly framed in a broader context of non-environmental benefits, in order to

back them up (Gordon 2016b; Schreurs 2008; Toly 2008). However, the non-environmental co-benefits of climate policies are not the only possibility to justify climate policies, as C40 suggests. Another solution suggested is to highlight the financial reasonability of climate policies, both with regards to avoiding future higher costs and threats to the global economy, but also to attract short-term investments. Just as the concept of green growth, this suggestion can be seen in the broader context of the green growth debate, relying inter alia on the findings of the Stern Report (Stern 2006). Next to these suggested solutions for justifying climate policies, C40's problem-solving knowledge includes research and education as possible ways of dealing with climate change. The idea behind this suggestion is that if cities have access to research results, they will be better able to contribute their part to achieving climate goals. Further, by doing research themselves, they can contribute to a better understanding of climate change. This solution has to be seen in the general global context where providing and receiving information has become accepted as a climate protection measure (Methmann 2010), but also in the context of C40's conceptual knowledge emphasizing the importance of data and scientific information. The last aspect of C40's problem-solving knowledge is the solution to make use of carbon offsetting and negative emission technologies. This problem solution perfectly fits in the wider context of C40's way of knowing climate change. Accordingly, carbon offsetting is described as a market-based climate governance mechanism (see Pattberg and Stripple 2008) which is in line with the green growth paradigm and the negation of the need to immediately and rapidly reduce emissions (see Hickel and Kallis 2019).

The contextualizations and assessments of the different aspects of knowing have made clear that C40's way of knowing climate change is very much in line with what can be called the 'hegemonic way of knowing climate change', centering around green growth, low-carbon development trajectories, partnering between state and private actors and building on scientific accounts of climate change (see Bäckstrand and Lövbrand 2019; Lövbrand 2014; Mahony and Hulme 2018; Methmann 2010). It is therefore not surprising that I did not identify any aspects of C40's knowledge as 'critical knowledge'.

Climate Alliance – in terms of definitional knowledge – knows climate change as a phenomenon with 'many faces'. Therefore, climate change is also understood as a meteorological phenomenon, measurable in changing temperatures. However, these changes can also be perceived by other means, such as individual observations. Further, climate change is seen as not only having meteorological, but also economic and social consequences (as well as origins). According to Climate Alliance's definitional knowledge, climate change is a phenomenon that affects humans and natural environments differently in different places all over the world. This definitional knowledge can be seen in the context of calls for rendering

the manifold meanings of climate change more accessible and drawing back on peoples' actual experiences (see Jasanoff and Long Martello 2004c; Pettenger 2007b). Climate change is also defined as a problem of (un)fairness. The unfairness of climate change, according to this definition, comprises two aspects: the unfair distribution of the effects of climate change, and the unequal responsibility for the very existence of the problem of climate change. This definition can be seen against the general climate governance context, being coined by the two principles 'polluter pays' and 'common but differentiated responsibilities' (see von Lucke 2017). These principles touch upon questions of fairness in the governance of climate change as they try to deal with the fact that different parts of the world have contributed to the emergence of the problem to different degrees, and are disproportionately affected by its consequences (Harris 2006; von Lucke 2017). This aspect of Climate Alliance's definitional knowledge thus can to be seen in the context of wider discussions about the 'unfair' character of climate change in the international climate change regime. Generally, the contribution to climate change is an aspect which plays an important role in how Climate Alliance knows climate change. Hence, industrialized countries and the people living therein, are seen as main culprits of climate change – because of the lifestyle they led over the last 200 years. Climate change is thus also known as a lifestyle problem.

Conceptually, Climate Alliance's knowledge is based both on scientific data and approaches, as well as on people's experiences and empirical expertise. Therefore, direct interaction of people and the exchange of their experiences is seen as significant for the generation of knowledge about climate change. This conceptual knowledge is to be seen in line with Climate Alliance's general way of knowing: as climate change is defined as a multifaceted phenomenon, it is consequential that it can not only be understood by scientific data, but in several different ways – for example by listening to people and their experiences with happening changes. Further, this conceptual knowledge can be seen in the context of some scholars' findings that it is easier for humans to understand a problem if it is not only rationally evaluated, but if they can actually emotionally relate to the problem (see Adger et al. 2011; Roelvink and Zolkos 2011; Weber 2010). However, I also found that this conceptual knowledge is to be seen in the context of Climate Alliance's 'platform' function, which explicitly aims at enabling direct connections and interactions (Busch 2015: 223). Further, the concepts of 'social and climate justice', and 'buen vivir' play an important role in Climate Alliance's conceptual knowledge. The concept of 'social and climate justice' reinforces Climate Alliance's definitional knowledge seeing climate change not only as a meteorological phenomenon, but also as a social and economic issue. Just as the definitional knowledge base, this can be seen in the broader context of the justice discussions inherent to the global climate change regime (Ottinger et al. 2017; Schlosberg and Collins 2014; von Lucke 2017). The concept 'buen vivir'

is an initially indigenous concept which is taken up by Climate Alliance to conceptualize a good life for everyone, understood as a different kind of lifestyle. The concept is prominent amongst anti-growth and anti-neoliberal NGOs and social movements with affinity to indigenous concepts (Kothari et al. 2014; Vanhulst and Beling 2014), whose concepts and ideas seem to be co-constitutive with Climate Alliance's way of knowing climate change.

Climate Alliance knows solutions to the problem of climate change (respectively, the multiple problems) to be mutual education and exchange, as well as a change of currently dominant behaviors and lifestyles. Therefore, climate change is known as a problem that concerns everyone globally (though differently) and which can also be addressed by everyone. This problem-solving knowledge therefore is very well in line with Climate Alliance's conceptual and definitional knowledge, which clearly form the context for these suggested solutions. Different to C40's knowledge, I interpreted parts of how Climate Alliance knows climate change as 'critical knowledge'. This critical knowledge is – sometimes more, sometimes less – inherently present in the formerly presented three forms of knowledge. It is thus idealized to present these aspects as part of a particular form of critical knowledge, however useful in terms of conceptual clarity. I distilled as critical aspects of how Climate Alliance knows climate change the critique of the currently dominant perceptions of climate change's root causes, the fact that indigenous concepts and ways of living are considered, as well as its explicit critique of political and economic developments and actors. These forms of knowledge constitute critical knowledge in so far as they fulfill the criteria of critical engagement with current knowledge structures, and the consideration of anti-hegemonic alternatives.

On the co-productive context of the two ways of knowing

Following up on the detailed outline of how the two networks know climate change, I briefly compared the different aspects coining the two ways of knowing. I concluded that they share many aspects to a certain degree, however, that these are often differently pronounced. Some aspects of one way of knowing are neglected by the other way of knowing, or even explicitly rejected. To get an idea of where these differences in knowing climate change come from, I added to the comparison a reflective chapter. In this part, I tried to understand the respective knowledge environment coining each way of knowing. As I outlined in my conceptual reflections, knowing and its socio-material environment are co-producing. Therefore, it is necessary to take into account the environment in which knowledge is produced. For the sake of this thesis, I considered the two networks' historical foundations and general guiding principles, their sociopolitical convictions, as well as their knowledge production processes as important aspects of their knowledge environment, and as 'plausible conjectures' (Boswell et al. 2019: 30) of the provenance of the differences in their ways of knowing. To do so, I drew in

particular on the information derived from interviews with TMN staff as it was my goal to understand how the networks themselves understand the environment in which they produce knowledge.

In this vein, I found some aspects of C40's historical development and guiding principles, especially the assumption that cities can outperform nation states, that climate policies are economically rational, and that data gathering and information exchange are essential, to have co-developed with its way of knowing climate change. This is the case because they coin the knowledge environment in which C40 produces its knowledge about climate change. In Climate Alliance's case it is especially its historical foundation as a bottom-up network and the high diversity of members which can be seen as having co-developed with the way how Climate Alliance knows climate change. In terms of sociopolitical convictions, I found that the two networks represent two different worldviews on climate change, which in turn obviously shape the way of how climate change is being known. C40 can be seen as representing a so-called 'light green', and 'bright green' position (Leach 2015), including some elements of the 'ecological modernization', 'green governmentality' (Bäckstrand and Lövbrand 2006), as well as 'market liberal' worldviews (Clapp and Dauvergne 2011). These worldviews share with C40's way of knowing sociopolitical convictions valuing nature in terms of its economic value, seeing humanities' role in managing nature and the life with environmental problems, and putting faith in the innovative power of science and technology to solve persisting problems, thus creating win-win situations. On the other hand, Climate Alliance's way of knowing overlaps with 'dark green' (Leach 2015), 'civic environmentalism' (Bäckstrand and Lövbrand 2006), and 'social greens' (Clapp and Dauvergne 2011) worldviews seeing nature and its ecosystems at stake by human activities, and therefore aiming for deeper structural changes. Climate Alliance's perception of climate change as a problem of fairness that needs to be addressed by valuing 'social and climate justice', and by aiming for a 'good life' with changing behavior patterns clearly reflects these positions. These differences in C40's and Climate Alliance's sociopolitical position towards nature, ecosystems, climate change and humans' interdependence and interconnection form part of the knowledge environment of the two networks. Therefore, these aspects can be seen as shaping the way how climate change is known by the networks. They can further be seen as influencing the provenance of their different ways of knowing climate change.

Another aspect characterizing the respective knowledge environment is the process how knowledge is produced. Therefore, I considered this aspect as a last possible explanation for the differences in knowing climate change. I drew most information on TMNs' knowledge production processes from the interviews with city network staff. I found that C40's knowledge production process is mostly laid out as a commissioning process in which external experts

are chosen to realize work that the network is not able to do itself. Also member cities seem to be involved in some knowledge production processes. What I drew from the interviews is that C40 seems to privilege scientific, respectively academic knowledge and actors, but also includes economic actors, such as consultancies and companies in its knowledge production process. Based on what other scholars found (Clapp and Dauvergne 2011; Methmann 2010), I assume that these actors again represent a techno-scientific and market-liberal view on climate change and therefore reinforce the co-production of these views with C40's way of knowing. Climate Alliance's knowledge production process also seems to be coined by working with external actors to develop information and tools. However, also Climate Alliance staff, as well as municipal members seem to play important roles throughout the knowledge production process. From an interview with Climate Alliance staff, I understood that partnerships with external partners are ended by the network if the external partners no longer conform with the networks' norms and interests. In Climate Alliance's case it was more difficult to make general statements about the knowledge production process. However, I still concluded that some actors and their respective ways of knowing seem to be privileged knowledge production partners. These are Climate Alliance staff, members and other political institutions working at other political levels (such as the nation state). Climate Alliance also seems to include what C40 calls 'experts'. However, the network seems to be willing to end such cooperations if the ideas and believes do no longer match. What this short insight into the two networks' knowledge production processes has shown is that they seem to value different experts and their knowledges. This, in turn, influences and co-produces the two networks' ways of knowing. However, as the number of interviews (for both networks) has been quite limited, these information on the knowledge production processes have to be seen as first insights only. As the process of how knowledge is being produced and in cooperation with which other actors is very important for how an issue is known and finally acted upon, it is necessary that future research follows this track even further, to satisfyingly answer the question of how TMNs come to know what they know.

According to Boswell et al. (2019: 30)'s definition of 'plausible conjectures', I concluded that the differences in the historical development, the guiding rationales, the differing sociopolitical convictions, as well as the knowledge production approaches and especially the fact that the networks (here in form of the interviewed staff) themselves consider these aspects to be important for what they do, allow 'plausible conjectures' about the provenance of the differences in knowing climate change. Accordingly, I can conclude that the two networks converge around specific ways of knowing and types of knowledge, whereas they rather crowd out differing ones. At the same time, this shows that alternative ways of how climate change is known are both possible, as well as represented by city networks in the global governance

of climate change. By having outlined how the different ways TMNs know climate change are plausibly constituted, I also contributed to a pressing analytical issue in times of an identified 'Anthropocene': to expose and challenge underlying assumptions that influence how we make sense and respond to changing environments around us (Lövbrand et al. 2015: 212). Further, my analysis contributes a part to the puzzle of understanding how the epistemic object 'climate change' is differently *made* by different actors (see Allan 2017: 157).

These differences in knowing will very likely have consequences for how climate change is acted upon and how the future is imagined (Felt et al. 2017; Jasanoff 2015b; Mahony and Hulme 2018). Therefore, I added a last reflection on the differences between the two ways of knowing. These reflections consider the visions for the future that networks project and which ways forward they pave accordingly. These aspects are decisive as they are influencing how the networks' member cities will transform in view of climate change. Based on my findings that the two networks' way of knowing co-produces with two different climate change worldviews, I suggested that the two networks have two different imaginaries and therefore visions for the future. In line with these visions, they also have different expectations about the political strategies of how to achieve these visions. For a city, this means that to become part of a city network also means to join an environment in which a specific socio-technical imaginary is predominant. This, again, could influence how this city imagines the future and which kind of climate policies it implements. C40 spreads a future imaginary in which the social order is relatively similar to the current one and where relatively small social changes are needed to reach the goal of a climate-friendly future. In turn, the role attributed to advances in science and technologies and respective future solutions is huge. Climate Alliance projects a future imaginary in which the social order and life, including the economic system are actively and openly transformed, in which consumption is reduced and in which factors other than economic performance are valued. Science and technology do in so far play a role as they need to support the goal of getting energy from 100% renewable resources and of becoming much more energy efficient. These imaginaries and projected pathways are decisive because they influence political, social and economic decisions. To understand why the influence of the pathways suggested by TMNs might be so decisive for what their member cities do in light of climate change, I want to recall some of the main findings of TMN scholarship: city networks are considered decisive actors in the governance of climate change, precisely because of their guiding potential for cities on how to face climate change (Bouteligier 2013; Busch et al. 2018; C. A. Johnson 2018). Further, one of the reasons why cities join networks is because they actively seek to get information on how to govern climate change locally (see Bulkeley et al. 2003; Haupt et al. 2018, 2020; Romero-Lankao et al. 2018). This means that member cities are actively looking for such suggested pathways and imaginaries when joining networks. Their

suggested ways forward might therefore indeed have consequences for the built, social, and economic environment of their member cities. This assumption is reinforced by my research's finding that both in C40's, and in Climate Alliance's case, the respective way of knowing is clearly mirrored in the climate policy documents that I exemplarily analyzed for the two member cities Copenhagen and Munich. Despite being only a very limited and illustrative analysis, this nevertheless shows that, at least in the two city cases I focused on for this study, a city networks' way of knowing seems to be co-constitutive with and for its member cities' knowledge and actions. Therefore, the results of my research suggest that the way of how exactly city networks know climate change, and connected to that, also what they propose as adequate actions, can be one of the main differences between TMNs. To confirm this suggestion, it would be of utmost importance for future research to investigate if and how these differences in knowing are perceivable in a greater number of member cities' climate change policies.

What I further conclude is that the two networks play different roles in reinforcing, respectively challenging traditional ways of knowing climate change. Hoffmann (2013) projected that a particularity of transnational climate governance initiatives would be that they understand climate change differently to how the traditional, multilateral system understands it (on this discussion see also Dietzel 2019). He further suggested that transnational actors rather define climate change as a "global problem of transformation towards decarbonization" (Hoffmann 2013: 14). My analysis indeed confirms this assumption for Climate Alliance's way of knowing climate change and also the way how acting upon climate change is presented as being connected to a deeper socio-economic transformation. However, I cannot confirm this assumption for C40, which I found to reinforce the 'traditional' way of knowing and acting upon climate change, by suggesting rather reformative, or transitive changes than a true 'transformation' (Stirling 2015). When I started out with my analysis, one of my aims was to identify more clearly the role that different TMNs play in the governance of climate change. Based on my findings for the two networks investigated, I found that according to their prevalent way of knowing, city networks can either contribute to the reinforcement of hegemonic (knowledge and governance) structures which have traditionally coined climate change governance – or they can add alternative points of view and knowledges. Further, city networks indeed make use of a particular form of power to govern climate change which Okereke et al. (2009: 73) pointed to: they (at least partly) contribute to the creation of alternative mentalities, therefore render the epistemic object climate change practical and extend the understanding of what is considered an acceptable understanding of and response to climate change.

Summarizing once again, I found that the two ways of how C40 and Climate Alliance know climate change present two alternative ways of knowing. These two ways project different pathways of how to achieve the goal that both networks – and their ways of knowing – share; to be 'climate-friendly'. At the same time, the differing ways of knowing can be explained because they are being co-produced with more general structures and ideas present in the global governance of climate change, but also with the very specific knowledge environment of each network. At the same time, it can be assumed that those differences will have an influence on how exactly the two networks' member cities act upon climate change. As already stated in the beginning of this conclusion, I suggest that the co-existence of these different ways of knowing and respective ways forward is very positive. But why?

Fostering epistemic plurality for successfully dealing with climate change

As suggested before, climate change is a 'wicked' problem which has many different causes, consequences and potential solutions (Hoffmann 2013; Hulme 2009; Wesselink et al. 2013). Therefore, there is no single, 'best' way of knowing and acting upon climate change. Rather, what is important is to acknowledge that climate change is inseparably connected to social dynamics, ultimately raising ethical questions which have to be politically discussed and decided. If only one particular way of knowing becomes too dominant, even hegemonic, and gets questioned less, these ethical questions are 'de-politicized' (Standring 2017; Swyngedouw 2013). This 'de-politicization' consolidates 'post-democratic' or 'post-political' conditions which favor techno-managerial expert administration over democratic debate and contestation (Lövbrand et al. 2015; Swyngedouw 2009). Being aware of the ethical issues raised by climate change means to acknowledge that ultimately, human decisions in view of the threat of climate change are not technical questions, but decisions about equity, fairness and natural ethics (Hulme 2020: 1; O'Lear 2016: 4). Being faced with ethical questions, it is important to outline different potential alternatives of seeing, understanding, perceiving, and ultimately of acting upon the issue. These alternatives should be openly, politically discussed, which is only possible if they are admitted as valid ways of knowing, seeing and acting (Hulme 2020; Machin 2013; Stirling 2015; Swyngedouw 2013). Therefore, a wide variety of different ways of knowing are generally welcomed and highlighted as potential enabling factors for a transition to a more sustainable future:

> Recognizing competing ways of seeing and knowing nature and society may contribute not only towards mapping out possible future trajectories of environmental change but also towards investigating a wider set of policy choices and constructing alternative framings and visions for society in the future (Beck et al. 2014: 86).

In line with this perception, current IR research investigates if and how moving towards greater epistemic plurality, although here in research itself, could be a means to decolonize climate change governance, and to account for different ways of knowing, as well as the different ways in how climate justice unfolds (Wilkens and Wiener 2021). Seen from this angle, it is very positive and productive that different city networks represent different ways of knowledge and ultimately embody these on global and local climate governance levels. Through their co-existence, a certain epistemic plurality in knowing the epistemic object 'climate change' is fostered. Further, the parallel existence of two alternative ways of knowing within the two city networks analyzed can be seen as a fruitful engagement with "the multiple realities of climate change as they unfold across the world" (Livingston et al. 2018: 89), responding to the needs of a governance landscape characterized by polycentricity (Livingston et al. 2018). Therefore, these alternatives highlight that the questions raised by climate change are not as simple as to be climate-friendly or not, but that there are radically different political alternatives that need to be deliberated and struggled over (Machin 2013: 87ff; Standring 2017: 56). Machin even goes so far as to claim that "(…) to have any hope of acting against climate change we need to disagree" (Machin 2013: 2; for a similiar argument see Nursey-Bray 2017). TMN scholarship similarly argues that "there is no single ('best practice') route to a low-carbon, climate-resilient or climate-just city, and that there are potentially many pathways for governing urban climate transitions" (Van der Heijden 2019: 7). The fact that city networks point out and embody alternative pathways of knowing and governing climate change therefore also does justice to the multiple possible alternatives of doing so. TMNs' alternative ways of knowing are further answering the need of representing alternative, partially contradicting understandings. The positive evaluation of this finding rests on the belief that for legitimate and successful climate governance it is essential to "appreciate the plurality of plausible futures emerging from diverse ways of knowing both future(s) and climate change" (Wilkens and Wiener 2021: 5). Having outlined this plurality in knowing climate change represented by different city networks, this thesis also contributed to an important task of IR scholars, identified by Bäckstrand and Lövbrand (2019): to counter the perception that we are faced with a desperate crisis of imagination in which the possible realm of climate politics is very constrained:

> By emphasizing the plurality and discontinuity of political rationalities in the post-Copenhagen landscape, we believe that students of IR can begin to unsettle some of the political assumptions that seem to have defined the realm of the possible in Paris. This is an important analytical task that may help us to counter what critics have called 'the crisis of imagination' in climate politics (Klein, 2015) and hereby extend ongoing efforts explore new political trajectories for a carbon constrained world (Bäckstrand and Lövbrand 2019: 528f).

Through my analysis, I have contributed to this emphasis (and commendation) of actually existing pluralities in knowing and connected suggestions for climate action.

However, I have to highlight that this plurality only exists through the comparison of the two (from the beginning) very different networks. Despite the fact that some cities are found to be part of several city networks, the greater part seems to be a member in only one network (Bansard et al. 2017; Busch 2015). This suggests that these cities being part of only one network could not be aware of this epistemic plurality. This should be a focus in future research – does the epistemic plurality present actually arrive at member cities and their climate policies? Also, in the scope of this thesis, I cannot say anything about the many other city networks and their ways of knowing. This means that a similar analysis should be realized for other TMNs in the future, to confirm or reject the assumption that city networks are contributing to more epistemic plurality in the governance of climate change, generally.

In the introduction, I have started with the assumption that focusing on the specific actors 'TMNs' and their way of knowing would contribute a piece of the puzzle to the question of how we know climate change more broadly. This piece in the end turned out to be not only one piece, but actually different pieces – because there is no unequivocal answer to how we know climate change. Not generally, and not for city networks. However, having shown that these different ways of knowing contribute to a certain epistemic plurality for the epistemic object of climate change is a great finding. It shows that indeed, there is some plurality which might foster debates and accordingly stimulate many different pathways of successful climate policies. This thesis has thus contributed to outlining the plurality of political rationalities in the climate governance landscape and therefore highlighted that, indeed, there are many efforts ongoing to find new political trajectories in a world faced with climate change.

9 Bibliography

Ackoff, Russell L. (1989), 'From data to wisdom', *Journal of applied systems analysis* 16 (1), 3-9.

Acuto, Michele (2013a), 'The new climate leaders?', *Review of International Studies* 39, 835-857.

--- (2013b), 'City Leadership in Global Governance', *Global Governance* 19, 481-498.

--- (2013c), *Global Cities, Governance and Diplomacy. The urban link* (London/ New York: Routledge).

--- (2016), 'Give cities a seat at the top table', *Nature* 537, 611-613.

Acuto, Michele and Steele, Wendy (2013), 'Introduction', in: Michele Acuto and Wendy Steele (eds.), *Global City Challenges. Debating a Concept, Improving the Practice* (London/ New York: Palgrave Macmillan), 1-14.

Acuto, Michele and Rayner, Steve (2016), 'City networks: breaking gridlocks or forging (new) lock-ins?', *International Affairs* 92 (5), 1147-1166.

Adger, W. Neil; Barnett, Jon; Chapin, Stuart F.; and Ellemor, Heidi (2011), 'This must be the place: underrepresentation of identity and meaning in climate change decision-making', *Global Environmental Politics* 11 (2), 1-25.

Adger, W. Neil; Barnett, Jon; Brown, Katrina; Marshall, Nadine, et al. (2013), 'Cultural dimensions of climate change impacts and adaptation', *Nature Climate Change* 3 (2), 112-117.

Adler, Emanuel and Bernstein, Steven (2005), 'Knowledge in power: the epistemic construction of global governance', in: Michael Barnett and Raymond Duvall (eds.), *Power in Global Governance* (Cambridge: Cambridge University Press), 294-318.

Allan, Bentley B. (2017), 'Producing the Climate: States, Scientists, and the Constitution of Global Governance Objects', *International Organization* 71 (1), 131-162.

--- (2018), 'From subjects to objects: Knowledge in International Relations theory', *European Journal of International Relations* 24 (4), 841-864.

Alvesson, Mats and Kärreman, Dan (2001), 'Odd couple: making sense of the curious concept of knowledge management', *Journal of Management Studies* 38 (7), 995-1018.

Anderson, Kevin and Peters, Glen (2016), 'The trouble with negative emissions', *Science* 354 (6309), 182-183.

Andonova, Liliana; Betsill, Michele M.; and Bulkeley, Harriet (2009), 'Transnational Climate Governance', *Global Environmental Politics* 9 (2), 52-73.

Angelo, Hillary and Wachsmuth, David (2020), 'Why does everyone think cities can save the planet?', in: Jens Hoff, Quentin Gausset, and Simon Lex (eds.), *Non-State Actors in the*

Green Transition. Building a Sustainable Future (London/ New York: Routledge), 193-210.

Arup and C40 (2011), 'Climate Action in Megacities. C40 Cities Baseline and Opportunities' (London: Arup/ C40).

Aust, Helmut Philipp (2015), 'Shining Cities on the Hill? The Global City, Climate Change, and International Law', *The European Journal of International Law* 26 (1), 256-278.

Aye, Goodness C. and Edoja, Prosper Ebruvwiyo (2017), 'Effect of economic growth on CO2 emission in developing countries: Evidence from a dynamic panel threshold model', *Cogent Economics & Finance* 5 (1), 1379239.

Aylett, Alexander (2015), 'Institutionalizing the urban governance of climate change adaptation: Results of an international survey', *Urban Climate* 14, 4-16.

Bach Nielsen, Anne and Papin, Marielle (2020), 'The hybrid governance of environmental transnational municipal networks: Lessons from 100 Resilient Cities', *Environment and Planning C: Politics and Space*, online first.

Bäckstrand, Karin (2003), 'Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance', *Global Environmental Politics* 3 (4), 24-41.

--- (2006), 'Multi-Stakeholder Partnerships for Sustainable Development: Rethinking Legitimacy, Accountability and Effectiveness', *European Environment* 16 (5), 290-306.

--- (2008), 'Accountability of Networked Climate Governance: The Rise of Transnational Climate Partnerships', *Global Environmental Politics* 8 (3), 74-102.

Bäckstrand, Karin and Lövbrand, Eva (2006), 'Planting trees to mitigate climate change: Contested discourses of ecological modernization, green governmentality and civic environmentalism', *Global Environmental Politics* 6 (1), 50-75.

--- (2019), 'The Road to Paris: Contending Climate Governance Discourses in the Post-Copenhagen Era', *Journal of Environmental Policy & Planning* 21 (5), 519-532.

Bäckstrand, Karin; Kuyper, Jonathan W. ; Linnér, Björn-Ola; and Lövbrand, Eva (2017), 'Non-state actors in global climate governance: from Copenhagen to Paris and beyond', *Environmental Politics* 26 (4), 561-579.

Bansard, Jennifer S.; Pattberg, Philipp H.; and Widerberg, Oscar (2017), 'Cities to the rescue? Assessing the performance of transnational municipal networks in global climate governance', *International Environmental Agreements: Politics, Law and Economics* 17 (2), 229-246.

Barbehön, Marlon; Münch, Sybille; and Schlag, Gabi (2019), 'Interpretationen in der Politikwissenschaft', *Zeitschrift für Politikwissenschaft*, 1-11.

Barber, Benjamin (2013), *If Mayors Ruled the World. Rising Cities, Declining Nation States* (New Haven: Yale University Press).

Barbi, Fabiana and Valente De Macedo, Laura (2019), 'Transnational Municipal Networks and Cities in Climate Governance', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics: Agency and Empowerment* (Cambridge: Cambridge University Press), 59-79.

Barnett, Michael and Finnemore, Martha (2004), *Rules for the World: International Organizations in Global Politics* (Ithaca, NY: Cornell University Press).

Beck, Silke (2015), 'Science', in: Karin Bäckstrand and Eva Lövbrand (eds.), *Research Handbook on Climate Governance* (Cheltenham/ Northhampton: Edward Elgar Publishing), 286-296.

Beck, Silke; Forsyth, Tim; Kohler, Pia M.; Lahsen, Myanna, et al. (2017), 'The Making of Global Environmental Science and Politics', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (Cambridge, MA: The MIT Press), 1059-1086.

Beck, Silke; Borie, Maud; Chilvers, Jason; Esguerra, Alejandro, et al. (2014), 'Towards a reflexive turn in the governance of global environmental expertise. The cases of the IPCC and the IPBES', *GAIA-Ecological Perspectives for Science and Society* 23 (2), 80-87.

Berger, Peter L. and Luckmann, Thomas (1997 [1966]), *Die gesellschaftliche Konstruktion der Wirklichkeit. Eine Theorie der Wissenssoziologie. Mit einer Einleitung zu deutschen Ausgabe von Helmuth Plessner.* (6th edn., 41. - 42 Tsd.; Frankfurt a.M.: Fischer Taschenbuch Verlag GmbH).

Berkes, Fikret (2009), 'Indigenous ways of knowing and the study of environmental change', *Journal of the Royal Society of New Zealand* 39 (4), 151-156.

Betsill, Michele M. (2001), 'Mitigating Climate Change in U.S. Cities: Opportunities and Obstacles', *Local Environment* 6, 393-406.

Betsill, Michele M. and Bulkeley, Harriet (2004), 'Transnational Networks and Global Environmental Governance: the Cities for Climate Protection Program', *International Studies Quarterly* 48, 471-493.

--- (2006), 'Cities and the Multilevel Governance of Global Climate Change', *Global Governance* 12, 141-159.

--- (2007), 'Looking Back and Thinking Ahead: A decade of Cities and Climate Change Research', *Local Environment* 12, 447-456.

Betsill, Michele M.; Dubash, Navroz K.; Paterson, Matthew; van Asselt, Harro, et al. (2015), 'Building Productive Links between the UNFCCC and the Broader Global Climate Governance Landscape', *Global Environmental Politics* 15 (2), 1-10.

Biermann, Frank and Pattberg, Philipp (2008), 'Global Environmental Governance: Taking stock, moving forward', *Annual Review of Environment and Resources* 33, 277-294.

Bliesemann de Guevara, Berit and Kurowska, Xymena (2020), 'Interpretive approaches in political science and international relations', in: Luigi Curini and Robert Franzese (eds.), *The SAGE Handbook of research methods in political science & IR* (2; London/ Thousand Oaks/ New Delhi: Sage Publications Ltd.), 1221-1240.

Boasson, Elin Lerum (2018), 'Entrepreneurship. A Key Driver of Polycentric Governance?', in: Dave Huitema, et al. (eds.), *Governing Climate Change. Polycentricity in Action?* (Cambridge: Cambridge University Press), 117-134.

Boasson, Elin Lerum and Huitema, Dave (2017), 'Climate governance entrepreneurship: Emerging findings and a new research agenda', *Environment and Planning C: Politics and Space* 35 (8), 1343-1361.

Bornemann, Basil; Glaab, Katharina; and Partzsch, Lena (2019), 'Politikwissenschaftliches Interpretieren des Anthropozäns – Zur Bedeutung interpretativer Politikforschung im Umgang mit Objektivität, Normativität und Performativität von Meta-Konzepten', *Zeitschrift für Politikwissenschaft* 29, 325–344.

Boswell, John; Corbett, Jack; and Rhodes, R. A. W. (2019), 'Comparative Intuition', in: Jack Corbett, John Boswell, and R. A. W. Rhodes (eds.), *The Art and Craft of Comparison* (Strategies for Social Inquiry; Cambridge: Cambridge University Press), 1-18.

Bourdieu, Pierre (1973), 'The three forms of theoretical knowledge', *Social Science Information* 12 (1), 53-80.

Bouteligier, Sophie (2009), 'Cities break new ground', *The Broker Online*. <http://www.thebrokeronline.eu/Special-Reports/Special-Report-Cities-of-the-world-unite/Cities-break-new-ground>, accessed 29 January 2018.

--- (2013), *Cities, Networks, and Global Environmental Governance. Spaces of Innovation, Places of Leadership* (London/ New York: Routledge).

--- (2014), 'A Networked Urban World. Empowering Cities to Tackle Environmental Challenges', in: Simon Curtis (ed.), *The Power of Cities in International Relations* (London/ New York: Routledge), 57-68.

--- (2015), 'Multinational Companies and Urban Climate Governance. Market Making or Successful Policy Innovation?', in: Craig A. Johnson, Noah J. Toly, and Heike Schroeder (eds.), *The Urban Climate Challenge. Rethinking the Role of Cities in the Global Climate Regime* (London/ New York: Routledge), 82-97.

Bracken, Louise J. and Oughton, Elizabeth A. (2012), 'Making sense of policy implementation: The construction and uses of expertise and evidence in managing freshwater environments', *Environmental Science & Policy* 30, 10-18.

Brand, Ulrich (2010), 'Sustainable development and ecological modernization – the limits to a hegemonic policy knowledge', *Innovation – The European Journal of Social Science Research* 23 (2), 135-152.

Bremer, Scott and Meisch, Simon (2017), 'Co-production in climate change research: reviewing different perspectives', *Wiley Interdisciplinary Reviews: Climate Change* 8 (6), e482.

Brundtland, Gro Harlem (1989), 'Global Change and Our Common Future - Environment ', *Environment* 31 (5), 16-43.

Bryant, Toba (2002), 'Role of knowledge in public health and health promotion policy change', *Health Promotion International* 17 (1), 89-98.

Buchanan, Karen S. (2013), 'Contested discourses, knowledge, and socio-environmental conflict in Ecuador', *Environmental Science & Policy* 30, 19-25.

Bueger, Christian (2015), 'Making Things Known: Epistemic Practices, the United Nations, and the Translation of Piracy', *International Political Sociology* 9, 1-18.

Bulkeley, Harriet (2010), 'Cities and the Governing of Climate Change', *Annual Review of Environment and Resources* 35, 229-253.

--- (2013), *Cities and Climate Change* (Critical Introductions to Urbanism and the City; London/ New York: Routledge).

Bulkeley, Harriet and Betsill, Michele M. (2003), *Cities and Climate Change. Urban Sustainability and Global Environmental Governance* (Routledge Studies in Physical Geography and the Environment; London/ New York: Routledge).

--- (2005), 'Rethinking Sustainable Cities: Multilevel Governance and the 'Urban' Politics of Climate Change', *Environmental Politics* 14 (1), 42-63.

Bulkeley, Harriet and Castán Broto, Vanesa (2013), 'Government by experiment? Global cities and the governing of climate change', *Transactions of the Institute of British Geographers* 38, 361-375.

Bulkeley, Harriet and Betsill, Michele M. (2013), 'Revisiting the urban politics of climate change', *Environmental Politics* 22 (1), 136-154.

Bulkeley, Harriet; Davies, Anna; Evans, B. O. B.; Gibbs, David, et al. (2003), 'Environmental Governance and Transnational Municipal Networks in Europe', *Journal of Environmental Policy & Planning* 5 (3), 235-254.

Bullough, Robert V. Jr. and Goldstein, Stanley L. (1984), 'Technical curriculum form and American elementary school art education', *Journal of Curriculum Studies* 16 (2), 143-154.

Busch, Henner (2015), 'Linked for action? An analysis of transnational municipal climate networks in Germany', *International Journal of Urban Sustainable Development* 7 (2), 213-231.

Busch, Henner; Bendlin, Lena; and Fenton, Paul (2018), 'Shaping local response – The influence of transnational municipal climate networks on urban climate governance', *Urban Climate* 24, 221-230.

C40 (2016a), 'Benefits of Climate Action. Piloting A Global Approach To Measurement' (London: C40).

--- (2016b), 'Benefits of Climate Action. Piloting A Global Approach To Measurement. Appendix' (London: C40).

--- (2016c), 'Unlocking Climate Action in Megacities' (London: C40).

--- (2016d), 'Deadline 2020. How cities will get the job done' (London: C40/ Arup).

--- (2017), 'About C40', <http://www.c40.org/about>, accessed 18 March 2019.

--- (2018), 'C40 Cities Annual Report 2017', <https://c40-production-images.s3.amazonaws.com/other_uploads/images/2056_C40_ANNUAL_REPORT_2017.original.pdf?1544802871>, accessed 9 March 2019.

--- (2019a), 'Cities', <https://www.c40.org/cities>, accessed 18 March 2019.

--- (2019b), 'Careers', <https://www.c40.org/careers>, accessed 19 March 2019.

--- (2019c), 'Our Partners & Funders', <https://www.c40.org/partners>, accessed 18 March 2019.

--- (2019d), 'Research library', <https://www.c40.org/c40_research>, accessed 17 April 2019.

--- (2020a), Interview with C40 staff, 23 September 2020 (via Zoom, 23 September 2020).

--- (2020b), Interview with C40 staff, 10 September 2020 (via Zoom, 10 September 2020).

C40 and CDP (2013), 'Wealthier, Healthier Cities. How climate change action is giving us wealthier, healthier cities. Based on the CDP responses from 110 global cities' (London: CDP/ C40).

C40 and Arup (2015a), 'Polisdigitocracy: Digital Technology, Citizen Engagement and Climate Action' (London: C40/ Arup).

--- (2015b), 'Executive Summary. Powering Climate Action: Cities as Global Changemakers' (London: C40/ Arup).

C40 and LSECities (2016), 'Co-benefits of urban climate action: A framework for cities. A working paper by the Economics of Green Cities Programme, LSE Cities, London School of Economics and Political Science' (London: C40/ LSECities).

C40 and Arup (2016a), 'Deadline 2020. How cities will get the job done' (London: C40/ Arup).

--- (2016b), 'How U.S. Cities Will Get the Job Done' (London: C40/ Arup).

C40 and McKinsey, McKinsey Center for Business and Environment (2017), 'Focused acceleration: A strategic approach to climate action in cities to 2030', <https://www.c40.org/researches/mckinsey-center-for-business-and-environment>, accessed 30 March 2020.

C40 and NewClimateInstitute (2018), 'Opportunity 2030: Benefits of Climate Action in Cities. Quantifying the benefits of city-level measures in buildings, transport and energy supply' (Cologne/ Berlin/ London: NewClimate-Insitute for Policy and Global Sustainability gGmbH/ C40).

C40 and NYCSustainability, NYC Mayor's Office of Sustainability (2019), 'Defining Carbon Neutrality for Cities & Managing Residual Emissions. Cities' Perspective & Guidance' (New York/ London: NYC Mayor's Office of Sustainability/ C40).

C40 and Bloomberg, Michael R. (n.d.-a), 'Advancing Climate ambition: Cities as Partners in Global Climate Action. Infographic', <https://www.c40.org/researches/advancing-climate-ambition-infographic>, accessed 30 March 2020.

C40 and Johnson&Johnson (n.d.), 'Toward a Healthier World. Connecting the dots between Environmental Health & Public Health', <https://c40-production-images.s3.amazonaws.com/researches/images/73_TOWARD_A_HEALTHIER_WORLD.original.pdf?1543933503>, accessed 15 January 2020.

C40 and Arup (n.d.), 'Global Aggregation of City Climate Commitments. Methodological Review' (London: C40/ Arup).

C40 and Bloomberg, Michael R. (n.d.-b), 'Advancing climate ambition: cities as partners in global climate action', <https://www.c40.org/researches/advancing-climate-ambition-cities-as-partners-in-global-climate-action>, accessed 30 March 2020.

C40; BloombergPhilanthropies; and StockholmEnvironmentInstituteUS (2014), 'The contribution of urban-scale actions to ambitious climate targets', <https://www.c40.org/researches/the-contribution-of-urban-scale-actions-to-ambitious-climate-targets>, accessed 30 March 2021.

C40; NewClimateInstitute; and GCoM, Global Covenant of Mayors for Climate & Energy (2018a), 'Climate Opportunity: More Jobs; Better Health; Liveable Cities. Quantifying the Benefits of Climate Change Mitigation Measures in Buildings, Transport and Energy Supply' (London/ Berlin/ Cologne: C40/ NewClimateInstitute/ GCoM).

C40; BloombergPhilanthropies; and Arup (n.d.), 'City Climate Hazard Taxonomy. C40's classification of city-specific climate hazards', <https://www.c40.org/researches/city-climate-hazard-taxonomy>, accessed 30 March 2020.

C40; CitiesAlliance; FutureEarth; ICLEI, Local Governments for Sustainability, et al. (2018b), 'the science we need for the cities we want: working together to implement the global

research agenda on cities and climate change. joint statement' *CitiesIPCC Cities and Climate Change Science Conference, March 5-7, 2018* (Edmonton, Canada)

C40; GCoM, Global Covenant of Mayors for Climate & Energy; Bazaz, Amir; Bertoldi, Paolo, et al. (2018c), 'Summary for Urban Policy-Makers. What the IPCC Special Report on Global Warming of 1.5°C means for Cities', <https://www.ipcc.ch/site/assets/uploads/sites/2/2018/12/SPM-for-cities.pdf>, accessed 19 March 2019.

Caney, Simon (2005), 'Cosmopolitan Justice, Responsibility, and Global Climate Change', *Leiden Journal of International Law* 18, 747-775.

Carr, Wilfred and Kemmis, Stephen (1986), *Becoming critical - Education, knowledge and action research* (Philadelphia: Falmer).

Cashore, Benjamin; Auld, Graeme; and Newsom, Deanna (2004), *Governing Through Markets: Forest Certification and the Emergence of Nonstate Authority* (New Haven, CT: Yale University Press).

Castán Broto, Vanesa (2017), 'Urban Governance and the Politics of Climate change', *World Development* 93, 1-15.

CDP; C40; and BloombergPhilanthropies (2014), 'Protecting Our Capital. How climate adaptation in cities creates a resilient place for business' (London: CDP).

Chan, Sander; van Asselt, Harro; Hale, Thomas; Abbott, Kenneth W., et al. (2015), 'Reinvigorating International Climate Policy: A Comprehensive Framework for Effectice Nonstate Action', *Global Policy* 6 (4), 466-473.

Christoff, Peter and Eckersley, Robyn (2013), *Globalization and the Environment* (Globalization; Plymouth: Rowman & Littlefield).

Clapp, Jennifer and Dauvergne, Peter (2011), *Paths to a Green World. The Political Economy of the Global Environment* (2nd edn.; Cambridge/ London: The MIT Press).

ClimateAlliance (2008), 'Compensation of CO2 Emissions. Agreed resolution of the General Assembly of the Climate Alliance on 3rd April 2008 in the city of Aachen', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_Compensation_EN_200804.pdf>, accessed 30 March 2020.

--- (2009), 'Climate Alliance Position Paper regarding REDD - for the Protection of Forests - Adopted by the General Assembly on 23rd April 2009 in Brussels', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Positionpaper_REDD_EN_200904.pdf>, accessed 29 March 2020.

--- (2010a), 'Leave the oil in the ground! Resolution of the Climate Alliance General Assembly on April 15 2010 in Perugia/Italy regarding Ecuador's 'Yasuní Proposal'',

<https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_Yasuni_DE_201004.pdf>, accessed 29 March 2020.

--- (2010b), 'Cities investing in energy efficiency and renewable energy sources are drivers of economic recovery. Resolution of the Climate Alliance General Assembly 2010 regarding the allocation of remaining funds in the European Economic Recovery Plan to cities', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_EERP_EN_201004.pdf>, accessed 29 March 2020.

--- (2011), 'Electric mobility. Framework conditions: Climate Alliance's perspective', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_Electric_mobility_EN_201105.pdf>, accessed 29 March 2020.

--- (2012a), 'The Millenium Consumption Goals - a crucial completion of the Millenium Development Goals. Resolution of the Members of Climate Alliance at the General Assembly on 24 May 2012 in the city of St. Gallen', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_MDG_EN_201205.pdf>, accessed 29 March 2020.

--- (2012b), 'Amazonian Indigenous REDD+. Resolution of the Climate Alliance General Assembly on 24 May 2012 in the city of St. Gallen', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_REDD_EN_201205.pdf>, accessed 29 March 2020.

--- (2014), 'Teaming up in Europe for a sustainable energy future. Climate Alliance resolution on a strong and ambitious 2030 framework for climate and energy policies, and fair and responsible sharing of tasks across all levels of government', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_Teamingup_EN_201405.pdf>, accessed 29 March 2020.

--- (2015a), 'UNREDDY. A critical look at REDD+ and indigenous strategies for comprehensive forest protection' (Luxembourg: Climate Alliance/ ASTM).

--- (2015b), 'The Post-2015 Development Agenda - from Visions to Measures and Solutions', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_Post2015_EN_201504.pdf>, accessed 29 March 2020.

--- (2015c), 'A good life is simple. Campaign material information' (Frankfurt a.M.: Climate Alliance).

--- (2016a), 'Climate Alliance. 2015 European Secretariat Year in review' (Frankfurt a.M.: Climate Alliance).

--- (2016b), 'Bridges to Amazonia' (Frankfurt a.M.: Climate Alliance).

--- (2017a), 'The Future We Want. Championing Climate Justice' (Frankfurt a.M.: Climate Alliance).

--- (2017b), 'Implementing Adaptation to Climate Change at the Local Level', <https://www.climatealliance.org/fileadmin/Inhalte/1_About_us/Resolutions/CA-Resolution_adaptation_EN_FINAL.PDF>, accessed 29 March 2020.
--- (2017c), 'Local and Regional Authorities as Drivers of Climate Action and Sustainability towards a Good Life for All', <https://www.climatealliance.org/fileadmin/Inhalte/6_Events/2017/2017_Int_Conference_Essen/Resolution_A_Good_Life_For_All_EN.pdf>, accessed 29 March 2020.
--- (2017d), 'The Future We Want. Bridging Europe and Amazonia' (Frankfurt a.M.: Climate Alliance).
--- (2017e), 'The Future We Want. Shaping Our Future' (Frankfurt a.M.: Climate Alliance).
--- (2018a), 'Change the Power - (Em)Power to Change: Local Authorities towards the SDGs and Climate Justice: Why and how can municipalities use the online tool Change the Future' (Brussels: Climate Alliance).
--- (2018b), 'Climate Alliance. Review and Outlook. 2017/2018' (Frankfurt a.M.: Climate Alliance).
--- (2019a), 'Global Climate Change Policy and Its Implication for Municipalities. The implication of the Paris Agreement, EU-Commissions 2050 Strategy and IPCC-Report for municipalities & cities' (Frankfurt a.M./ Brussels: Climate Alliance).
--- (2019b), 'Tools and methods', <http://www.climatealliance.org/nc/activities/tools-and-methods.html?page=68>, accessed 17 April 2019.
--- (2019c), 'Resolutions', <http://www.climatealliance.org/about-us/the-association/resolutions.html?page=364%2F>, accessed 21 January 2020.
--- (2019d), 'Member List', <https://www.climatealliance.org/fileadmin/Inhalte/2_Municipalities/Member_List_January2019.pdf>, accessed 12 March 2019.
--- (2019e), 'Municipal action', <http://www.climatealliance.org/about-us/climate-action/municipal-action.html?page=264>, accessed 13 March 2019.
--- (2019f), 'Climate action', <http://www.climatealliance.org/about-us/climate-action.html?page=264>, accessed 13 March 2019.
--- (2019g), 'Municipalities', <https://www.climatealliance.org/nc/kommunen/das-netzwerk.html>, accessed 12 March 2019.
--- (2019h), 'The association', <http://www.climatealliance.org/about-us/the-association.html>, accessed 13 March 2019.
--- (2020), Interview with Climate Alliance staff (via DFNconf, 29 May 2020).
--- (n.a.), 'Practice Cube. Climate Active Neighbourhoods' (Frankfurt a.M.: Climate Alliance).

--- (n.d.-a), 'CO2 Accounting & Monitoring - A long standing pillar of Climate Alliance's work', <https://www.climatealliance.org/fileadmin/user_upload/Climate_Alliance_CO2_Moniorin g_Position_Paper-EN.pdf>, accessed 30 March 2020.

--- (n.d.-b), 'Transforming Our World. Local Authorities for Global Sustainable Development' (Frankfurt a.M.: Climate Alliance).

ClimateAlliance and ASTM (2013a), 'We Are All Witnesses. People in a Changing Climate' (Luxembourg: ASTM/ Climate Alliance).

--- (2013b), 'The Land We Grab. Seizing Tropical Rainforest and Soil. Eyewitnesses from the Amazon and Africa … And how Europe is involved' (Luxembourg: ASTM/ Climate Alliance).

ClimateAlliance; Energinvest; GRELiège; and REScoop.eu (2017), 'Setting up innovative financing schemes for energy efficiency renovations: a guidance for local authorities' (Frankfurt a.M.: Climate Alliance).

ClimateAlliance; ASTM; CEPA; Greenpeace, et al. (2014), 'Our Hold Over the World's Raw Materials. Facts and eyewitness reports from the Congo, Peru, Ecuador, Nigeria and the Arctic over the downsides of our consumption' (Luxembourg: ASTM/ Climate Alliance).

Coaffee, Jon and Lee, Peter (2016), *Urban resilience: Planning for risk, crisis and uncertainty* (London/ New York: Palgrave Macmillan).

Corfee-Morlot, Jan; Lamia, Kamal-Chaoui; Donovan, Michael, G.; Cochran, Ian, et al. (2009), *Cities, Climate Change and Multilevel Governance* (OECD Environmental Working Papers N° 14; Paris: OECD publishing).

Cornell, Sarah; Berkhout, Frans; Tuinstra, Willemijn; Tàbara, J David, et al. (2013), 'Opening up knowledge systems for better responses to global environmental change', *Environmental Science & Policy* 28, 60-70.

CPH, City of Copenhagen (2012), 'CPH 2025 Climate Plan. A Green, Smart and Carbon Neutral City' (København: Technical and Environmental Administration).

--- (2016), 'CPH 2025 Climate Plan. Roadmap 2017-2020' (København: Technical and Environmental Administration).

--- (2018), 'Circular Copenhagen. Resource and Waste Management Plan 2024' (København: Technical and Environmental Administration).

--- (2020), 'CPH 2025 Climate Plan. Roadmap 2021-2025' (København: Technical and Environmental Administration).

Crombie, Alistair (1994), *Styles of Scientific Thinking in the European Tradition* (London: Gerald Duckworth).

Curtis, Simon (2014), *The Power of Cities in International Relations* (London/ New York: Routledge).

Daniels, Stephen and Endfield, Georgina H. (2009), 'Narratives of climate change: introduction', *Journal of Historical Geography* 35, 215-222.

Davenport, Thomas H. and Prusak, Laurence (1998), *Working knowledge: How organizations manage what they know* (Boston: Harvard Business School Press).

Davidson, Kathryn and Gleeson, Brendan (2015), 'Interrogating Urban Climate Leadership: Toward a Political Ecology of the C40 Network', *Global Environmental Politics* 15 (4), 21-38.

De Lucia, Vito (2008), 'Polluter pays principle ', *The Encyclopedia of Earth* (updated 27 January 2016) <http://www.eoearth.org/view/article/155292/>, accessed 14 November 2019.

Dietzel, Alix (2019), *Global Justice and Climate Governance: Bridging Theory and Practice* (Edinburgh: Edinburgh University Press).

Dröge, Susanne (2016), 'The Paris Agreement 2015: turning point for the international climate regime', *SWP Research Paper* 4.

EASAC (2018), 'Extreme weather events in Europe. Preparing for climate change adaptation: an update on EASAC's 2013 study' (Halle (Saale)/ Brussels: European Academies Science Advisory Council)

Edge, David (1995), 'Reinventing the Wheel', in: Sheila Jasanoff, et al. (eds.), *Handbook of Science and Technology Studies* (Thousand Oaks/ London/ New Delhi: Sage Publications), 3-24.

Ewert, Gerry D. (1991), 'Habermas and education: A comprehensive overview of the influence of Habermas in educational literature', *Review of Educational Research* 61 (3), 345-378.

Feldman, David L. (2012), 'The future of environmental networks—Governance and civil society in a global context', *Futures* 44 (9), 787-796.

Felt, Ulrike (2017), 'Making Knowledge, People, and Societies', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (Cambridge, MA: The MIT Press), 253-257.

Felt, Ulrike; Fouché, Rayvon; Miller, Clark; and Smith-Doerr, Laurel (2017), 'Introduction', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (Cambridge, MA: The MIT Press), 1-26.

FIPLC, Forum of Indigenous Peoples and Local Communities on Climate Change (2000), 'The Hague Declaration of the Second International Forum of Indigenous Peoples and Local Communities on Climate Change', (updated November 11-12, 2000) <http://www.tebtebba.org/tebtebba_files/susdev/cc_energy/hague.html>, accessed 9 March 2019.

Fischer, Frank (2000), *Citizens, Experts, and the Environment: The Politics of Local Knowledge* (Durham, NC: Duke University Press).

--- (2003), 'Beyond empiricism: policy analysis as deliberative practice', in: Maarten A. Hajer and Hendrik Wagenaar (eds.), *Deliberative Policy Analysis: Understanding Governance in the Network Society* (Cambridge, UK: Cambridge University Press), 209-227.

--- (2019), 'Knowledge politics and post-truth in climate denial: on the social construction of alternative facts', *Critical Policy Studies* 13 (2), 133-152.

Fischer, Kaj et. al. (2015), 'Urbanization and Climate Diplomacy' *Climate Diplomacy Series* (Berlin: adelphi).

Forsyth, Tim (2020), 'Who Shapes the Politics of Expertise? Co-Production and Authoritative Knowledge in Thailand's Political Forests', *Antipode* 52 (4), 1039-1059.

Fuhr, Harald; Hickmann, Thomas; and Kern, Kristine (2018), 'The role of cities in multi-level climate governance: local climate policies and the 1.5 °C target', *Current Opinion in Environmental Sustainability* 30, 1-6.

Gherardi, Silvia and Miele, Francesco (2018), 'Knowledge management from a social perspective: The contribution of practice-based studies', *The Palgrave handbook of knowledge management* (Dordrecht: Springer), 151-176.

Giddens, Anthony (1986), *The constitution of society: Outline of the theory of structuration* (Berkeley: University of California Press).

Ginger, Clare (2006), 'Interpretive Content Analysis: Stories and Arguments in Analytic Documents', in: Dvora Yanow and Peregrine Schwartz-Shea (eds.), *Interpretation and method: Empirical research methods and the interpretive turn* (Armonk/ London: M.E. Sharpe), 331-349.

Glückler, Johannes; Lazega, Emmanuel; and Hammer, Ingmar (2017), 'Exploring the Interaction of Space and Networks in the Creation of Knowledge: An Introduction', in: Johannes Glückler, Emmanuel Lazega, and Ingmar Hammer (eds.), *Knowledge and Networks* (Knowledge and Space, 11; Cham: Springer Open), 1-21.

Gordon, David J. (2013), 'Between local innovation and global impact: cities, networks, and the governance of climate change', *Canadian Foreign Policy Journal* 19 (3), 288-307.

--- (2016a), 'From Global Cities to Global Governors: Power, Politics, and the Convergence of Urban Climate Governance', (Toronto: University of Toronto).

--- (2016b), 'The Politics of Accountability in Networked Urban Climate Governance', *Global Environmental Politics* 16 (2), 82-100.

--- (2019), 'Unpacking Agency in Global Urban Climate Governance', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics: Agency and Empowerment* (Cambridge: Cambridge University Press), 21-38.

Gordon, David J. and Acuto, Michele (2015), 'If Cities Are the Solution, What Are the Problems? The Promise and Perils of Urban Climate Leadership', in: Craig A. Johnson, Noah J. Toly, and Heike Schroeder (eds.), *The Urban Climate Challenge. Rethinking the Role of Cities in the Global Climate Regime* (New York/ London: Routledge), 63-81.

Gordon, David J. and Johnson, Craig A. (2018), 'City-networks, global climate governance, and the road to 1.5° C', *Current Opinion in Environmental Sustainability* 30, 35-41.

Gore, Christopher (2019), 'Agency and Climate Governance in African Cities', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics: Agency and Empowerment* (Cambridge, UK: Cambridge University Press), 190-209.

Grundmann, Reiner (2019), 'Die Wissenschaften in der Klimadebatte', *Aus Politik und Zeitgeschichte* 47/48, 30-34.

Guzzini, Stefano (2000), 'A Reconstruction of Constructivism in International Relations', *European Journal of International Relations* 6 (2), 147-182.

Haas, Peter M. (1992), 'Banning Chlorofluorocarbons: Epistemic Community Efforts to Protect Stratospheric Ozone', *International Organization* 46 (1), 187-224.

Habermas, Jürgen (1968/1973), *Erkenntnis und Interesse* (Frankfurt a.M.: suhrkamp taschenbuch wissenschaft).

--- (1987), *Knowledge and Human Interests*, trans. Jeremy J. Shapiro (Cambridge, UK: Polity Press).

Hacking, Ian (1992), ''Style' for historians and philosophers', *Studies in History and Philosophy of Science Part A* 23 (1), 1-20.

Hajer, Maarten A. (1995), *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process* (Oxford: Clarendon Press).

Harris, Paul G. (2006), 'The European Union and Environmental Change: Sharing the Burdens of Global Warming', *Colorado Journal of International Environmental Law and Policy* 17 (2), 309-356.

Harrison, Lisa and Callan, Theresa (2013), *Key Research Concepts in Politics & International Relations* (SAGE Key Concepts; Los Angeles/ London/ New York: SAGE).

Haupt, Wolfgang and Coppola, Alessandro (2019), 'Climate governance in transnational municipal networks: advancing a potential agenda for analysis and typology', *International Journal of Urban Sustainable Development*, 1-18.

Haupt, Wolfgang; Chelleri, Lorenzo; van Herk, Sebastiaan; and Zevenbergen, Chris (2018), 'The significance of city-to-city learning in transnational climate networks: a global perspective' *Cities & Climate Change Science Conference* (Edmonton, Alberta: citiesIPCC).

--- (2020), 'City-to-city learning within climate city networks: definition, significance, and challenges from a global perspective', *International Journal of Urban Sustainable Development* 12 (2), 143-159.

Hawkesworth, Mary (2015), 'Contending Conceptions of Science and Politics. Methodology and the Constitution of the Political', in: Dvora Yanow and Peregrine Schwartz-Shea (eds.), *Interpretation and method: Empirical research methods and the interpretive turn* (2nd edn.; Abingdon / New York: Routledge), 27-49.

Heikkinen, Milja; Ylä-Anttila, Tuomas; and Juhola, Sirkku (2019), 'Incremental, reformistic or transformational: what kind of change do C40 cities advocate to deal with climate change?', *Journal of Environmental Policy & Planning* 21 (1), 90-103.

Hickel, Jason and Kallis, Giorgos (2019), 'Is Green Growth Possible?', *New Political Economy*, 1-19.

Hickmann, Leo (2016a), 'The history of BECCS', *Carbon Brief* <https://www.carbonbrief.org/beccs-the-story-of-climate-changes-saviour-technology>, accessed 30 March 2021.

Hickmann, Thomas (2016b), *Rethinking Authority in Global Climate Governance. How transnational climate initiatives relate to the international climate regime* (Routledge Research in Global Environmental Governance; London/ New York: Routledge).

Hoffmann, Matthew J. (2011), *Climate Governance at the Crossroads: Experimenting With a Global Response After Kyoto* (Oxford: Oxford University Press).

--- (2013), 'Global Climate Change', in: Robert Falkner (ed.), *The Handbook of Global Climate and Environment Policy* (Malden/ Oxford: Wiley-Blackwell), 3-18.

Holtz-Eakin, Douglas and Selden, Thomas M. (1995), 'Stoking the fires? CO2 emissions and economic growth', *Journal of Public Economics* 57, 85-101.

Hughes, Sara and Romero-Lankao, Patricia (2014), 'Science and institution building in urban climate-change policymaking', *Environmental Politics* 23 (6), 1023-1042.

Hughes, Sara; Tozer, Laura; and Giest, Sarah (2019), 'The Politics of Data-Driven Urban Climate Change Mitigation', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics. Agency and Empowerment* (Cambridge, UK: Cambridge University Press), 116-134.

Hulme, Mike (2009), *Why we disagree about climate change: Understanding controversy, inaction and opportunity* (Cambridge, UK: Cambridge University Press).

--- (2010), 'Problems with making and governing global kinds of knowledge', *Global Environmental Change* 20, 558-564.

--- (2012), 'On the ‘two degrees’ climate policy target', in: Ottmar Edenhofer, et al. (eds.), *Climate Change, Justice and Sustainability: Linking Climate and Development Policy* (Dordrecht: Springer), 122-125.

--- (2015), 'Knowledge pluralism', in: Karin Bäckstrand and Eva Lövbrand (eds.), *Research Handbook on Climate Governance* (Cheltenham, UK/ Northhampton, MA: Edward Elgar Publishing), 555-565.

--- (2020), 'Preface: Why and How to Debate Climate Change', in: Mike Hulme (ed.), *Contemporary Climate Change Debates: A Student Primer* (London/ New York: Routledge), 1-9.

ICLEI (2019), 'Our members', <https://iclei.org/en/our_members.html>, accessed 13 March 2019.

INTERREG, Alpine Space Project (2018), 'Behaviour Change Policies State of the Art Report', <https://www.alianzadelclima.org/fileadmin/Inhalte/7_Downloads/SaMBA_D.T2.2_Behaviour_change_policies_state_of_the_art_report.pdf>, accessed 30 March 2020.

IPCC, Intergovernmental Panel on Climate Change (2014), 'Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change' (Geneva, Switzerland: IPCC).

--- (2019), 'Reports', <https://www.ipcc.ch/reports/>, accessed 6 December 2019.

Jackson, Patrick Thaddeus (2016), *The Conduct of Inquiry in International Relations: Philosophy of Science and its Implications for the Study of World Politics* (London/ New York: Routledge).

Jacobs, Michael (2013), 'Green growth', in: Robert Falkner (ed.), *Handbook of global climate and environmental policy* (Malden/ Oxford: Wiley-Blackwell), 197-214.

James, Paul and Verrest, Hebe (2015), 'Beyond the network effect: towards an alternative understanding of global urban organizations', *Geographies of Urban Governance* (Dordrecht: Springer), 65-84.

Jasanoff, Sheila (1995), *The fifth branch. Science advisers as policymakers* (Cambridge, MA: Harvard University Press).

--- (2004), *States of Knowledge : The Co-Production of Science and the Social Order* (International Library of Sociology; London/ New York: Routledge).

--- (2010a), 'Testing time for climate science', *Science* 328 (5979), 695-696.

--- (2010b), 'A New Climate for Society', *Theory, Culture & Society* 27 (2-3), 233-253.

--- (2015a), 'Science and technology studies', in: Karin Bäckstrand and Eva Lövbrand (eds.), *Research Handbook on Climate Governance* (Cheltenham/ Northhampton: Edward Elgar Publishing), 36-48.

--- (2015b), 'Imagined and Invented Worlds', in: Sheila Jasanoff and Sang-Hyun Kim (eds.), *Dreamscapes of Modernity. Sociotechnical Imaginaries and the Fabrication of Power* (Chicago/ London: The University of Chicago Press), 321-341.

--- (2015c), 'Future Imperfect: Science, Technology, and the Imaginations of Modernity', in: Sheila Jasanoff and Sang-Hyun Kim (eds.), *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power* (Chicago/ London: University of Chicago Press), 1-32.

Jasanoff, Sheila and Long Martello, Marybeth (2004a), 'Introduction. Globalization and Environmental Governance', in: Sheila Jasanoff and Marybeth Long Martello (eds.), *Earthly Politics. Local and Global in Environmental Governance* (Cambridge/ London: The MIT Press).

--- (2004b), 'Conclusion. Knowledge and Governance', in: Sheila Jasanoff and Marybeth Long Martello (eds.), *Earthly Politics. Local and Global in Environmental Governance* (Cambridge/ London: The MIT Press), 335-350.

--- (eds.) (2004c), *Earthly Politics. Local and Global in Environmental Governance* (Cambridge/ London: The MIT Press).

Johnson, Björn; Lorenz, Edward; and Lundvall, Bengt-Åke (2002), 'Why all this fuss about codified and tacit knowledge?', *Industrial and Corporate Change* 11 (2), 245-262.

Johnson, Craig A. (2018), *The Power of Cities in Global Climate Politics. Saviours, Supplicants or Agents of Change?* (London: Palgrave Macmillan).

Johnson, Craig A.; Schroeder, Heike; and Toly, Noah J. (2015a), 'Introduction: Urban Resilience, Low Carbon Governance and the Global Climate Regime', in: Craig A. Johnson, Noah J. Toly, and Heike Schroeder (eds.), *The Urban Climate Challenge. Rethinking the Role of Cities in the Global Climate Regime* (London/ New York: Routledge), 3-23.

--- (2015b), 'Conclusion. Governing the Urban Climate Challenge', in: Craig A. Johnson, Heike Schroeder, and Noah J. Toly (eds.), *The Urban Climate Challenge. Rethinking the Role of Cities in the Global Climate Regime* (London/ New York: Routledge), 227-243.

Jones, Meriel D.H. and Henderson-Sellers, Ann (1990), 'History of the greenhouse effect', *Progress in Physical Geography: Earth and Environment* 14 (1), 1-18.

Jordan, Andrew; Huitema, Dave; Van Asselt, Harro; and Forster, Johanna (2018), *Governing Climate Change: Polycentricity in Action?* (Cambridge/ New York: Cambridge University Press).

Karhunmaa, Kamilla (2019), 'Attaining carbon neutrality in Finnish parliamentary and city council debates', *Futures* 109, 170-180.

Keiner, Marco and Kim, Arley (2007), 'Transnational city networks for sustainability', *European Planning Studies* 15 (10), 1369-1395.

Kemmis, Stephen (2006), 'Exploring the relevance of critical theory for action research: Emancipatory action research in the footsteps of Jurgen Habermas', in: Peter Reason and Hilary Bradbury (eds.), *Handbook of Action Research: The Concise Paperback Edition* (4 edn.; London/ Thousand Oaks/ New Delhi: Sage Publications Ltd.), 94-105.

Kern, Kristine (2019), 'Cities as leaders in EU multilevel climate governance: embedded upscaling of local experiments in Europe', *Environmental Politics* 28 (1), 125-145.

Kern, Kristine and Alber, Gotelind (2009), 'Governing climate change in cities: modes of urban climate governance in multi-level systems 2009.' *The international conference on Competitive Cities and Climate Change, 9-10 October, 2009* (Milan, Italy)

Kern, Kristine and Bulkeley, Harriet (2009), 'Cities, Europeanization and Mulit-level Governance: Governing Climate Change through Transnational Municipal Networks', *Journal of Common Market Studies* 47 (2), 309-322.

Kirchhoff, Christine J.; Lemos, Maria Carmen; and Dessai, Suraje (2013), 'Actionable knowledge for environmental decision making: broadening the usability of climate science', *Annual Review of Environment and Resources* 38, 393-414.

Knox, Hannah (2014), 'Footprints in the City: Models, Materiality, and the Cultural Politics of Climate Change', *Anthropological Quarterly* 87 (2), 405-429.

Kothari, Ashish; Demaria, Federico; and Acosta, Alberto (2014), 'Buen Vivir, degrowth and ecological Swaraj: Alternatives to sustainable development and the green economy', *Development* 57 (3-4), 362-375.

Kreber, Carolin and Cranton, Patricia A. (2000), 'Exploring the scholarship of teaching', *The Journal of Higher Education* 71 (4), 476-495.

Kuhn, Timothy R. (2018), 'Introduction to Human Relations Virtual Special Issue: Knowledge and knowing in the study of organization: From commodity to communication', *Human Relations* Virtual Special Issue.

Labaeye, Adrien and Sauer, Thomas (2013), 'City networks and the socio-ecological transition. A European inventory' *WWWforEurope Working Paper* (27; Wien: Leibniz Information Centre for Economics)

Lachmund, Jens (2004), 'Knowing the Urban Wasteland: Ecological Expertise as Local Process', in: Sheila Jasanoff and Marybeth Long Martello (eds.), *Earthly Politics. Local and Global in Environmental Governance* (Cambridge/ London: The MIT Press), 241-262.

Lahsen, Myanna (2005), 'Technocracy, Democracy, and US Climate Politics: the Need for Demarcations', *Science, Technology & Human Values* 30 (1), 137-169.

--- (2016), 'Trust Through Participation? Problems of Knowledge in Climate Decision Making', in: Mary E. Pettenger (ed.), *The Social Construction of Climate Change. Power, Knowledge, Norms, Discourses* (Milton Park/ New York: Routledge), 173-196.

Law, John (2017), 'STS as Method', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (Cambridge, MA: The MIT Press), 31-57.

Leach, Melissa (2015), 'What is green? Transformation imperative and knowledge politics', in: Ian Scoones, Melissa Leach, and Peter Newell (eds.), *The politics of green transformations* (London/ New York: Routledge), 25-38.

Leander, Anna (2015), 'Ethnographic contributions to method development: 'Strong objectivity' in security studies', *International Studies Perspectives* 17 (4), 462-475.

Lee, Taedong and van de Meene, Susan (2012), 'Who teaches and who learns? Policy learning through the C40 cities climate network', *Policy Sciences* 45, 199-220.

Liew, Anthony (2007), 'Understanding data, information, knowledge and their inter-relationships', *Journal of knowledge management practice* 8 (2), 1-16.

Litfin, Karen (1998), 'Satellites and Sovereign Knowledge: Remote Sensing of the Global Environment', in: Karen Litfin (ed.), *The Greening of Sovereignty in World Politics* (Cambridge/ London: The MIT Press), 193-222.

Livingston, Jasmine E.; Lövbrand, Eva; and Alkan Olsson, Johanna (2018), 'From climates multiple to climate singular: Maintaining policy-relevance in the IPCC synthesis report', *Environmental Science & Policy* 90, 83-90.

Ljungkvist, Kristin (2014a), 'The Global City 2.0. An International Political Actor Beyond Economism?', Acta Universitatis Upsaliensis (Uppsala: University of Uppsala).

--- (2014b), 'The Global City: From Strategic Site to Global Actor', in: Simon Curtis (ed.), *The Power of Cities in International Relations* (London/ New York: Routledge), 32-56.

Lohmann, Larry (2009), 'Toward a different debate in environmental accounting: The cases of carbon and cost-benefit', *Accounting, Organizations and Society* 34, 499-534.

Long Martello, Marybeth (2008), 'Arctic indigenous peoples as representations and representatives of climate change', *Social Studies of Science* 38 (3), 351-376.

Lövbrand, Eva (2011), 'Co-producing European climate science and policy: a cautionary note on the making of useful knowledge', *Science and public policy* 38 (3), 225-236.

--- (2014), 'Knowledge and the Environment', in: Michele M. Betsill, Kathryn Hochstetler, and Dimitris Stevis (eds.), *Advances in international environmental politics* (London: Palgrave Macmillan), 161-184.

Lövbrand, Eva and Öberg, Gunilla (2005), 'Comment on 'How science makes environmental controversies worse' by Daniel Sarewitz, Environmental Science and Policy, 7, 385–403 and 'When Scientists politicise science: making sense of the controversy over The

Skeptical Environmentalist' by Roger A. Pielke Jr., Environmental Science and Policy, 7, 405–417', *Environmental Science & Policy* 8, 195-197.

Lövbrand, Eva; Stripple, Johannes; and Wimann, Bo (2009), 'Earth System governmentality. Reflections on science in the Anthropocene', *Global Environmental Change* 19, 7-13.

Lövbrand, Eva; Beck, Silke; Chilvers, Jason; Forsyth, Tim, et al. (2015), 'Who speaks for the future of Earth? How critical social science can extend the conversation on the Anthropocene', *Global Environmental Change* 32, 211-217.

Machin, Amanda (2013), *Negotiating climate change: Radical democracy and the illusion of consensus* (London/ New York: Zed Books Ltd.).

Mahony, Martin and Hulme, Mike (2018), 'Epistemic geographies of climate change: Science, space and politics', *Progress in Human Geography* 42 (3), 195-424.

Marschütz, Benedikt; Bremer, Scott; Runhaar, Hens; Hegger, Dries, et al. (2020), 'Local narratives of change as an entry point for building urban climate resilience', *Climate Risk Management* 28, 100223.

Maynard-Moody, Steven and Musheno, Michael (2015), 'Stories for Research', in: Dvora Yanow and Peregrine Schwartz-Shea (eds.), *Interpretation and Method. Empirical Research Methods and the Interpretive Turn* (2nd edn.; Abingdon/ New York: Routledge), 338-352.

McIntyre, Lee (2018), *Post-truth* (Cambridge/ London: The MIT Press).

Meckling, Jonas and Allan, Bentley B. (2020), 'The evolution of ideas in global climate policy', *Nature Climate Change* 10, 434-438.

Methmann, Chris Paul (2010), ''Climate Protection' as Empty Signifier: A Discourse Theoretical Perspective on Climate Mainstreaming in World Politics', *Millennium - Journal of International Studies* 39 (2), 345-372.

Miller, Clark A. (2004), 'Climate science and the making of a global political order', in: Sheila Jasanoff (ed.), *States of Knowledge. The co-production of science and social order* (London/ New York: Routledge), 46-66.

--- (2019), 'Sustainability, democracy and the techno-human future', in: Jens Hoff, Quentin Gausset, and Simon Lex (eds.), *The Role of Non-State Actors in the Green Transition: Building a Sustainable Future* (London/ New York: Routledge), 247-266.

Mingers, John (1997), 'Towards critical pluralism', in: John Mingers and Anthony Gill (eds.), *Multimethodology: Towards Theory and Practice for Mixing and Matching Methodologies* (Chichester: John Wiley and Sons), 407-440.

München, Landeshauptstadt (2014), 'Leitlinie Ökologie: Teil Klimawandel und Klimaschutz' *Perspektive München* (München: Referat für Stadtplanung und Bauordnung & Referat für Gesundheit und Umwelt).

--- (2015a), 'Leitmotiv und Leitlinien der Perspektive München' *Perspektive München* (München: Referat für Stadtplanung und Bauordnung).

--- (2015b), 'Regenwaldschutz - Schutz für Klima und Mensch. Was hat unser Konsum mit dem Leben der Ashánika im peruanischen Regenwald zu tun?' (München: Referat für Gesundheit und Umwelt).

--- (2017), 'Regenwaldschutz - Schutz für Klima und Mensch. Münchens Partnerschaft mit dem Volk der Ashánika im peruanischen Regenwald' (München: Referat für Gesundheit und Umwelt).

--- (2018), 'Integriertes Handlungsprogramm Klimaschutz in München (IHKM). Klimaneutrales München / Klimaschutzprogramm 2019' (München: Referat für Gesundheit und Umwelt. SG Energie, Klimaschutz).

--- (2020a), 'München in Zahlen - Interessante Fakten über die Stadt', <https://www.muenchen.de/sehenswuerdigkeiten/muenchen-in-zahlen.html>, accessed 4 February 2021.

--- (2020b), 'Netzwerke. München in europäischen Netzwerken', <https://www.muenchen.de/rathaus/Stadtverwaltung/Referat-fuer-Arbeit-und-Wirtschaft/Europa/Netzwerke.html>, accessed 9 January 2021.

Nagorny-Koring, Nanja Christina (2019), 'Leading the way with examples and ideas? Governing climate change in German municipalities through best practices', *Journal of Environmental Policy & Planning* 21 (1), 46-60.

NASA (2019), '2018 Fourth Warmest Year in Continued Warming Trend', <https://www.nasa.gov/press-release/2018-fourth-warmest-year-in-continued-warming-trend-according-to-nasa-noaa>, accessed 30 September 2019.

Nay, Olivier (2014), 'International organisations and the production of hegemonic knowledge: How the World Bank and the OECD helped invent the fragile state concept', *Third World Quarterly* 35 (2), 210-231.

Negev, Maya and Teschner, Naama (2013), 'Rethinking the relationship between technical and local knowledge: Toward a multi-type approach', *Environmental Science & Policy* 30, 50-59.

Nicolini, Davide; Gherardi, Silvia; and Yanow, Dvora (2003), 'Introduction', in: Davide Nicolini, Silvia Gherardi, and Dvora Yanow (eds.), *Knowing in Organizations. A Practice-Based Approach*, 3-30.

Nullmeier, Frank (1993), 'Wissen und Policy-Forschung. Wissenspolitologie und rhetorisch-dialektisches Handlungsmodell / Deutsche Vereinigung für Politische Wissenschaft', in: Adrienne Windhoff-Héritier (ed.), *Policy-Analyse: Kritik und Neuorientierung* (Opladen: Westdeutscher Verlag), 175-196.

Nullmeier, Frank and Rüb, Friedbert W. (1993), *Die Transformation der Sozialpolitik. Vom Sozialstaat zum Sicherungsstaat* (Theorie und Gesellschaft; Frankfurt/ New York: Campus Verlag).

Nursey-Bray, Melissa (2017), 'Towards socially just adaptive climate governance: the transformative potential of conflict', *Local Environment* 22 (2), 156-171.

O'Lear, Shannon (2016), 'Climate science and slow violence: A view from political geography and STS on mobilizing technoscientific ontologies of climate change', *Political Geography* 52, 4-13.

Okereke, Chukwumerije; Bulkeley, Harriet; and Schroeder, Heike (2009), 'Conceptualizing Climate Governance Beyond the International Regime', *Global Environmental Politics* 9 (1), 58-78.

Onuf, Nicholas (2007), 'Foreword', in: Mary E. Pettenger (ed.), *The Social Construction of Climate Change. Power, Knowledge, Norms, Discourses* (London/ New York: Routledge), xi-xv.

Ostrom, Elinor (2010), 'Polycentric systems for coping with collective action and global environmental change', *Global Environmental Change* 20, 550-557.

Ottinger, Gwen; Barandiarán, Javiera; and Kimura, Aya H. (2017), 'Environmental Justice: Knowledge, Technology, and Expertise', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (Cambridge, MA: The MIT Press), 1029-1058.

Papin, Marielle (2020), 'Where do novelties come from? A social network anaylsis of Transnational Municipal Networks in global climate governance', *Earth System Governance* 4, 1-11.

Park, Peter (1999), 'People, knowledge, and change in participatory research', *Management learning* 30 (2), 141-157.

Pattberg, Philipp and Stripple, Johannes (2008), 'Beyond the public and private divide: remapping transnational climate governance in the 21st century', *International Environmental Agreements: Politics, Law and Economics* 8, 367-388.

Pauw, Pieter; Brandi, Clara; Richerzhagen, Carmen; Bauer, Steffen, et al. (2014), 'Different perspectives on differentiated responsibilities: a state-of-the-art review of the notion of common but differentiated responsibilites in international negotiations', *Discussion Paper 6/2014*.

Peters, Glenn P.; Andrew, Robbie M.; Canadell, Josep G.; Friedlingstein, Pierre, et al. (2019), 'Carbon dioxide emissions continue to grow amidst slowly emerging climate policies', *Nature Climate Change* 10, 3-6.

Pettenger, Mary E. (2007a), 'Introduction: Power, Knowledge and the Social Construction of Climate Change', in: Mary E. Pettenger (ed.), *The Social Construction of Climate*

Change: Power, Knowledge, Norms, Discourses (Aldershot/ Burlington: Ashgate Publishing Ltd.), 1-22.

--- (2016), 'Introduction: Power, Knowledge and the Social Construction of Climate Change', in: Mary E. Pettenger (ed.), *The Social Construction of Climate Change. Power, Knowledge, Norms, Discourses* (Milton Park/ New York: Routledge), 1-19.

--- (ed.), (2007b), *The Social Construction of Climate Change : Power, Knowledge, Norms, Discourses* (Aldershot/ Burlington: Ashgate Publishing Ltd.).

Polanyi, Michael (2009), *The tacit dimension. With a new foreword by Amrtya Sen* (Chicago/ London: University of Chicago press).

Pregernig, Michael (2014), 'Framings of science-policy interactions and their discursive and institutional effects: examples from conservation and environmental policy', *Biodiversity and conservation* 23 (14), 3615-3639.

Prokopy, Linda Stalker; Carlton, J Stuart; Haigh, Tonya; Lemos, Maria Carmen, et al. (2017), 'Useful to Usable: Developing usable climate science for agriculture', *Climate Risk Management* 15, 1-7.

Rashidi, Kaveh and Patt, Anthony (2018), 'Subsistence over symbolism: the role of transnational municipal networks on cities' climate policy innovation and adoption', *Mitigation and Adaptation Strategies for Global Change* 28, 507-523.

RegionH, The Capital Region of Denmark (2020), 'Population', <https://www.regionh.dk/english/about-the-capital-region/facts-about-the-region/Pages/Population.aspx>, accessed 4 February 2021.

Reichertz, Jo (2016), *Qualitative und interpretative Sozialforschung: eine Einladung* (Heidelberg/ Berlin: Springer VS).

Rice, Jennifer L.; Burke, Brian J.; and Heynen, Nik (2015), 'Knowing climate change, embodying climate praxis: experiential knowledge in Southern Appalachia', *Annals of the Association of American Geographers* 105 (2), 253-262.

Rittel, Horst W.J. and Webber, Melvin M. (1973), 'Dilemmas in a general theory of planning', *Policy Sciences* 4 (2), 155-169.

Roelvink, Gerda and Zolkos, Magdalena (2011), 'Climate Change as Experience of Affect', *Angelaki. Journal of the theoretical humanities* 16 (4), 43-57.

Rogelj, Joeri; Forster, Piers M.; Kriegler, Elmar; Smith, Christopher J., et al. (2019), 'Estimating and tracking the remaining carbon budget for stringent climate targets', *Nature* 571 (7765), 335-342.

Román, Mikael (2010), 'Governing from the middle: the C40 Cities Leadership Group', *Corporate Governance* 10 (1), 73-84.

Romero-Lankao, Patricia; Burch, Sarah; Hughes, Sara; Auty, Kate, et al. (2018), 'Governance and policy', in: Cynthia Rosenzweig, et al. (eds.), *Climate Change and Cities. Second Assessment Report of the Urban Climate Change Research Network* (Cambridge/ New York: Cambridge University Press), 586-606.

Rothe, Delf and Shim, David (2018), 'Sensing the ground: On the global politics of satellite-based activism', *Review of International Studies* 44 (3), 414-437.

Sánchez-Cortés, Maria Silvia and Lazos Chavero, Elena (2011), 'Indigenous perceptions of changes in climate variability and its relationship with agriculture in a Zoque community of Chiapas, Mexico', *Climatic Change* 107, 363-389.

Sarewitz, Daniel (2011), 'Does climate change knowledge really matter?', *WIREs Climate Change* 2, 475-481.

Sassen, Saskia (2015), 'Bringing Cities into the Global Climate Framework', in: Craig A. Johnson, Noah J. Toly, and Heike Schroeder (eds.), *The Urban Climate Challenge. Rethinking the Role of Cities in the Global Climate Regime* (London/ New York: Routledge), 24-36.

Schindler, Delia (2006), 'Die Rolle von Ideen und Deutungsmustern in der Politik: Wissenspolitologische Perspektiven auf Netzwerke', in: Bettina Hollstein and Florian Straus (eds.), *Qualitative Netzwerkanalyse* (Wiesbaden: VS Verlag für Sozialwissenschaften), 99-123.

Schlosberg, David and Collins, Lisette B. (2014), 'From environmental to climate justice: climate change and the discourse of environmental justice', *Wiley Interdisciplinary Reviews: Climate Change* 5 (3), 359-374.

Schnegg, Michael (2019), 'The Life of Winds: Knowing the Namibian Weather from Someplace and from Noplace', *American Anthropologist* 121 (4), 830-844.

Schreurs, Miranda A. (2008), 'From the Bottom Up. Local and Subnational Climate Change Politics', *The Journal of Environment & Development* 17 (4), 343-355.

Schwartz-Shea, Peregrine and Yanow, Dvora (2013), *Interpretive research design: Concepts and processes* (London/ New York: Routledge).

Scoones, Ian; Newell, Peter; and Leach, Melissa (2015), 'The politics of green transformations', *The politics of green transformations* (London/ New York: Routledge), 19-42.

Shankar, Kalpana; Hakken, David; and Østerlund, Carsten (2017), 'Rethinking Documents', in: Ulrike Felt, et al. (eds.), *The Handbook of Science and Technology Studies* (4 edn.; Cambridge, MA: The MIT Press), 59-85.

Sillitoe, Paul (2007), 'Local Science vs. Global Science: an Overview', in: Paul Sillitoe (ed.), *Local Science vs. Global Science: Approaches to Indigenous Knowledge in International Development* (4; New York/ Oxford: Berghahn Books), 1-22.

Singer, Mona (2005), *Geteilte Wahrheit: Feministische Epistemologie, Wissenssoziologie und Cultural Studies* (Wien: Löcker).

Smeds, Emilia and Acuto, Michele (2018), 'Networking cities after Paris: Weighing the ambition of urban climate change experimentation', *Global Policy* 9 (4), 549-559.

Smith, Heather A. (2016a), 'Disrupting the Global Discourse of Climate Change: The Case of Indigenous Voices', in: Mary E. Pettenger (ed.), *The Social Construction of Climate Change. Power, Knowledge, Norms, Discourses* (Milton Park/ New York: Routledge), 197-215.

Smith, William D. (2016b), 'Presence of Mind as Working Climate Change Knowledge: A Totonac Cosmopolitics', in: Mary E. Pettenger (ed.), *The Social Construction of Climate Change. Power, Knowledge, Norms, Discourses* (Milton Park/ New York: Routledge), 217-246.

Soss, Joe (2015), 'Talking Our Way to Meaningful Explanations. A Practice-Centered View of Interviewing for Interpretive Research', in: Dvora Yanow and Peregrine Schwartz-Shea (eds.), *Interpretation and Method. Empricial Research Methods and the Interpretive Turn* (2nd edn.; Abingdon/ New York: Routledge), 161-182.

Standring, Adam (2017), 'Evidence-based policymaking and the politics of neoliberal reason: a response to Newman', *Critical Policy Studies* 11 (2), 227-234.

Steffen, Alex (2009), 'Bright Green, Light Green, Dark Green, Gray: The New Environmental Spectrum', <https://web.archive.org/web/20160112194947/http://www.worldchanging.com/archives/009499.html>, accessed 24 September 2020.

Steffen, Will; Broadgate, Wendy; Deutsch, Lisa; Gaffney, Owen, et al. (2015), 'The trajectory of the Anthropocene: the great acceleration', *The Anthropocene Review* 2 (1), 81-98.

Steffen, Will; Rockström, Johan; Richardson, Katherine; Lenton, Timothy M, et al. (2018), 'Trajectories of the Earth System in the Anthropocene', *Proceedings of the National Academy of Sciences* 115 (33), 8252-8259.

Stehle, Fee; Höhne, Chris; Hickmann, Thomas; and Lederer, Markus (2019), 'The Effects of Transnational Municipal Networks on Urban Climate Politics in the Global South', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics: Agency and Empowerment* (Cambridge, UK: Cambridge University Press), 210-230.

Stehr, Nico (1994), *Knowledge societies. The transformation of labour, property and knowledge in contemporary society* (London: Sage).

Stehr, Nico and Meja, Volker (2005), 'Introduction: The Development of the Sociology of Knowledge and Science', in: Nico Stehr and Volker Meja (eds.), *Society & Knowledge. Contemporary Perspectives in the Sociology of Knowledge & Science* (2nd revised edn.; New Brunswick/ London: Transaction Publishers), 1-30.

Stehr, Nico and Grundmann, Reiner (2012), 'How does knowledge relate to political action?', *Innovation–The European Journal of Social Science Research* 25 (1), 29-44.

Stern, Nicholas (2006), 'Stern Review: The Economics of Climate Change. Executive summary', <http://www.wwf.se/source.php/1169157/Stern%20Report_Exec%20Summary.pdf>, accessed 28 January 2016.

Stirling, Andy (2015), 'Emancipating transformations: from controlling 'the transition'to culturing plural radical progress', *The politics of green transformations* (London/ New York: Routledge), 72-85.

Süßbauer, Elisabeth (2016), *Klimawandel als widerspenstiges Problem: eine soziologische Analyse von Anpassungsstrategien in der Stadtplanung* (Wiesbaden: Springer VS).

Swyngedouw, Erik (2009), 'The Antinomies of the Postpolitical City: In Search of a Democratic Politics of Environmental Production', *International Journal of Urban & Regional Research* 33 (3), 601-620.

--- (2013), 'The non-political politics of climate change', *ACME: An International Journal for Critical Geographies* 12 (1), 1-8.

Toly, Noah J. (2008), 'Transnational Municipal Networks in Climate Politics: From Global Governance to Global Politics', *Globalizations* 5 (3), 341-356.

--- (2016), 'Cities Play Key Role in Climate Action', *Next City,* March 21, 2016.

Tozer, Laura and Klenk, Nicole (2018), 'Discourses of carbon neutrality and imagnaries of urban futures', *Energy Research & Social Science* 35, 174-181.

Turnhout, Esther; Bloomfield, Bob; Hulme, Mike; Vogel, Johannes, et al. (2012), 'Listen to the voices of experience', *Nature* 488 (7412), 454-455.

UCLG, United Cities and Local Governments (2018), 'Local and regional governments call for the implementation of the global research agenda on cities and climate change at CitiesIPCC Conference', (updated 13 March 2018) <https://www.uclg.org/en/media/news/local-and-regional-governments-call-implementation-global-research-agenda-cities-and>, accessed 28 August 2018.

Uhrqvist, Ola and Lövbrand, Eva (2014), 'Rendering global change problematic: the constitutive effects of Earth System research in the IGBP and the IHDP', *Environmental Politics* 23 (2), 339-356.

UNFCCC (1997), 'Kyoto Protocol to the United Nations Framework Convention on Climate Change (FCCC/CP/1997/L.7/Add.1)', <https://unfccc.int/sites/default/files/resource/docs/cop3/l07a01.pdf>, accessed 5 March 2019.

--- (2014), 'Decision -/CP.20 Lima call for climate action', <https://unfccc.int/files/meetings/lima_dec_2014/application/pdf/auv_cop20_lima_call_for_climate_action.pdf>, accessed 25 July 2019.

--- (2015a), 'Paris Agreement', <https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf>, accessed 25 July 2019.

--- (2015b), 'Adoption of the Paris Agreement: FCCC/CP/2015/L.9/Rev. 1', <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>, accessed 25 July 2019.

UNGA, United Nations General Assembly (2012), 'The future we want. Resolution adopted by the General Assembly on 27 July 2012 (A/RES/66/288)', <https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_66_288.pdf>, accessed 29 February 2019.

--- (2015), 'Transforming our world: the 2030 Agenda for Sustainable Development (A/RES/70/1)', <https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf>, accessed 24 March 2019.

--- (2016), 'Adoption of the final outcome of the Conference on Housing and Sustainable Urban Development (Habitat III), Quito, 17–20 October 2016, Item 10 of the provisional agenda (A/CONF.226/4)', <https://www.undocs.org/A/CONF.226/4>, accessed 24 March 2019.

United Nations, World Commission on Environment and Development (1987), 'Report of the World Commission on Environment and Development: Our Common Future', <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>, accessed 25 May 2018.

UNSG, United Nations Secretary-General (2018), 'Secretary-General's remarks on Climate Change (as delivered)', <https://www.un.org/sg/en/content/sg/statement/2018-09-10/secretary-generals-remarks-climate-change-delivered>, accessed 2 December 2020.

Van der Heijden, Jeroen (2017), *Innovations in urban climate governance: Voluntary programs for low carbon buildings and cities* (Cambridge/ New York: Cambridge University Press).

--- (2018), 'City and Subnational Governance: High Ambitions, Innovative Instruments and Polycentric Collaborations?', in: Andrew Jordan, et al. (eds.), *Governing Climate Change. Polycentricity in Action?* (Cambridge/ New York: Cambridge University Press), 81-96.

--- (2019), 'Studying urban climate governance: where to begin, what to look for, and how to make a meaningful contribution to scholarship and practice', *Earth System Governance*, Article 100005.

Van der Heijden, Jeroen; Bulkeley, Harriet; and Certomà, Chiara (2019), 'The Politics of Urban Climate Futures: Recognition, Experimentation, Orchestration', in: Jeroen Van der Heijden, Harriet Bulkeley, and Chiara Certomà (eds.), *Urban Climate Politics: Agency and Empowerment* (Cambridge/ New York: Cambridge University Press), 231-242.

Vanhulst, Julien and Beling, Adrian H. (2014), 'Buen vivir: Emergent discourse within or beyond sustainable development?', *Ecological Economics* 101, 54-63.

von Lucke, Franziskus (2017), 'O Justice, Where Art Thou? Developing a New Take on Climate Justice', *GLOBUS Research Paper 1/2017*.

Walsh, Lynda (2019), 'Decentering Science in Climate Communication', in: Katrin Kleemann and Jeroen Oomen (eds.), *Communicating the Climate. From Knowing Change to Changing Knowledge* (RCC Perspectives: Transformations in Environment and Society; München: Rachel Carson Center for Environment and Society), 15-22.

Warburton, Hilary and Martin, Adrienne (1999), *Local people's knowledge in natural resources research* (Chatham, UK: Natural Resources Institute).

Ward, James D.; Sutton, Paul C.; Werner, Adrian D.; Costanza, Robert, et al. (2016), 'Is Decoupling GDP Growth from Environmental Impact Possible?', *Plos One* 11 (10), e0164733.

Weber, Elke U. (2010), 'What shapes perceptions of climate change?', *Wiley Interdisciplinary Reviews: Climate Change* 1 (3), 332-342.

Welzer, Harald (2019), 'Wissen wird überbewertet. Nachhaltigkeitstransformation ist eine Sache der Praxis', *Aus Politik und Zeitgeschichte* 47-48, 16-20.

Wesselink, Anna; Buchanan, Karen S; Georgiadou, Yola; and Turnhout, Esther (2013), 'Technical knowledge, discursive spaces and politics at the science–policy interface', *Environmental Science & Policy* 30, 1-9.

Widerberg, Oscar and Pattberg, Philipp (2015), 'International Cooperative Initiatives in Global Climate Governance: Raising the Ambition Level or Delegitimizing the UNFCCC?', *Global Policy* 6 (1), 45-56.

--- (2019), 'Connect-it', [Visualisation of collaborative climate actions], <http://connect-it-climate.eu/#visualisation/4>, accessed 8 March 2019.

Widerberg, Oscar; Pattberg, Philipp; and Kristensen, Kristian (2016), 'Mapping the Institutional Architecture of Global Climate Change Governance' (Amsterdam: IVM Institute for Environmental Studies).

Wilkens, Jan and Wiener, Antje (2021), 'Contested Climate Justice in Sensitive Regions: Towards a Decolonial Perspective on Global Climate Governance. Paper prepared for presentation at the Panel 'Climate Change and Climate Justice in Global International Relations', at the International Studies Association's (ISA) Annual Convention in Las Vegas (Online), Wednesday, April 7, 9:30 PM – 10:45 PM CET.' *International Studies Association (ISA) Annual Convention* (Las Vegas (Online)).

Williamson, Phil (2016), 'Emissions reduction: Scrutinize CO2 removal methods', *Nature* 530 (7589), 153-155.

Wynne, Brian (1996), 'May the Sheep Safely Graze? A Reflexive View of the Expert-Lay Knowledge Divide', in: Scott Lash, Bronislaw Szerszynski, and Brian Wynne (eds.), *Risk, environment and modernity: Towards a new ecology* (London: Sage Publications Ltd.), 44-83.

--- (2010), 'Strange weather, again', *Theory, Culture & Society* 27 (2-3), 289-305.

Yanow, Dvora (2003), 'Accessing local knowledge', in: Maarten A. Hajer and Hendrik Wagenaar (eds.), *Deliberative Policy Analysis : Understanding Governance in the Network Society* (Cambridge, UK: Cambridge University Press), 228-247.

--- (2004), 'Translating Local Knowledge at Organizational Peripheries', *British Journal of Management* 15, 9-25.

--- (2014), 'Interpretive analysis and comparative research', in: Isabelle Engeli and Christine Rothmayr Allison (eds.), *Comparative policy studies* (London: Palgrave Macmillan), 131-159.

Yanow, Dvora and Schwartz-Shea, Peregrine (2015), *Interpretation and method: Empirical research methods and the interpretive turn* (2nd edn.; Abingdon, Oxon: Routledge).

Yusoff, Kathryn and Gabrys, Jennifer (2011), 'Climate change and the imagination', *Wiley Interdisciplinary Reviews: Climate Change* 2 (4), 516-534.

Zevenbergen, Chris; Gersonius, Berry; and van Herk, Sebastiaan (2016), *City-to-city learning for disaster resilience towards secure, sustainable and vibrant cities* (Delft: UNESCO-IHE).

10 Appendix

10.1 List of documents analyzed

Documents are enumerated in the order of their analysis. I attributed the ‘document number’ to the respective document throughout the analysis. The number accounts for the chronological order in which I analyzed the documents.

10.1.1 C40 Documents

DOC. NR.	PUBLISHED BY	NAME OF THE DOCUMENT	YEAR OF PUBLICATION
1	C40 and NYC Mayor's Office of Sustainability	Defining Carbon Neutrality for Cities & Managing Residual Emissions. Cities' Perspective and Guidance	2019
3	C40	Benefits of Climate Action. Piloting A Global Approach To Measurement	2016
4	C40	Consumption-based GHG Emissions of C40 Cities	2018
7	C40	Benefits of Climate Action. Piloting A Global Approach To Measurement. Appendix	2016
11	C40	Summary for Urban Policy-Makers. What the IPCC Special Report on Global Warming of 1.5°C means for Cities	2018
12	C40 and Johnson&Johnson	Toward a Healthier World. Connecting the dots between Environmental Health & Public Health	no date

15	C40 and New Climate Institute	Opportunity 2030: Benefits of Climate Action in Cities. Quantifying the benefits of city-level measures in buildings, transport and energy supply	2018
16	C40, New Climate Institute and Global Covenant of Mayors for Climate and Energy	Climate Opportunity: More Jobs; Better Health; Liveable Cities. Quantifying the Benefits of Climate Change Mitigation Measures in Buildings, Transport and Energy Supply	2018
18	C40 and McKinsey Center for Business and Environment	Focused acceleration: A strategic approch to climate action in cities to 2030	2017
19	C40 and ARUP	Deadline 2020. How cities will get the job done	2016
21	C40 and ARUP	How U.S. Cities Will Get the Job Done	2016
24	C40 and LSECities	Co-benefits of urban climate action: A framework for cities. A working paper by the Economics of Green Cities Programme, LSE Cities, London School of Economics and Political Science	2016
26	C40	Unlocking Climate Action in Megacities	2016
28	C40 and ARUP	Polisdigitocracy: Digital Technology, Citizen Engagement and Climate Action	2015
30	C40; ARUP and Bloomberg Philanthropies	City Climate Hazard Taxonomy. C40's classification of city-specific climate hazards	no date
32	C40 and ARUP	Executive Summary. Powering Climate Action: Cities as Global Changemakers	2015
34	C40; Bloomberg Philanthropies and Stockholm Environment Institute US	The contrbution of urban-scae actions to ambitious climate targets	2014

36	C40 and ARUP	Global Aggregation of City Climate Commitments. Methodological Review	no date
38	C40 and Bloomberg, Michael R.	Advancing Climate ambition: Cities as Partners in Global Climate Action. Infographic	no date
40	C40 and Bloomberg, Michael R.	Advancing Climate ambition: Cities as Partners in Global Climate Action	no date
42	C40; ARUP; Bloomberg, Michael R.; UN-Habitat; UCLG United Cities and Local Governments; ICLEI; CDP; carbonn Climate Registry cCR; World Resources Institute WRi	Woking Together: Global Aggregation of City Climate Commitments	no date
44	C40; CDP; Bloomberg Philanthropies	Protecting Our Capital. How climate adaptation in cities creates a resilient place for business	2014
46	C40 and ARUP	Climate Action in Megacities. Executive Summary. C40 Cities Baseline and Opportunities Volume 2.0	2014
48	C40 and ARUP	C40 Cities: The Power to Act	2014
50	C40	The Rio Numbers: C40 Cities can reduce greenhouse gas emissions by over a billion tons per year in 2030	2012
52	C40 and CDP	Wealthier, Healthier Cities. How climate change action is giving us wealthier, healthier cities. Based on the CDP responses from 110 global cities	2013
54	C40 and ARUP	Climate Action in Megacities. C40 Cities Baseline and Opportunities. Version 1.0	2011

Table 6: Overview C40 documents analyzed for this study

DOC. NR.	PUBLISHED BY	NAME OF THE DOCUMENT	YEAR OF PUBLICATION
2	Climate Alliance	UNREDDY. A critical look at REDD+ and indigenous strategies for comprehensive forest protection	2015
5	Climate Alliance	Change the Power - (Em)Power to Change: Local Authorities towards the SDGs and Climate Justice: Why and how can municipalities use the online tool Change the Future	2018
6	Climate Alliance	Practice Cube. Climate Active Neighbourhoods	no date
8	Climate Alliance	The Future We Want. Bridging Europe and Amazonia	2017
9	Climate Alliance	The Future We Want. Championing Climate Justice	2017
10	Climate Alliance	The Future We Want. Shaping Our Future	2017
13	Alpine Space Project INTERREG	Behaviour Change Policies State of the Art Report. Sustainable Mobility Behaviors in the Alpine Region - SaMBA	2018
14	Climate Alliance	Global Climate Change Policy and Ist Implication for Municipalities. The Implication of the Paris Agreement, EU-Commissions 2050 Strategy and IPCC-Report for municipalities and cities	2019
17	Climate Alliance	Climate Alliance. Review and Outlook. 2017/2018	2018

20	Climate Alliance and Action Solidarité Tiers Monde (ASTM)	We Are All Witnesses. People in a Changing Climate	2013
22	Climate Alliance	C02 Accounting & Monitoring - A long standing pillar of Climate Alliance's work	no date
23	Climate Alliance and Action Solidarité Tiers Monde (ASTM)	The Land We Grab. Seizing Tropical Rainforest and Soil. Eyewitnesses from the Amazon and Africa ... And how Europe is involved	2013
25	Climate Alliance; ASTM; CEPA; Greenpeace; FEDEPAZ	Our Hold Over the World's Raw Materials. Facts and eyewitness reports from th Congo, Peru, Ecuador, Nigeria and the Arctic over the downsides of our consumption	2014
27	Climate Alliance	Bridges To Amazonia	2016
29	Climate Alliance	Transforming Our World. Local Authorities for Global Sustainable Development	no date
31	Climate Alliance	A Market Model for the Energy Transition - A New Energy System Design	2015
33	Climate Alliance	A good life is simple. Campaign material information	2015
35	Climate Alliance; Energinvest; GRE Liège; REScoop.eu	Setting up innovative financing schemes for energy efficiency renovations: a guidance for local authorities	2017
37	Climate Alliance	Local and Regional Authorities as Drivers of Climate Action and Sustainability towards a Good Life for All	2017
39	Climate Alliance	Implementing Adaptation to Climate Change at the Local Level	2017

41	Climate Alliance	The Post-2015 Development Agenda - from Visions to Measures and Solutions	2015
43	Climate Alliance	Teaming up in Europe for a sustainable energy future	2014
45	Climate Alliance	Resolution of Climate Alliance on the EU climate and energy policies in light of the 2030 framework	2013
47	Climate Alliance	The Millenium Consumption Goals - a crucial completion of the Millenium Development Goals	2012
49	Climate Alliance	Amazonian Indigenous REDD+. Resolution of the Climate Alliance General Assembly on 24 May 2012 in the city of St. Gallen	2012
51	Climate Alliance	Elecrtic mobility. Framework conditions: Climate Alliance's perspective	2011
53	Climate Alliance	Resolution of Climate Alliancefor a turning point in power generation: decentralised renewable energies instead of nuclear power	2011
55	Climate Alliance	Leave the oil in the ground! Resolution of the Climate Alliance Assembly on April 15 200 in Perugia/Italy regarding Ecuador's "Yasuní Proposal"	2010
56	Climate Alliance	Cities investing in energy efficiency and renewable energy sources are drivers of economic recovery. Resolution of the Climate Alliance General Assembly 2010 regarding the allocation of remaining funds in the European Economic Recovery Plan to cities	2010

57	Climate Alliance	Climate Alliance Position Paper regarding REDD - for the Protection of Forests - Adopted by the General Assembly on 23rd April 2009 in Brussels	2009
58	Climate Alliance	Climate Alliance Resolution to 100% Ecologcial, Social and Public Procurement	2009
59	Climate Alliance	Compensation of CO2 Emissions. Agreed resolution of the General Assembly of the Climate Alliance on 3rd April 2008 in the city of Aachen	2008

Table 7: Overview Climate Alliance documents analyzed for this study

PUBLISHED BY	NAME OF THE DOCUMENT	YEAR OF PUBLICATION
CITY OF COPENHAGEN	CPH 2025 Climate Plan. A Green, Smart and Carbon Neutral City	2012
CITY OF COPENHAGEN	CPH 2025 Climate Plan. Roadmap 2017-2020	2016
CITY OF COPENHAGEN	Circular Copenhagen. Resource and Waste Management Plan 2024	2018
CITY OF COPENHAGEN	CPH 2025 Climate Plan. Roadmap 2021-2025	2020

Table 8: Overview documents published by the City of Copenhagen analyzed for this study

PUBLISHED BY	NAME OF THE DOCUMENT	YEAR OF PUBLICATION
LANDESHAUPTSTADT MÜNCHEN. REFERAT FÜR STADTPLANUNG UND BAUORDNUNG. REFERAT FÜR GESUNDHEIT UND UMWELT	Perspektive München. Leitlinie Ökologie: Teil Klimawandel und Klimaschutz	2014
LANDESHAUPTSTADT MÜNCHEN. REFERAT FÜR GESUNDHEIT UND UMWELT	Regenwaldschutz – Schutz für Klima und Mensch. Was hat unser Konsum mit dem Leben der Asháninka im peruanischen Regenwald zu tun?	2015
LANDESHAUPTSTADT MÜNCHEN. REFERAT FÜR GESUNDHEIT UND UMWELT	Regenwaldschutz – Schutz für Klima und Mensch. Münchens Partnerschaft mit dem Volk der Asháninka im peruanischen Regenwald	2017
LANDESHAUPTSTADT MÜNCHEN	Integriertes Handlungsprogramm Klimaschutz in München (IHKM). Klimaneutrales München / Klimaschutzprogramm 2019	2018

Table 9: Overview documents published by the City of Munich analyzed for this study

10.2 Initial questionnaire for content analysis

1. What storyline(s) is (are) evident in the document?

2. What is the communication purpose or message of the document?

3. Who are the subjects and what is the target group, and what relationships between or among them does the storyline convey?

4. What information is present (and absent) from the document? (what is considered as being 'relevant' enough to be part of the documents)

→ how is information presented?
→ On which ground is the information based?/ what is the background of the information?
→ How is selected information related to the storyline?
→ Which normative positions are reflected in the document? → in what ways does the document highlight or deemphasize particular normative positions?

5. How are stories and arguments in the document related to broader (policy) contexts?

6. Is there anything else that stroke me?

Answer if possible:

7. Who made decisions about the document?

8. Who produced the document, and what is the nature of their roles and relationships in the context of the document and the more general policy context?

9. How was the document produced?

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